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Food Hygiene and Sanitation

With Case Studies

Second Edition

About the Author

Sunetra Roday is currently the Principal of the Maharashtra State Institute of Hotel Management and Catering Technology, Pune. Her professional career spans 32 years during which she has been an academician throughout. She completed her BSc (Honours) in Home Science and MSc (Food and Nutrition) from Lady Irwin College, New Delhi, after which she took up a teaching assignment at Government Girls Degree College, Bhopal, for a year. She also has a master's degree in tourism management.

Since 1980, Ms Roday has been a faculty member at MSIHMCT, formerly known as Food Craft Institute and has been teaching hygiene and sanitation to students of PG diploma, degree, and certificate courses for over 29 years. She has contributed significantly towards the growth of MSIHMCT from a craftsman-training institute to a full-fledged college, offering education and training in hotel management to all strata of society. She has tirelessly worked for four years for rural development and was actively involved in imparting technology, skills and information to the rural folk. Ms Roday has the distinction of being the first woman project officer for the Community Development Project, Ministry of HRD, Government of India, a project that she initiated in 1986.

Ms Roday has authored best-selling textbooks such as *Food Science and Nutrition*, and *Tourism Operations and Management*. Besides these, she has authored several books and booklets on subjects such as cookery: theory and practical, food preservation and home science for the HSC Board, MS and NCERT, New Delhi. She has also developed industrial training manuals for students of hotel management, and travel and tourism. Several of her books are in use as course textbooks or sources of reference in a number of universities/colleges/junior colleges by students of hotel management, home science, travel and tourism as well as the food and travel industry.

Ms Roday has visited Canada on a staff-exchange programme through the Association of Canadian Community Colleges. There she studied tourism development in the Niagara region.

She is a member of the Central Classification Committee (HRACC) Department of Tourism, Government of India, for inspection of hotels for classification.

She is actively involved in consultancy projects, curriculum development and nutrition counselling and has coordinated and conducted several training programmes for personnel from corporate houses, industrial canteens, residential schools, hotels, guesthouses and for the Ministry of Tourism under Capacity Building for Service Providers in the areas of hygiene, nutrition and food production. She has profound interest in teaching, student counselling, environmental conservation and travelling, besides hygiene and nutrition.

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Dedicated to my beloved parents

My mother

Mrs Sudha A Shrouti

on her 85th birthday

and

My father

Late Col. A W Shrouti

whose fond memories I will cherish for ever

Contents

Preface

The first edition of *Food Hygiene and Sanitation* received an overwhelming response and served the basic purpose of creating awareness about this very important subject, something that directly affects the quality of life we lead.

Advances in technology have changed our lifestyles in many ways. The tourism and hospitality industry has witnessed a marked change. It is one of the fastest-growing sectors in the economy. Tourist numbers, both international and domestic, will continue growing in the coming years. Commensurate with this has been an increase in the number of people consuming meals away from home in various categories of catering establishments. Technological advances in the processing, packaging and transport industry now give the food-service manager an opportunity to offer unlimited choices on the menu all-year round. We see a distinct change in the lifestyles and meal patterns of people round the globe. Today's consumers are conscious about their health and well-being and are concerned about the quality of food and beverages served. Consumer awareness has increased with easy access to information at the press of a button. Being aware about the need for good health, consumers now ask questions about the safety of food being served and read labels on items they purchase. Manufacturers, on the other hand, are aware of international standards which enhance the product quality, safety and the benefits of certified products in the global market. Quality-conscious catering establishments want to assure their customers that the highest standards of hygiene are being followed while preparing and serving food, and most follow the HACCP approach.

Today there are many standards of quality, designed by agencies certifying that systems and procedures followed are in order. To ensure the availability of safe and wholesome food, the Food Safety and Standards Act 2006 was laid down in India, which encompasses all food laws and regulations.

These accelerated developments have necessitated a revision of the earlier edition to keep the students who handle food abreast with the latest food-processing techniques, food standards, laws and regulations enacted recently as well as emerging concerns related to food and disease. The second edition includes these major changes along with environment-friendly practices to preserve not only the health and well-being of humankind, but also conserve the planet Earth.

This new edition has the following three new chapters included to keep students up-to-date on current developments and practices in the industry:

- Food Preservation Techniques
- Quality and Food Standards
- Recent Concerns

Real-life case studies, latest food laws and acts, hospital and transport catering and green technologies have been covered in relevant chapters in this edition.

The book is designed to serve as a textbook for students of

- All degree and diploma programmes in Hotel Management and Catering Technology
- BSc in Hospitality Studies

- Students opting for Food Science, Microbiology and Dietetics
- Institutional Food Administration
- Food Service Management

This can also be a reference book for

- Minimum Competency Vocational Courses in Cookery and Bakery
- SSC, HSC and Home Science Courses
- Trainers and consultants in Food Service Industry
- Craftsmanship courses in Cookery, Bakery, Canning and other similar trades
- Food Processing Industry
- All food handlers

For the benefit of industry professionals, detailed checklists have been prepared to help managers analyse weak areas and take corrective action.

I am sure this revised edition will serve to convince the present and future food handlers of the importance of this subject and highlight their role in averting food-borne diseases through hygienic food handling.

SALIENT FEATURES

All chapters are extensively referenced combining theory with real case studies from the catering industry. Keywords used in the text are explained at the end of each chapter along with simple exercises, both objective and subjective, to help students check their understanding of the topic. To summarise, the salient features are as follows:

- **Coverage of all important topics**—Microbes and Food Quality, Hygienic Food handling, Environmental Sanitation, Personal Hygiene and Safety, Regulatory Agencies, Principles of Food Hygiene, Food Borne Diseases and Pest Control
- **New chapters**—HACCP and Quality Assurance, Food Preservation and Food Additives, and Recent Concerns
- **360° application-based learning support**
    - *Interactive Case Studies* to impart interactiveness and application approach to readers
    - *Newspaper collages* to update students with latest developments/issues in the subject area
    - *Detailed Checklist for Industry Professionals* to analyse weak areas in food sanitation and take appropriate corrective measures
- **Excellent pedagogy**
    - Over 200 chapter-wise questions including Multiple Choice Questions, Fill in the Blanks and Review Questions
    - More than 100 illustrations
    - Chapter-wise Key Terminologies

CHAPTER ORGANISATION

The book is presented in five major parts to enable the reader understand the principles and practices underlying food sanitation:

- Part I is on Microbiology and Food Quality
- Part II deals with Hygienic Food Handling
- Part III covers Sanitation of Premises and Environment
- Part IV tackles Personal Hygiene and Safety
- Part V discusses Regulatory Agencies

The structure follows a logical flow beginning with the fundamentals of sanitation so that the reader is familiarised with the basic concepts of health and disease in Part I, while its application to keep food safe and healthy is discussed in the chapters that follow.

The chapter on *microbiology* describes the *microbes present naturally in different foods* and *beneficial role of microbes* as additional topics. *New types of contaminants* are included in Chapter 2. The new Chapter 3 on *food preservation* covers all processes and common additives which are used in processed foods available today. Chapter 4 has *listeriosis* added on.

The chapters on *purchase and storage of food* have been clubbed for better understanding and so has the chapter on *sanitary procedures while preparing and serving food*, to maintain continuity and flow.

Many new operations have been added to the chapter on *special food operations*, namely, *hospital food service, airline catering, railway catering, sea catering* and *home deliveries. Indoor air quality and en-conditioning* have been introduced under the topic of *ventilation* and *recent advances in waste disposal* are added to the topic on *methods of waste disposal*.

E-waste and its management is added to *environmental pollution*. *Useful safety devices* are included under the chapter on *safety at the workplace*.

Latest food laws—The Food Safety and Standards Acts of India 2006—as well as *additional rules on irradiation, plastics and edible oil, and codex Alimentarius* have been briefly explained.

A complete new chapter on *Quality and food standards* has been added to the text, stressing on the significance of the team 'quality' in today's scenario. *Relevant ISO standards*, namely, *quality management systems, environmental management systems* and *food safety management system* have been briefly explained in simple, easy-to-comprehend language. *Hazard analysis* and critical control points are explained in detail with steps and formats that are easy to apply. *Sanitation risk management* has also been added in this edition.

An additional chapter on *recent concerns* highlights the emerging pathogens, i.e., diseases which were unheard of earlier, and introduces the reader to new trends in food packaging and technology. The chapter covers *diseases such as mad cow disease, swine flu, bird flu and chikungunya along with preventive measures for the same*. The reader is introduced to *genetically modified foods* which have swarmed the market along with *latest trends in food labeling and packaging technology* for the wide array of foodstuff one sees in the supermarket stores. It tells us how the consumer can be assured of the freshness of the pack and how smart packaging helps in monitoring products through the food-supply chain. The reader is introduced to *eco-friendly practices used in pest control, pollution control as well as in packaging technology*.

Case studies based on real-life situations have been included in this edition to increase one's thinking and decision-making abilities. These added learning opportunities will help students increase their knowledge, comprehend complex situations, apply theoretical knowledge to practical situations, make necessary assumptions and evaluate and select the best course of action to safeguard health.

After reading through the text, food handlers will not find themselves at a loss but will be able to promote and practice good hygienic measure and will be able to comprehend latest quality standards when they join the industry.

Sunetra Roday

Publisher's Note

Do you have a feature request? A suggestion? We are always open to new ideas, as the best ideas come from you. Please send your comments to *tmh.sciencemathsfeedback@gmail.com*. Request you to please mention the title and author name in the subject line.

Piracy-related issues may also be reported.

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I extend my sincere thanks to Tata McGraw-Hill, its managerial, editorial and production staff—Ms Vibha Mahajan, Ms Shalini Jha, Ms Smruti Snigdha, Ms Renu Upadhyay, Ms Sohini Mukherjee and Mr P L Pandita. Suggestions for improving the book further are welcome at *sunetraroday@gmail.com*.

Finally, last but not the least, I am indebted to my entire family for putting up with my impossible hours and schedule.

Sunetra Roday

Abbreviations

3R's	Reduce Reuse Recycle
AGMARK	Agricultural Produce (Grading and Marketing) Act 1937
BHA	Butylated Hydroxy Anisole
BHC	Benzene Hexachloride
BHT	Butylated Hydroxy Toluene
BIS	Bureau of Indian Standards
BOAA	Beta-N-Oxalylamino-L-Alanine
BPA	Bisphenol-A
BSE	Bovine Spongiform Encephalopathy
BVO	Brominated Vegetable Oil
CCP	Critical Control Point
CFC's	Chlorofluorocarbons
CFU	Colony Forming Unit
CJD	Creutzfeldt–Jakob Disease
CPI	Continuous Process Improvement
DDT	Dichloro Diphenyl Trichloroethane
EEC	Enteropathogenic *Escherichia coli*
FAO	Food and Agriculture Organisation
FDA	Food and Drug Administration
FIFO	First In First Out
FPO	Fruit Products Order 1955
FSSAI	Food Safety and Standards Authority of India
GAP	Good Agricultural Practices
GHP	Good Hygiene Practices
GM	Genetically Modified
GMO	Genetically Modified Organisms
GMP	Good Manufacturing Practices

GMS	Glyceryl Monostearate
GPM	Green Pest Management
Gy	Gray
H1N1	Novelle Influenza A virus
H5N1	Influenza A virus sub type H5N1
HACCP	Hazard Analysis Critical Control Point
HPAI	Highly Pathogenic Avian Influenza
HTST	High Temperature Short Time
IAQ	Indoor Air Quality
IPM	Integrated Pest Management
IRCTC	India Railways Catering and Tourism Corporation
ISO	International Organisation for Standardisation
kGy	KiloGray
LTH	Low Temperature Holding
MBM	Meat and Bone Meal
MMPO	Milk and Milk Products Order 1992
MSG	Monosodium Glutamate
PAH	Polycyclic Aromatic Hydrocarbons
PCO	Photo Catalytic Oxidation
PDCA	Plan Do Check Act
PFA	Prevention of Food Adulteration Act 1954
pH	Hydrogen Ion Concentration
PHL	Public Health Laboratory
Ppm	Parts per million
psi	Pounds of Pressure per Square Inch
PSP	Paralytic Shellfish Poison
QUATS	Quaternary Ammonium Compounds
RFID	Radio Frequency Identification
RH	Relative Humidity
SBS	Sick Building Syndrome

SRM	Sanitation Risk Management
TQM	Total Quality Management
TTI	Time Temperature Indicators
UHTS	Ultra High Temperature Sterilisation
UN	United Nations
UV	Ultraviolet
UVGI	Ultraviolet Germicidal Irradiation
VOC	Volatile Organic Compounds
WHO	World Health Organisation

Introduction

SIGNIFICANCE OF SANITATION IN THE CATERING INDUSTRY

Man's quest for knowledge to keep the body healthy can be traced right back to the Indus Valley Civilisation and the Vedic period. References in the chapters of the Mahabharata (600 BC) point out very emphatically to the unholy connection between an unsanitary, pest-infested environment and ill-health among the masses. Importance of sanitary practices were recognised in those early ages and now form an integral part of the operations encountered in the food industry.

Vast changes in the Indian social and cultural practices have been brought about by rapid modernisation and influence of the media. We are now faced with a situation where people venture out of their homes more often than previously, to savour the delicacies and the ambience provided by the ever-expanding food industry. Increase in buying power and long hours spent away from home commuting to work places, make eating out a necessary part of people's daily life. Thus, eating out, besides being a social event, is a matter of convenience such as the catering facilities available at hospitals, schools, colleges, industries, and also while travelling by any mode of transportation such as rail, ship, road and air.

Marriages being five-star events, a menu for every occasion as advertised by independent caterers, crowded fast-food joints, endless waiting at the friendly neighbourhood mess or the distant dhaba, the 'hot favourite' on the menu being wiped out before closing time, and the frequency with which new pubs keep cropping up, are some of the indicators of the fact that eating out in a big way is here to stay.

The ever-increasing market for convenience foods—tinned, canned, chilled, frozen and preserved foods presents a whole array of complex operations in food processing. This weaning away from the traditional fare of yesteryears provides a tremendous challenge to the food industry. More so because the responsibility is not only to serve attractive and nutritious food to the public but to ensure that it is wholesome and bacteriologically safe.

Understanding the important role that sanitation plays in every aspect of food storage, processing and its holding and disposal of wastes, is the responsibility of every food service personnel. Effective use of sanitary procedures and their proper implementation is the only way of maintaining hygienic conditions, enabling food served to be safe and socially accepted.

Many centuries earlier bacteriologists and chemists discovered the fact that breaking the chain of infectious contact from person to person, from person to spoon, cup or plate to person, or from person to food to person is the most certain way of restricting food-borne illness. Thus prevention of food contamination by employees, safe handling of food and its subsequent storage till consumption and sanitary washing of mouthed dishes and utensils and proper waste disposal are the major steps in maintaining hygienic conditions and a clean environment.

Despite the fact that sufficient information is now available on sanitary techniques and measures, it is not effective due to improper application. Most jobs of cleaning, sanitising and waste disposal are relegated to unskilled personnel who have little knowledge or training as to the importance and reasoning behind the various steps incorporated in a sanitation program. Personnel actually handling food who are ill-informed or poorly trained and who do not practice personal hygiene can be responsible for food contamination. Rising incidents of food poisoning reported in the media or the frequent 'tummy upsets' one experiences after a meal taken outside the home, point out to the harm that negligence or poor quality sanitary practices could result in. Since food sanitation has a direct effect on the health of individuals patronising the catering facility, it is obligatory on the part of the management to lay down definite guidelines for maintaining hygienic conditions and ensuring their proper implementation. This in turn would guarantee to some extent a regular flow of clientele who are very selective of the places they eat at. Also it is essential that the importance of hygienic practices be reinforced from time to time by way of meetings, discussions and slide shows. Requirements laid down by the regulating agencies for procuring licences should be strictly adhered to.

Food service workers who maintain a good standard of personal hygiene could prevent contamination of food, surfaces or equipment he or she handles. Personal hygiene refers to the individual efforts one undertakes in order to preserve and improve physical, mental and social health. Good habits, exercise, cleanliness, a balanced diet, sufficient sleep and relaxation-all promote optimum efficiency at work, alertness and a positive attitude towards service of customers.

In order to meet the present day public demand, large quantities of food need to be cooked and served. In certain cases the service of food has to be staggered, hence food has to be made in advance and 'held' till finally consumed. The temperature and climatic conditions prevalent in India, as well as the pH value of most food articles are conducive to growth and proliferation of bacteria causing food-borne diseases.

The food handler is the biggest threat to the safety of food. Food prepared in catering establishment is at a greater risk of contamination because it is prepared in large quantities and is being handled by many people. Because of the large quantities of food needed and staggered meal timings, it has to be prepared well in advance and served over an extended period. During peak hours it may be difficult to hold food outside the danger zone. Because of all these reasons, careless handling on part of a single employee can contaminate food and permit harmful microorganisms to multiply in food.

Food should ideally be consumed immediately after preparation or held at temperatures outside the 'danger zone' which inactivate or kill bacteria.

Despite proper temperature control human contamination of food is possible, unless specific and constant hygienic practices are implemented. Healthy employees could transfer microorganisms present on or in their bodies or else they could be 'carriers' of major illnesses. Therefore a thorough medical examination is mandatory to declare all food handlers free from infection.

Cleanliness should be the basis of all food sanitation programmes and should be aimed at food protection as well as improving and maintaining the quality of food. The onus is on the food service worker to break the chain of transmission of disease causing organisms from carrier to food and from food to the victim or consumer.

Apart from sanitary conveniences and facilities available, the size of the establishment and hygienic aspect is of equal importance in the starring or classification of hotels and grading of restaurants. Maintaining high hygienic standards in the establishment is the moral responsibility of all food service workers.

The number of food-poisoning cases reported each year is on the increase. Sometimes symptoms may persist for a day or even less and patients may not take any medication or consult a doctor. Such illness, even if of a short duration, can cause great discomfort and these figures are not included in the official report. So the actual cases of food poisoning approximately ranges from 10 to 100 times more than the reported cases. As the catering industry grows, so does the problem of food-borne illness, unless all food handlers are trained in safe food-handling practices.

This text aims at analysing the solution to this big problem of safe food in five main sections.

The chapters which follow cover all these aspects which are discussed at length. No matter how we look at the problem, the responsibility lies with the management of the food industry in implementing sanitary procedures and creating a right attitude among its staff towards safeguarding public health.

KEY TERMS

Contamination Contamination is the entry and multiplication of infectious agents into or onto inanimate objects, for example food, water, equipment and so on.

Danger zone The danger zone is the temperature range between 5 °C and 63 °C (40 °F and 145 °F) within which most bacteria grow best.

Food sanitation This term refers to all the hygienic measures taken to ensure that food served is wholesome and safe to consume.

Health Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.

Hygiene The art and branch of science that deals in preserving good health is *hygiene*—derived from *Hygieia*, the Goddess of health.

Sanitation The word Sanitation, derived from the Latin word '*Sanus*' meaning 'sound and healthy' or 'clean and whole', encompasses knowledge as well as acceptance and effective application of sanitary measures. In other words, the term sanitation refers to the hygienic measures of promoting health through prevention of human contact with hazardous wastes.

REVIEW QUESTIONS

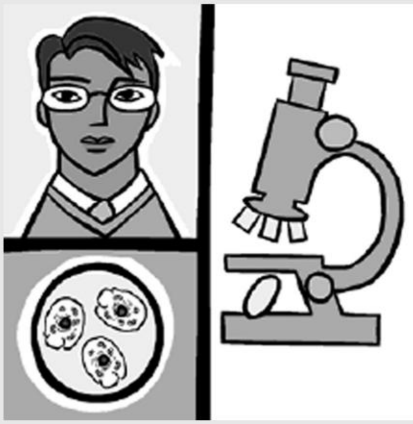
Significance of Sanitation in the Catering Industry

1. Why do foods prepared in large quantities tend to spoil faster?
2. Why are more people consuming meals outside the home?
3. What is the temperature range of the 'danger zone' in food preparation?
4. What is the main role of any catering establishment?
5. List 10 occasions when people consume meals outside the home?
6. Fill in the blanks with appropriate words.
   (a) The word __________ means to create and maintain a healthful environment.
   (b) A __________ is a disease caused by consuming contaminated food.
   (c) Diseases related to food can be transmitted to humans indirectly by pests, __________, __________, __________ and contaminated equipment and utensils.
   (d) The importance of sanitation in any large-scale feeding programme cannot be undermined because of the large __________ of people who may be affected.
7. State whether True or False. If false, correct the statement.
   (a) The eating habits of people is changing and fast foods as well as convenience foods are gaining popularity.
   (b) All food-borne illnesses can be prevented.
   (c) Man has been aware of protecting his food supply since ancient times.

(d) Most cases of food poisoning remain unreported.
(e) Increased handling and processing of food increases the chances of food contamination.

8. Differentiate between the following.
(a) Hygiene and Sanitation
(b) Contamination and spoilage
(c) Clean and sanitary

9. How is a food-borne illness directly transmitted by a food handler?



Part I

MICROBIOLOGY AND FOOD QUALITY

- Microbiology
- Food Contamination and Spoilage
- Food Preservation
- Food-borne Diseases

1

- Common food-borne microorganisms—viruses, bacteria, fungi and parasites
- Characteristics of microorganisms
- Growth of bacteria
- Factors affecting growth of microbes
- Control of microbial growth in foods
- Beneficial role of microorganisms in food

Microbiology

INTRODUCTION

Every year thousands of people all over the world fall ill after consuming food that seemed absolutely normal but was actually contaminated by harmful organisms. With more people eating away from home, outbreaks of food-borne disease are now becoming more frequent.

To understand the chain of events which precede an outbreak of disease caused by contaminated food, it is necessary to know something about the organisms responsible. These organisms are too small to be seen with the unaided eye and can only be seen under a microscope. That is why they are called microorganisms or microbes and their study is called microbiology.

A compound microscope magnifies a microbe up to 1500 times and an electron microscope up to 5,00,000 times.

The food handler should know that some microorganisms are useful to us and some are harmful causing food spoilage and disease.

COMMON FOOD-BORNE MICROORGANISMS—VIRUSES, BACTERIA, FUNGI AND PARASITES

There are five groups of microorganisms of importance in food microbiology. They are viruses, bacteria, fungi, algae and protozoa.

Viruses

Viruses are strictly parasitic and cannot be cultivated outside the living host cell. They feed on living cells of plants and animals and are pathogenic. They are very minute in size and can only be observed under an electron microscope.

Shape and Size Viruses appear as spheres, rods and icosahedrons (a figure with 20 triangular faces). Others appear as coils surrounded by a jacket. They vary in size from 0.015 microns to 0.2 microns. A micron is a unit of length equal to one thousandth of a millimetre.

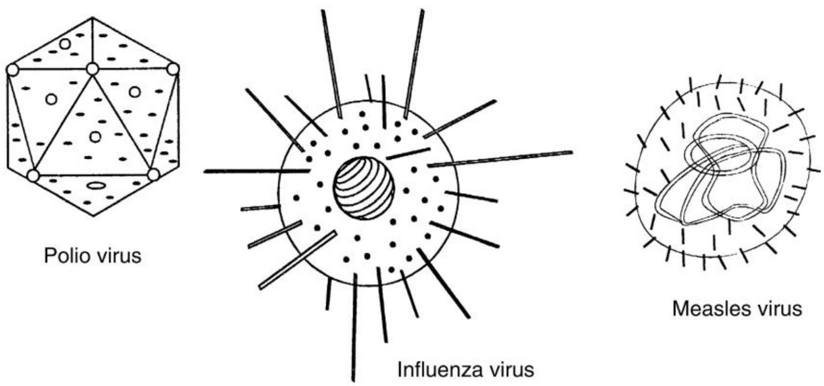


Fig. 1.1 *Some common parasitic viruses*

Viruses attach themselves to plant, animal or bacterial cells and the nuclear material present in the virus is released in the cell. At the expense of the cell the virus multiplies inside the cell. When sufficient number of particles are formed the cell bursts and the released viruses attack other cells. Those that are parasitic on bacterial cells are called bacteriophages.

Some viruses are harmful to the food industry. They attack the bacteria used as a starter in the manufacture of cheese and yoghurt. The bacteria are then incapable of fermenting lactose to lactic acid and this affects the overall quality of the product.

Poliomyelitis and infectious hepatitis are viral diseases caused by contaminated food and drinking water. Shellfish such as oysters, cockles and mussels from sewage polluted waters, can cause viral food poisoning if food is not cooked thoroughly. Other common viral diseases are influenza, common cold, mumps, measles and chicken pox. Viruses are present in the nose and throat discharges and in the faeces of infected persons. They are capable of becoming inanimate and resting for long periods in a crystalline form.

Some viruses are useful to humans. These viruses can produce antigens which are used as vaccines to protect humans and animals against serious and crippling viral diseases like poliomyelitis.

Bacteria

Bacteria are found everywhere—in and on soil, water, air, plants, animals, humans and their food.

Bacteria are both useful and harmful to humans. They are capable of fermenting sugar to lactic acid. This makes them important in the manufacture of dairy products like curds, yoghurt, buttermilk and cheese, and fermented vegetable products like sauerkraut and dill pickles.

Some bacteria can oxidise ethyl alcohol to acetic acid and are necessary for the manufacture of vinegar. They leaven *idli*, *dosa* and *dhokla* batters and develop desirable flavours in them.

They help in fermenting and curing coffee and cocoa beans and in the production of enzymes, acids and other substances like glutamate and certain stabilisers added to food.

Many bacteria are pathogenic to humans and animals. Most food infections and food poisonings, are of bacterial origin. They are also responsible for spoilage of food.

Canned foods, fruit juices and alcoholic beverages are spoiled by acid producing bacteria. They spoil beverages and milk by forming rope or slime in them. They may cause surface discolouration on many foods or putrefy foods accompanied with the development of a foul smell.

A FOOD HANDLER SHOULD KNOW THESE

1. *Bacteria are the most common cause of food poisoning.*
2. *They are present everywhere.*
3. *We cannot see them.*
4. *They do not have legs or wings but are carried from one place to another by humans, animals, water and wind.*
5. *Under favourable conditions they are present in large numbers.*
6. *An awareness of how they grow and reproduce is necessary if we want to control them.*

Shape and Size Bacteria are minute, unicellular organisms of variable shape and activity. They are so minute that it would take 1000 bacteria to cover the point of a pencil. The size of a bacterial cell ranges from 0.2 microns to 10 microns and on an average is 1 micron in size. They can be seen through the oil immersion lens of a compound microscope. They can be identified by their shape, size and cell arrangement. Four shapes are observed: rod-shaped, spherical, spiral and comma-shaped.

- *Rod-shaped bacteria* They may or may not have organs of locomotion called flagella. Some species are capable of forming a resistant structure called an endospore. The bacteria in this group cause typhoid, tuberculosis and food poisoning. Some coliform bacteria (so called because they are present in the colon) which are part of the normal flora of the intestines of humans are also rod shaped and are indicators of faecal pollution. They are undesirable in foods because their presence may indicate the possibility of other enteric pathogens. Enteric pathogens are microorganisms that cause diseases of the intestinal tract or enteron.
- *Spherical bacteria* They are also called cocci and may be arranged in many different ways.
    1. Pairs of cocci are called diplococci, for example, bacteria causing pneumonia.
    2. Chains of cocci are called streptococci, for example, bacteria causing sore throat and tonsillitis.
    3. Irregular clusters are known as staphylococci, for example, bacteria causing Staph food poisoning.
    4. Tetrads are cubes of four to eight cocci, for example, bacteria causing spoilage of foods.
- *Spiral bacteria* They are also called spirilla and cause diseases such as syphilis.
- *Comma-shaped bacteria* They are also called vibrios and cause diseases such as cholera.

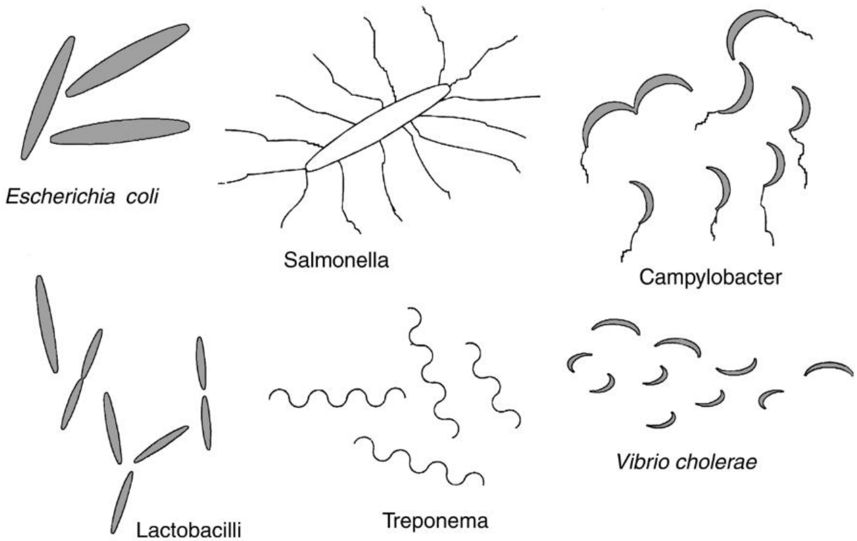


Fig. 1.2 *Different shapes of bacteria*

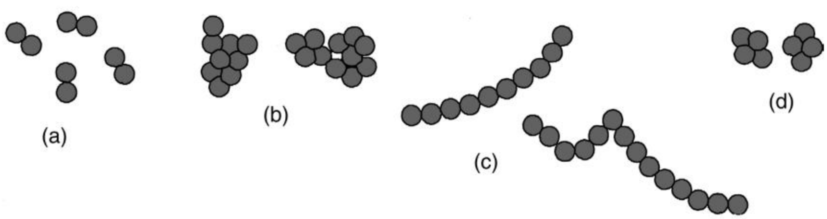


Fig. 1.3 *Cell arrangements in cocci (a) diplococci, (b) staphylococci, (c) streptococci, (d) tetrads*

Flagella Some bacteria are motile in liquids and swim about by means of hair-like structures called flagella.

Flagella may be present singly or in clusters at one or both ends or all around the cell.

Capsule and Slime Layer Some bacteria may be surrounded by a capsule or a slime layer. This covering has a protective function and increases resistance to adverse conditions such as heat or chemicals. The capsule or slime layer is responsible for sliminess or ropiness of contaminated food.

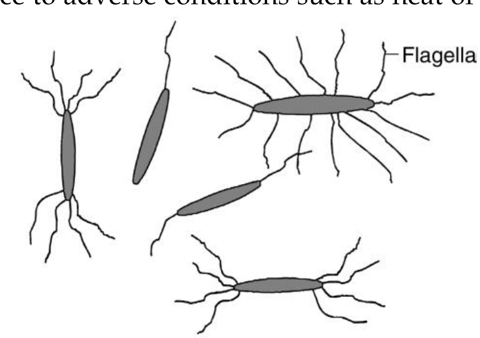


Fig. 1.4 *Flagellated bacteria*

Endospores Bacteria of the genera *Bacillus* and *Clostridium*, which cause food poisoning, are capable of producing a resistant structure within the cell. This structure is called an endospore. The endospore or spore is a resting body and is formed when conditions are unfavourable for growth. The cell gradually disintegrates leaving the spore intact. These spores are resistant to unfavourable conditions like high temperature, desiccation and some chemicals. They can remain dormant for a long time. That is why it is necessary to calculate the time and temperature required to destroy most heat resistant spores when canned foods have to be sterilised.

These sporing bacteria are responsible for some of the spoilage of foods and for causing food poisoning. When spores settle on a suitable food supply, they germinate into vegetative cells and multiply very rapidly.

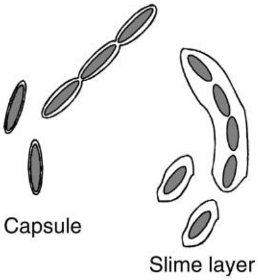


Fig. 1.5 *Capsule and slime layer*

Reproduction When suitable conditions for growth exist, bacteria reproduce by dividing themselves into two every 20 or 30 minutes. This process of cell division is called binary fission.

When a bacterial cell grows to its maximum size, a constriction appears at both sides of the centre axis. This constriction grows inwards

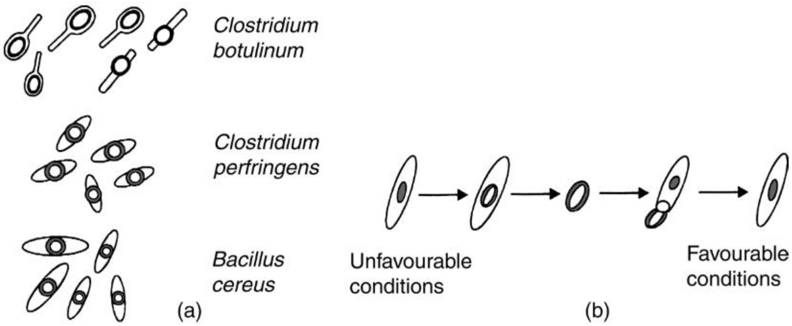


Fig. 1.6 *(a) Endospores seen in certain spore-bearing bacteria (b) endospore formation and germination*

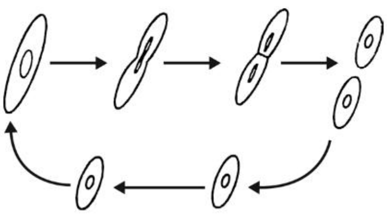


Fig. 1.7 *Binary fission*

and divides the cell into two new cells. By this division a single bacterium can produce approximately two million bacteria in seven hours and 7000 million after 12 hours under optimum conditions for growth by multiplying every 20 minutes. When the environment becomes unsuitable for growth, i.e., when nutrients are exhausted or waste products accumulate, the cell dies. The food handler should realise that a single bacterium seldom occurs in food and after multiplication for a couple of hours the number of bacteria increases dramatically and the food becomes potentially hazardous.

Bacteria live and multiply in many food stuffs. Very often the type of food, atmospheric temperature and humidity of the kitchen provide ideal conditions for multiplication of bacteria. Protein rich foods like meat, fish and poultry, whether raw or cooked, are excellent media for bacterial growth, especially when these foods are stored without refrigeration.

Fungi

Fungi includes the lower plants and are usually multicellular, but the plant body is not differentiated into roots, stem and leaves. They are mainly saprophytes and lack chlorophyll. Some may be parasitic. They vary in size from the small microscopic yeasts to mushrooms in the fields. All of them are widely distributed in nature. Fungi include both yeasts and molds.

Yeast Yeast are unicellular and are found naturally in soil and dust.

Shape and Size Yeast are much larger in size than bacterial cells. They are 5–10 microns in size and vary in shape from ovoid, lemon-shaped, pear-shaped, triangular or elongated.

Reproduction They reproduce either asexually by polar budding or sexually by forming ascospores. During budding a small protuberance or bud grows on the mother cell. This bud or daughter cell grows in size, breaks off and eventually grows into an identical cell. Budding is a common method of reproduction in yeast. In sexual reproduction, four to eight ascospores are produced by two parent cells.

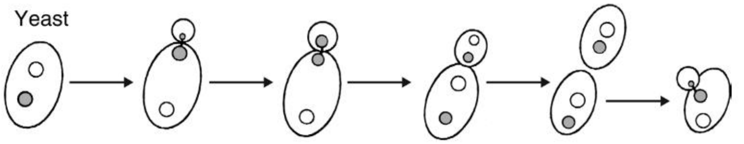


Fig. 1.8 *Budding*

Yeast cells are capable of fermenting sugars anaerobically to alcohol and carbon dioxide.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow[\text{under anaerobic conditions}]{\text{Yeast}} \underset{\text{Ethyl alcohol + Carbon dioxide}}{2C_2H_5OH + 2CO_2}$$

This makes them important in making bread and alcoholic beverages. The yeast, *Saccharomyces cerevisiae* is of industrial importance in bakeries and breweries. Food yeast is rich in B-complex vitamins.

Certain yeasts rich in protein can be cultivated on industrial wastes as a source of food. This protein rich food is called single cell protein (SCP). They are useful in beer and wine making and as a first step in the manufacture of vinegar.

Yeasts can grow on the surface of high acid and salt containing pickles and chutneys and spoil them by oxidising the acid and allowing less acid tolerant organisms to grow. Some are osmophilic and can grow well in high concentrations of sugars or salts. They spoil dry fruits, fruit juices, squashes, honey and soy sauce by forming alcohol and carbon dioxide. Temperatures of around 25° to 30°C are best for their growth. They prefer foods containing carbohydrate which have a slightly acidic pH. They are not pathogenic and are more useful than harmful. They require a moisture level above 20 per cent to survive and multiply.

Molds Molds are multicellular. Their bodies are thread-like or filamentous. The filaments are called hyphae and the entire body is called mycelium. Hyphae may be submerged, i.e., growing within the food, or aerial, i.e., growing into the air above the food.

Shape and Size The body is filamentous with spore heads of varying shapes and sizes. They are 2–10 microns in diameter and several mm in length.

Mold growth may be cottony, dry or powdery, velvety or slimy. It may be white or coloured yellow, green, blue and black and is seen on dead organic matter. The colour and type of mold growth is generally characteristic of a genus.

They are mainly saprophytes but some are plant pathogens. They grow readily on bread, jam, cheese, leather, cow dung, etc. They are responsible for spoilage or rotting of fruits and vegetables, giving them either a water soaked, mushy appearance or forming dry, hard, discoloured patches.

Reproduction Reproduction in molds is mainly by asexual spores. Spores are borne in hundreds on the ends of hyphae, either inside a spore sac or outside it. *Rhizopus* and *Mucor* bear spores inside the dome-shaped spore head whereas in *Penicillium* and *Aspergillus* spores are budded off in chains. When the spore head matures, the spores are liberated.

These spores are very light and are present in abundance in the air and soil. When they settle on any suitable organic matter they germinate into a new mycelium.

Molds are useful to humans. They are used to ripen cheese and to add flavour and colour to it. Blue cheese or Roquefort cheese is ripened by *Penicillium roqueforti* and Camembert cheese by *Penicillium camemberti*. Some species of *Penicillium* produce life saving antibiotics. *Aspergillus oryzae* is used for making soy sauce. Molds are used in many oriental fermented foods like *tempeh*.

Some molds are harmful because they produce toxins. Species of *Aspergillus* produce a toxic substance called aflatoxin when they grow on peanuts, corn, wheat grain and their meal. Some are parasitic, for example, ringworm is a mold which is parasitic on skin and hair. Certain varieties of mushrooms growing in the fields are highly toxic and can cause death, for example, *Amanita sp.* Any food with plentiful mold growth should be discarded. Molds die at moisture levels below 13 per cent.

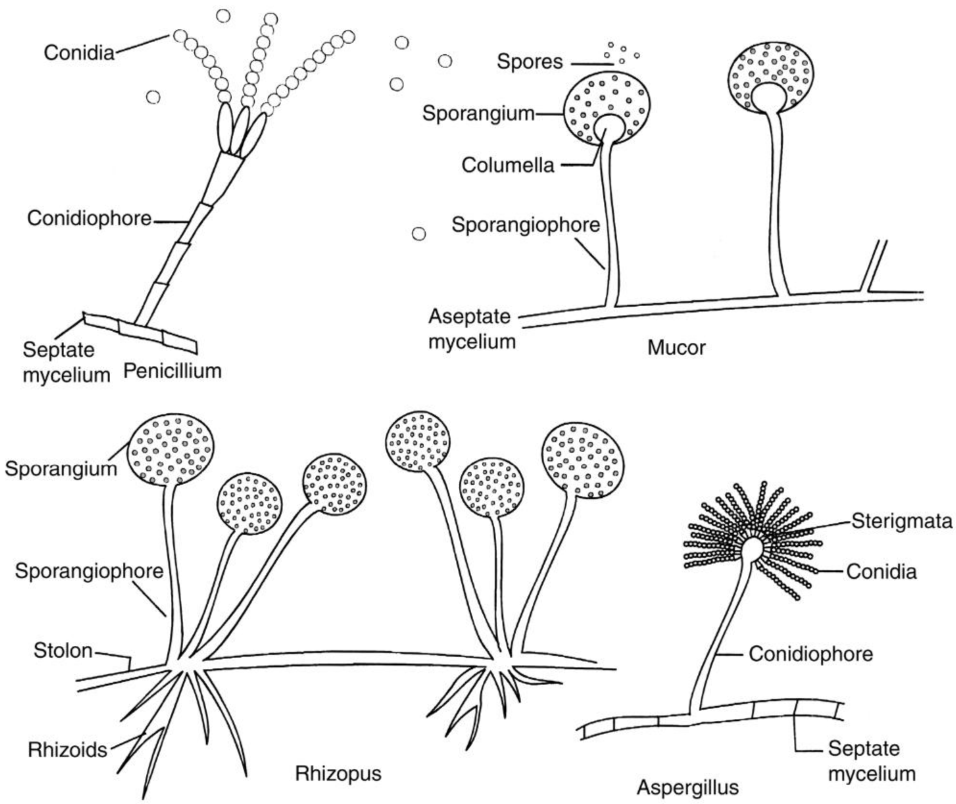


Fig. 1.9 *Molds of economic importance*

Algae

Algae include both unicellular and multicellular organisms found naturally in water. They contain chlorophyll and are photosynthetic.

Shape and Size Algae vary in shape and size from one micron to many feet in length.

Reproduction Algae reproduce asexually and sexually. They are generally nonpathogenic, although some may have an unpleasant odour and slimy texture. Unicellular algae are of importance in water purification and sewage treatment plants. They are also important as primary producers of food for the aquatic environment.

A pathogenic algae *Gonyaulaux catenella* is found in seawater planktons. Molluscs who feed on this plankton become poisonous.

Multicellular algae is of importance as a source of agar for microbiological media. Red and brown algae are used as a source of food and blue green algae as fertilisers because they are rich in proteins. Alginic acid and its salts are made from brown algae. This is used in ice creams to prevent ice crystal formation and to give a smooth texture. It is also used in cheese and frosting.

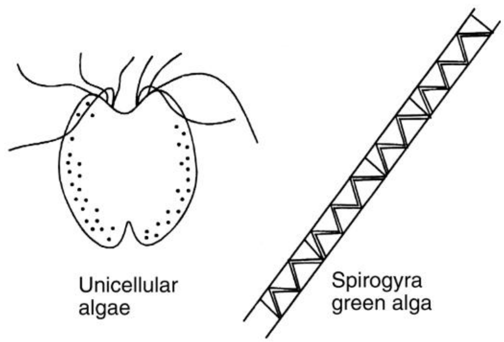


Fig. 1.10 *Unicellular and multicellular algae*

Protozoa

Protozoans belong to the animal kingdom. They are unicellular. Some are parasitic.

Shape and Size Protozoa vary in shape and size from 2 to 200 microns.

Reproduction Protozoa reproduce sexually and asexually. They are a source of food for fish and other aquatic animals.

Pathogenic varieties include *Entamoeba histolytica* which causes amoebic dysentery, *Trypanosoma* causing sleeping sickness and *Plasmodium* which causes malarial fever.

Amoebiasis occurs when drinking water is contaminated by sewage or through salads and root vegetables grown on soil to which untreated excreta is applied as a fertiliser. Entamoeba forms cysts which require heat for their destruction.

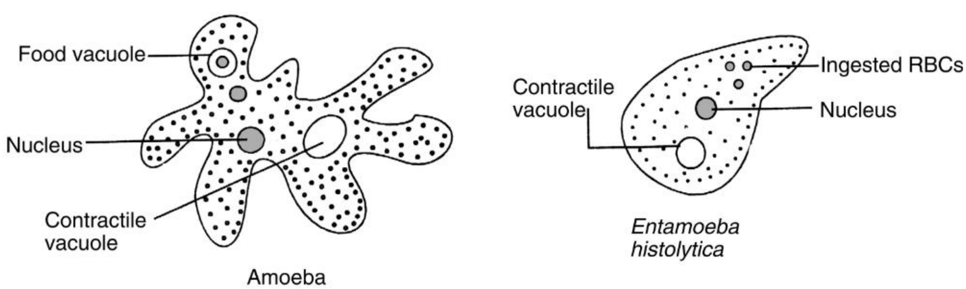


Fig. 1.11 *Protozoans*

CHARACTERISTICS OF MICROORGANISMS

Nutrition

Microorganisms acquire their nourishment by any of the following three methods:

1. By feeding on dead and decaying organic matter. Such microorganisms are called saprophytes. Bacteria, yeasts and molds are saprophytic.
2. By feeding on living host cells. Such microorganisms thrive at the expense of the host and are called parasites. Viruses, some bacteria, some fungi and protozoa are parasitic on plants and animals.
3. By manufacturing their own food. Green algae contain chlorophyll and can produce their own food by the process of photosynthesis just like plants.

Respiration

On the basis of oxygen requirements, microorganisms are classified into three broad categories:

1. *Aerobes*: These microorganisms use oxygen to release energy from food, for example, algae, protozoa and some bacteria like *Salmonella* which causes typhoid.
2. *Anaerobes*: These microorganisms obtain their energy without oxygen, for example, viruses, some fungi and bacteria such as *Clostridium* which cause food poisoning.
3. *Facultative organisms*: They can respire either aerobically or anaerobically like *Shigella* which causes bacillary dysentery and *Staphylococci* which causes food poisoning.

Most microorganisms are harmless to humans. The metabolic wastes produced by parasitic microorganisms like viruses, bacteria, fungi and protozoa are toxic to living cells. These poisons or toxins produce the symptoms of disease such as fever, inflammation, headache, nausea and gastro-intestinal upsets.

GROWTH OF BACTERIA

True growth is defined as an orderly increase in all cell constituents. However, microbial growth is measured in terms of increase in cell number.

The time period which lapses between two successive cell divisions is called generation time. It varies in different organisms. The environmental conditions available also determine the time required for cell division.

Many common methods of preserving food and keeping it fit for consumption depend not on the destruction or removal of microorganisms but on (a) delay in the initiation of growth and (b) hindrance to growth once it has begun.

Most microorganisms, when added to food, multiply at a very rapid rate under favourable conditions. A single bacterial cell divides into two every 20 to 30 minutes. If the rate of multiplication is maintained, a single cell will produce one billion new cells after a period of 10 hours.

If the logarithms of the number of organisms per ml. and the time in hours is plotted on a graph, it is observed that the rate of multiplication is not maintained indefinitely, but four distinct phases of growth are observed as indicated in Fig. 1.12. To control bacterial growth we must first be familiar with these phases.

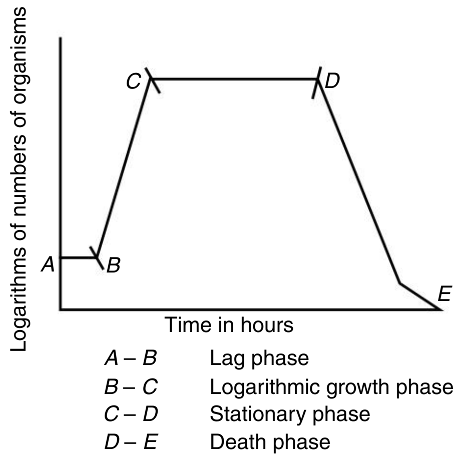


Fig. 1.12 *Four phases of microbial growth*

Growth Phases

1. The initial phase is called the *lag phase* during which there is no growth. The number of bacteria remains constant and the cells get adjusted to their new environment. Bacteria show an increase in size but not in number.
2. In the *exponential* growth phase or *logarithmic growth phase*, the rate of growth increases at a very rapid or logarithmic pace. In this phase the generation time is constant and the growth rate is the highest.
3. In the *stationary phase* the rate of multiplication decreases gradually and average generation time increases. During this phase the number of living bacteria remains constant due to the death of some bacteria and the rate of growth equals the rate of death. They may die from lack of nourishment.
4. In the *death phase* the number of living bacteria declines rapidly at the same rate at which they grew. The number of surviving cells taper off very gradually. The more vulnerable cells die first and the resistant forms remain for some months or even years. They die because of a change in the environment such as (a) exhaustion of nutrients, (b) accumulation of toxic metabolic waste products, or (c) alteration of pH, etc.

Applications of the Growth Phase to the Food Industry

To prevent spoilage of food it is important that the lag phase and exponential growth phase are lengthened as much as possible. This can be achieved by the following ways:

1. by reducing the amount of contamination, i.e., keeping contaminating organisms away from food.
2. by preventing addition of actively growing organisms which are already in the logarithmic phase of growth—unclean utensils, containers and equipment that come in contact with food may harbour such organisms.
3. by providing one or more unfavourable environmental conditions like low temperature, heat, unfavourable pH, reducing the moisture level, keeping oxygen away or adding inhibitors, etc.

   The more unfavourable the conditions, the longer the time required for growth of microorganisms.
4. by actual damage to organisms by processing methods such as heating or irradiation.

To give food the desired storage life and delay the initiation of growth, it is better to use a combination of methods rather than a single method.

How Generation Time Affects Microbial Count

The length of generation time varies with the environmental conditions during growth. Environmental conditions include the type of food, its pH, temperature, moisture content, presence of oxygen and presence of inhibitors. Generation time (GT) shortens as conditions become more favourable and lengthens as they become less favourable.

Any change in the environment that will extend the GT will more than proportionally lengthen the keeping time of food. For example, lowering the temperature at which food is stored will lengthen the GT and hence the shelf life or keeping time.

If we start with a single cell which has a GT of 30 minutes, there will be about 1 million cells in 10 hours but only 1000 cells if the GT is 60 minutes and only 32 cells if it is 120 minutes.

Relationship between the GT and number of microorganisms

Generation time	*No. of organisms*
30 minutes	1 million
60 minutes	1,000
120 minutes	32

This emphasises the importance of avoiding contamination of food with microorganisms that are in the logarithmic phase of growth because when their GT is the shortest, the lag phase will be brief and multiplication of microorganisms leading to spoilage of food will proceed at a very rapid rate.

Table 1.1 **Beneficial Uses of Microorganisms**

Dairy products	Curds, Yoghurt, Cottage Cheese
Ripened dairy products	Cheeses
Fermented bakery products	Bread, Baba au rhum
Vegetable fermentation	Sauerkraut, Pickles
Fermented foods	Idli, dosa, dhokla
Meat products	Sausages
Sauces	Soy sauce
Vinegar production	Different types of vinegars
Non-alcoholic beverages	Coffee and tea production
Alcoholic beverages	Beer, wine etc.
Source of protein	Single cell protein
Production of enzymes	Amylase, Invertase, Protease
Production of animal feed	Yeast cakes, Spirulina, SCP
Antibiotic production	Penicillin, Clavacin
Vitamin production	B complex

Contd...

Table 1.1 (Contd)

Decay of organic matter	Compost, biosanitizers
Toxic Chemical Breakdown	Breakdown of toxic (potential carcinogens) chlorinated-aromatic compounds in industrial waste by genetically altered hybrid bacteria.

FACTORS AFFECTING GROWTH OF MICROBES

Various environmental conditions affect the growth and multiplication of microbes. The important factors which have an influence on growth are explained below:

1. *Food and nutrients*: The microbial flora present on food depends to a great extent upon its composition. Food serves as a substrate for microbes. They use our food supply as a source of nutrients for their growth. Microorganisms require food for energy and growth. They need carbohydrates and proteins as a source of carbon and nitrogen respectively. Some microorganisms can synthesise a few or all of the vitamins needed, others depend on food for them. Along with vitamins, trace elements are also required.

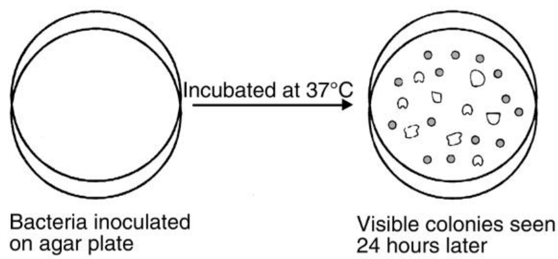


Fig. 1.13 *Bacterial growth on culture media*

   In the laboratory microbes are cultivated on media which meets their growth requirements. Nutrient agar is a type of solid media which is commonly used for cultivating microorganisms. This media contains a beef extract, peptone, agar agar and water. When bacteria are inoculated on this media, they multiply rapidly by binary fission. In 24 hours, visible colonies appear on the media. When the food supply is exhausted or conditions are unfavourable the bacteria form spores or die.

2. *pH level*: Most bacteria prefer a neutral pH between 6.5 to 7.5, but some can grow at a low or high pH. Molds and yeast grow better in an acidic medium of pH 4 to 4.5 as compared to bacteria. In general, foods with an acidic pH have a better keeping quality, like curds, pickles and fruits.

   Molds can tolerate a wider difference in pH than yeast and bacteria. Foods containing buffers, i.e., substances which resist the change in pH, permit more microbial activity than food without buffers. Milk proteins are good buffers and allow lactic acid bacteria to grow considerably, without suppressing their growth.

3. *Water Activity* (a_w): As water accounts for a large percentage of the weight of the cell, it is absolutely necessary for growth of all microorganisms. Water or moist conditions encourage the growth of most microorganisms. Therefore, food should be stored in well ventilated, dry and cool storage areas and not in a humid kitchen.

   In general, bacteria need more moisture than yeasts and molds and hence fungi grow faster on dry food material like bread and cereal grains. The growth of microorganisms depends on the available moisture and not total amount of moisture.

Relative humidity is high during the rainy season and in coastal areas, and has a significant effect on microbial growth. Food spoilage is hastened under conditions of high relative humidity. A relative humidity of 65 to 70% favours mold growth.

4. *Temperature*: High and low temperatures have a significant influence on microbial growth. At high temperatures (above 65°C), microorganisms are destroyed and at low temperatures, their growth is retarded (below 5°C).

   Each organism has an optimum temperature at which it grows best. It also has a minimum temperature below which it cannot grow and a maximum temperature above which it cannot grow. Organisms having an optimum temperature below 20°C are called psychrophilic organisms, for example, *Pseudomonas*. They grow at refrigeration temperature and some grow on frozen foods. The mold *Penicillium* also grows at low temperatures. Mesophilic organisms have an optimum temperature between 20°C and 45°C. Most bacteria,

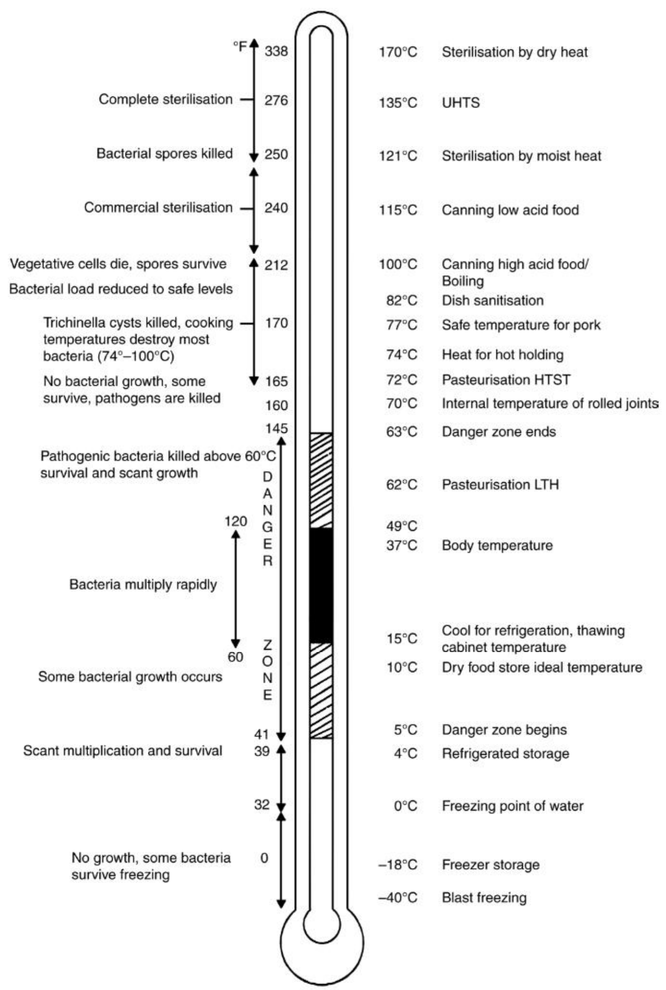


Fig. 1.14 *Effects of temperature on bacterial growth and survival*

specially human pathogens belong to this group. Thermophilic organisms have an optimum temperature above 45°C, for example, the spore-forming microorganisms like *Clostridium* and *Bacillus*. Effect of temperature on bacterial growth and survival is shown in Fig. 1.14.

5. *Oxygen*: Oxygen is necessary for all aerobic microorganisms. Anaerobic microorganisms do not require it and it may even be toxic to certain anaerobic microorganisms. Molds and most yeast grow best in the presence of oxygen, while bacteria may be aerobic, anaerobic or facultative. Pathogens may grow better in inadequately ventilated areas than in airy places.
6. *Time*: If microorganisms are given a favourable environment in terms of temperature, moisture and nourishment, they multiply rapidly and in a short span of time they would have multiplied to numbers large enough to cause harm. Foods often contain small numbers of pathogenic microorganisms, which multiply rapidly and can cause food-borne illness after such food is consumed. Food which is consumed as soon as it is cooked is at a lower risk of causing food poisoning.
7. *Osmotic Pressure*: The osmotic pressure of foods varies with the kind and amount of solute dissolved in food. The amount of sugar or salt in solution has an osmotic effect on microorganisms. This is because of the semipermeable nature of the cell. If a bacterial cell is kept in a hypotonic solution (a solution having an osmotic pressure lower than that of the bacterial cell), water from the surrounding media will enter the cell resulting in swelling. If the difference in osmotic pressure is still more, the cell bursts. This phenomenon is known as plasmoptysis. If the bacterial cell is kept in a hypertonic solution (a solution having an osmotic pressure higher than that of the bacterial cell), water from the interior of the cell goes into the surrounding medium resulting in the shrinkage of the cell. This phenomenon is called plasmolysis.

   Bacteria cannot grow in high concentrations of sugar and salt. Yeasts can grow in fairly high concentrations, whereas moulds grow in the highest concentrations of sugar. Bacteria require low concentrations of solute for their growth. Some osmophilic yeasts grow at high osmotic pressures and spoil dry fruits, pickles and fruit juice concentrates. A concentration of 3–10 per cent salt inhibits most microorganisms except the salt tolerant ones.
8. *Sunlight or Ultraviolet Rays*: Microbial growth is encouraged in dark humid places and not in well lit and naturally ventilated places. This is because ultraviolet rays are present in sunlight. These rays destroy microbes. They are used to purify air in food storage areas and for surface sterilisation of certain foods like meat and cheese.

CONTROL OF MICROBIAL GROWTH IN FOODS

Microbial growth in foods can be controlled in a number of ways. When the conditions necessary for bacterial growth are not available, growth and multiplication will be restricted. Microorganisms can be prevented from growing by the following methods: controlling temperature, removing oxygen, adding chemical preservatives, reducing the moisture content and exposure to ultraviolet rays. The different methods of controlling microbial growth have been discussed at length in Chapter 3 on Food Preservation.

Controlling Temperature

Most microorganisms require a warm temperature to multiply. Pathogenic microorganisms grow and multiply best at normal body temperature of 37°C. It has been seen that maximum number of microbes multiply between the temperature range of 5°C to 63°C. This temperature range is known as the danger zone. Multiplication slows down towards both ends of the danger zone. See Fig. 1.15.

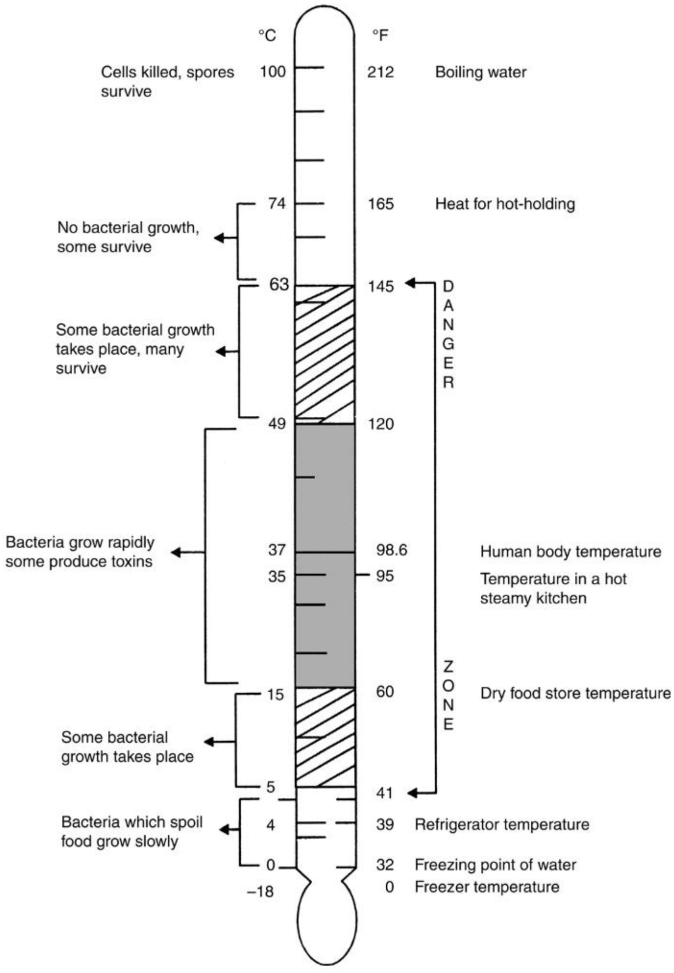


Fig. 1.15 *Danger zone in food preparation*

It is imperative for all food handlers to realise that food should be stored outside this zone.

Cold Preservation At low temperatures microbes are not destroyed. Their growth rate is retarded and so their numbers in food is controlled. Microbial growth is controlled by freezing, refrigeration and chill storage of food. When frozen food is thawed and temperatures become favourable, these microorganisms are capable of growth and reproduction once again.

Heat High temperatures destroy microorganisms by denaturation of cell proteins and inactivation of enzymes needed by them for their metabolism. At temperatures above 63°C bacteria stop multiplying and as the temperature increases, they are gradually destroyed. The thermal death

Fig. 1.16 *Spores survive ordinary cooking temperatures*

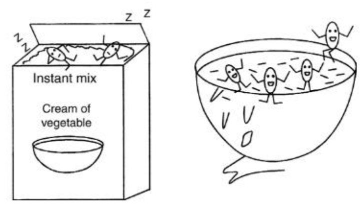


Fig. 1.17 *Reconstituted foods spoil at room temperature*

time (TDT) is the time needed at a given temperature to kill a number of microbes. Heat used to destroy microbes may be in the form of wet heat or dry heat.

Wet heat This is more commonly used in the food industry. If carefully administered, it is a useful method of controlling microorganisms. Wet heat is used in processes such as pasteurisation, canning, boiling, steaming, stewing and poaching food.

Dry heat Along with high temperatures, dry heat brings about dehydration of the food or surface of food. Dry heat is used in baking, roasting, grilling, smoking, and sun drying of food.

Removing Oxygen

Removal of oxygen can stop aerobic microorganisms from growing. This can be done by packing foods in airtight containers or vacuum packing of foods as in canned foods. However, anaerobic microorganisms can still grow in such foods if these have been inadequately processed.

Adding Chemical Preservatives

These substances retard deterioration of food by preventing microbial growth. The use of Class II preservatives has been restricted by law. If these preservatives are used in foods, they should be mentioned on the label. Preservatives may be added to food, they may be applied on the surface of foods, wrappers may be impregnated with preservatives, ice used to chill foods may contain an antibiotic which is a permitted preservatives or they may be used as gases around food.

Reducing the Moisture Content

The moisture content of foods like milk is reduced by evaporation, dehydration or desiccation of the food. Microorganisms survive in such foods, but they remain dormant. When such foods are rehydrated, the microorganisms become active once again. Class I preservatives like sugar and salt are natural substances that bind water which is present in the food and make it unavailable to microorganisms like bacteria. Molds and yeasts, which are osmophilic, can grow on such foods. Milk, eggs, fruits and vegetables are some of the foods which are preserved by reducing the moisture content. Such foods can be safely stored at room temperature till they are rehydrated.

Exposure to Ultraviolet Rays

Ultraviolet rays are lethal to bacteria. They have poor penetrating power and can be used only for surface sterilisation or for sterilising the air in a room. They are used to control mold growth on the surface of bakery products and to prevent spoilage of meat while tenderising and ageing.

Microbes Present Naturally in Different Foods

We have already read that microbes are ubiquitous (present everywhere) and the microbial flora on food depends largely on the source of contamination. There are some microbes that are generally present in different food items. The food handler should understand that more the number of times a food is handled the greater are the chances of further contamination. The normal flora of microbes present in various categories of food is listed below.

Cereals Microbes present on the outer surface of harvested grains include those from the soil, from insects and from other sources. Washing, milling and bleaching of cereals and their products helps in reducing the microbial load. Coliform bacteria and spores of *Bacillus*, along with other bacteria, may be present in cereals such as rice along with spores of the mold *Aspergillus* and *Penicillium*. The number of bacteria present per gramme of cereal may vary from a few hundred to millions. The surface of a freshly baked loaf of bread or freshly made chappatis is practically devoid of viable microbes. Bread can get contaminated by microbes from the air, the hands of the baker, the blades of the slicing machine or from the wrapper. The spores of the bacteria, which cause the defect ropiness in bread, are not destroyed during baking.

Sweeteners Sugarcane juice has a high microbial count from the sugarcanes, the soil, and from the extracting equipment and containers used. Bacteria of the species *Leuconostoc* and *Bacillus*, a variety of other bacteria, yeasts and some molds are present. Raw sugar contains osmophilic yeasts, molds and bacteria of the species *Bacillus*, *Clostridium* and *Desulfotomacalum*. Honey contains the microbes yeast and bacteria from the nectar of flowers and the intestinal contents of honey bee. *Clostridium botulinum* spores from honey have been implicated as a cause of infant botulism.

Eggs The white and yolk of freshly laid eggs is generally free from microbes but the shells soon get contaminated by faecal matter from the hen, the contents of the poultry farm, the water used to wash the eggs and the boxes in which eggs are packed. *Salmonellae* may be found in eggs as well as the shell and in dried or frozen egg powders. These *Salmonellae* may enter the eggs through contaminated poultry feed.

Poultry The organisms from feet, feathers and droppings are added to the normal flora of the skin. Microorganisms found on the feet and the cut surfaces include *Pseudomonas, Achromobacter, Micrococcus, Proteus, Bacillus,* etc.

Milk Milk from healthy cattle contains relatively few bacteria. It gets contaminated from the exterior of the animal. Bacteria from manure, soil and water are also found in milk. If dairy utensils are not cleaned and *sanitised*, they can be the most important source of contamination and may add considerable numbers of bacteria of the most undesirable kinds. Species of *Streptococci, Lactobacilli, Leuconostoc* and yeasts constitute the normal flora of milk.

Fish Fish flesh is highly perishable. The flora present on living fish will depend on the microbial load and the temperatures of water in which they breed. Psychrophiles like *Pseudomonas* are seen in colder Northern waters, while mesophiles are found in larger numbers in tropical waters. Microbes are present in the slime layer that covers the outer surface of fish and in the intestinal contents. Bacteria of the genera *Pseudomonas*, *Micrococcus*, *Alcaligenes*, *Escherichia*, *Vibrio*, *Clostridium* and *Bacillus*, are some of the bacteria on fish that contaminate trawlers, boxes and everything they come in contact with.

Meat Like fish, meat is also an excellent medium for the growth of many microorganisms because it has adequate moisture, it is rich in proteins and contains ample growth factors or vitamins and is at a favourable pH for most organisms. While the healthy inner flesh of meat generally has little or no microorganisms, it gets quickly contaminated during the normal slaughtering process. The exterior of the animal, i.e., the hide, hooves and hair harbour many different microorganisms from the dung, soil, water and fodder. These may be found in meat and bring about spoilage and disease.

Vegetables and Fruit Fruits and vegetables are subjected to contamination from containers during transportation to the market or to the processing plants. Adequate washing of fruits and vegetables reduces the number of bacteria, especially in the case of root vegetables and salad vegetables. Microorganisms on the surface of fruits and vegetables include normal surface flora and also those from soil and water, and some plant pathogens. Genera of bacteria usually present are *Achromobacter*, *Aerobacter*, *Pseudomonas*, and *Lactobacillus*. The natural flora on the surface of fresh grapes is mainly yeast.

BENEFICIAL ROLE OF MICROORGANISMS IN FOOD

We have read earlier in the chapter that some microorganisms are useful in the food industry. The beneficial role of microorganisms in the production of fermented foods, dairy products, bakery products, alcoholic beverages and vinegar is elaborated in this section.

Fermentation is a chemical process that breaks down organic materials. This process is carried out by microbes such as bacteria, yeast and moulds. It is useful in the production of bread, cheese and yoghurt, and alcoholic beverages like wine and beer, etc. The microbes that bring about food fermentations may be added to the food in the form of a pure culture or mixed culture; or very often no culture is added as the desired microbes are naturally present in adequate numbers in the food. For example, while making idli, the bacteria *Leuconostoc*, *Streptococcus* and *Pediococcus* that bring about fermentation of the rice and black gram paste are already present in sufficient numbers on the grains.

Some Important Microbial Reactions

Bakery Products In bread dough, sugars are fermented by the yeast *Saccharomyces cerevisiae* to ethanol (alcohol) and CO_2.

Alcoholic Beverages

$$\text{Sugar from grape juice} \xrightarrow[\text{fermentation}]{\text{YEAST}} \text{Wine} + CO_2$$

$$\text{Sugar from malted grains of barley} \xrightarrow[\text{fermentation}]{\text{YEAST}} \text{Beer} + CO_2$$

Yeast for beer making — *Saccharomyces carlsbergensis*

Other fermented beverages are:

Ale	-	made from malted barley
Cider	-	made from apples
Sake	-	Japanese rice wine

Distilled spirits contain higher percentages of ethyl alcohol, e.g., whiskey, vodka, rum, etc.

Rum is produced by distillation of alcoholically fermented sugarcane juice or molasses.

Whiskeys are produced from saccharified and fermented grains such as rye, wheat and corn.

Saccharomyces cererisiae var. ellipsoideus that gives a high percentage of alcohol is used for fermentation.

Fermentation of Milk

$$\underset{\text{Lactose(milk sugar)}}{C_{12}H_{22}O_{11} + H_2O} \xrightarrow{\text{Lactase enzyme}} \underset{\substack{\text{Glucose}\\+\\\text{Galactose}}}{2C_6H_{12}O_6} \xrightarrow[\text{enzymes}]{\text{System of}} \underset{\text{Lactic acid}}{2CH_3CHOHCOOH}$$

Microorganisms used in making **yoghurt**

Lactobacillus bulgaricus

Streptococcus thermophilus

Cheese is ripened by bacteria or mold

Hard cheese - *Lactobacillus casei*

Lactobacillus bulgaricus

Swiss cheese - *Propionibacterium*

Normal Flora of **Curds** is species of

Lactobacilli

Leuconostoc

Streptococci and Yeast

Manufacture of Vinegar

The manufacture of vinegar involves two steps:

Step 1

$$\underset{\text{Sugar}}{C_6H_{12}O_6} \xrightarrow[\text{Fermentation}]{\text{YEAST}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + \underset{\text{carbon-di-oxide}}{2CO_2}$$

The yeast that brings about fermentation of any carbohydrate rich substrate such as sugarcane juice, fruit juice etc. is *Saccharomyces cerevisiae*

Step 2

$$\underset{\text{Ethyl alcohol}}{2\,CH_3\,CH_2OH} + 2O_2 \xrightarrow[\text{action}]{\text{Bacterial}} \underset{\text{Acetic acid}}{2\,CH_3\,COOH} + 2H_2O$$

Bacteria which are used to oxidise the alcohol formed in the first step to acetic acid or vinegar are:

1. *Acetobacter aceti* and
2. *Gluconobacter*

Table 1.2 **Beneficial Role of Microorganisms in Some Food Products**

S.No.	Food product	Raw material	Microorganisms involved
1.	Idli	Rice + black gram	*Leuconostoc mesenteroides* *Streptococcus faecalis* *Pediococcus cerevisiae*
2.	Soy sauce	Soybeans and wheat bran	*Aspergillus oryzae, Streptococci, Lactobacilli*
3.	Tamari Sauce	Soybeans + rice	*Aspergillus tamari*
4.	Tempeh	Soybeans	*Rhizopus stolonifer*
5.	Poi	Corms of taro plant	Lactic acid bacteria, yeasts, molds.
6.	Coffee	Coffee berries	*Pectinolytic bacteria, Leuconostoc mesenteroides, Lactobacillus brevis, Lactobacillus plantarum, Streptococcus faecalis*
7.	Cocoa	Cocoa beans	*Candida yeast enzymes*
8.	Vinegar	Starchy vegetables, malted grains, sugars and fruit juice	*Saccharomyces cererisiae* var. *ellipsoideus alcoholic fermentation; Acetobacter and Gluconobacter acidic fermentation*
9.	Sauerkraut	Cabbage	*Enterobacter, Leuconostoc mesenteroides Lactobacillus plantarum*
10.	Pickles	Cucumber, Dill, Olives	*Pediococcus cerevisiae*
11.	Curds	Milk	*Streptococcus lactis* *Streptococcus cremoris* *Leuconostoc cremoris*
12.	Cheese Hard Swiss Roquefort Camembert Cheddar Yoghurt	Milk Flavour and eye formation	*Streptococcus lactis,* *Lactobacillus casei* *Propionibacterium freudenreichii* *Penicillium roqueforti* *Penicillium camemberti* *Streptococcus thermophilus,* *Streptococcus faecalis* *Streptococcus thermophilus* *Lactobacillus bulgaricus*

SUMMARY

The food handler should understand the importance of keeping food free from disease causing organisms and other harmful agents. The safety of foods must always be considered while storing, preparing and serving foods. The food handler should know that some microorganisms are useful to us and affect the basic characteristics of food products. Others are harmful and can cause spoilage of food and disease.

Microorganisms such as viruses, bacteria, yeasts, molds, algae and protozoa affect humans and their food. These microorganisms may be parasitic and need a living host or they may be saprophytic and live on dead organic matter. The parasitic microorganisms produce disease in humans and affect their health. As microorganisms are present everywhere, it is not possible to keep them out of food completely. But their growth in food can be controlled by various ways such as controlling temperature, removing moisture, controlling the amount of oxygen available, using chemical preservatives or by treatment with ultraviolet rays. To be able to control them it is necessary to know where they occur and what are the factors necessary for their growth.

Controlling microbial growth can help the food service manager in preventing spoilage of food and spread of disease.

The beneficial role of different micro organisms in the preparation of a wide array of food items should be understood by all catering professionals.

KEY TERMS

Aerobes Need oxygen for growth.

Algae A group of plants containing chlorophyll, found in water and may be one-celled to many celled, and vary widely in size, shape and colour.

Anaerobes Do not need oxygen and sometimes oxygen may be harmful to them.

Antibiotics They are substances produced by microorganisms that are capable of either inhibiting the growth or killing other organisms. For example, the molds *Penicillium notatum* and *Streptomyces gricens* produce antibiotics that destroy certain bacteria.

Autotrophs They can synthesise their own food by converting simple inorganic substances into complex protoplasm.

Bacteria Minute, unicellular organisms of variable shape and activity, devoid of chlorophyll some of which may be harmful or useful to humans. Average size is 1 µm (micrometre or micron).

Bound Water The water that is not available to microorganisms for their growth as it is bound to solutes like sugars and salts dissolved in water.

Colony A large number of microbial cells that develop from a single cell and become visible. May contain more than 10 million cells.

Culture medium It is a balanced mixture of nutrients required for growth and multiplication of microbes at concentrations that will promote good growth, e.g., nutrient agar. There are many different media that may be prepared from natural or synthetic substances and may be in solid or liquid form.

Encapsulation The process in which some rod-shaped bacteria form a dense, slime-like protective case over its cell wall that makes it more resistant to destruction by heat, chemicals, etc.

Facultative These microorganisms can grow either in the presence or in the absence of oxygen. For example, the microbes present in the human intestinal tract like *Escherichia coli*.

Generation Time It is the time period that lapses between two successive cell divisions.

Heterotrophs They cannot synthesise their complex protoplasm from simple inorganic substances and need organic compounds for their growth.

High Temperature Short Time (HTST) pasteurisation. The process in which a food product is heated to 72°C (165°F) for 15 seconds, then immediately cooled to 10°C (50°F) or less.

Microaerophilic Are basically aerobic but oxygen requirement is less, e.g., *Lactobacilli* species.

Microbiology A branch of biology that deals with the study of microscopic organisms.

Micron A micron or a µm (micrometre) is a unit of length that is equal to one thousandth of a millimetre or one millionth of a metre.

Microorganism Any microscopic or ultramicroscopic animal or plant organisms that are too small to be seen with the unaided eye. They include viruses, bacteria, fungi, algae and protozoa.

Microscope A microscope is an instrument consisting of a lens or a combination of lenses for making enlarged images. It is used to observe objects that are too small to be seen with the unaided eye (objects smaller than 30 µm).

Molds A type of fungi that are multicellular and grow on damp, decaying organic matter; growth may be cottony, powdery, slimy or furry.

Osmophilic Organisms, specially yeasts that can grow at high osmotic pressure. For example, *Zygosaccharomyces* species grow in high concentrations of sugar while *Saccharomyces rouxii* can grow in a high concentration of salt causing spoilage of pickles.

Osmosis The tendency for a solvent to pass through a semi-permeable membrane, like the cell wall of a living cell, into a solution of higher concentration, so that the concentration of solute on both sides of the membrane is equal.

Parasites A plant or animal that lives on or in another living organism; at the cost of the organism without any benefit to the host; usually causing disease or harm.

Pasteurisation A method of high temperature food preservation in which food is heated to 63°C (145°F) for 30 minutes or 72°C (161°F) for 15 seconds and immediately cooled to 10°C (50°F) or less.

pH level The degree of acidity or alkalinity of a food measured by the hydrogen ion concentration. The higher the hydrogen ion concentration lower will be the pH and vice versa. It is measured on a pH scale of pH 1 to pH 14 by a pH meter or by pH papers.

Protozoa A group of microscopic animals made up of a single cell, living mainly in water, many forms of which are parasitic.

Psychrophiles Cold-loving microorganisms that can survive at temperatures as low as −28°C (−19°F) and can multiply at temperatures as high as 20°C (68°F).

Putrefaction Anaerobic decomposition of proteins by bacteria with the development of foul smelling compounds.

Reconstitute To rehydrate dried food products by combining them with water or other liquids.

Relative Humidity The percentage of moisture in the air, as compared with the maximum amount that the air could contain at the same temperature.

Saprophytes Any organism that lives on dead or decaying organic matter for its survival.

Spores A bacterial spore is a resistant structure formed in some rodshaped cells that can withstand unfavourable conditions. They remain dormant till conditions become favourable and form a vegetative cell that can multiply and grow.

Thermophiles Microbes that grow better at temperatures from 45°C to 60°C and sometimes higher.

Ubiquitous Present everywhere in our environment, in and on humans, plants, animals, water, air, soil and inanimate objects.

Vegetative cell An actively growing bacterial cell that can reproduce.

Viruses A group of ultramicroscopic infective organisms that cause various diseases and can multiply only in living cells. They are much smaller than bacteria and require an electron microscope to be seen.

Water Activity (a_w) Is a measure of the amount of water available for the growth of microbes and is expressed as

$$a_w = \frac{\text{Vapour pressure of the solution}}{\text{Vapour pressure of the solvent}}$$

Water activity (a_w) The amount of water in food that is available to microorganisms for their growth. Some water is bound to other substances and hence does not support microbial growth.

Yeast A type of fungi that are larger than bacteria, are single celled, reproduce by budding and are capable of fermenting sugars to form ethyl alcohol.

REVIEW QUESTIONS

1. Why is a knowledge of microbiology essential for a food service manager?
2. List four basic environmental needs for the growth of bacteria.
3. Name two beneficial effects and two harmful effects of the following (a) bacteria, (b) yeast, (c) molds.
4. (a) Give the chemical reaction which takes place when sugar is fermented by yeast.
   (b) When is this reaction desirable?
5. Describe how a food would appear if it were spoilt by (a) mould, (b) yeast
6. How does the pH of a food affect its shelf life?
7. Briefly describe (a) bacterial spores, (b) pasteurisation, (c) hyphae and (d) binary fission.
8. Fill in the blanks with a suitable answer.
   (a) Viruses are strictly __________ and cannot be cultivated outside the living host cell.
   (b) Comma-shaped bacteria are called __________.
   (c) Bacteria that grow well at refrigerator temperature are called __________.
   (d) The cotton-like growth which appears on the surface of food is __________.
   (e) The process of preserving food by extracting moisture from it is called __________.
   (f) A concentration of three to ten per cent salt inhibits most __________.
   (g) Under suitable conditions, a single bacterial cell could multiply and become approximately __________ in seven hours.
   (h) Bacteria that can grow in the absence or presence of oxygen are called __________.
9. Match the microorganisms in Column *A* with a suitable answer from Column *B*

A	*B*
1. Coliform bacteria	(a) food poisoning
2. Shigella	(b) poisonous mushroom
3. *E. histolylica*	(c) poliomyelitis
4. *Penicillium roqueforti*	(d) antibiotics
5. *Clostridium*	(e) indicator of faecal pollution
6. *Aspergillus oryzae*	(f) hepatitis
7. *Amanita*	
8. Brown algae	(g) icecream

Contd...

(Contd)

A	*B*
9. *Staphylococci*	(h) bacillary dysentery
10. *Saccharomyces cerevisiae*	(i) soy sauce
	(j) wine making
	(k) amoebic dysentery
	(l) spore-bearing bacteria
	(m) ripening of cheese

A	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
B	–	–	–	–	–	–	–	–	–	–

10. Select the most appropriate answer for the following.
    (a) The temperature and time required for pasteurisation of milk by the flash method is
        (i) 72°C for 15 minutes
        (ii) 72°C for 15 seconds
        (iii) 62°C for 30 seconds
        (iv) 62°C for 30 minutes
    (b) Which statement best describes bacteria
        (i) all bacteria are harmful
        (ii) some bacteria are harmful
        (iii) bacteria are only useful
        (iv) only spore-forming bacteria are harmful
    (c) Food poisoning bacteria will multiply most rapidly at
        (i) 63°C
        (ii) 37°F
        (iii) 37°C
        (iv) 5°C
    (d) Food contaminated with food poisoning bacteria will usually
        (i) taste, smell and appear normal
        (ii) looks and tastes normal but has an unpleasant smell
        (iii) looks normal but tastes awful
        (iv) looks dry and stale and has an off taste
11. State whether True or False
    (a) Foods containing a high percentage of sugar or acid are less likely to be spoilt by bacteria.
    (b) Microorganisms are killed at once when food is frozen.
    (c) Spore formation is a means of reproduction in molds.
    (d) Bacterial spores are easier to destroy than mold spores.
    (e) Protein-rich foods are excellent media for bacterial growth.
    (f) It is easy to destroy bacteria which have a capsule on them.
    (g) Most molds are parasitic to man.
    (h) Plasmolysis is observed in bacteria present in sugar syrup and honey.

2

- Types of contaminants in food
- Natural toxins
- Toxic metals and chemicals
- Pesticide residues
- Presence of extraneous material
- Residue from processing and packaging material
- Reasons for food spoilage
- Criteria for judging whether food is fit for consumption
- Classification of food according on the basis of shelf life
- Conditions that could lead to food spoilage
- Signs of spoilage in fresh, dry and preserved foods

Food Contamination and Spoilage

INTRODUCTION

Food should be protected from contamination through all the stages it undergoes before it reaches the table. Sanitation affects every phase of food handling and quality control should be maintained throughout.

Spoilage in foods begins as soon as

1. vegetables and fruits are harvested or picked
2. eggs are laid
3. fish is caught
4. an animal is slaughtered for meat
5. milk is drawn from the milch animal and
6. continues till the food is consumed

To prevent food from getting spoiled it is important to know how and why food gets spoiled, which are the foods that are likely to spoil rapidly; what are the factors that bring about quicker spoilage and how food can be prevented from getting spoiled.

To protect food from spoilage it is essential that we prevent microorganisms from entering into food and prevent those that have already entered into it from multiplying.

Food spoilage can be defined as decomposition and damage caused to food by various agents, making it unsuitable for consumption.

The term *contaminated* is used for those foods which are not fit to be eaten for sanitary reasons. Although they may look, smell and taste good, they may contain harmful chemicals, non-food matter and bacteria.

The term *spoilt* is used for those foods which look harmful and unfit to eat. Spoilt food has an unattractive colour, smell, taste and appearance.

In *both* these cases, food is unfit for consumption because of the presence of undesirable changes which have taken place and the food is labelled as spoilt.

TYPES OF CONTAMINANTS IN FOOD

Food can be contaminated or spoilt by any of the following sources and at any stage from the farm to the table till it is consumed. Sources of contamination of food include:

Air, Water, Plant, Soil, Food handler, Machinery and Equipment, Sewage and Trucks or Carts during transport.

Food contamination refers to the presence of harmful chemicals and microorganisms that can cause illness or injury in food when such food is consumed.

Food contamination is a serious health problem that needs to be tackled. The effect of chemical contaminants on human health may sometimes be seen only after years of prolonged exposure at low levels, for example, carcinogens in food may build up in the body causing cancers. Unlike most microbiological agents, chemical contaminants present in food are not destroyed by thermal processings. Contaminants in food can be broadly classified into the following categories:

Fig. 2.1 *Throw away food which appears, smells or tastes spoilt immediately*

Biological

Contaminants include microorganisms growing in food causing spoilage and infection, cysts of parasites like nematodes and other worms that can cause infestations, protozoal infestations like amoebiasis, etc. When untreated human excreta is used as a fertilizer for plants, these organisms contaminate food. Rodents urinate or leave their droppings behind which harbour several kinds of disease producing bacteria and are responsible for the spread of human diseases. Microorganisms such as bacteria yeasts and mold can enter food at any stage of processing from the farm to the table and contaminate it. The effect of bacterial food infections and other infestations are discussed in detail in Chapter 4 on *Food-Borne Diseases*.

Table 2.1 Concentration of Metal Contaminants Permissible in Some Articles of Food

S.No.	Name of metal contaminant	Article of food	Parts per million by weight
1.	Lead	Beverages, fats and oils ice cream turmeric, tea all sugars, cocoa, yeast	0.5 1.0 10.0 5.0
2.	Copper	Beverages tea	7.0 150.0
3.	Arsenic	Milk, beverages Carbonated water Infant milk and foods	0.1 0.25 0.05
4.	Tin	Processed and canned products, Jams, marmalades, fruit pulp, juices Infant foods and milk	250 5.0
5.	Zinc	Ready to drink beverages and fruit pulps Infant foods	5.0 50 (but not less than 25)
6.	Cadmium	Infant foods Other foods	0.1 1.5
7.	Mercury	Fish	0.5
8.	Chromium	Refined sugar	20 ppb
9.	Nickel	All hydrogenated fats and oils such as vanaspati, table margarine, bakery shortening, fat spread, etc.	1.5

NATURAL TOXINS

Certain plants and animals may contain natural substances that are poisonous and may produce gastro-intestinal disturbances. Some may even prove fatal.

Naturally Occurring Toxicants in Plants

Lathyrus Sativus or Kesari dal *Kesari dal* contains a neurotoxin called BOAA (beta-oxalyl amino alanine). The toxin causes a disease of the nervous system that results in paralysis of the lower limbs. Diets containing large amounts of *Kesari dal* cause the disease lathyrism. The dal is often used to adulterate *tuvar dal* and Bengal gram flour or besan. The toxin can be removed by steeping or parboiling the grains before cooking.

Soybeans Soybeans contain trypsin inhibitors that inhibit the breakdown and availability of proteins in the digestive system. This may result in intestinal disorders. The trypsin inhibitor can be destroyed by adequate heat treatment.

Green Potatoes Green, sprouting and damaged potatoes contain high amounts of solanine that is toxic to humans. It causes vomiting, abdominal pain and diarrhoea within eight hours after consumption. Such potatoes should be discarded.

Argemone Seeds The seeds of *Argemone mexicana*, a weed growing along with mustard seeds yields 22% to 36% nonedible argemone oil. *Argemone oil* contains the toxin sanguinarine that causes epidemic dropsy characterised by swelling of legs, diarrhoea and difficulty in breathing, and can be fatal. Mustard oil or other oils may be contaminated with this oil. Weeds of argemone should be removed before flowering to prevent contamination as the seeds resemble mustard seeds.

Mycotoxins

Ergot Ergotin is a mycotoxin produced by *Claviceps purpurea*, a parasitic fungus that attacks wheat, barley and rye grains and causes the disease *ergotism*, when bread made from such infected cereals is consumed. The main symptoms are convulsions and gangrene.

Cereals and Groundnuts Groundnuts and cereals that are improperly stored may have the mould *Aspergillus flavus* and *A. parasiticus* growing on it. This mould produces a mycotoxin called aflatoxin. The toxin acts on the liver and damages it. The toxin is produced at favourable

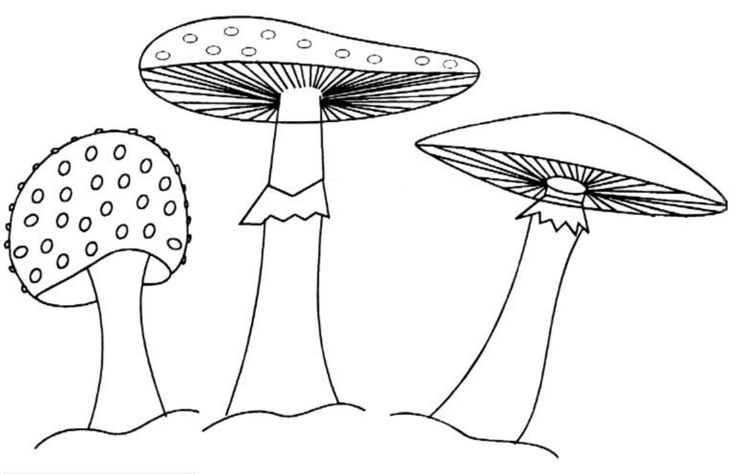


Fig. 2.2 *Poisonous mushrooms of Amanita species*

moisture and temperature levels. Other important mycotoxins are patulin produced by Penicillium species.

Poisonous Mushrooms Mushrooms are edible fungi but some varieties are poisonous, like *Amanita phalloides* and *A. muscaria.* They produce hepatotoxic factors that damage the liver and result in death. The toxin muscarin is produced by *A. muscaria* that stimulates the nerves. Symptoms are nausea, headache, excessive salivation and tears, dizziness and confusion.

Table 2.2 **Tolerance Limits for Contaminants**

Contaminant	*Limit*
Uric acid	100 mg/kg grains
Ergot	Maximum 3% by weight
Aflatoxin (mycotoxins)	30 µg/kg
Karnal bunt	0.5% by weight

Sea Food Toxins

Mussels and Clams (Shellfish) Ocean mussels and clams may be poisonous during some periods of the year when they feed on small crustaceans who in turn have been feeding on dinoflagellates (single-celled organisms). These dinoflagellates are toxic algae that produce the heat stable toxin PSP (paralytic shellfish poison), which is extremely toxic to humans. Symptoms include itching, numbness of lips and tongue, muscular weakness and respiratory paralysis that can be fatal.

There are many natural toxins in foods, but most of these toxins cause toxicity only when consumed in excess. Small amounts of most of these may not be toxic; hence, toxins represent only minor hazards as compared to bacterial hazards (refer Table 2.3).

TOXIC METALS AND CHEMICALS

Metals, when consumed in excess of the requirements, could cause toxicity. These contaminants may be present in the environment and may accumulate during the different stages of food preparation. By the time food is ready to be consumed, it can reach levels that are toxic to humans. Some of the toxic metals are listed below. Table 2.4 gives an outline of all toxic metals and chemicals.

Selenium

When soil contains excessive amounts of selenium, it may get carried into food and cause gastro-intestinal disturbances, loss of appetite and stunted growth.

Zinc

If acidic foods are kept in galvanised metal containers for long periods of time, they may contain toxic levels of zinc. High consumption of zinc can cause anaemia, growth depression, dizziness, drowsiness, nausea and diarrhoea.

Table 2.3 Natural Toxic Substances in Food

S.No.	*Toxin*	*Food in which it is present*	*Main symptoms*	*Preventive measures*
1.	BOAA (β-oxalyl amino-L-alanine)	*Kesari dal* or *Lathyrus sativus* used as an adulterant in *tuvar dal*	Lathyrism—paralysis of lower limbs	Steep or parboil *dal* before use; ban the crop
2.	Trypsin inhibitor	Soybeans	Indigestion	Heat treatment to inactivate the inhibitor; use processed soy products
3.	Solanine	Green potatoes	Abdominal pain, vomiting and diarrhoea	Discard green, damaged or sprouting potatoes
4.	Mycotoxin	Ergot fungus infected cereals	Ergotism	Control moisture level in grains to prevent mould growth
5.	Sanguinarine	Argemone oil used as an adulterant in mustard oil	Epidemic dropsy	Purchase oil from reliable suppliers
6.	Aflatoxin	Mouldy peanuts and grains	Liver damage	Dry grains well; store at appropriate temperature
7.	Muscarin	Poisonous mushrooms of *Amanita* sp. like *Amanita muscaria*	Affects the nerves; liver damage	Purchase mushrooms or spawn for cultivation from recognised outlets
8.	PSP-paralytic shellfish poison (an alkaloid)	Ocean mussels and clams	Itching, numbness of lips, muscular weakness and paralysis	Avoid seafood at certain periods of the year, e.g; during red tide. Toxins are heat stable

Table 2.4 Toxic Effects of Some Metals and Chemicals

S.No.	*Substance*	*Foods commonly involved*	*Toxic effect*
1.	Selenium	Food grains and fodder from excessive selenium in soil	Gastro-intestinal disturbances, stunted growth
2.	Zinc	Acidic foods stored in galvanised iron utensils	Dizziness, vomiting, anaemia
3.	Arsenic	Fruits sprayed with pesticides containing lead arsenate	Cutaneous lesions, lung cancer
4.	Lead	Drinking water, some processed foods	Paralysis, brain damage
5.	Cadmium	Fruit juices and soft drinks in contact with cadmium plated vessels	Excessive salivation, liver and kidney damage
6.	Cobalt	Water, beer	Cardiac failure
7.	Copper	Acid foods in contact with tarnished copperware	Abdominal pain, vomiting, diarrhoea
8.	Tin	Canned food left in the opened can	Headache, diarrhoea, vomiting, metallic taste in the mouth
9.	Brass	Acidic foods cooked in utensils that are not tin-plated	Astringent taste in the mouth, vomiting
10.	Fluoride	Water with high levels of fluorine	Skeletal and dental fluorisis
11.	Barium	Foods contaminated with rat poison	Violent peristalsis, abdominal pain, vomiting and diarrhoea, paralysis
12.	Mercury	Seed grains treated with mercury fungicide	Paralysis, brain damage
13.	Pesticides	Any type of food	Damage to liver, kidney, brain and nerves; can lead to death
14.	Monosodium-glutamate or Ajinomoto	Chinese food, especially soups, fast foods, gravies	Headache, burning and tingling in arms and neck; banned for infants in USA

Lead

Lead can contaminate food through various sources like:

1. Lead pipes that convey drinking water; soft water and alcoholic drinks dissolve more lead than hard water does.
2. Mineral pigment in food; lead chromate may be used as an adulterant in turmeric powder.
3. Some pesticides contain lead arsenate.
4. By exposure to dust containing lead.
5. By contact with machines.

The permissible level of lead in drinking water is 0.1 parts per million.

Symptoms of lead poisoning are

1. Nausea, constipation, fatigue, abdominal pain, anaemia and insomnia.
2. Reduction in the body's resistance to fight disease.
3. Brain damage and mental retardation.

Cadmium

Cadmium is used for plating utensils, for fittings of electrical cookers or for refrigerator shelves. It is readily dissolved by acids present in fruit juices, wines, soft drinks, tomatoes, etc. It also occurs as a contaminant in water. Symptoms of toxicity occur in 15 to 30 minutes after ingestion of contaminated food. These include increased salivation, headache, vomiting, persistent diarrhoea and abdominal cramps. Later on there may be liver or kidney damage.

Cobalt

Cobalt poisoning can occur by consumption of contaminated beer. Symptoms of toxicity are cardiac insufficiency and myocardial failure.

Copper

This poisoning occurs when copper utensils are used to store cooked foods, especially those that are acidic, or when copper utensils are used to cook food. Symptoms of toxicity include vomiting, diarrhoea, abdominal pain, astringent taste in the mouth and constriction of the throat in acute cases. Copper may also act as a haemolytic agent and cause anaemia by breaking down RBCs.

Tin

Tin poisoning is seen in acidic canned foods or moist foods left in the can after opening it. It also occurs in foods containing nitrates or oxalates. Symptoms of poisoning include vomiting, diarrhoea, constipation, headache, metallic taste in the mouth and retention of urine.

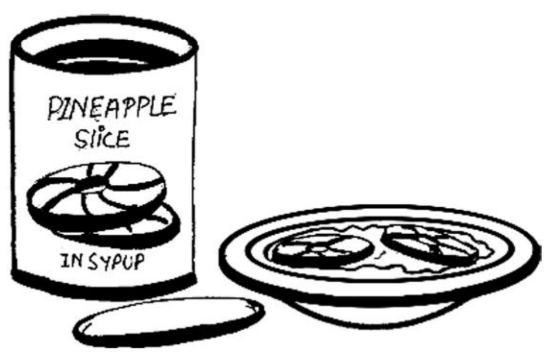


Fig. 2.3 *Do not leave food in opened cans. Transfer it into another container and treat as fresh food*

Brass

Brass is an alloy of copper and zinc. Brass vessels are sturdy, they are good conductors of heat and are used for cooking food after they are plated with tin and nickel. If the plating wears out and acidic foods are cooked in it, it results in poisoning similar to copper and zinc poisoning. Care should be taken to ensure that the plating of tin is intact.

Fluoride

Excessive amount of fluoride in drinking water is toxic. It results in skeletal and dental fluorosis. The enamel of the teeth becomes mottled and dull.

PESTICIDE RESIDUES

Pesticide spray residues may contaminate foods such as cereals, fresh fruits and vegetables. Pesticides may also get into foods through soil, water and air.

The improper application of pesticides like Aluminium phosphide or zinc oxide results in health hazards as these pesticides leave behind residues in the form of other compounds of aluminium or zinc metals. Other important chemicals are

1. Arsenic
2. Barium
3. Mercury

Arsenic

Exposure to arsenic over years causes cutaneous lesions, cancer of the lungs and many other symptoms. Many insecticides, weedkillers and rat poisons contain arsenic. It is also present in water from polluted streams. Fruits, vegetables and shellfish are likely to be contaminated with arsenic.

Barium

Barium poisoning can occur when food is accidentally contaminated with rat poison. This results in abdominal pain, violent persitalsis (rapid contraction and dilation of walls of the alimentary canal), causing vomiting and purging, and paralysis.

Mercury

Seed grains treated with mercury fungicides or consumption of fish bred in water contaminated by industrial wastes containing mercury can lead to paralysis and brain damage.

PRESENCE OF EXTRANEOUS MATERIAL

Contaminants present in food could be nail chippings, hair, stones, grit, dirt or other extraneous matter.

Accidental contamination by metallic fragments and shards of glass may render food harmful. Some common metal fragments are stapler pins, flexible aluminium wire, metal curls and fine filings from canned food opened with a defective opener. Glass chips may enter food from broken glassware, or misuse of glass for taking out crushed ice.

Physical contaminants may be organic or inorganic. Organic contaminants include plant parts, debri, weeds, seeds, poisonous seeds of Dhatura, dead insects, excreta, uric acid, rodent hair, etc., while inorganic contaminants include lumps of earth, stones, dust, glass, etc.

RESIDUE FROM PROCESSING AND PACKAGING MATERIAL

Most foodstuff available in the market today has been subjected to some form of processing and packaging. While processing and packaging may prolong the life of the product, the main purpose of packaging is to provide a physical barrier for contaminants. Processing and packaging contaminants are not present in raw food materials but are generated during the stages in processing like high temperature, fermentation, etc. Processing contaminants are formed by chemical reactions between natural and/or added food constituents during processing. Examples are nitrosamines, polycyclic aromatic hydrocarbons (PAH) and trans fat.

The level of these contaminants in processed foods can be minimised by regulating processes. Processing equipments may also contribute towards metal contamination through metal fragments from equipments like copper as well as lubricants, cleaning and sanitizing agents.

Although packaging materials help in keeping food free from contaminants, some are known to add contaminants to food.

The chemical Bisphenol-A (BPA) used in plastic food containers and cans is known to leach from products and get absorbed in low concentrations by the human body and may contribute to the development of breast cancer. Phthalates are found in adhesives, cling films and some printing inks. They may be carcinogenic and are also linked to hormonal imbalances. Apples with little stickers stuck on them and any food wrapped in cling film could have been contaminated by phthalates. Small amounts of aluminium may pass onto food from cookware or packaging. Food contact materials should be checked for safety.

REASONS FOR FOOD SPOILAGE

Contamination of food results in its spoilage. Food spoilage can be broadly classified into six groups. Foods spoil mainly because of any one or more of the following reasons.

1. *Microbiological action*: Microorganisms are present everywhere and in all the sources of contamination mentioned above. These organisms can contaminate food and spoil it. Milk turns sour because of bacterial action, yeasts ferment fruit juices and mold grows on bread which has to be discarded. Microbial growth in foods may be obvious like the examples listed above. Some bacteria which cause food poisoning or food infection may contaminate food which is unhygienically handled. In such cases, microbial growth may not be obvious. Not all microorganisms can cause disease, in fact some are useful to the food industry. Foods having a high protein, moisture, vitamin and mineral content are an ideal media for bacterial growth.
2. *Presence of contaminants*: If any unwanted inedible matter is added to or is present in food, the food is said to be spoiled and should be rejected.

   Radiation used for preserving spices and those emitted by microwave ovens, although invisible, may also prove hazardous to health if used in excess.

   This kind of contamination occurs at any stage right from harvesting to food service.

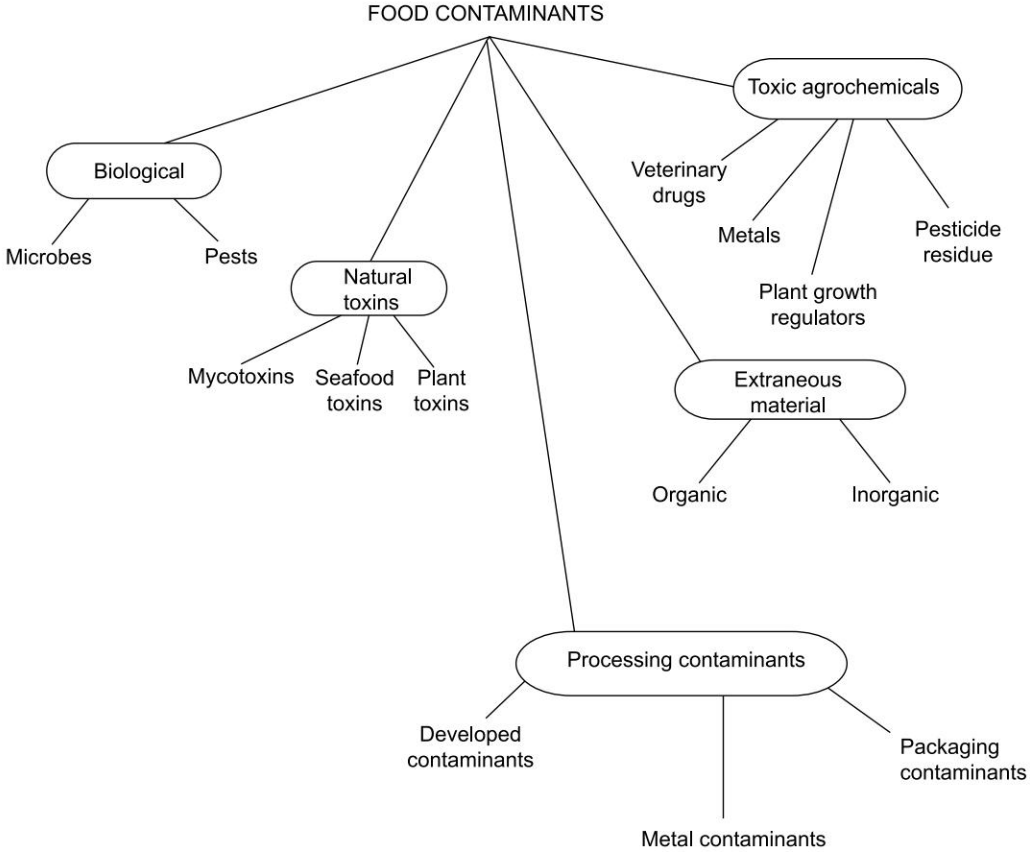


Fig. 2.4 *Types of contaminants in food*

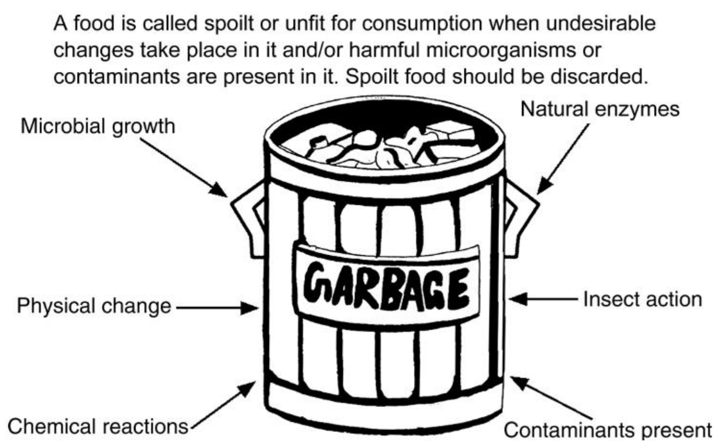


Fig. 2.5 *Causes of spoilage of food*

3. *Action of insects*: Foods are spoilt because of the presence of worms, weevils, fruit flies, moths, etc. These may damage the food and reduce its nutrient content. Food spoilt by insects is not fit for human consumption. The presence of insects or insect body fragments or droppings in food served to customers is highly objectionable and will affect the reputation of the catering establishment.
4. *Natural enzymes*: Foods spoil by autolysis or the action of various enzymes naturally present in them. Signs of spoilage seen in fruits and vegetables include overmaturing, softening, browning and sprouting. After picking or harvesting, fruits and vegetables remain alive for some time. They respire and ripen, and if they are not consumed or processed soon, they become over-ripe and ultimately spoil.

   Enzymes naturally present in meat act on mutton fibres and bring about autolysis. If these natural changes are not controlled, foods may spoil. As action of enzymes is influenced by temperature, refrigeration will retard the action and blanching will destroy the enzyme.
5. *Physical changes*: These changes occur in food by freezing, desiccation, evaporation and absorption of moisture. Freezer burn is a physical change seen in deep frozen foods.

   Mechanical damage during harvesting and transporting foods, like bruising and crushing of fruits and vegetables, broken eggs and cracked shells, can accelerate spoilage by microorganisms because of easy access. It also results in greater susceptibility to decay and discolouration by enzyme action. This can be prevented by proper storage and transport facilities.
6. *Chemical reactions*: Chemical changes, which are not catalysed by natural enzymes or action of microorganisms, can also result in chemical spoilage of foods. A reaction between acidic food and iron from the can causes hydrogen swell in canned foods. Development of oxidative rancidity in fats and the fatty phases of foods results in spoilage of fried snacks and oil-based pickles. Other changes include oxidative discolouration, flavour changes and nutritive loss.

   Spoilt food can cause a great financial loss to the catering establishment. Spoilt food is best discarded. However, bacteria causing food poisoning may spoil the food without showing any visible signs of spoilage. This is discussed in detail in Chapter 4. The caterer should take utmost care to prevent spoilage from occurring. It is best to remember that once a food is spoilt, no amount of cooking, freezing or proper handling can make the food fit for consumption.

CRITERIA FOR JUDGING WHETHER FOOD IS FIT FOR CONSUMPTION

A food is wholesome and fit for consumption if the following criteria are fulfilled.

1. Food should be at the desired stage of development or maturity, for example, fruits should not be over-ripe.
2. Food should be free from pollution at any stage in production or handling, for example, vegetables grown in areas fertilised by sewage should not be consumed raw. Food handled by dirty and/or diseased workers, should be discarded. Food contaminated by flies or rodents should be considered as suspect food.
3. Food should be free from objectionable changes resulting from microbial attack or action of enzymes in the food.

CLASSIFICATION OF FOOD ON THE BASIS OF SHELF LIFE

Foods can be categorised into three main groups on the basis of their shelf life or perishability.

1. *Non-perishable or stable foods*: These foods do not spoil unless they are handled carelessly. They should be stored in a cool, dry place. They can be stored for one year. They should be picked and cleaned before storage. If necessary, grains can be washed with water to remove any dust and dirt sticking to them. These should then be dried in the sun, allowed to cool and stored in containers with tight fitting lids.

   Non-perishable foods include sugar, jaggery, hydrogenated fat, vegetable oil, ghee, whole grains, dals, whole nuts, dry salted fish and meat, papads, canned foods, preserves such as pickles, jams and *murabbas.*
2. *Semi–perishable foods*: These foods do not spoil for a fairly long time if stored properly. They are less likely to decay due to microbiological contamination than other perishable foods. Natural chemical breakdown is also slower in such foods. If they are stored in a cool place with adequate ventilation they have a moderately long shelf life. Use of proper containers is equally important. Semiperishable foods include processed cereals, pulses and their products like flour, Bengal gram flour, millet flour, semolina, parched rice, popcorn, etc. Their shelf life depends on the storage temperature and moisture in the air.

   Other semiperishable foods are potatoes, onions, nuts, frozen foods kept solidly frozen at "zero" to −18°C and canned foods that need refrigeration, apples, citrus fruits, pumpkin, etc. Foods in this group can be stored for a week to a couple of months at room temperature without the development of any undesirable changes in flavour and texture.
3. *Perishable foods*: This is the largest of the three groups and includes most of the food items we consume everyday, such as milk and milk products, eggs, poultry, meat, fish, most fruits and vegetables such as bananas, pineapple, papaya, green leafy vegetables, etc. As these foods contain high amounts of protein, moisture and other nutrients, they are an ideal medium for bacterial growth. They also spoil easily by natural enzymatic changes. They have a very short shelf life of a few hours to a few days, after which they spoil rapidly. It is this group which is responsible for the outbreak of food-borne illnesses.

   This group also includes all prepared menu items, opened canned foods and frozen foods which have thawed. Foods in this group must be stored at low temperatures to retard the action of microorganisms and enzymes.

CONDITIONS THAT COULD LEAD TO FOOD SPOILAGE

Foods spoil easily if they are improperly handled. To prevent spoilage in foods it is necessary that care is taken to ensure purity, wholesomeness, taste and attractiveness of foods and beverages served. Food spoilage is hastened if conditions are favourable for microbial, enzymatic and chemical contaminants and insect action or if food is mechanically damaged.

Therefore, it is essential that foods are stored well. The following conditions could lead to spoilage of foods:

1. buying more food than required
2. buying poor quality commodities due to lack of accurate purchase specifications
3. insufficient inspection of incoming commodities

4. lack of promptness in storing delivered items
5. inadequate storing facilities
6. failure to separately store dairy products, meats, vegetables and prepared foods
7. failure to maintain refrigerators and freezers in good operating condition
8. negligence in maintaining storage areas in a sanitary condition at all times
9. insufficient training and supervision of personnel handling the foods

SIGNS OF SPOILAGE IN FRESH, DRY AND PRESERVED FOODS

The signs of food spoilage vary with the type of food, the cause of spoilage and the environment. Spoilage can be caused by one or more of the different factors mentioned earlier.

Signs of spoilage generally seen in foods vary and depends on the chemical composition of the food. Changes seen are: softening, hardening, discolouration, mold growth, fermentation, drying, oozing out of liquid, off odours such as mouldy, alcoholic or putrid, and presence of insects etc.

Food Spoilage and Contamination In Different Kinds of Foods

Canned Food Although canned foods have excellent keeping quality because the contents of the sealed cans are practically free from microorganisms, some heat resistant spores may remain or bacteria may enter cans which are not properly sealed. If cans are stored at warm temperatures these heat resistant, anaerobic spores or bacteria may germinate, multiply and spoil the contents of the can. Sometimes the acid from the food reacts with iron of the container and spoils the food by forming hydrogen gas. The spoilage of canned foods results either from chemical or microbial spoilage or both.

Inadequately processed canned food is spoiled by thermophilic bacteria as the spores of such bacteria are more heat resistant. The bacterium *Bacillus coagulans* causes flat sour spoilage in which the ends of the can remain flat during production of acid, as no gas is formed. *Clostridium thermosaccharolyticum*, a thermophilic spore forming anaerobe forms acid and carbon dioxide and hydrogen gas while it grows in improperly heat treated canned food. The ends of the cans bulge due to gas formation, causing it to burst resulting in leakage of the contents. Low-acid foods such as canned corn and peas in brine may promote the growth of *Desulfotomaculum nigrificans*, a spore forming obligate thermophile forming hydrogen sulphide, which can be smelt once the can is opened.

Signs of possible canned food spoilage are the following:

1. Cans have a puffy, swollen appearance because of bulging ends.
2. Cans are leaky, corroded or rusty.
3. Contents spurt out when the can is opened.
4. Contents smell putrid or of hydrogen sulphide.
5. Brine or syrup looks cloudy, bubbly, slimy or mouldy.
6. Contents are discoloured.

Canned food which is doubtful should be discarded without tasting the contents.

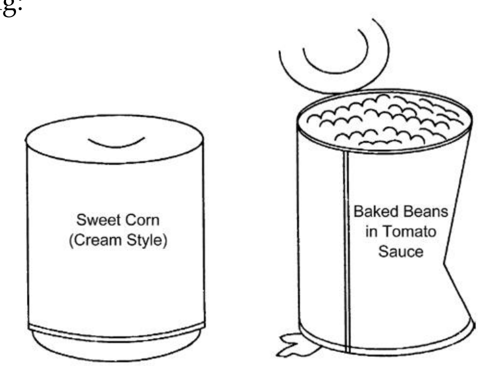


Fig. 2.6 *Spoiled canned food should be discarded without tasting it*

Frozen Foods It is hard to detect spoilage in frozen foods unless there are changes in colour and smell.

However, if the following precautions are taken food-borne illnesses can be prevented.

1. do not use frozen foods if off smell, taste or discolouration is there
2. do not re-freeze food which has been thawed
3. thaw only what you need
4. do not purchase unsound packages
5. do not keep frozen food out of the freezer for long before cooking or serving
6. do not accept food which has a large quantity of ice crystals formed inside the packet

Frozen foods do contain some bacteria as freezing only retards bacterial growth and does not kill them. Bacteria multiply when food has thawed and is in the danger zone. Therefore, once frozen foods are thawed, they are highly perishable.

Fruits and Vegetables Fruits and vegetables may get damaged during transportation. Mechanical damage increases the susceptibility to decay and growth of microbes may take place. The microbial spoilage of fruits and vegetables are due to plant pathogens and saprophytic organisms. Fruit and fruit products have a lower pH as compared to vegetables and are spoiled by fungi. Vegetables have a near neutral pH and are spoiled by both bacteria and fungi. Fruits become more susceptible to spoilage by fungi after harvesting and as they ripen. The mold *Penicillium* causes blue rot and green rot in citrus fruits, while apples are susceptible to brown rot caused by mold *Monilia.* Boxed fruit may rot in transit due to the mold *Rhizopus* and *Mucor*. Various rots are formed when bacteria multiply on moist vegetables, e.g., soft rot that gives the vegetable a water soaked appearance and black mold rot caused by *Aspergillus niger* that forms dark brown to black masses of spores commonly known as smut on onions. Saprophytic bacteria also cause sliminess and souring of vegetables that are stored wet in high stacks. The type of spoilage seen depends to a large extent on the composition of the vegetable or fruit.

These show the following signs of spoilage:

1. presence of mould, leading to rot
2. green leafy vegetables are wilted and limp
3. discolouration and mushy texture
4. presence of insects and worms
5. green potatoes, sprouted potatoes and overmature vegetables
6. skin or peel is damaged or bruised

Milk Fresh milk has a near neutral pH and is highly susceptible to bacterial spoilage. When milk is processed to manufacture cream, cottage cheese or butter, the pH falls due to growth of lactic acid bacteria, favouring the growth of spoilage yeasts. Yeasts may cause rancidity, gas and off flavours in milk products. The first sign of spoilage is souring or curdling of milk. The organisms normally present in milk bring about the changes in milk when it is held at room temperature. There are four major stages in souring of milk.

1. Lactose is converted to lactic acid by *Streptococcus lactis* and *Lactobacilli.*
2. Lactic acid tolerant bacteria grow.
3. Film yeasts and molds grow on the surface of milk and acidity is reduced.
4. Protein decomposing organisms grow causing proteolysis and putrefaction. Some bacteria that bring about souring, i.e., some species of *Lactobacilli* are homo-fermentative, i.e., they produce mainly lactic acid with small amounts of acetic acid, carbon dioxide and other volatile products. Others are hetero-fermentative, i.e., they produce appreciable amounts of acetic acid, carbon dioxide and other volatile products along with lactic acid.

Milk may spoil because of contamination by other organisms. Some of the other defects in milk are:

1. ***Ropy Milk*****:** Organisms causing ropiness are commonly found in water bodies such as pools, wells and streams. If water from such sources contaminates dairy utensils and equipment, the causative organism *Alcaligenes viscolactis* may contaminate the milk. This bacterium produces slimy capsular material that makes the milk slimy. At times the milk becomes so viscous that it can be pulled into threads.
2. ***Stormy Fermentation of Milk*****:** If the bacterium *Clostridium perfringens* contaminates milk, it converts lactose to acids and gas. The acid produced by the organism stops its own growth and hence, though the organisms are proteolytic, the proteins are not broken down. The large amount of gas produced gives the milk or curds a frothy, stormy appearance.
3. ***Colour Changes*****:** Pigmented bacteria if present in milk may change the colour of the milk to blue, yellow, red or brown. *Pseudomonas syncyanea* changes the colour of milk to shades of bluish-grey; *Pseudomonas synxantha* may give a yellowish colour to the layer of cream; while *Micrococcus roseus* and *Serratia marcescens* may colour the milk red and *Pseudomonas putrifaciens* may colour the milk brown.
4. ***Flavour Changes*****:** The delicate flavour of milk may change to sharply acidic, bitter, burnt, fishy, musty, fruity, etc., depending on the organisms that have contaminated the milk. *Pseudomonas putrifaciens* may give a putrid flavour and coliform bacteria may produce sharp acidic flavour or a bitter flavour.

Signs of spoilage are:

1. change in taste to sour or bitter: milk, buttermilk or curds have a frothy, bubbly surface
2. change in smell
3. rope formation
4. discolouration
5. fat separates out into clumps
6. milk curdles when heated
7. butter tastes rancid
8. cheese and curds develop off odours, mould growth and become a little slimy

Cheese Cheese spoils even at refrigeration temperatures as fungi causing spoilage are able to grow at such temperatures. Common spoilage molds belong to *Penicillium* species and yeasts such as *Saccharomyces* and *Candida* also spoil cheese.

Meat Aerobic organisms grow on the surface of meat and cause spoilage. *Pseudomonas* produce a slime on the surface, *Leuconostoc* changes the red colour of meat to shades of green and grey as a result of production of oxidizing compounds, yeasts may grow causing sliminess, off odours and discolouration, molds may grow and cause stickiness, whiskers and coloured spots. Under anaerobic conditions, off flavours, discolouration and putrefaction may take place by species of *Clostridium, Alcaligenes, Proteus,* etc. Bad meat shows the following signs and spoils more readily when more surface area is exposed, as in minced meat:

1. discolouration
2. putrid smell
3. slimy appearance and feel

Organ meats such as liver, kidney and brain are more perishable than muscle meat.

Fish Fish flesh is highly perishable and spoilage of fish begins soon after the fish is dead and *rigor mortis* sets in. Fish spoils due to autolysis or by oxidation and hydrolysis of fat or by microbial spoilage. Microbial spoilage involves putrefaction and discolouration by various organisms. A yellow to greenish yellow discolouration is brought about by *Pseudomonas fluorescence,* a red to pink discolouration by *Serratia* and *Micrococcus* and a brownish discolouration by yeast.

Spoilt fish shows the following signs:

1. dull or sunken eyes
2. gills are gray or green
3. off odour
4. flesh separates from the bone and is flabby
5. depression remains in flesh when outer skin is pressed
6. few scales are left on fish
7. shellfish claws and tail lose their spring

Poultry The enzymes of the fowl contribute to the deterioration of the dressed bird. The organisms from the feet, feathers and intestine are the primary source of all bacteria. Most of the bacterial growth takes place on the skin, the lining of the body cavity and any cut surface. Decomposition products slowly diffuse into the flesh. Poultry often develops 'taint', acid and sour odour.

The method of plucking feathers has a marked influence on the keeping quality of the bird.

Eggs Stale eggs float in water. The egg shell is the spoilage indicator in whole eggs. Spoilt egg shows the following signs:

1. cracked shell
2. leaking contents
3. egg yolk is exposed
4. shell has a dirty discoloured appearance. No egg graded below B can be used in a commercial establishment
5. each opened egg must be checked for blood spot, meat spot, foul odour or other contamination

Cereals and Pulses Grains, nuts and oilseeds are often contaminated before harvest by fungi. *Aspergillus flavus* is commonly seen in stored grains. Although they do not spoil easily, signs of spoilage are:

1. musty odour and off flavour
2. presence of weevils, beetles, moths and worms
3. clumping of wholegrains
4. presence of dirt, mud and stones

Chocolates and Confectionery They have a high sugar content and are spoiled by the yeast *Zygosaccharomyces rouxii.*

Cooked Foods These foods are at high risk of getting spoilt. They show various signs of spoilage or may not show any visible signs and yet harbour microorganisms capable of causing food-borne diseases. Leftovers should be stored carefully and doubtful food should not be consumed. Very often there are no obvious signs of spoilage in cooked foods.

Food spoilage can be prevented by following several basic rules to protect food from contamination. Spoilage of food depends upon the perishability of food.

The food handler should be able to select wholesome food and identify likely signs of spoilage in food.

SUMMARY

Food spoilage refers to decomposition or decay by microbes, animal parasites, natural enzymes, physical or chemical changes as well as external contaminants. Spoilt food should always be discarded. Food that is decayed is easier to recognise than foods spoilt by microorganisms or unobvious contaminants. Foods have been categorised as perishable, semiperishable and non-perishable on the basis of the ease with which they spoil. They need to be stored properly. Food spoilage begins from the time food 15 harvested, till it is consumed. Animal products pick up contaminants in the slaughter house itself. The food handler should see that foods are not allowed to spoil and that there is no wastage.

KEY TERMS

Aflatoxin A poisonous mycotoxin produced by *Aspergillus flavus* found in nuts, corn, wheat and other grains and in bread and peanut butter which is improperly handled or stored. Causes low grade fever and may be carcinogenic.

Contaminated Food The term contaminated is used for those foods that are not fit to be eaten for sanitary reasons. Although food may look, smell and taste good, it may contain harmful chemicals, non-food matter and bacteria.

Enzymes Are biological catalytic agents produced by a living organism that is capable of bringing about chemical changes in other substances without being used up. As enzymes are made up of protein, they are denatured or inactivated on heating.

Food Spoilage Food spoilage can be defined as decomposition and damage caused to food by various agents, making it unsuitable for consumption.

Hydrogen Swell A type of chemical spoilage in acidic canned food resulting from a reaction between the acid from food and iron from the can causing the can to bloat.

Non-perishable Food Foods such as whole grains, sugar, oil, preserves, etc., which have a shelf life of approximately one year as long as they are hygienically handled and stored.

Food products that have a long shelf life of and resist spoilage unless they are improperly handled and stored.

Perishable Food Foods such as milk, eggs, meat, fish, cooked food and most fruits and vegetables that have a short shelf life of a few hours to a few days and need to be frozen if they have to be kept longer.

Food products that spoil readily unless specially processed or preserved and include most of the ingredients used daily in catering establishments.

Putrefaction Anaerobic decomposition of protein by microbes characterised by formation of H_2S gas and foul odours.

Rancidity The development of off flavours and odours in fats and oils because of exposure to oxygen, heat or enzyme action.

Semi-perishable Food Foods like processed cereals, flours, potatoes, onions, apples, etc., which can be stored for a week to a few months at room temperature.

Food products that have a shorter shelf-life than non-perishable foods.

Sewage The waste matter from the toilets, bathrooms, kitchen and other drains carried off by sewers. Liquid waste from above sources is also called gray water.

Spoiled The term *spoilt* is used for those foods that look harmful and unfit to eat. Spoilt food has an unattractive colour, smell, taste and appearance.

Spoilage organisms Microorganisms that make the food product unfit for human consumption by changing the taste, texture, odour, colour and overall appearance. Spoilage organisms do not cause disease but bring about wastage of food.

Thawing The stage when a frozen food reaches an unfrozen state, i.e., when the ice crystals that were formed during the freezing process, melt.

Wholesome Food that is healthful, at the right stage of maturity, free from pollutants and contaminants and is fit for consumption.

REVIEW QUESTIONS

1. Explain the different types of spoilage seen in food.
2. Differentiate between the terms contaminated and spoiled. Which type of food is more harmful and why?
3. Discuss the types of contaminants found in food. Suggest five simple measures to prevent contamination of food.
4. Explain the following terms
   (a) Wholesome food.
   (b) Perishable foods.
   (c) Non-perishable foods.
   (d) Mycotoxins.
5. Match the items in column I with an appropriate answer from column II

I	*II*
1. Lead chromate	(a) Rat poison
2. Kesari dal	(b) Dental fluorosis
3. Barium toxicity	(c) Astringent taste in mouth
4. Fluoride toxicity	(d) Turmeric powder
5. Unplated brass cookware	(e) Solanine
6. Green potatoes	(f) Lathyrism
	(g) Sanguinarine
	(h) Poisonous mushrooms
	(i) Chinese restaurant syndrome

6. Select the most appropriate answer in the following.
   (a) Food considered unfit for use should be
      (i) fed to domestic animals
      (ii) cooked well to destroy germs
      (iii) frozen immediately to prevent further spoilage
      (iv) discarded at once
   (b) Dented cans should be
      (i) discarded immediately
      (ii) used as soon as possible
      (iii) stacked on shelves
      (iv) refrigerated
   (c) Normally, canned food has a shelf life of
      (i) one month
      (ii) six months
      (iii) one year
      (iv) five years
7. List five spoilage indicators in each of the following foods
   (i) Fish
   (ii) Meat
   (iii) Milk
   (iv) Green leafy vegetables
8. What are the signs of spoilage seen in canned foods. Elaborate the signs and probable reasons for the same.

3

- **Basic principles of food preservation**
- **Methods of food preservation**
- **Food Additives**

Food Preservation

INTRODUCTION

As we have read in the previous chapter, most foods are highly perishable and need to be subjected to a number of processes if its shelf life has to be extended. Without adequate processing, foods cannot be stored indefinitely. We have also read in the previous chapter on Food Contamination and Spoilage that most foods are easily decomposed mainly by microbial action and natural changes taking place in food. The rate of spoilage depends on the nature and composition of different foods. Once the food handler is familiar with the principles underlying food contamination and spoilage, he/she will be able to handle food correctly and extend its keeping quality.

BASIC PRINCIPLES OF FOOD PRESERVATION

Food is preserved basically to extend its shelf life and ensure that it reaches the consumer in a wholesome state. Since the time gap between production and consumption is large, varying from a few hours to one to two years, all food handlers should understand the basic principles on which food preservation is based. These principles are based on creating conditions to keep microorganisms away from food and destroying those that are present in food by creating unfavourable conditions. There are various methods used to preserve food. Whatever the method used for preservation of food, the following principles are involved.

1. Preventing or delaying spoilage caused by microorganisms by:
   a. Restriction of access of microorganisms to food,
   b. Inhibiting or retarding the growth of microorganisms already present in food,
   c. Inactivation or destruction of the microorganisms in food.
2. Avoiding or delaying natural chemical changes in food brought about by oxidation, ripening, enzymes, etc.
3. Preventing physical changes or damage to food during transportation, by pests, etc.

METHODS OF FOOD PRESERVATION

Keeping Microorganisms Away from Food

Many foods have a natural protective covering like the skin of animals, the shell of egg, the peel on fruit, which keeps the inner tissues of healthy plants and animals free from microorganisms unless it is damaged. Food that has to be processed should be of good quality with the protective covering intact, before it is packaged. Both the kind and number of microorganisms present on food need to be known before the time and processing temperature are ascertained. Aseptic techniques need to be followed if the microbial load is to be controlled. The food should be free from disease or spoilage organisms. This can be achieved by packaging of foods to prevent contamination during handling.

Loose wrappers, cartons, hermetically sealed containers along with sanitary conditions in the slaughter house, dairy, market, etc., can largely help in keeping out microorganisms from food.

Removal of Microorganisms from Food

Microorganisms present in food can be removed by washing and trimming solid food. Surface microorganisms present on fruits and vegetables from the soil can be removed by washing provided the wash water is clean and moisture content does not increase.

Trimming spoilt portions of food or the outer leaves of cabbage can help remove large microbial loads.

Use of Low Temperature

Low temperatures preserve food by retarding chemical reactions, enzymatic action, and growth and activity of microorganisms. The lower the temperature the better will be the quality of preserved food. At low temperatures, microorganisms are not killed and since no food is sterile, the microorganisms present in and on the food will multiply once the temperatures become favourable.

Refrigeration/Chilling Temperatures of 1°C to 4°C prevent food from spoiling for short periods. Low temperature merely retards the decay of food, but frozen foods kept at −18°C preserve food for a year and at −28°C food can be preserved for up to two years.

Chilling temperatures retard microbial growth and biochemical changes that affect colour, texture, flavour and nutritive value. Most perishable foods such as eggs, dairy products, chicken, meat and seafood are held at chilling temperatures for a limited time without affecting their condition. They need to be consumed by the 'best before date'. The relative humidity (R.H.) in refrigerated storage is another important factor that needs to be controlled. A low R.H. results in loss of moisture and wilting and shrinkage in fruits and vegetables. A high R.H. favours surface spoilage by microorganisms.

Cook-Chill In this system food is cooked in the kitchen in advance and rapidly chilled and stored at 0°C to 3°C. It is reheated just before it is served. The cook-chill system is used for almost all kinds of foods and is popular in airlines and institutional catering. Proper cooking procedures and hygienic standards need to be followed to ensure safety and quality.

Precautions for cook-chill foods

1. Food should be properly cooked to destroy microorganisms and complete the cooking process.
2. Cooked food should be portioned and chilled in a blast chiller unit within 30 minutes of cooking.
3. Chilling temperature of 3°C must be reached within 1.5 hours after cooking.
4. Chilled storage temperature should be between 0°C to 3°C.
5. While distributing cook-chilled foods temperature should be as low as possible.
6. During reheating the internal temperature of food must reach 70°C and it should be held at that temperature for at least two minutes.
7. Food cooked by this process should be reheated just before it is consumed and it should not be consumed after two hours of reheating.
8. The critical safety limit for chilled food is 10°C and if the temperature during storage or distribution exceeds this limit the food should be discarded.
9. Recipes should be suitably modified for cook-chill foods to prevent curdling or changes in consistency of soups, sauces and crispness of batter fried products.
10. The storage life of cook-chill meals should not exceed five days.

The caterer should know that even at chilling temperature bacterial, chemical and enzymatic reactions are taking place, but at a more slower rate than at room temperature. Chilling temperatures only help to prolong shelf life by a few days.

Freezing

Food is preserved for long periods by reducing its temperature to −18°C or lower. At this temperature, water present in food is converted to ice and microbial growth stops. Freezing retains colour, flavour and nutritive value. However, the texture of some foods is adversely affected. If properly stored, frozen food has a shelf life of 3–12 months. Fruits, vegetables, meat, fish and poultry can be preserved in this way.

Food to be frozen should be frozen quickly so that small ice crystals form in the cells of the food, which is desirable. Slow freezing causes large irregular shaped ice crystals to form in the cells. These contain the flavour and nutrients. When food is thawed, if large ice crystals are present they pierce the cells and some flavour and nutrients leach out and are lost.

Food is quickly frozen by using any one of the following equipments.

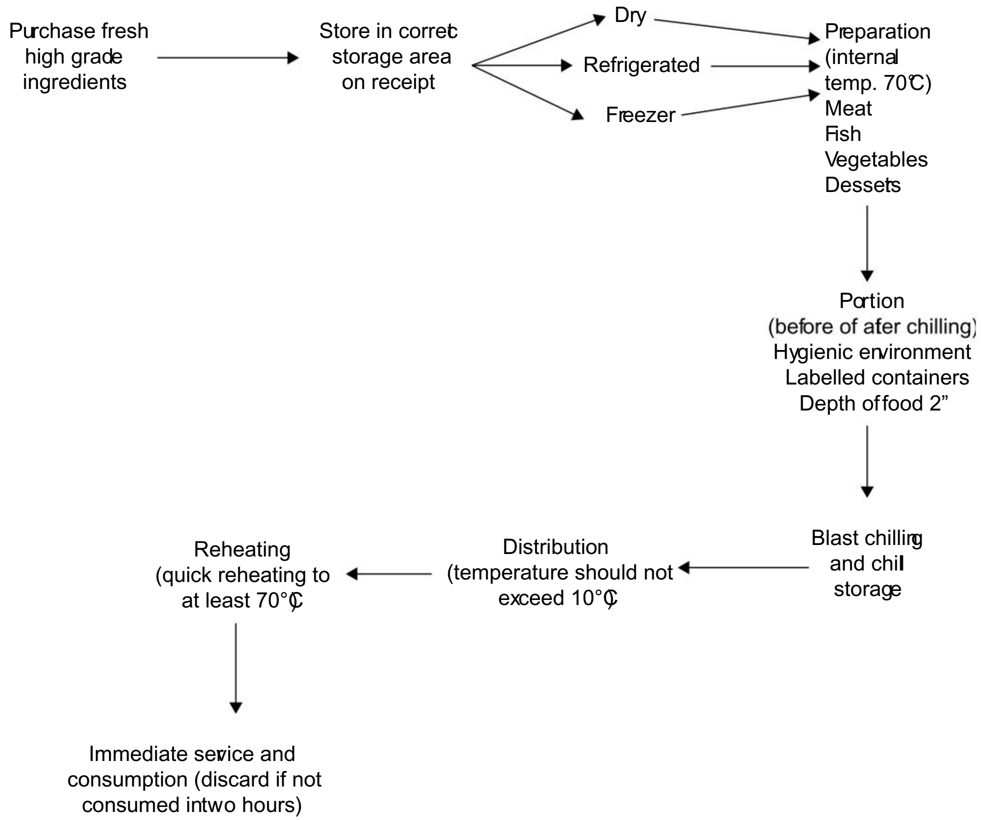


Fig. 3.1 *Steps in cook-chill process.*
Source: Food Science and Nutrition

Blast Freezers Extremely cold air at −32°C to −40°C is vigorously circulated over food while it passes through an insulated tunnel causing food to freeze swiftly. Freezing time varies from 75 to 90 minutes depending on type of packaging.

Plate Freezers Food to be frozen is placed in contact with a metal surface that is cooled by a refrigerant. They are used for ice creams, juices, etc., both packaged and unpackaged foods.

Immersion Freezers Packaged or unpackaged food is frozen by immersing it or spraying it with a freezing agent. They are used for freezing poultry. Liquid nitrogen at −196°C is sprayed into the freezing chamber. Liquid carbon dioxide may also be used. Warm air is constantly removed from the chamber.

Freeze Flow In this system food freezes but does not harden.

A wide variety of frozen foods, both cooked and uncooked, are available in the market. They should be thawed/cooked as per manufacturer’s instruction to ensure that microorganisms do not multiply during these processes. Some are to be cooked in the frozen state. Frozen foods once thawed should never be refrozen. This is because when food is thawed its temperature is within the 'danger zone' in which bacteria present in food multiply rapidly.

Cook-Freeze It is a specialised method of a food processing system in which food is cooked and immediately blast frozen at −18°C or below, and stored at that temperature till it has to be served. Such food has a shelf life of three to six months. The food should be frozen immediately so that large ice crystals do not form and freshness is retained. Freezing should be accomplished within one to one and a half hours of cooking the food.

Once the foods are frozen they should be stored at −18°C and reheated either in a combination oven or in a microwave oven if quantity is less.

Advantages of cook-freeze

1. Complete utilization of staff time.
2. Complete utilization of equipment.
3. Portion control and minimal wastage.
4. Less frequent deliveries from commissary.
5. Food can be prepared in advance, when in season and prices are low, days or weeks in advance during lean periods.
6. Menus can be planned and prepared in advance.
7. Lesser staff required with more variety in menu.
8. Overall savings in staff, equipment, space, fuel, and food costs.

Steps in cook-freeze system To ensure microbial safety of food, the following steps should be followed

1.	Purchasing and storing	Licensed suppliers, Temperature control
2.	Pre-preparation	Clean kitchen and equipment, Wholesome ingredients
3.	Cooking	Use proper method of cooking, Use a probe thermometer, Check internal temperatures
4.	Portioning and packaging	Use clean sanitized containers of correct size, Accurate portion size filled to 5 cm depth, Cover/seal containers
5.	Labelling	Label should state production date, best by date, name of preparation, number of portions and shelf-life
6.	Freezing	Freeze immediately below −5°C within 1.5 hours, Once frozen, shift food to deep freeze storage
7.	Storing	Record temperature of freezer regularly (at least −18°C) Destroy outdated packages. Follow FIFO and keep freezer door well shut
8.	Transporting	Distribute in refrigerated vans in insulated containers. If temperature increases, use up the food and do not refreeze
9.	Thawing and reheating	Thaw in thawing cabinet. Reheat to at least 70°C for two minutes. Serve immediately and discard food unconsumed for two hours

Follow proper instructions while preparing and storing food to prevent loss of flavour and texture. Avoid slow freezing and freezer burns caused due to prolonged storage and badly packaged food.

Creating Anaerobic Conditions

Vacuum Cooking Also known as *sous-vide,* it is a form of cook-chill using a combination of processes. The food is first sealed in a plastic pouch. It is then cooked by steam and quickly chilled in ice-water. It can be used by many types of catering establishments.

Steps in vacuum cooking

Put prepared food in plastic pouches, add seasonings

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Vacuum packaging at 1,000 millibars pressure and sealing of pouch

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Cook by steam in oven at 100°C

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Chill in iced water/air blast chiller

↓

Label and refrigerate at 3°C

↓

Reheat in boiling water or steam oven

Although this system has many advantages, its main disadvantages are uneven cooking if size of cut food varies, longer cooking time and extra cost of vacuum pouches and packing equipment.

Creating a Vacuum Removal of oxygen can stop microorganisms from growing. This can be done by packing foods in airtight containers or vacuum packing of foods as in canned foods. However, anaerobic microorganisms can still grow in such foods if these have been inadequately processed.

Vacuum Packing Vacuum packing of prepared food in vacuum packs or special plastic pouches is an excellent means of preserving food. Vacuum-packed food does not get oxidised, there is minimal weight loss or drip and, once packed, chances of cross-contamination is reduced. Packs should be stored at appropriate storage temperature, well labelled, and FIFO must be followed strictly. If the contents of the pack are discoloured or if pack is bloated or leaking it should be discarded immediately. Strict hygiene needs to be followed for such processed food.

Use of High Temperatures

High temperatures destroy microorganisms by denaturation of cell proteins and inactivation of enzymes needed by them for their metabolism. At temperatures above 63°C bacteria stop multiplying and as the temperature increases they are gradually destroyed. The thermal death time (TDT) is the time needed at a given temperature to kill a number of microbes. Heat used to destroy microbes may be in the form of wet heat or dry heat.

Wet Heat This is more commonly used in the food industry. If carefully administered, it is a useful method of controlling microorganisms.

Blanching Foods that are to be frozen, dried or canned are immersed in hot boiling water for a few minutes prior to processing. Blanching helps in removal of peel, inactivation of enzymes that oxidise vitamin C, removal of gas in tissue spaces and causes wilting of the tissues, which helps in proper filling of the can. The enzymes that bring about discolouration or browning as seen in apples, pears and potatoes are also inactivated.

Pasteurisation This method is used to control microorganisms in milk, fruit juices and wines. Food may be pasteurised/sterilised by any one of the three methods:

(a) Low temperature holding (LTH) method at 62°C for 30 minutes.
(b) High temperature short time (HTST) or flash method at 72°C for 15 seconds.

The heat treatment kills pathogenic microorganisms and some spoilage organisms at temperatures below 100°C for specified time and food is cooled promptly after heating.

(c) Ultra high temperature sterilization (UHTS) at temperatures above 135°C for 2 seconds. This method makes foods commercially sterile. Such foods are packed under aseptic conditions and can be stored at room temperature for three to six months.

Cooking (Boiling, Steaming, Stewing and Poaching) In these methods of cooking, wet or moist heat is used. The temperature attained is 100°C. At this temperature most microorganisms are destroyed but spores survive. Foods cooked by these methods cannot be stored for long periods.

Dry Heat It is used in the following methods:

Sun drying, smoking and freeze drying Also make use of heat to preserve food. In these methods, dry heat is used to control microorganisms. Dry heat brings about dehydration of the foods or of the surface of food. It destroys molds, yeast and most bacteria and spores.

Cooking (baking, roasting, grilling) In these methods of cooking, food is cooked by dry heat. The temperature reached on the surface is approximately 115°C. Most bacteria are destroyed. Internal temperature of food is generally lower.

If food has to be kept for some time, it should be cooked thoroughly. Foods cooked by dry heat methods do not spoil as fast as foods cooked by moist heat methods as they have a lower moisture content.

Removal of Moisture from Food

Microorganisms need moisture for their growth. If foods are dried or dehydrated, i.e., if the moisture is extracted from food, they will not be spoilt by bacteria, yeasts or molds.

Moisture can be removed by sun drying, mechanical dryers—spray or roller driers, or freeze drying.

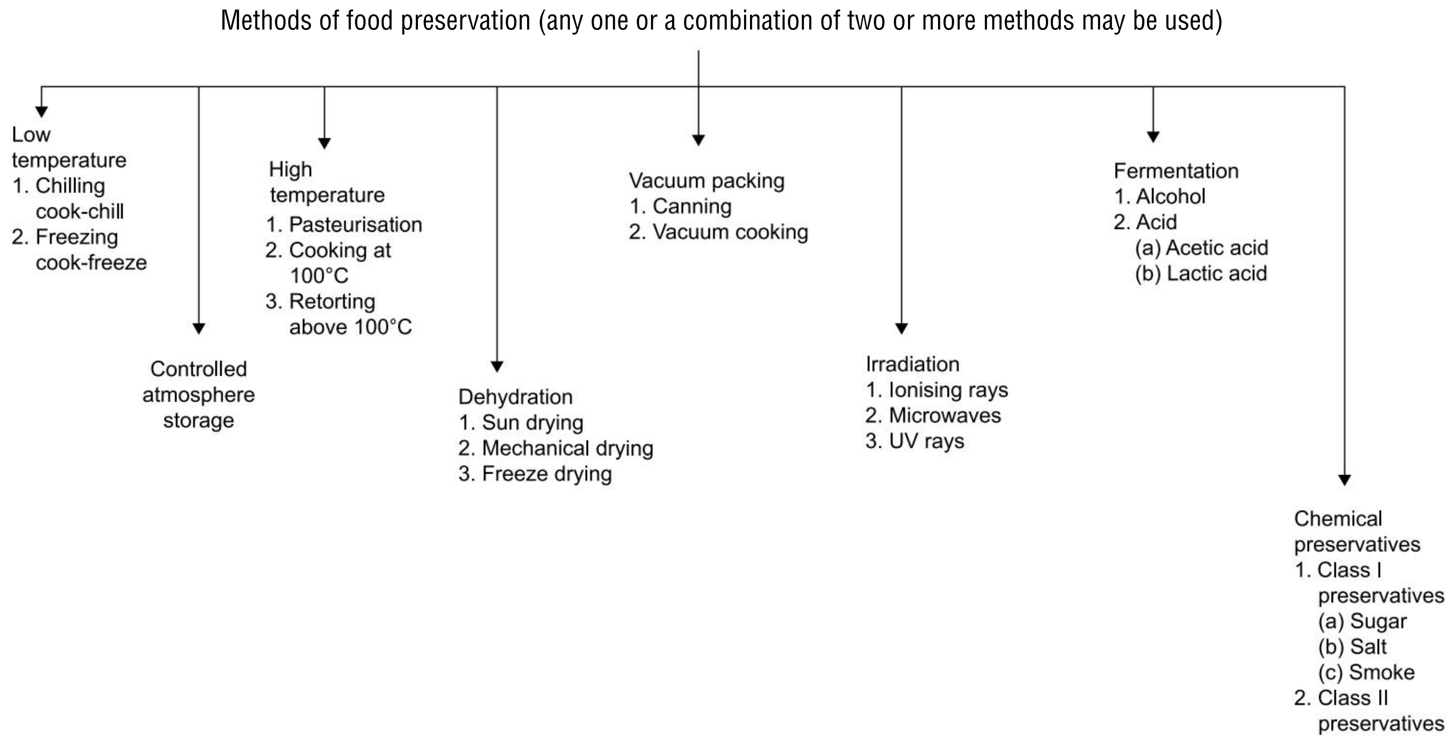


Fig. 3.2 *Classification of methods of food preservation*

Sun Drying It is used to dry certain fruits such as grapes, figs, and apricots, which are placed on trays. The fruit may be turned during drying. Light coloured fruit is sulphured to prevent enzymatic browning.

Disadvantage Can be used in hot dry climates only.

Use of Mechanical Dryers The food to be dried is passed on conveyor belts through hot air with controlled relative humidity, or hot air is passed through the food. Liquid food such as milk is dried either by passing it over heated rollers or by spraying the liquid into a current of dry heated air. Dried food should be packed in airtight containers immediately.

Freeze Drying In this process of dehydration the food to be dried is first frozen in a cabinet. A vacuum is created by pumping out the air in the cabinet and by the process of sublimation ice turns into vapour. Freeze-dried food needs no further refrigeration or preservation. It is light in weight and retains its size and shape, and when soaked in water, regains its original size and flavour. Freeze drying is used to dry fruits, vegetables, meat, poultry and seafood.

Advantages of drying

1. Dried food is easy to transport and store.
2. It has a long shelf-life provided it remains dry.
3. It occupies less storage space.
4. It is a cheap method of preservation and is convenient to use.

Use of Preservatives

A preservative is any substance that retards deterioration of food. There are two groups of preservatives used in food.

Class I Preservatives This class includes sugar, common salt, glucose, fructose, alcohol, spices, vinegar or acetic acid, honey, and wood smoke. There is no restriction by law on the addition of these substances in food. Sugar and salt reduce the amount of available moisture, i.e., they lower the water activity (a_w) in the food.

Class II Preservatives This class includes chemicals that inhibit microbial growth and can be added to certain foods only in definite permitted limits. They are usually added at the end of the processing operation and their presence has to be mentioned on the label, i.e., there is a restriction on the use of these preservatives in food by law. They include salts of benzoic acid, fumaric acid, sulphurous acid, nitrates and nitrites of sodium and potassium, sorbic, propionic and acetic acid. Nisin, an antibiotic, is used in the preservation of cheese.

They are used to preserve food in the following ways.

1. They may be added to food, for example, sodium benzoate is added to tomato sauce and potassium metabisulphite to lemon squash.
2. They may be applied on the surface of foods. Sulphur dioxide is used on dry fruits and borax is used to wash vegetables and whole fruit.
3. Wrappers may be impregnated with sorbic acid to prevent surface spoilage of cheese.
4. The ice used to chill foods like fish may contain tetracycline, an antibiotic that is a permitted preservative.

5. They may be used as gases around food. Fruits and vegetables are stored in an atmosphere containing two to three per cent carbon dioxide to retard the ripening process.

Table 3.1 **Uses of Chemical Preservatives**

Class I	*Class II*
They include sugar, salt, vinegar, spices, smoke and oil. (a) *Sugar:* A high concentration of sugar prevents molds, yeast and bacteria and is used to preserve jams, jellies, marmalades, fruit preserves, candied fruit, glaced fruit, crystallised fruit and chutneys. (b) *Salt:* Microorganisms cannot grow in high concentrations of salt. Meat is pickled in salt solution, e.g., ham and ox tongue. Salt is used for pickling and curing. Mango, lime and vegetable pickles are preserved by salt. Salt and sugar preserve food by binding water and making it unavailable for microbial activity. (c) *Smoke:* It is a complex mixture of alcohols, acids, phenols and toxic substances that inhibit microbial growth. Meat to be smoked is first salted and then smoked. Temperature control during smoking is essential to maintain the texture. (d) *Vinegar:* 4% acetic acid in water is used for pickling vegetables such as onions, gherkins, red cabbage, shallots and to preserve chutneys.	They include salts of various acids. (a) Benzoic acid and its salts, e.g., sodium benzoate in tomato sauce, squashes and syrups. (b) Sulphurous acid and its salts, e.g., potassium metabisulphite in fruit beverages such as lime cordial, sulphuring before dehydration of fruits and vegetable, and in bulk storage of fruit pulp. (c) Nitrates and nitrites of potassium and sodium are used in the preservation of meat and for colour retention in pork. (d) Propionic acid and its salts such as sodium and calcium propionate are used as mold inhibitors on cheese surface and to prevent rope in bread. (e) Sorbic acid and its salts like potassium sorbate is used in fruit juice, sauces, jam, flour, confectionery and in margarine to prevent yeast and mold growth.

Controlled Atmosphere Storage

When fruits and vegetables are harvested they are still alive and respire using up oxygen and giving out carbon dioxide, water vapour and heat. The faster the rate of respiration the quicker the ripening process. The ripening rate can be reduced by

1. Lowering the temperature
2. Reducing available oxygen
3. Increasing the carbon dioxide concentration

All three methods are used in controlled atmosphere storage.

Fruits can be stored for varying lengths of time under controlled conditions, thus extending their shelf life.

Modified atmosphere storage is also used for food storage. It differs from controlled atmosphere storage because in controlled atmosphere storage the percentage of gas is monitored, while in modified atmosphere the air is initially replaced with gas, but no further measures are taken to check the percentage of gas in the atmosphere. The concentration and proportion of gases used varies with the kind and variety of fruit. The carbon dioxide concentration is usually increased and oxygen concentration is decreased for fresh fruits and vegetables stored in cold rooms. Modified atmosphere packaging is another technique of enhanced preservation based on gas storage.

Preservation by Fermentation

Select microorganisms act on certain foods such as milk, soybeans, cereals, pulses and cabbage, and give it a distinctive taste, better acceptance, higher nutritive value and a longer shelf life. When foods are fermented by select microbial action new food products are formed. The distinctive taste, texture and aroma that develops is due to the formation of acids, mainly lactic acid and alcohol, which also helps to preserve the food. The preservative effect of these substances is generally supplemented by one or more methods of preservation if the shelf life is to be extended.

The acids developed in the food help in preserving foods such as curds, cheese, fermented milk, pickles, sauerkraut, olives, etc. The alcohol that forms when fruit juices and grains are fermented also has a preservative effect.

Examples of food fermentations are

1. Alcoholic beverages such as beer and wine

$$\underset{\text{Simple sugar}}{C_6H_{12}O_6} \xrightarrow[\text{Anaerobic conditions}]{\text{Yeast}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + 2CO_2 \uparrow$$

2. Acetic acid fermentation in vinegar manufacture

$$\underset{\text{Ethyl alcohol}}{C_2H_5OH} + O_2 \xrightarrow[\text{Acetobacter}]{\text{Aerobic}} \underset{\text{Acetic acid}}{CH_3COOH} + H_2O$$

3. Lactic acid fermentation in curds and yoghurt

$$\underset{\text{Lactose}}{C_6H_{12}O_6} \xrightarrow[\text{Lactobacilli}]{} \underset{\text{Lactic acid}}{2C_3H_6O_3}$$

Preservation by Radiation

Radiation of various frequencies ranging from low frequency microwaves to high frequency gamma rays are being used to preserve various foods. Radiations can be classified into two categories on either side of the light spectrum.

1. Low frequency, long wavelength and low energy rays—from radio waves to infrared rays.
2. Higher frequency, shorter wavelength and higher energy rays on the other side of the light spectrum are of two types:
   (a) Shorter wavelength, lower frequency and lower energy rays, e.g., ultra violet rays.
   (b) Higher frequency, short wavelength and high energy rays, e.g., ionising rays that are capable of breaking molecules into ions.

Ultraviolet (UV) Irradiation This type of radiation is most widely used in the food industry. Ultraviolet rays are an invisible form of light. They lie just beyond the violet end of the visible spectrum. They are present in sunlight. They can be produced artificially by low pressure mercury vapour lamps.

Ultraviolet rays are effective in killing bacteria and viruses. They have poor penetrating power and can be used for surface sterilisation of food or for sterilizing the air in storage and processing rooms. They are used to control mold growth on the surface of bakery products and to prevent spoilage of meat while it is tenderised and aged. Treating knives for slicing bread, treating water for beverages and sanitising of food service utensils are some of the other successful uses of UV rays.

Microwave Oven Microwaves are short radio waves that heat food by penetrating it. These waves cause molecules in food to vibrate rapidly. The friction caused by the rapidly moving molecules creates heat that cooks the food.

Microwaves are produced by an electronic vacuum tube called a magnetron. They penetrate food to a depth of 1.5 inches. Cooking is faster in a microwave oven, because heat is produced, inside the food and no heat is lost. Natural flavour is better retained if correct cooking procedures are followed.

Ionizing Rays or Cold Sterilisation Foods are exposed to ionising radiation to extend its shelf life. These rays transfer some of their energy as they pass through food killing pathogenic and spoilage causing microorganisms.

Food irradiation in low doses of 0.05 —70 kilo grays is used for the following purpose.

1. To inhibit sprouting, e.g., potatoes, onions, garlic, ginger and shallots.
2. To control insect infestation, e.g., rice, wheat and dry fruits.
3. To reduce microbial load, e.g., spices, meat, chicken and frozen fish.
4. To extend shelf life and delay ripening, e.g., mango, papaya and banana.
5. To sterilise food, e.g., packaged food and food in hermetically sealed containers.
6. For treatment of water.

Ionizing radiation is electromagnetic like radio waves, infrared light or ultraviolet light. Its controlled use can protect food without making it radioactive. It is more powerful than UV rays. The advantages of irradiation are:

1. It can be used for heat sensitive food and frozen food as it does not increase the temperature.
2. Nutritive value and chemical changes in foods are minimal as compared to any other method of preservation.
3. Food can be sterilised after it is packed.

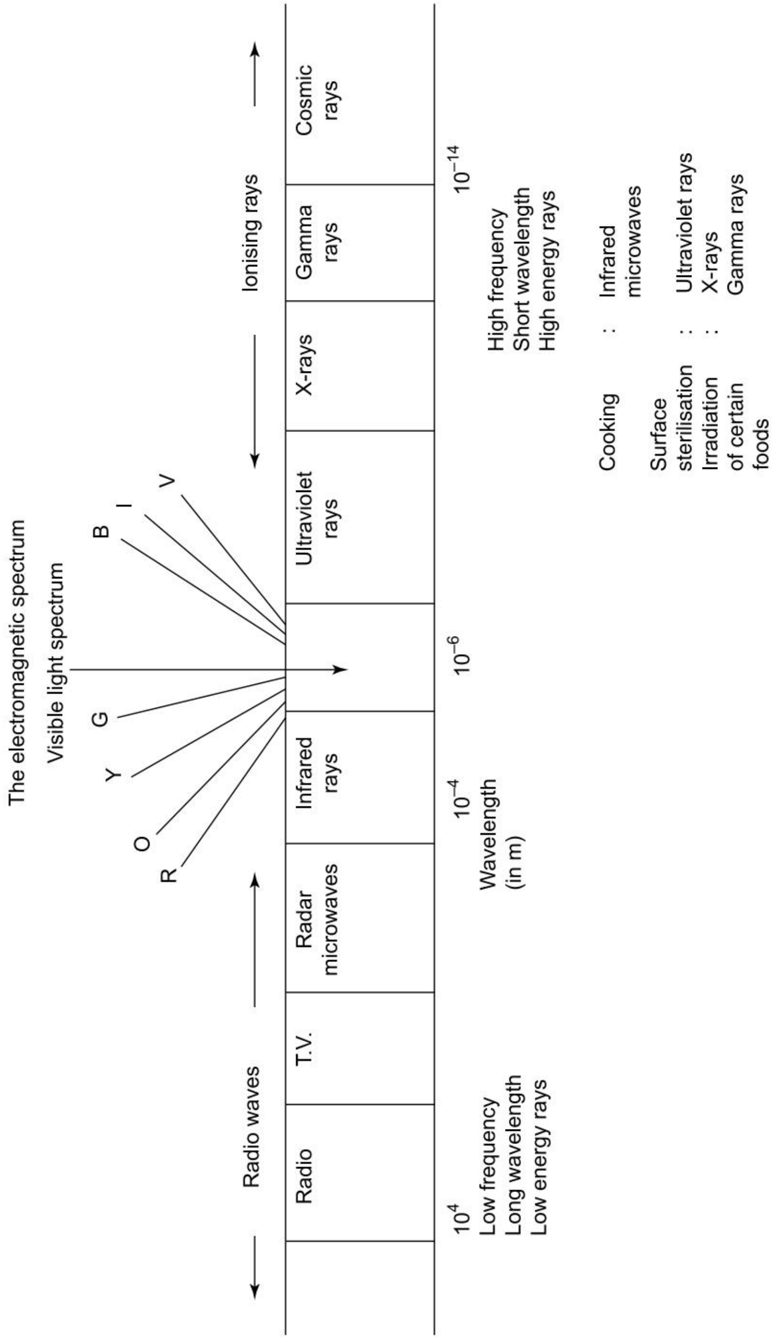


Fig. 3.3 *Types of radiation used for processing food*

Combination of Two or More of the Above Methods

Canning In this process temperatures used are above 100°C. All microorganisms that could spoil food under normal conditions of storage are destroyed by heating the food in an autoclave at temperatures between 115°C and 125°C. The exact temperature and time required for canning depends on the type of food to be canned. Acidic foods such as fruit are heated to 100°C only, because the natural acid also helps in preservation by preventing microbial growth. A vacuum is created inside the can or the air in the headspace may be replaced by nitrogen gas to prevent growth of aerobic bacteria.

This is the most common method of food processing used in developed countries. It is used to preserve fruits, vegetables, fish, meat, poultry, etc. In this process, no preservative is added to the food that is sealed in airtight containers. These containers are then heated to sterilise the food.

Steps in Canning/ Bottling of Food

Cleaning and preparing: The food to be canned is cleaned thoroughly and prepared for canning. For example, fruits and vegetables may be cut, peeled, sliced or stoned. Some foods may be blanched. All these processes reduce the microbial load present on the surface of the fruit/ vegetable.

Filling: Raw prepared food is filled into cans or bottles either mechanically at the rate of approximately 1,200 containers a minute or by hand. Filling should be carefully controlled to ensure that the headspace, i.e., the amount of empty space in the can is neither too little nor too large.

Exhausting: A partial vacuum is created in the can by removing part of the air. As oxygen is reduced bacterial spoilage is retarded. Exhausting prevents the ends of the can from bulging during heating.

Sealing: Cans and bottles are sealed with airtight lids by sealing machines.

Processing: The sealed containers are now heated at a controlled temperature for a specified length of time. The time and temperature depends on the food being processed and the size of the container. Cans are processed in equipments called retorts. They are commercially sterilised using steam under pressure.

Cooling: As soon as processing is over, cans are cooled immediately to stop further cooking. Cans are cooled by dipping them in cold water, spraying them with cold water or partially cooling them by water as well as by air-cooling.

The processed cans are then labelled and packed in cartons to be marketed.

Disadvantages

1. Heat labile nutrients are lost.
2. Heat required for processing affects the texture, colour and flavour of the product.
3. Cost of canned food is high in India because of the cost of the can.
4. Once opened, canned food should be treated like fresh food and consumed within stipulated period.

Advantages

1. Convenience.
2. Long shelf life.
3. Needs little preparation.
4. No chemical preservatives used.
5. Variety of food is available.

Table 3.2 Concentrations of Class II Preservatives Permitted in Some Common Foodstuffs

S. No.	*Article of food*	*Preservative*	*Parts per million*
1.	Sausages	Sulphur dioxide	450
2.	Fruit juice concentrate	Sulphur dioxide	1,500
3.	Dehydrated soup mixes	Sulphur dioxide	1,500
4.	Raisins and sultanas	Sulphur dioxide	750
5.	Squashes, crushes, syrups (to be diluted and consumed)	Sulphur dioxide or Benzoic acid Sorbic acid salts	350 600 100
6.	Jam, marmalade, jelly	Sulphur dioxide Benzoic acid Sorbic acid and its calcium/ potassium/sodium salts	40 200 500
7.	Fruit juices (tin/pouch/bottle)	Sorbic acid salts	200
8.	Tomato puree, sauce, paste and other sauces	Benzoic acid	750
9.	Fat spread	Sorbic/Benzoic acid and its salts	1000
10.	Pickled meat and bacon	Sodium and/or Potassium nitrite	200
11.	Smoked fish (in wrappers)	Sorbic acid	Only wrapper can be impregnated
12.	Cheese	Sorbic acid and its salts Nisin	3000 12.5
13.	Flour for baked food	Sodium diacetate or Propionates or Methyl Propylhydroxy - Benzoate	2,500 3,200 500

Note: Sorbic acid and its salts are calculated as Sorbic acid

FOOD ADDITIVES

Food additives are substances not normally consumed as a food by itself and as such are not nutritive, but are added to food to improve its nutritive quality, freshness and sensory quality, or as a processing aid in the manufacture of food.

They include:

1. Preservatives
2. Antioxidants
3. Emulsifying agents
4. Food colours
5. Flavouring agents
6. Nutrient supplements
7. Anticaking agents
8. Non-nutritive sweeteners
9. Sequestrants
10. Bleaching agents

Preservatives

This is any substance that prevents or retards deterioration of food. They have been discussed earlier in this chapter under Food Preservation.

Antioxidants

Fats and the fatty phases of food become rancid mainly due to oxidation of fatty acids present in it. This results in loss of organoleptic qualities and nutritive value. Antioxidants prevent the oxidation of fatty acids. For example, BHA (Butylated hydroxy anisole), BHT (butylated hydroxy toluene) TBHQ are added to oils in which snacks are fried. Fumaric acid is used in butter, cheese, wafers and savoury snacks (farsan) to prevent rancidity. Other antioxidants are EDTA (ethylenediamine tetraacetic acid), tocopherols, ascorbic acid, etc.

Antioxidants used in food should have the following properties:

(a) fat soluble
(b) heat stable
(c) should not impart foreign flavour or colour to food
(d) the antioxidant and its oxidation product should be non-toxic.

Food Emulsifiers or Emulsifying Agents

Emulsions are formed when two immiscible liquids are agitated. This is usually unstable and the two phases soon separate unless an emulsifying agent is present. Emulsifying agents enhance the formation of small droplets and reduce the rate at which the droplets come together. The emulsion thus becomes stable.

Emulsification process plays an important role in food technology. Common food emulsions are

Milk (fat in water)
Butter (water in fat)
Margarine (water in fat)
Mayonnaise (oil in water)

The emulsifying agents have both hydrophilic (H_2O loving) and hydrophobic (H_2O repelling) groups. The hydrophilic group is attracted to H_2O and the hydrophobic group is attracted to oil. Thus the emulsifying agent is adsorbed at the inter-phase of the two liquids.

Commercially used emulsifying agents are GMS (glyceryl mono stearate), stearyl tartarate, and polyoxyethylene monostearate. Lecithin in egg yolk and caseinogen in milk are natural emulsifying agents.

Food Colours

The understanding of structure—colour relationship has made it possible to synthesise any shade of colour from simple coal tar residue chemicals.

There are two types of colours used in the food industry:

1. Artificial or synthetic
2. Natural

Colour requirements of the food industry

1. Non-toxic and approved by regulatory agencies like Food and Drug Administration.
2. Stable to conditions of processing and storage like high temperature, acidity, etc.
3. Easy to blend with food.
4. Reasonably priced.

Advantages of synthetic colours

1. Excellent stability to processing and storage conditions.
2. High purity.
3. Easy blending.
4. Low cost.

Disadvantages

1. Doubtful about its safety.

Advantages of natural colours

1. Safety: Safe to consume in any amounts.
2. The natural carotenoid pigments can be converted to vitamin A in our body.

Disadvantages

1. Poor stability.
2. High cost.
3. Limited range of shades.
4. Very low pigment content.

Permitted synthetic colours

1. Red : Ponceau 4 R, Carmoisine, Erythrosine.
2. Yellow : Tartrazine, Sunset Yellow FCF.
3. Blue : Indigo carmine, Brilliant Blue FCF.
4. Green : Fast Green FCF.

Table 3.3 Sources of Natural Colours

S. No.	*Name of pigment*	*Shade*	*Source of colour*
1.	Anthocyanin	Red to Blue also purple	Black grapes, cocum fruit
2.	Carotenoid	Yellow to red also orange	Citrus peels, Annatto seeds
3.	Betalins	Red to purple	Beetroot

Contd...

Table 3.3 (Contd.)

S. No.	Name of pigment	Shade	Source of colour
4.	Chlorophyll	Green	Green plants
5.	Curcumin	Yellow to orange	Turmeric
6.	Caramel	Brown to black	Sugars
7.	Cochineal	Scarlet	Dried insects. 70,000 insects yield 1 lb colour
8.	Flavones	Yellow	Leaves of Safflower

Non-nutritive Sweeteners

They do not provide any calories and are added in very small quantities to sweeten food. These low calorie sweeteners are of two types:

1. Bulk sweeteners that are indigestible and include sugar alcohols like sorbitol, mannitol and xylitol are usually used in chewing gum and confectionery.
2. High intensity sweeteners that need to be added in very small quantities like saccharin, ace sulfame and aspartame, which are artificial sweeteners and may be sold as tabletop sweeteners. The use of artificial sweeteners is permitted in certain foods only like soft drink concentrates, *paan masala*, etc.

Anticaking Agents

These substances keep the products dry and they prevent dry foods from forming lumps or caking. They are used commonly in ready food mixes, e.g., instant idli mix, instant pulao, baking powder, etc.

Examples of anti-caking agents are calcium phosphate, magnesium carbonate, magnesium oxide, etc.

Flavouring Agents

Various essences like orange, lemon, etc., are volatile oils in an alcohol base. In citrus drinks, fumaric acid is used as a flavouring agent and for cloud retention instead of brominated vegetable oils (BVO), which have been banned because they are carcinogenic i.e. capable of producing cancer. Synthetic flavours are also used to overcome loss of flavour in processing or to add a new flavour. Synthetic fruit flavours are chemicals which are blends of esters and alcohol.

Nutrient Supplements

Vitamins and minerals, proteins, amino acids, etc., are sometimes added to fortify foods such as convenience foods, for example, iodised salt, iron enriched wheat flour, lysine in bread, etc. Nutrient supplements are extensively used in baby foods.

Bleaching Agents

Chemicals such as Nitrous oxide are used as bleaching agents for refined flour. Bleaching agents are also used in the manufacture of certain cheeses to impart a white colour, for example, hydrogen peroxide and potassium bromide.

Chelating or Sequestering Agents (Sequestrants)

These are substances that combine with metal contaminants and sets it aside so that it can be removed from food. In other words it immobilises metals and prevents wine and other beverages from clouding, for example, phosphoric acid and citric acid.

These ten additives are also called intentional additives. Besides these, other chemicals may enter the food at any stage from the farm to the table and are referred to as contaminants or incidental additives as they remain in food. Incidental additives are present in small amounts in the final product after they have performed their functions. They are:

1. Pesticides and insecticides that remain in the crop after harvesting or from stored products. They are generally found in fresh food rather than processed food.
2. Antibiotics and growth regulators that are used to regulate the growth of animals and plants, for example, hormones and sprout inhibitors.

Food additives are thus of two types:

1. Intentional and
2. Incidental

The amount of any additive present in food needs to be ascertained before it is used.

SUMMARY

Food, unless processed or preserved, is bound to spoil. The spoilage rate depends on the composition of food, the temperature at which it is stored and the time for which it is held at a specific temperature. Food needs to be protected from spoilage and contamination at all stages till it is consumed. Food spoils for various reasons and a wise food handler should be able to protect food from spoilage by subjecting it to various processes.

The objective of food processing is to remove unwanted matter from food, make it safe for consumption, increase its digestibility, enhance its flavour, colour, and taste, minimise nutrient loss, extend the shelf life and increase the overall acceptability of the food.

Food is preserved by use of low temperature, high temperature, adding chemical preservatives, vacuum packing, modified atmosphere packaging, aseptic packaging, irradiation, fermentation, etc. A single method or a combination of methods may be used.

Apart from preservatives, different additives are used in processed foods to improve the quality, freshness and sensory quality. They are intentionally added to food. Their use must be mentioned on the label. The level of incidental additives present in food is also a cause for concern.

KEY TERMS

Asepsis Free from or keeping away disease causing or spoilage microorganisms.

Blast chillers Use of rapidly moving cold air to chill food evenly and rapidly. This may be fitted with temperature probes.

Blanching Immersing food in boiling hot water for a few minutes to help remove the peel, inactivate enzymes and remove air from tissue spaces as well as destroy microbes.

Canning Method of preservation in which food is sealed in airtight tins and subjected to adequate heat for sufficient time to destroy harmful organisms. Food is preserved by creating a vacuum, sealing in an airtight can and by high temperature.

Commercially sterile Packaged food that has been subjected to sufficient heat to prevent any growth of microorganisms that may cause spoilage under normal storage conditions.

Controlled atmosphere storage Storage of fruits and vegetables in a cold modified atmosphere in which percentage of CO_2 and O_2 are controlled to preserve the food.

Cook-chill A catering system process in which food is cooked and rapidly chilled just above freezing point and reheated prior to service. Very popular system for bulk institutional catering.

Cook-freeze A specialised food production and distribution system where food has a shelf life of three to six months. Similar to cook-chill system, but certain recipes containing ingredients affected by freezer temperatures may need modification.

Cross contamination The process by which a food item gets contaminated by contact with a bacteria carrying non-food items like knives, chopping boards, equipment etc or with raw food.

Danger zone The temperature range of 5°C to 63°C in which microorganisms multiply rapidly in food. At temperatures below 5°C they become dormant and at temperatures above 63°C they start getting killed.

Food additives These include numerous — chemicals permitted by law to be added to food to improve its overall quality.

Freezer burn Dehydration and discolouration of foods that are frozen for long periods without being packaged.

Freeze drying A method of dehydration in which the food is first frozen and the ice is vaporised. Freeze dried foods need no preservation or refrigeration and regain their original size and flavour when rehydrated.

Gray (Gy) A gray is equal to 100 rad. A kilogray is equal to 1,000 gray.

Incubation time The time lapse between the consumption of contaminated food and the appearance of the first symptoms of disease.

Intoxication A foodborne disease that occurs due to the consumption of food containing poisonous plants or animals or microbial toxins.

Irradiation Exposing food to ionizing radiation that kills pathogenic bacteria and spoilage bacteria, hence preserves it.

Kilogray (kGy) A unit for measuring radiation. A kilogray (kGy) is equal to 100 kilorads (krad).

MAP (modified atmosphere packaging) Method used for extending the shelf life of fresh food by replacing the surrounding air or space within the package with a specific mixture of gases/ gas that inhibits the growth of bacteria and molds.

Microwaves They are short radio waves that can be used to cook food. Its wavelength ranges from 1 mm to 30 cm.

Pasteurisation A process to destroy the pathogens in milk and liquid foods and extend its shelf life. Two methods—low temperature holding (LTH) method at 62°C for 30 minutes and high temperature short time (HTST) method at 72°C for 15 seconds. This heat treatment kills pathogenic microorganisms and some spoilage organisms at temperatures below 100°C for specified time and food is cooled promptly after heating.

Pathogens Disease causing microorganisms, they cause many foodborne diseases.

Poisoning A type of foodborne disease caused by ingesting harmful chemical, poisonous plant or animal products or food contaminated with microbial toxins.

Potentially hazardous foods A food that is natural or synthetic and is capable of supporting rapid growth of harmful microorganisms. They include raw or heat treated animal foods, foods of plant origin that are cooked or raw such as cooked rice, cooked pulses, sprouts and all protein rich moist foods like meat , fish, poultry, *paneer*, etc.

Smoking Preserving meat or fish to which salt is applied by subjecting it to wood smoke to inhibit growth of microorganisms, retard fat oxidation and develop characteristic flavour.

Thermal death time (TDT) It is the time needed at a given temperature to kill a number of microbes.

UHTS Ultra high temperature sterilization of food stored in tetrapacks packed under aseptic conditions and heated to 135°C for 2 seconds.

Vulnerable age groups Highly susceptible population who may be immunocompromised, elderly, infirm, infants or pre-school children and are more likely to experience foodborne diseases.

REVIEW QUESTIONS

1. Why is it necessary to preserve food?
2. Describe the principles underlying food preservation.
3. Explain the steps in the cook-freeze system.
4. What are the benefits of preserving food by irradiation?
5. Discuss the role of salt and sugar in preserving food.
6. Which class II preservative would you recommend for the following items:
   (a) Tomato Ketchup
   (b) Lemon Squash
   (c) Pork products
   (d) Bread
   (e) Margarine
7. List the additives to be used for the following.
   (a) To prevent off-flavour and odour in oil.
   (b) To improve the appearance and taste of a birthday cake.
   (c) To prevent lump formation in baking powder.
8. State whether True of False. If false correct the statement.
   (i) Food additives may be intentional or incidental.
   (ii) Non-nutritive sweeteners do not provide any nutrients except calories.
   (iii) There is no restriction by law on the use of Class I preservatives.
   (iv) If food additives are used in food in the permitted quantity, there is no need to mention the same on the label.
   (v) Bread is often fortified with the amino acid lysine.
9. Match the following additives in column I with a suitable answer from column II

I	*II*
1. Xylitol	(a) Natural colour
2. Butylated hydroxy toluene	(b) Class I preservative
3. Cochineal	(c) Sweetener in chewing gum
4. GMS	(d) Class II preservative
5. Acetic acid	(e) Prevents oxidation of fat
	(f) Synthetic colour
	(g) Commercial emulsifying agent

10. The chemical preservative ________ is added to tomato sauce to extend its shelf life.

4

- Diseases and their classification
- Mode of transmission of disease
- Food-borne illness: food poisonings, food infections
- Bacterial food poisonings or intoxications
- Bacterial food infections
- Listeriosis
- Viral infections
- Parasitic infestations
- Food allergies
- Control of food-borne illnesses

Food-Borne Diseases

INTRODUCTION

A food-borne illness is a general term applied to all types of illnesses caused by an organism, substance or material of any kind which is present in food and gains entrance into the body when such food is consumed.

The cause of contamination is generally faulty handling, poor sanitary practices, insects, rodents or microorganisms. The natural decay that occurs in animal or plant tissues is accompanied by foul odours, and changes in appearance and taste. As the spoilage is visible, people reject the food. The main cause for concern is food which is spoilt but where spoilage is not visibly noticeable. Such food is likely to be consumed and may result in disease.

Food may transmit disease by any of the following ways:

1. The food itself may be wholesome but may act as a vehicle of disease transmission. Pathogenic organisms can be transmitted from one person to another through many routes like soiled linen, unclean cups, handkerchiefs, door handles, etc. Food handled with soiled

hands or on which an ill person or a carrier has coughed or sneezed, can also cause illness. Diseases like tuberculosis, tonsillitis, typhoid and influenza can be easily transmitted this way.

2. The food may serve as an ideal medium for rapid growth and multiplication of a large number of microorganisms like Staphylococci and Salmonella. This may result in food poisoning or food infection. These microorganisms can cause violent illness of the stomach and intestinal tract. Some of these bacteria release toxins into the food. The bacteria may die but the toxins formed cause food poisoning.

   Other bacteria do not act until they are consumed along with food. They then cause an infection of the gastro-intestinal tract.

3. Food poisoning may be caused by agents other than microorganisms. These include toxic chemicals, poisonous plants like poisonous mushrooms, insecticides and pesticides. Toxic metals such as cadmium, zinc, lead, etc., or excessive use of mono-sodium-glutamate in Chinese food may lead to severe reactions. Some individuals may show abnormal sensitivity to certain foods and develop allergies. Common food allergens are egg white, shellfish and strawberries.

   Food-borne hazards may thus result from microbial action, toxic metals and pesticides, animal parasites, natural poisons in foods or allergic reactions of a person due to sensitivity to a particular food.

Of all the food-borne hazards listed above, diseases caused by microbial action in food is most widespread. Microorganisms cause food poisoning and food infection and animal parasites cause infestation. All these can be controlled by hygienic handling of food and good personal hygiene. The food service manager has a crucial role to play in reducing the risk of food spoilage and the spread of food-borne disease. In *Chapter 2* we have read about food spoilage and its prevention. This chapter deals with the pathogens in the kitchen and environment that need to be controlled and eradicated. Carelessness on part of the food handler can result in anything ranging from severe discomfort to chances of dying from the illness. It can cost the outlet lakhs of rupees in terms of closure for disinfection of premises, wastage of food, disposal of equipment and damage to the reputation through closure, court cases and negative publicity. Before we study about the various food-borne diseases and their mode of transmission, it is necessary to understand some basic concepts about disease.

DISEASES AND THEIR CLASSIFICATION

A disease is a negative state of health. It is defined as a deviation from normal health which adversely influences the daily routine of a person. The term 'disease' is associated with absenteeism from work, reduced work efficiency and loss of production. All this has a marked influence on any service-oriented industry like the catering industry.

Diseases are broadly classified into two categories: communicable diseases and non- communicable diseases. Communicable diseases include infectious or contagious diseases and parasite infestations. Non-communicable diseases include deficiency diseases, organic diseases and allergic diseases.

Communicable Diseases

Infectious Diseases These are caused by microorganisms and are transmitted by direct or indirect contact. Infectious diseases include illnesses like typhoid, hepatitis and influenza. Some infectious

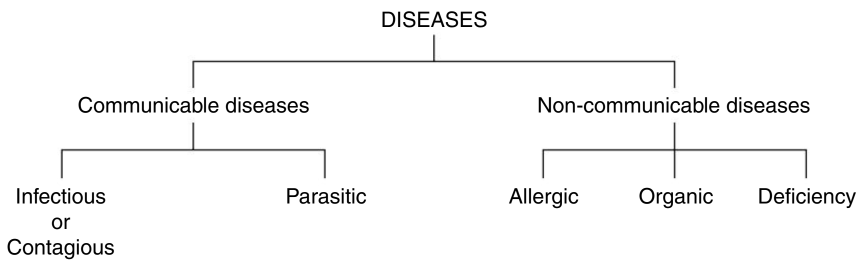


Fig. 4.1 *Classification of diseases*

diseases are highly contagious and are transferred by direct contact with the patient. People suffering from contagious diseases like chicken pox need to be isolated.

Parasitic Diseases These are diseases which are caused by the presence of animal parasites like tapeworms, roundworms and pinworms, which grow in the human gut. They come from improperly washed vegetables which are contaminated with untreated sewage used as manure and which are consumed raw.

Non-communicable Diseases

Deficiency Diseases These occur because of a shortage of certain nutrients or foods in our daily diet. Night blindness results from a deficiency of Vitamin A and anaemia from iron deficiency. Protein calorie malnutrition results from a shortage of food.

Organic Diseases These diseases are caused by malfunctioning of certain organs in our body for example, pancreatic malfunction causes diabetes.

Allergic Diseases These disorders occur because of the abnormal sensitivity of the body to certain foods which are normally consumed in the diet. These reactions are restricted to some people only and may be caused by egg white, shellfish, strawberries and many other foods.

MODE OF TRANSMISSION OF DISEASE

Diseases may be transmitted by more than one route. The common routes of transmission are:

1. *Contact transmission:* by direct or indirect contact with the source of disease
2. *Vehicle transmission:* where milk, water and other foods act as vehicles for transmitting disease
3. *Vector transmission:* by insects and other invertebrate hosts that transmit infection by inoculation into the skin, by biting or by depositing infective material on skin, food and other objects by their feet and bodies or by regurgitating on food
4. *Air-borne transmission:* by droplet infection, droplet nuclei and infected dust. Droplet infection can occur when a person sneezes or coughs and expels particles of moisture containing a large number of organisms, up to a radius of 1 metre or more. When the moisture from smaller droplets evaporates, a minute particle of virus or bacteria which are called droplet nuclei, remain suspended in the air.

   Infected dust: larger droplets of moisture settle down on the floor and become a part of dust. During dusting or sweeping these dust particles become air-borne and get inhaled or settle on uncovered food and drink.

Disease is transmitted through food either directly or indirectly. In direct transmission of disease, the following pathway is involved (Fig. 4.2).

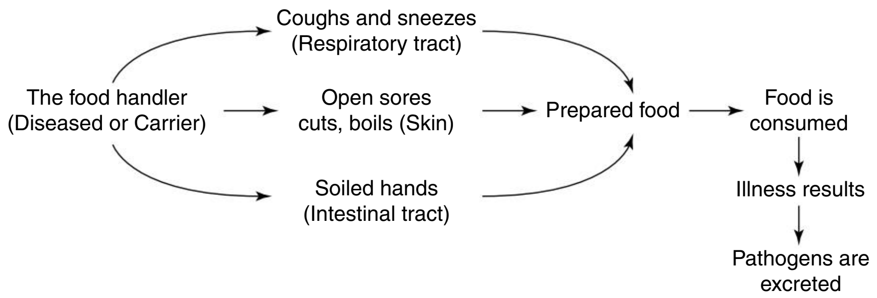


Fig. 4.2 *Direct transmission of disease*

Direct Transmission

The food handler transmits pathogens to food. Because of coughing or sneezing on or near the food, droplets containing microorganisms may fall on the food.

Diseases of the intestinal tract are transferred by unwashed or improperly washed hands. If food is handled by hands soiled with faecal matter, disease-causing agents are transferred to the prepared food. Consumption of such food causes illness. When food is openly displayed, it can get contaminated by the customer handling the food.

Indirect Transmission

The host of a communicable disease may transmit pathogens indirectly through various routes onto prepared food and from there to other people consuming the offending food (Fig. 4.3). The other indirect routes of transmission of disease causing agents or pathogens are through:

1. contaminated utensils and equipment
2. sewage polluted water and food grown on polluted soil or through faulty plumbing
3. soiled linen, door handles and taps
4. insects like flies and cockroaches
5. rodents like rats and mice
6. infected animals and their products

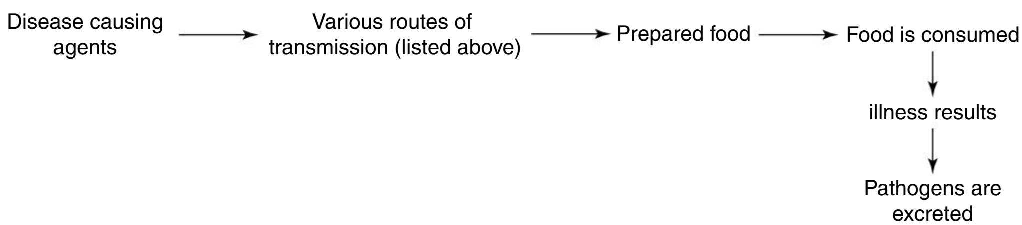


Fig. 4.3 *Indirect transmission of disease*

Food may be contaminated through unclean utensils and equipment. The pathogenic organisms eliminated from the human body are found in sewage. Sewage is mainly faecal matter. If untreated sewage is allowed to drain into any drinking water, the water as well as fish breeding in such waters get contaminated. Salad vegetables, roots and tubers are at a greater risk of contamination as they are consumed raw and because they are in direct contact with the soil. Rats, mice, flies and cockroaches can also transmit disease. They live in sewers and garbage dumps. Unpasteurised milk and meat from diseased animals can transfer pathogens of animal origin.

The spread of communicable diseases can be controlled and these diseases are discussed in detail later on in this chapter.

Cross-contamination

Harmful microorganisms present in one food can contaminate another food. This process is known as cross-contamination and is defined as the transfer of microorganisms from something dirty to something clean, or from a food with many bacteria to a food with less bacteria, by means of a non-food vehicle such as

1. chopping boards, knives, utensils and equipment
2. work surfaces, dish cloth, etc.
3. hands of the food handler
4. drops of liquid oozing from contaminated food
5. infected droplets from coughs and sneezes

Cross-contamination can occur whenever clean and dirty operations are mixed or if the same equipment is used for handling raw and cooked meat without cleaning and sanitising it between use. Raw meats and its juices contain many bacteria which are transferred to cooked meat by using the same equipment. Cross-contamination of cooked meat can be prevented by:

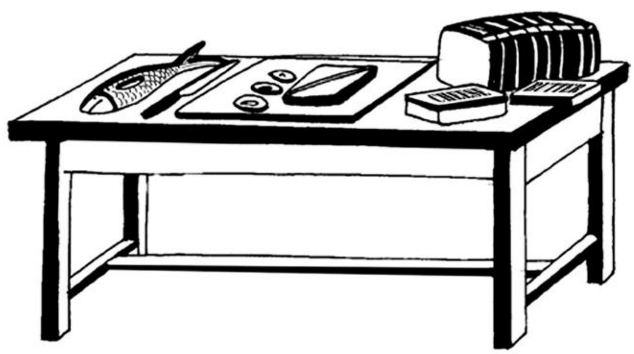


Fig. 4.4 *Cross-contamination can cause food poisoning*

1. storing raw and cooked meat separately and not next to or on top of each other, to prevent drops of liquid oozing
2. colour coding equipment such as chopping boards and knives for handling only one type of food, for example using the colour pink for raw meat and poultry and brown for cooked meat and poultry
3. preparing cooked and raw meats on separate tables

Other examples of cross-contamination are:

1. When a dishwasher places clean and sanitised plates on a table reserved for dirty plates, the plates get contaminated.
2. When a busboy brings used plates to the dishwashing machine and picks up clean plates without washing his hands, the clean plates get contaminated.

3. When the chef places a dirty cardboard box on a food preparation table, the table gets contaminated and any food kept on that table will also get contaminated.

Even when a potentially hazardous food gets contaminated, it does not become harmful immediately. The bacteria transferred to the food need time and a warm temperature to multiply before the food can cause a food borne illness when consumed.

FOOD-BORNE ILLNESS

Microorganisms which cause food-borne illnesses are bacteria, viruses, protozoans and nematodes. Among all these microorganisms, bacterial contamination is the most common cause of food poisoning in the catering industry. It usually results from mishandling of food. These illnesses are characterised by a severe disturbance of the stomach and intestines which occurs after consuming food in which the offending bacteria were given a chance to multiply. Such illnesses are broadly divided into two categories: food poisonings and food infections.

Food Poisoning

Food poisoning or food intoxication is an illness caused by toxins present in contaminated food. The toxin may be a poisonous chemical toxin which is accidentally or intentionally added, a naturally occurring poison like solanine in green potatoes or a toxic metabolite excreted by bacteria.

In bacterial food poisoning, the toxin is produced during multiplication of cells. When food is consumed, the toxin already present irritates the lining of the stomach and causes vomiting. If the toxin reaches the intestine, it may cause abdominal pain and diarrhoea. The incubation period for such food poisonings is comparatively shorter (one to six hours) than that for bacterial food infections. The offensive food may not contain any living bacteria, which may have been destroyed during heating.

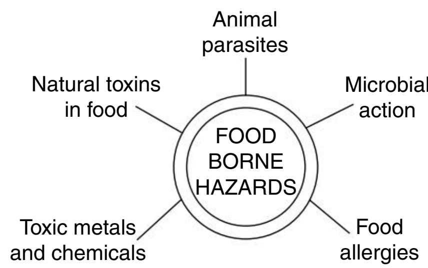


Fig. 4.5 *Food-borne hazards result in food-borne illnesses*

SOME IMPORTANT FACTS

- *Food poisoning causes more than 23 million lost working days in a year*
- *The number of reported cases has doubled in the last ten years*
- *In spite of more public awareness about hygiene, food poisoning is on the increase*
- *The standards of food hygiene in most establishments is very poor*

Toxins need much higher temperatures to be destroyed than the bacteria which produce them. They may thus be present in inadequately heated foods, even if the bacteria have been destroyed. However, some food poisonings occur only when large numbers of live bacteria are ingested. When these bacteria reach the intestinal tract they produce the toxin, for example, *Clostridium perfringens.*

Food Infections

Food infection is an illness caused by microorganisms. It results from the consumption of food that contains living bacteria which are multiplying and capable of producing disease. The illness which results is the reaction of the body to the presence of microorganisms or to their metabolites. The gastric juices secreted in the stomach is acidic and destroys some bacteria. In the small intestine the pH is neutral and bacteria multiply rapidly. This irritates the lining of the intestines, resulting in nausea, diarrhoea and abdominal pains. The incubation period for an infection to occur is 12 hours or more (Refer Table 4.1).

For bacterial food poisoning or infection to occur, approximately one million or more bacteria must be present in food. It is likely that food could be contaminated with several hundred causative bacteria. If conditions for growth are favourable, these bacteria could multiply to over one million in a short span of three to four hours (Refer Fig. 4.6).

The time lapse between the consumption of food and the appearance of symptoms is called the incubation time. The incubation time and the severity of the attack of bacterial poisoning or infection will depend on several factors such as:

1. The type of organism causing the illness: Some types cause a more severe illness than others.
2. The susceptibility of the individual: This depends on the age of the person as well as his or her state of health. The very young, the old and infirm and people who are convalescing are more susceptible. They may suffer even after ingesting fewer bacteria.
3. The number of bacteria or the amount of toxin consumed: The greater the number of bacteria and the greater the amount of toxin swallowed, the quicker and more severe is the attack.

Table 4.1 **Difference between Food Poisoning and Food Infection**

Food poisoning	*Food infection*
Caused by toxin	Caused by living microorganisms
Incubation period: two hours	Incubation period: 12–24 hours
Symptoms: nausea and vomiting diarrhoea, usually no fever	Symptoms: diarrhoea, abdominal pain, vomiting, fever
Duration: one day, sometimes longer	Duration: one to seven days, sometimes longer

BACTERIAL FOOD POISONINGS OR INTOXICATIONS

Staphylococcus Food Intoxication

Staph food poisoning is one of the most common types of food poisoning caused by the toxin produced by *Staphylococcus aureus.* This bacteria is widespread and is frequently found in the throat and nose of 30 per cent of all healthy people and in the nasal discharges of persons recovering from a cold. On the skin,

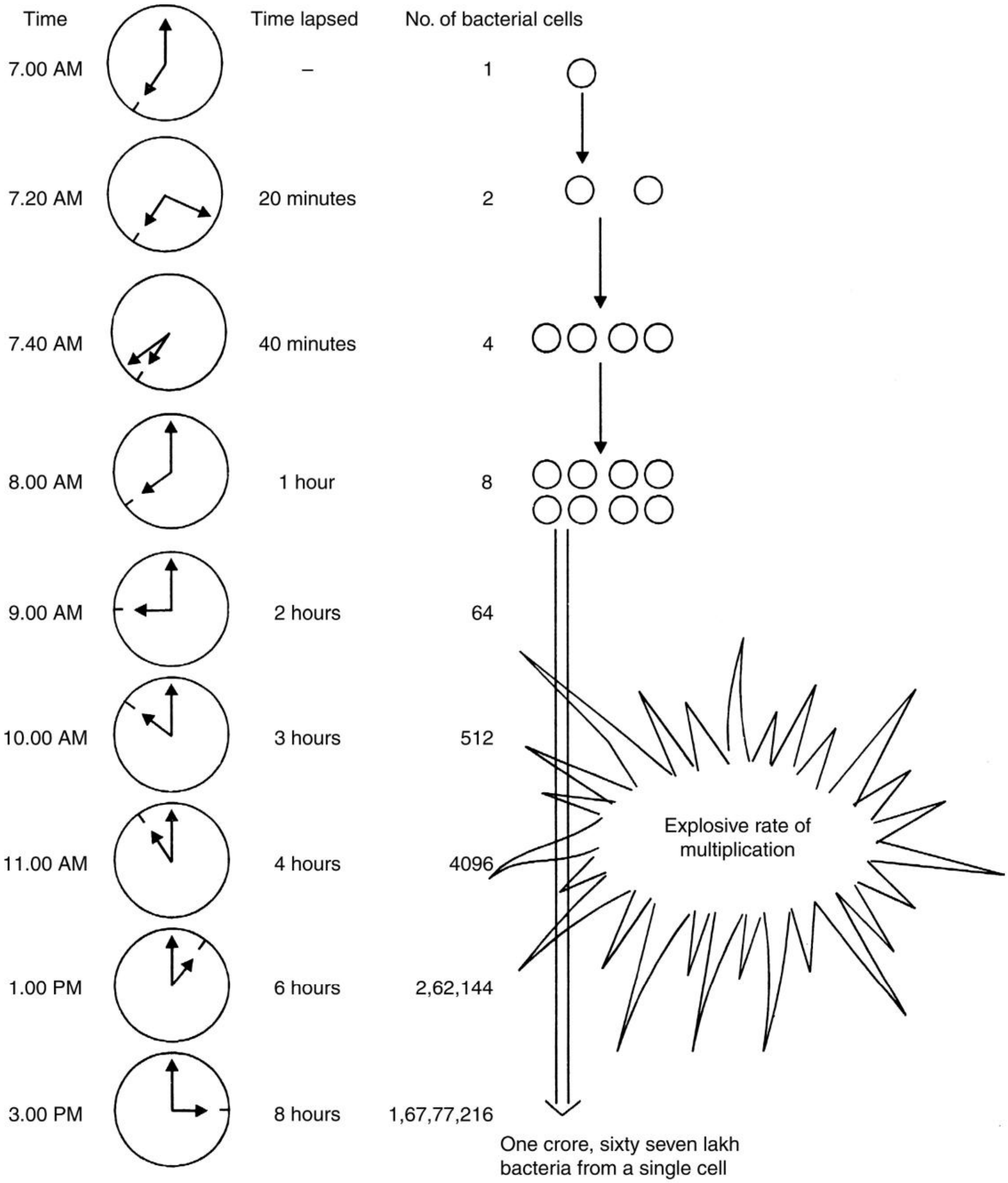


Fig. 4.6 *The number of bacteria doubles every twenty minutes under favourable conditions*

it is present in pimples, boils and infected wounds. Droplets from the nose or throat sneezed or coughed into the air could contaminate air, clothing, handkerchiefs and skin. Hands could be contaminated by soiled handkerchiefs or tissues or by touching the nose or any eruptions on the skin, and could get heavily contaminated with these microorganisms. If hands are not washed and scrubbed well, contamination is transferred to food, utensils or equipment during food preparation. Hence, the need for food service personnel to follow proper sanitary procedures in food preparation and practise correct hand habits.

Staphylococci are facultative aerobes and are able to survive without oxygen. They do not form spores. The toxin they produce is heat resistant, therefore, although the bacteria are easily destroyed by heating for ten minutes at 66°C the toxin may survive heating at 100°C for 30 minutes.

Like in other bacteria, acid type foods are not suitable for the growth of staphylococci. However, they are not affected by high levels of sugar or salt and may be found in cured meats.

Organism: strains of *Staphylococcus aureus*
Type of toxin: enterotoxin
Incubation period: two to six hours
Duration of illness: six to 24 hours
Symptoms: salivation, nausea, vomiting, abdominal cramps, diarrhoea, sub-normal body temperatures; mortality is extremely low, in severe cases blood and mucous may be found in the stools.
Foods commonly involved:

1. protein-rich foods that have undergone much handling like meat, fish, milk and poultry
2. cooked foods intended to be eaten cold for example, custards, trifles, cream puddings, sandwiches with egg, ham or meat filling, ham salad, cold cuts
3. foods exposed to lukewarm temperatures for a few hours
4. foods insufficiently refrigerated due to large bulk or high refrigeration temperatures
5. left-over foods along with gravy which are not stored at adequately low temperatures

Mode of transmission: sources from where microorganisms enter food are mostly human or animal and include droplet infection from nasal passages, for example, sneezing, and direct contact with boils and infected wounds.

Prevention

1. Use raw ingredients free from *Staphylococcus aureus,* for example, pasteurised milk, and keep employees with any Staphylococcal infection like boils etc. away from food.
2. Prevent cross-contamination from raw meat to cooked meat and from contaminated equipment, utensils or hands to high risk foods.
3. Kill the organisms by heat treatment, for example, pasteurisation.
4. Since the toxin is resistant to heat and hence is destroyed only when boiled gradually for at least 30 minutes, we cannot rely on cooking to prevent the illness.
5. The growth of Staphylococci can be controlled by rapid cooking, chilling and prompt refrigeration.
6. Practice personal hygiene.

Botulism

This is an uncommon type of food poisoning. It is produced by an anaerobic spore-forming bacteria which is found in the soil. The organism produces a toxin which is extremely poisonous and affects the nervous system resulting in the death of approximately two-thirds of the affected victims.

As these bacteria are present in the soil, they contaminate vegetables. When they are present in marine soil and beds of fresh water lakes, fish also get contaminated. Since the organism is a strict anaerobe, it is unable to grow unless oxygen is excluded. Therefore, it is usually able to grow in canned, bottled and vacuum packed foods. The spores of this organism are extremely heat

Fig. 4.7 *Newspaper clippings on food poisoning*

resistant. Some spores can survive boiling for six hours. However, the organism cannot grow if the pH is below 4.5, so canned acidic foods are safe. In addition, the toxin is easily destroyed by heat. Heating food to 80°C for 15 minutes is sufficient to destroy the toxin.

Organism: Clostridium botulinum
Toxin: neurotoxin
Incubation period: 18 to 38 hours
Duration of illness: death in 24 hours to eight days, or slow convalescence over six to eight months
Symptoms: nausea, vomiting, diarrhoea, fatigue, dizziness, double vision, difficulty in swallowing and in speaking, dryness of the mouth and constriction of the throat, paralysis of involuntary muscles which spreads to the respiratory system and the heart. Death results due to respiratory failure.
Therapy: anti-toxin should be given immediately.

Foods commonly involved:

1. Inadequately processed home-canned foods, including low and medium acid foods, acid foods like canned tomatoes, peaches and pears in which other microorganisms are present. These microbes aid the growth and toxin production of *C. botulinum* by raising the pH.
2. Smoked products that have been under-processed.
3. Damaged, leaky and rusty cans or cans with broken seals. The contents may or may not have a spoiled appearance.

Mode of transmission: The spores are transferred from the soil into food which is then consumed.

Prevention:

1. Use approved heat processes for canned food.
2. Reject gassy or spoiled canned food and refuse to taste doubtful food.
3. Avoid leftover cooked foods that are not well reheated, or raw and precooked foods that have been frozen, thawed and held at room temperature.
4. Smoked fish should be heated to at least 85°C for 30 minutes and should be frozen immediately after packaging.
5. Heat food to 100°C for a few minutes to destroy toxin which is thermolabile.

Bacillus cereus Food Poisoning

Bacillus cereus is a spore-forming aerobic rod-shaped bacteria which causes a toxic type of food-borne illness. It is found in soil, dust, water and on cereal grains. It is a common type of food poisoning. The food usually affected is rice, especially boiled rice which is prepared and used on the following day. The spores survive boiling. They germinate, multiply and release a toxin in rice if it is not refrigerated. If the rice is not reheated thoroughly the toxin is not destroyed and the rice will cause food poisoning.

Outbreaks sometimes follow celebrations where rice was not washed properly in clean water or was boiled in advance and cooled slowly.

Organism: Bacillus cereus

Toxin: an enterotoxin produced in food

Incubation period: one to 16 hours

Duration of illness: twelve to 24 hours

Symptoms: the onset of the symptoms is sudden and they include abdominal pain, acute vomiting and diarrhoea; usually there is no fever

Foods commonly involved: cereals like reheated boiled rice, cornflour thickened sauce, Chinese fried rice, spices

Mode of transmission: contaminated cereals, grains especially rice, from the environment, as spores are present in soil.

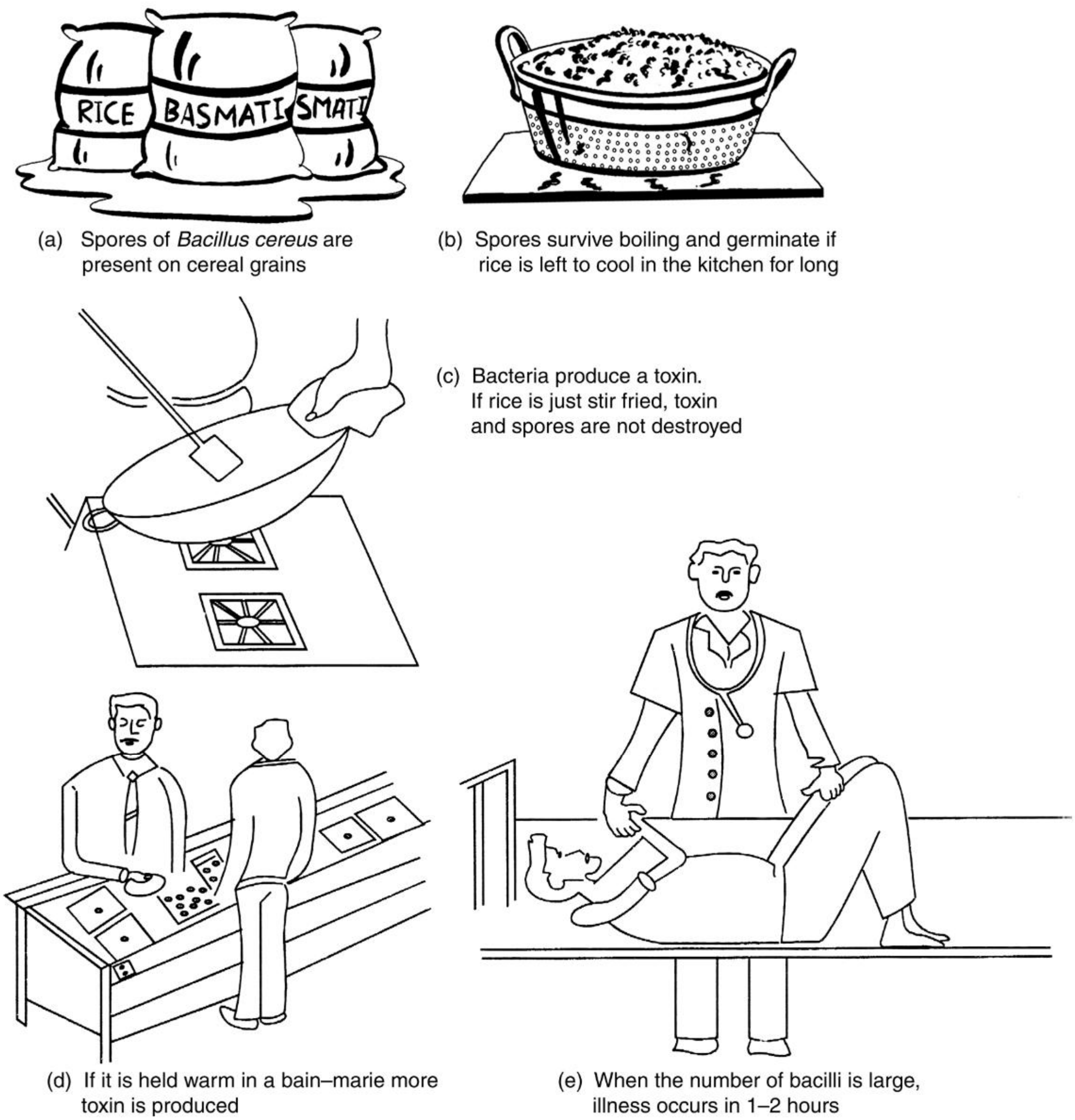
Prevention:

1. Cool cooked food rapidly and refrigerate promptly.
2. Reheat food thoroughly and serve immediately.
3. Keep the interval between cooking and eating as short as possible.

Perfringens Food Poisoning

Clostridium perfringens is a spore-forming anaerobe found in the human and animal intestinal tract, soil, dust, contaminated raw meat, poultry and some dried foods.

The illness is caused by large numbers of rod-shaped microrganisms growing in food. The spores can survive normal cooking temperatures and multiply rapidly in cooked meat which is cooled slowly or stored in a warm place. The toxin is released in the intestine after the living microorganisms have been ingested.



(a) Spores of *Bacillus cereus* are present on cereal grains

(b) Spores survive boiling and germinate if rice is left to cool in the kitchen for long

(c) Bacteria produce a toxin. If rice is just stir fried, toxin and spores are not destroyed

(d) If it is held warm in a bain–marie more toxin is produced

(e) When the number of bacilli is large, illness occurs in 1–2 hours

Fig. 4.8 *Spread of Bacillus cereus food poisoning*

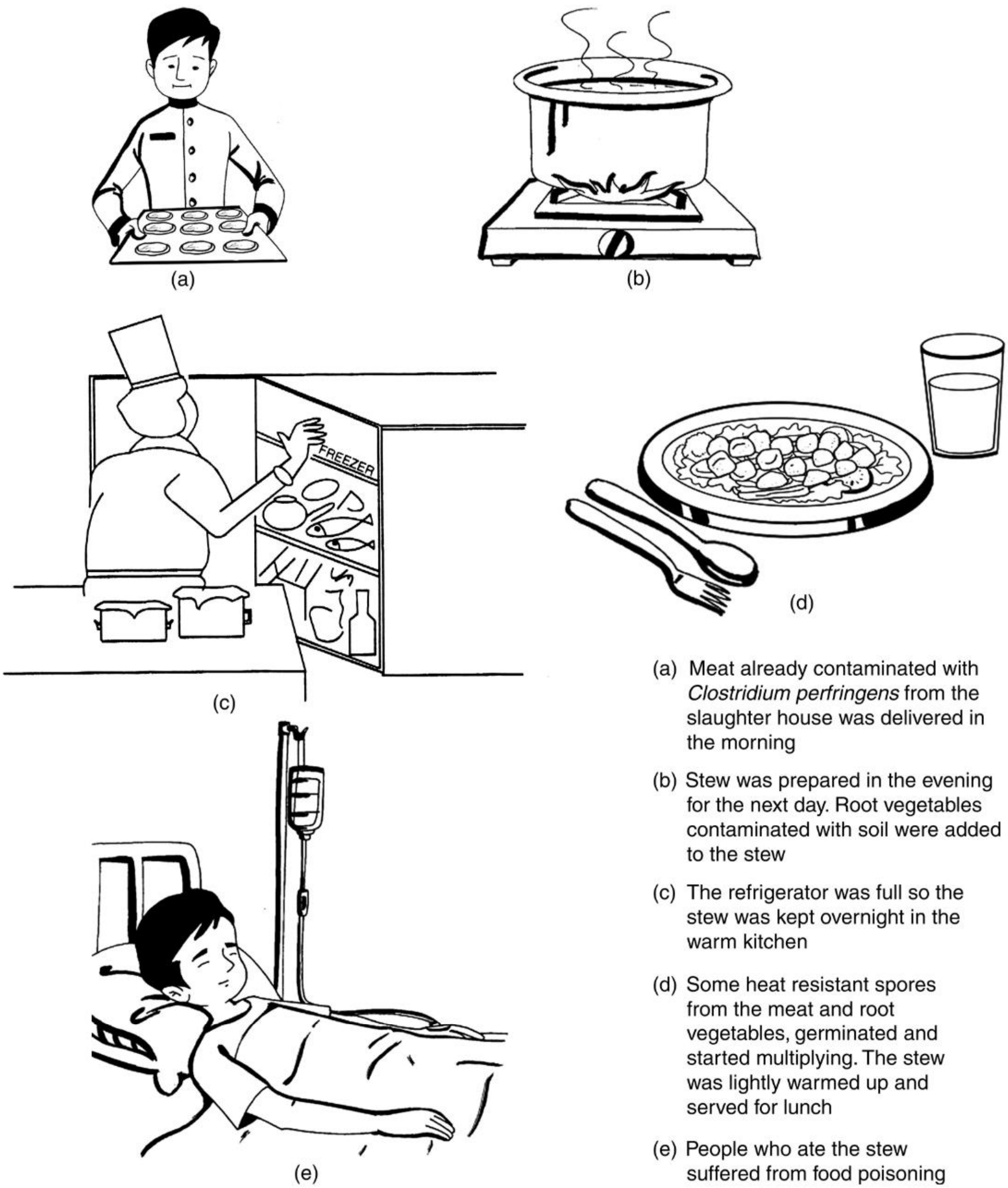


Fig. 4.9 *Transmission of Clostridium perfringens food poisoning*

Organism: Clostridium perfringens (welchii)
Toxin: enterotoxin produced in intestine
Incubation period: eight to 24 hours
Duration of illness: one to two days

Mode of transmission: from human faeces via hands to the food by direct contact, vector transmission by flies sitting on excreta, cross contamination from raw to cooked meat, dusty kitchens and dirty cardboard boxes placed on work tables. In raw meat from intestines and excreta

Symptom: abdominal pain, diarrhoea and nausea, vomiting rarely occurs, mild vertigo; mortality rate may be as high as two per cent

Foods commonly involved:

1. meat dishes, rolled joints which provide anaerobic conditions necessary for growth
2. rechauffe dishes or reheated dishes kept at warm temperatures for considerable periods of time
3. stewed and roasted meat and poultry
4. sauces, gravies, pies, salads and casseroles

Prevention:

1. Thorough cooking of food, especially meat preparations.
2. Cool food rapidly to prevent multiplication of bacteria and reheat thoroughly just before serving.
3. Handle raw and cooked food separately to prevent cross-contamination.
4. Kitchen and personal hygiene.
5. Wash all fruits and vegetables thoroughly.

BACTERIAL FOOD INFECTIONS

Salmonellosis

This is the commonest cause of bacterial food-borne disease and the most serious. Organisms of the salmonella group cause an infection in the intestine. Many species are infectious. These rod-shaped bacteria are aerobic and non-spore producing. They are present in the intestine of humans and animals and are excreted in the faeces. Illness occurs when living organisms are ingested in large numbers. If a small number of organisms are allowed to multiply in food then infection can result.

Organism: viable cells of *Salmonella choleraesuis* or *Salmonella enteritidis, Serotype typhimurium*
Incubation period: twelve to 24 hours
Duration of illness: one to seven days

Mode of transmission:

1. contact transmission: direct contact by food handler ill with salmonellosis or a carrier of the disease
2. cross-contamination: if the food handler does not wash hands after handling raw meat and poultry, after a visit to the toilet or does not adequately clean and sanitise the chopping board and other equipments
3. vector transmission by rodents and flies from faecal matter
4. use of cracked eggs or seafood from polluted waters

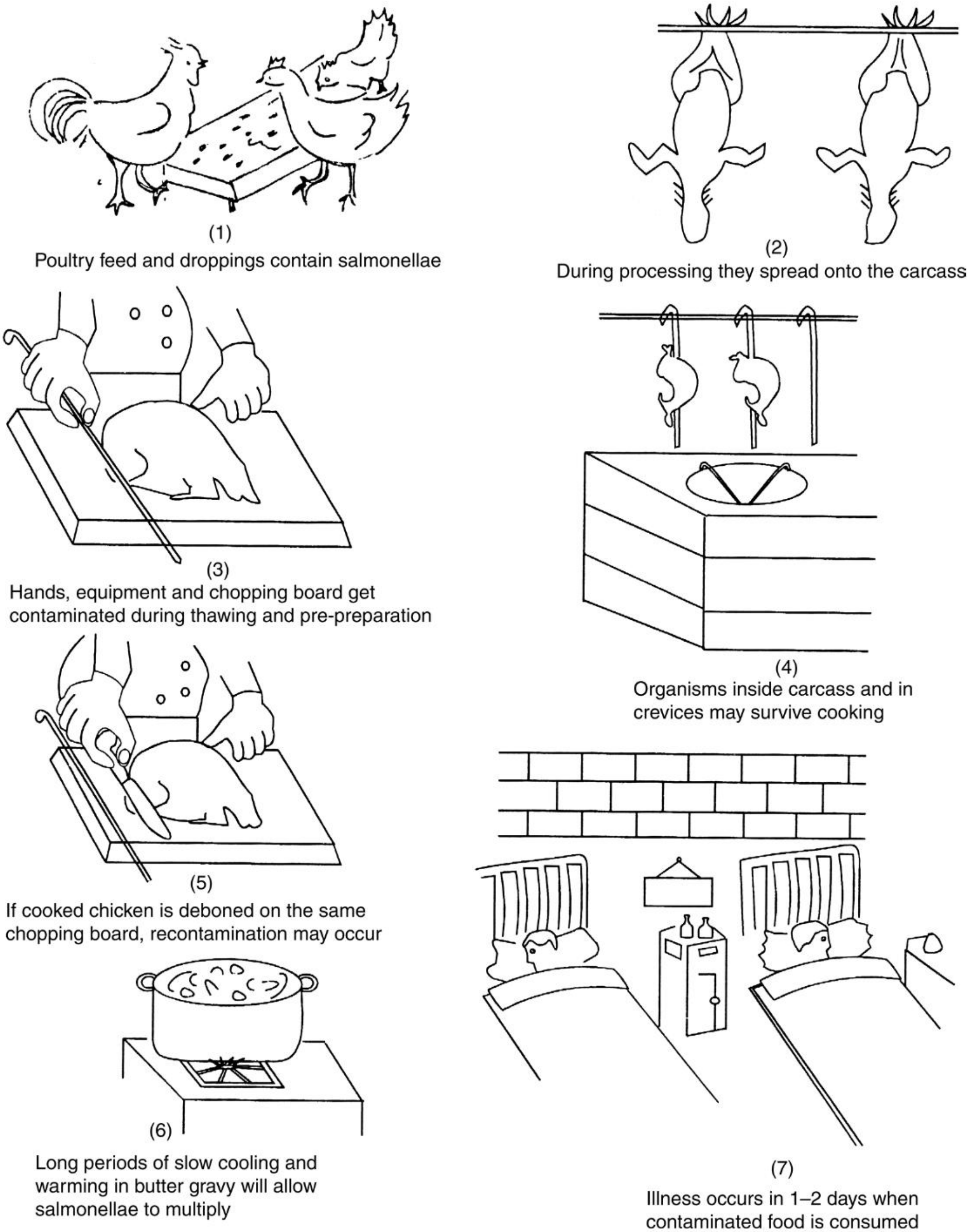


Fig. 4.10 *Spread of Salmonella infection at every stage*

Symptoms: diarrhoea, abdominal pain, chills, fever, vomiting, dehydration, enteritis or local infection may also occur; watery, greenish, foul-smelling stools

Foods commonly involved:

1. animal products like meat, poultry, dirty shelled eggs and products made from them: meat and poultry that may have got contaminated at the slaughter house by diseased animals
2. ducks' eggs
3. high risk foods exposed to warm temperatures for long hours, for example, milk, fish, mutton biriyani
4. seafood from polluted waters
5. canned foods that are opened, have got contaminated and are held without refrigeration once opened

Conditions necessary for an outbreak:

1. the food must contain or get contaminated with the organism
2. these bacteria should be present in considerable numbers
3. live organisms should be ingested

Prevention:

1. Purchase meat, poultry, eggs and fish that have been thoroughly inspected for wholesomeness.
2. Wash hands often, especially after using the toilet and after handling raw meat, poultry and any soiled objects.
3. The food handler's nails should be trimmed and clean.
4. Keep equipment clean and hygienic.
5. Rodents and insects in the vicinity of food preparation areas should be controlled.
6. Growth of the organism may be prevented by adequate refrigeration as Salmonella are very sensitive to temperature and do not multiply in low temperatures.
7. These bacteria can be destroyed by thorough cooking to at least 66°C for at least twelve minutes.
8. Leftover food should be reheated quickly and thoroughly.

Typhoid and Paratyphoid (Enteric Fever)

Typhoid Typhoid fever is caused by *Salmonella typhi,* whereas paratyphoid fever is caused by *Salmonella enteritidis.* Both organisms are excreted in the faeces and urine of patients suffering from the disease or are excreted by healthy carriers. Outbreaks of both diseases are caused by water contaminated by sewage and food contaminated by food handlers directly or indirectly.

Typhoid is a common infection seen in India, especially in areas where hygiene standards are poor.

Organism: Salmonella typhi
Incubation period: fourteen days
Duration of illness: one to eight weeks

Mode of transmission:

1. vehicle transmission through contaminated milk and water
2. direct contact through hands that are contaminated
3. vector transmission by flies and other insects

Symptoms: malaise, headache, high and continued fever, cough, anorexia, vomiting, diarrhoea, bleeding from the bowels

Foods commonly involved: raw milk, vegetables grown on sewage farms, especially if eaten raw, and contaminated water

Prevention:

1. Ill persons or suspected carriers should not be allowed in food preparation and service areas.
2. Use boiled cooled water.
3. There should be proper sewage disposal and non-leaky sewer pipes.
4. Use pasteurised milk and other dairy products.
5. Control the growth of rodents and insects.
6. Protect by immunisation with vaccines.

Paratyphoid *Organism: Salmonella enteritidis,* serotype Paratyphi A, B and C.
Incubation period: one to 15 days
Duration of illness: one to three weeks

Mode of transmission:

1. vehicle transmission through contaminated foods like frozen foods, ice and ice creams
2. direct contact by infected carriers and persons who have not washed hands adequately; the source is the faeces and urine of infected persons
3. vector transmission through houseflies

Foods commonly involved: contaminated foods, especially confectionery; frozen foods and ice creams

Prevention: same as for typhoid

Bacillary Dysentery or Shigellosis

It is caused by a rod-shaped bacteria that causes an infection in the intestine of humans. The main cause for spread of this infection is poor personal hygiene and faulty sewage disposal.

Organism: Shigella sonnei, S. dysenteriae
Incubation period: one to seven days

Mode of transmission:

1. direct contact with hands and clothing soiled with excreta of a person who is ill with the disease or is a carrier
2. vehicle transmission through contaminated food and water
3. vector transmission through houseflies

Symptoms: abdominal cramps, fever, chills, diarrhoea, watery stools (frequently containing blood and or mucous), nausea, dehydration

Foods commonly involved:

1. moist, mixed foods like fish or macaroni salad, mutton cutlets,
2. mutton pie, blancmanges and puddings
3. milk, beans and potatoes

Prevention:

1. Practice methods of personal hygiene. Ill persons or carriers should not be allowed in food preparation and service areas.
2. Cook foods thoroughly. Chill foods promptly in small portions.
3. Protect and treat water.
4. Control flies and other pests.
5. Dispose of sewage in a sanitary manner.

Cholera

Cholera is caused by the comma-shaped bacteria *Vibrio cholerae* which is present in water contaminated by faeces of people suffering from cholera. When bacteria enter the body, they multiply rapidly in the small intestine and violent diarrhoea sets in. This infection occurs mainly in Asia and Southern Europe.

Organism: Vibrio cholerae
Incubation period: one to six days

Mode of transmission:

1. direct contact with hands and clothing soiled with the excreta of a diseased person
2. ingestion of polluted and contaminated water, food and aerated water
3. contaminated equipment
4. vector transmission by houseflies

Symptoms: sudden onset of severe watery diarrhoea, vomiting, cramps in the legs, thirst and rapid dehydration; the stools are compared to rice water; there may be griping pain in the abdomen; epidemics take a serious turn and mortality rate varies from five to 75 per cent or more.

Foods commonly involved:

1. fish and shellfish from polluted waters
2. aerated drinks prepared from polluted waters
3. contaminated, stale food

Prevention:

1. Protect food and drink from flies and dust.
2. Use suitable disinfectants and wash hands properly.
3. Dispose of wastes and excreta properly.
4. Water should be chlorinated and boiled before consumption.
5. Do not consume suspect food which may be raw, stale or overripe fruit which may be exposed to the source of infection.
6. Cook food thoroughly as vibrios are killed by boiling for a few seconds.

Vibrio Parahaemolyticus

This is a common cause of food poisoning in Japan. These non-cholera vibrios are found in seafood such as fish and shellfish and in coastal waters. The infection occurs when seafood is not cooked thoroughly.

Organism: Vibrio parahaemolyticus
Incubation period: Twelve hours

Mode of Transmission:

1. contaminated seafood and seawater
2. cross-contamination from salt water fish and sea water used for cleaning food and food contact surfaces

Symptoms: acute diarrhoea, abdominal pain, mild fever, vomiting, chills, headache and prostration

Foods Commonly Involved: salt water fish, prawns, crabs and other shellfish

Prevention:

1. Cook foods thoroughly.
2. Chill foods to be held, immediately.
3. Avoid cross-contamination from salt-water fish.
4. Do not use sea water for washing foods which are to be eaten raw.
5. Sanitise equipment and work surfaces.
6. Do not use sea water for cleaning production areas.

Enteropathogenic Infection or Gastro-enteritis

Although *Escherichia coli* is a normal inhabitant of the intestinal tract of humans, many strains cause acute diarrhoea in infants and some can infect adults also. It is also often the cause of a gastro-intestinal upset called 'travellers diarrhoea'. The disease causing strains are enteropathogenic, i.e., they cause disease in the enteron or intestine. They are present in the human and animal intestine and are excreted in faeces.

Organism: Enteropathogenic Escherichia coli (EEC)
Incubation period: Twelve hours to two days

Mode of transmission: Raw food contaminated with sewage, contaminated hands, cross-contamination of food and careless storage, sewage pollution of water

Symptoms: Two types of infections are seen. In the Ist type E. *coli* may produce an enterotoxin and result in a cholera-like illness. The ingested organism colonises in the upper small intestine and produces the toxin resulting in travellers' diarrhoea and infantile diarrhoea.

The second type of *E. Coli* infection results in an invasive type of illness. This is a dysentery-like syndrome with fever, chills, profuse watery diarrhoea with mucous and blood and colitis.

Foods Commonly Involved: Raw meat and poultry contaminated with excreta, salads and other vegetables consumed raw

Prevention:

1. Chill food rapidly in small quantities.
2. Cook food thoroughly.
3. Practice personal hygiene.
4. Wash all vegetables thoroughly, especially salad vegetables and chutney ingredients like coriander leaves, mint and green chillies.
5. Protect and treat water.
6. Dispose sewage in a sanitary manner.

LISTERIOSIS

Listeria are aerobic, non-spore forming bacteria that can cause serious food borne infection in the vulnerable age group, particularly the old, infirm, chronically ill patients, pregnant women and infants. These bacteria are found in the soil, vegetables and animal feed.

This fatal food borne illness is uncommon but if infected, the chances of death are high. *Listeria monocytogenes* was resposible for causing more than 40 deaths in the United States in 1985. Listeria is capable of forming and growing in biofilms. Bacteria in biofilms are more difficult to kill with sanitisers and disinfectants and the bacterium thrives in wet areas, refrigerators and food store drains.

Organism: Listeria monocytogenes, a bacterium.

Incubation Period: When food contaminated with Listeria is consumed, the bacteria multiplies in the gastrointestinal tract causing listeriosis.

Mode of Transmission: Milk and meat of infected animals; susceptible foods which are refrigerated, like soft cheese, salads, sausages. Listeria is a ubiquitous organism and because of its ubiquitous nature is difficult to keep out. Airborne droplets from contaminated drains contaminate the floor and ultimately food. Cockroaches, backflow in drains, cracks and crevices in the kitchen, cutting boards etc. harbour Listeria.

Symptoms: Miscarriages and still births in pregnant women, meningitis and septicaemia in infants.

Foods commonly involved: Refrigerated foods that are likely to be contaminated and cannot be heated like soft cheeses, prepacked salads, sausages, meat, milk products and foods served in Deli's, also chilled raw chicken and unpasteurised milk. Since the organism is capable of growing at 5°C, hence the refrigerator which is used to control the growth of most other pathogens cannot be relied upon to control the growth of Listeria. The bacterium grows in mildly acidic conditions. They have been isolated from fruits, vegetables, milk, cheese, meats and seafood.

Prevention:

1. Proper maintenance of drains and grease trap systems in the kitchen to prevent backflow of water.
2. Regular pest control as fruit flies and cockroaches that thrive in drains can spread the disease.
3. Introducing technically sound cleaning practices for floor drains, sinks and greasetraps that prevent the formation of potentially harmful airborne droplets from drain water, which gets sprayed into the air through traditional cleaning methods.
4. Washing any item that accidently falls on the floor before placing it on a food contact surface.
5. Discarding food items that accidently fall on the floor.
6. Thorough cleaning of both food contact and non-food contact areas specially difficult to clean and frequently missed nooks and corners in the kitchen. Areas in and around equipment, especially wet grinding and refrigeration areas, chopping boards and slicers as well as wash-up areas, sinks and drainage boards.
7. Thorough heating up of frozen and refrigerated foods.
8. Pasteurisation of milk and use of the same for making cheese.

VIRAL INFECTIONS

Infectious Hepatitis

This is an acute communicable disease caused by a virus. It is very common in India, especially in overcrowed areas where standards of personal hygiene are low. It spreads through contaminated water or food. The hepatitis virus is found in the faeces, urine and vomit of infected people and in polluted waters. The disease has a fairly long incubation time as well as duration. Because of severe nausea and dehydration, the patient may need to be hospitalised. The virus may survive ordinary cooking practices.

Organism: Hepatitis A virus
Incubation period: twenty-five days

Mode of transmission:

1. contact transmission: food or water contaminated by direct contact with the faecal-oral route of the diseased person or carrier
2. contact with the hands of an infected person which are not adequately washed
3. vehicle transmission by consuming contaminated food, polluted drinking water or shellfish
4. vector transmission by houseflies.

Symptoms: jaundice, loss of appetite, abdominal discomfort, severe nausea and vomiting which could result in dehydration, fever, weakness, marked weight loss

Foods commonly involved: milk and other beverages; shellfish, contaminated foods, contaminated water

Prevention:

1. The food handler should maintain proper standards of cleanliness.
2. Prevent the entry of persons sick with hepatitis or those who are carriers in food preparation and service areas.
3. Control the growth of houseflies.
4. Shellfish should be cooked thoroughly and foods like milk should be adequately heated.
5. Keep plumbing in excellent order; prevent contact of sewage with food or food contact surfaces.

PARASITIC INFESTATIONS

Amoebic Dysentery

Amoebiasis is caused by the protozoan *Entamoeba histolytica.* The disease may occur with or without clinical manifestations. Amoebic dysentery is considered to be the intestinal manifestation of the disease.

Organism: Entamoeba histolytica
Incubation period: three to four weeks

Mode of transmission: by ingestion of cysts in food and drink, vehicle transmission by contaminated vegetables from fields irrigated with contaminated water, vector transmission due to flies and rodents

Table 4.2 Other Food Borne Illness

S.No.	*Illness*	*Causative agent*	*Main source of infection*	*Symptoms*	*Preventive measures*
	Bacterial Illnesses				
1.	Streptococcal Food poisoning	*Streptococcus faecalis*	Persons with sore throat, faecal contamination of hands and nasal discharges	Vomiting, diarrhoea, abdominal pain	Pasteurisation of milk; careful handwashing and hygiene; thorough cooking; prompt refrigeration
2.	Brucellosis	*Brucella abortus*	Contaminated milk	Irregular fever, sweating, headache, sore throat	Use pasteurised milk
3.	Campylobacter Infection	*Campylobacter jejuni* or *C. coli*	Cross-contamination, farm animals and birds, contaminated water, undercooked poultry	Fever, diarrhoea, abdominal pain	Avoid cross-contamination; thorough cooking; prompt refrigeration, no pets allowed in kitchen
	Viral Illnesses				
1.	*Influenza	Influenza virus	Direct contact, droplet infection, infected articles, contaminated food and utensils	Fever, head cold, sore throat, respiratory infection, muscular pain and weakness	Sick food handlers should be kept away from kitchen and service areas

Contd...

Table 4.2 (Contd.)

S.No.	*Illness*	*Causative agent*	*Main source of infection*	*Symptoms*	*Preventive measures*
2.	Viral food infection	Norwalk virus	Fish and shellfish from contaminated waters	Fever, headache abdominal pain vomiting, diarrhoea	Approved suppliers cook shell fish, for at least 4 mins Treat sewage before disposal
	Parasitic Illnesses				
1.	Tape worm infestation	*Taenia solium and Taenia saginata*	Raw or insufficiently cooked diseased pork or beef containing cysts	Malaise, digestive disorder, abdominal pain, hungry feeling, vague discomfort	Cook pork and beef thoroughly; purchase only from licensed shop
	Roundworm Infestation				
2.	(a) Ascariasis	*Ascaris lumbricoides*	Contaminated food that contains the eggs of this parasite, contaminated soil and water	Worms infest small intestine, abdominal pain, pneumonia	Personal hygiene; thorough hand washing
	(b) Threadworm Infestation	Pinworms or threadworms *(Enterobius vermicularis)*	Dirty finger nails harbouring eggs of the parasite, clothing, soil and sewage-contaminated foods	Infest upper part of large intestine, cause itching and swelling near the anus when adult worm lays eggs	Trim finger nails; wash hands after touching unsanitary parts; remove all soil from vegetables
3.	Diphyllobothriasis	*Diphyllobothrium latum* (fish tapeworm)	Fresh water fish like Salmon contaminated with live larvae	Appear in 3–6 weeks. Anaemia occurs in severe infections	Thorough cooking of fish to destroy larvae at min. 60°C

Contd...

Table 4.2 (Contd)

S. No.	*Illness*	*Causative agent*	*Main source of infection*	*Symptoms*	*Preventive measures*
4.	Anisakiasis	*Anisakis* spp. a nematode	Saltwater fish such as striped bass, Pacific snapper, cod, herring	Appear after several days, irritation of the throat and digestive tract, diarrhoea and abdominal pain	Purchase from approved sources, parasite is destroyed by heavy salting, thorough cooking freezing for 7 days at −29°C (−20°F)
5.	Giardiasis	*Giardia lamblia* a trophozoite	Ingestion of cysts are transmitted through contaminated food and water or by the faecal-oral route (hands or fomites)	Each cyst produces two trophozoites which multiply in the small intestine and attach themselves to the mucosa causing abdominal cramps, distension and tenderness, fatty diarrhoea	Use potable water; wash hands thoroughly after using the toilet and before handling food

*Although it is an airborne infection, it can be transmitted through food also, hence it is included here.

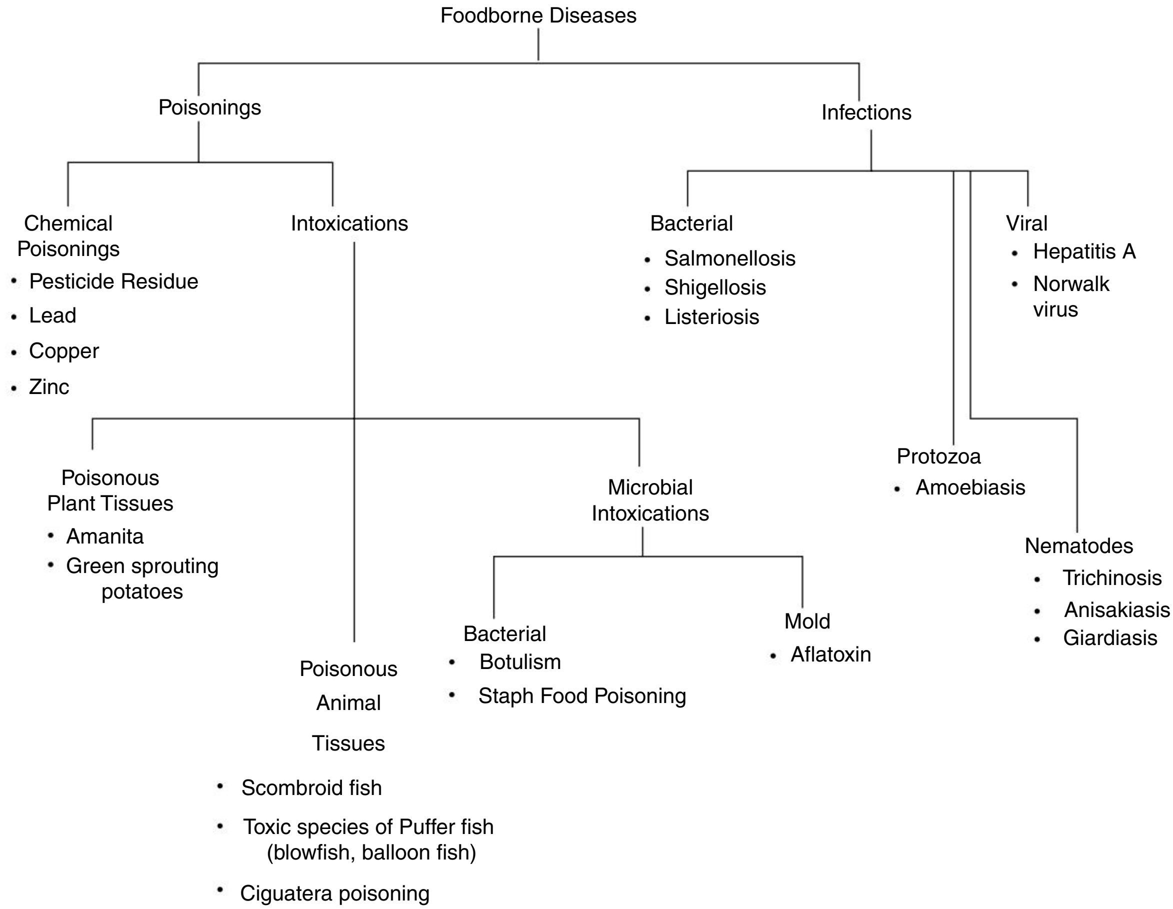


Fig. 4.11 *Classification of foodborne diseases*

that feed and settle on uncovered food, infected food handlers can spread the infection through unhygienic habits—viable cysts could be present on the hands and under the fingernails of these carriers

Symptoms: these range from abdominal discomfort to slight diarrhoea, alternatively, constipation or severe diarrhoea

Foods commonly involved: water contaminated with sewage, moist foods contaminated with human faeces

Prevention:

1. Use boiled drinking water.
2. Wash or disinfect uncooked fruits and vegetables thoroughly.
3. Protect food against rodents and flies.
4. Food handlers should be medically examined periodically to identify those who are ill or are carriers. They should not be allowed to handle food and equipment in food preparation areas.
5. Proper sewage disposal methods should be adopted.

Trichinosis

This is a parasitic food infestation caused by a threadlike round worm found in pigs. It is caused by consumption of raw or incompletely cooked pork which contains the encysted larvae. The encysted larvae are released during digestion of meat, and these larvae develop into adults in the mucous membrane of the intestine and reproduce. The numerous larvae produced reach the skeletal muscles where they encyst causing muscle soreness, swelling and weakness and produce the symptoms of the disease.

Organism: Trichinella spiralis, a nematode
Incubation period: varies between four to 28 days and in case of heavy infestation, twenty four hours

Mode of transmission: Vehicle transmission through consumption of undercooked, infested meat and sausages, vector transmission by infected swine, rabbits, rats, etc.

Symptoms: Nausea, vomiting, diarrhoea, colic, fever and sweating; later on there is muscle soreness, swelling, chills and skin lesions; a severe manifestation may result in death.

Foods commonly involved: raw or insufficiently cooked pork or pork products containing live larvae.

Prevention:

1. Purchase and serve only inspected pork and pork products.
2. Cook pork and susceptible meats thoroughly to at least 68°C (155°F) for 15 seconds. Roasts should reach the temperature of at least 74 to 77°C (165 to 170°F) in the centre of the cut. The safe end point is when the colour of pork turns from pink to gray.
3. When cooked in a microwave oven, the internal temperature of pork should reach at least 82°C (180°F) and should be allowed to stand covered for two minutes after cooking to obtain temperature equilibrium.
4. Freeze pork at −15°C or lower for 20 days or at −29°C for 12 days.
5. Eliminate rats.
6. Adopt effective methods of garbage disposal. Avoid feeding garbage to pigs.

FOOD BORNE ILLNESSES AND HAZARDS

Bacterial Food Poisonings or Intoxications

1.	Staphylococcus food intoxication	3.	*Bacillus cereus* food poisoning
2.	Botulism	4.	Perfringens food poisoning

Bacterial Food Infections

1.	Salmonellosis	6.	Campylobacter infection
2.	Typhoid and paratyphoid	7.	Streptococcal infection
3.	Bacillary dysentery	8.	Brucellosis
4.	Cholera	9.	Listeriosis
5.	Enteropathogenic infection		

Viral Infections

1. Infectious hepatitis	2. Influenza

Parasitic Infestations

1. Amoebiasis	4. Giardiasis
2. Trichinosis	5. Roundworm infestation
3. Tapeworm infestation	

Naturally Occurring Toxicants in Foods

1. Lathyrus sativus	5. Cereals and groundnuts
2. Soybeans	6. Poisonous mushrooms
3. Green potatoes	7. Mussels and clams
4. Argemone oil	8. Ergot

Toxic Metals and Chemicals

1. Selenium	8. Tin
2. Zinc	9. Brass
3. Arsenic	10. Fluoride
4. Lead	11. Barium
5. Cadmium	12. Mercury
6. Cobalt	13. Pesticides
7. Copper	

Food Allergies

1. Eggs	3. Chocolates
2. Shellfish	4. Strawberries

FOOD ALLERGIES

An allergy is defined as a special reaction of an individual to some ingredient of food. Some people show abnormal sensitivity to foods that are harmless to a non-allergic person. The substance that causes the allergy is called an allergen. Allergens may be present in foods like eggs, wheat, fish, shellfish, chocolate, strawberries and cow's milk.

Symptoms of allergies vary from urticaria or hives to gastro-intestinal upsets and may be mild to extremely severe. The food responsible for causing the allergy should be avoided.

In the catering industry, the service staff should have basic knowledge of various recipes on the menu in terms of ingredients used, so as to guide the customers about food selection in case of allergy.

CONTROL OF FOOD-BORNE ILLNESSES

Food-borne diseases are generally transmitted through careless food handlers who are either suffering from the disease or are carriers of microorganisms. A healthy food handler may transmit microorganisms indirectly through cross-contamination. These diseases are a constant threat to the food industry. They can be prevented by practising the basic principles of hygiene listed below.

1. Food should be handled in a hygienic manner by all food handlers and infected handlers should be kept away.
2. Cross-contamination from raw to cooked foods can be prevented by washing hands and all equipment or surfaces in contact with raw food.
3. The time gap between preparation and service of food should be reduced to avoid long storage in a warm environment.
4. Large masses of food, which have to be reheated later should be cooled quickly to 15°C and refrigerated immediately.
5. Food should be reheated thoroughly so that the centre of the food gets heated to temperatures high enough to destroy bacteria.
6. Frozen foods should be thawed carefully at temperatures between 10 and 15°C and frozen food should not be cooked till it has thawed. Foods once thawed should not be refrozen unless it has been cooked well after thawing.
7. Cooked foods which are to be served hot should be stored above 63°C. Avoid cooling and heating food repeatedly.
8. Leftover food should be refrigerated immediately to keep it out of the danger zone.
9. Food should be prepared in quantities required and quantities for which adequate refrigerated storage space is available. This will prevent perishable or high risk items from spoiling.
10. Suspect food should be discarded immediately without tasting it.
11. The kitchen and cooking equipment should be cleaned daily and regular pest control measures should be taken.
12. Adequate toilet and wash basin facilities with a continuous supply of water should be provided.
13. High risk foods like meat, poultry, eggs and milk should be purchased from certified dealers only.

SUMMARY

A food-borne disease is transmitted to people through the food they eat. Diseases caused by microorganisms such as bacteria, viruses and parasitic infestations are communicable. They are generally transmitted through the food handler who is either suffering from the disease or is a carrier of disease-producing microorganisms. Sometimes they are transferred by cross-contamination. Diseases are transmitted by direct or indirect transmission, and they result in contamination of food.

Food may just serve as a vehicle of transmission of disease, or microorganisms may rapidly grow in food and cause either food poisoning or food infection. Food poisoning is caused by the toxins produced by bacteria and food infection is caused by living bacteria creating an infection in the intestinal tract. Food may also cause disease because of presence of non-microbial agents like poisonous plants and animals, toxic metals and chemicals or because of allergens.

These diseases can make a person very uncomfortable and sometimes may prove fatal. Common symptoms are nausea, vomiting, diarrhoea and weakness. These diseases pose a constant threat to the food industry. They can be prevented by practising the basic rules of hygiene at every stage from food purchasing till serving the food.

KEY TERMS

Carrier A carrier is a person who harbours a specific infectious agent in the absence of obvious signs and symptoms of the disease and serves as a potential reservoir of infection for other people.

Carriers are either temporary carriers or chronic carriers:

Chronic carriers They harbour and excrete the disease producing organism for indefinite periods. The duration of the chronic carriers' state varies with the disease. In typhoid, the carrier state lasts for several years, whereas in chronic dysentery the carrier state lasts for one year or more.

From the point of view of spread of disease, chronic carriers are a far more important source of infection than people who are actually suffering from the disease. This is because chronic carriers are difficult to identify and it is likely that they may be handling food and spreading infection unknowingly.

The first known chronic carrier of typhoid fever was Mary Mallon, often referred to as 'Typhoid Mary'. She worked as a cook in New York and infected at least 53 people with typhoid fever in the early 20th century, before she could be identified as the source of infection and removed from the job.

Communicable disease A communicable disease is an illness caused by a specific infectious agent or its toxic products. The disease occurs through transmission of that agent or its products from the source to the susceptible host either directly or indirectly. It includes contagious as well as infectious diseases.

Contagious disease A contagious disease is one which is transmitted through direct contact, like chickenpox.

Contamination The term contamination means the entry and multiplication of an infectious agents into or onto inanimate objects like food and equipment.

Cross contamination It is the transfer of microorganisms from something dirty to something clean or from a food with many bacteria to a food with less bacteria by means of a nonfood vehicle.

Deli A shop where prepared cooked meat, smoked fish, cheeses, salads, etc., are sold. Derived from word delicatessen.

Enteric Of the intestine or enteron.

Food Borne Diseases Food Borne Diseases are harmful illnesses mainly affecting the gastro-intestiual tract and are transmitted through consumption of contaminated food or drink.

Food borne hazards Danger caused through consumption of food and beverage due to presence of anyone or more of the following in food namely microorganisms, allergens, parasites, natural toxins, toxic metals and chemicals that could result in food borne disease.

High risk food Ready to eat foods that can easily support the growth of food poisoning bacteria if not, handled carefully and will not be cooked any further before being served but may be reheated, like meat pates, cooked egg dishes, cooked fish, etc.,

Incubation period The time lapse between the entry of infectious agent into the body and the appearances of symptoms.

Infection An infection is the entry and multiplication of an infectious agent in the body. It indicates that the body responds in some way to defend itself against the invader.

Infectious agents could be bacteria, viruses, fungi or protozoans.

Infectious disease An infectious disease is a disease of humans or animals resulting from an infection, for example typhoid.

Infestation An infestation denotes the presence of parasites on the surface of the body or invasion of tissues by animal parasites like head louse and round worms.

Temporary carriers They excrete the organism only for a short period of time. Temporary carriers may be of three types.

(a) *Incubatory carriers* These carriers shed the organism during the incubation period of the disease.

(b) *Convalescent carriers* These carriers continue to excrete organisms during the period of convalescence.

(c) *Healthy or contact carriers* These carriers acquire the disease producing organism without suffering from the disease and may continue to excrete the disease agent for variable periods.

Ubiquitous Can be found nearly anywhere.

REVIEW QUESTIONS

1. Match the items in Column *A* with a suitable answer from Column *B*

A	*B*
1. *Escherichia coli*	(a) Trypsin inhibitor
2. *Clostridium botulinum*	(b) Ricewater stools
3. *Vibrio cholerae*	(c) Chronic carrier
4. Viral infection	(d) Anaerobic spore forming bacteria
5. Trichinella	(e) Metallic taste in mouth
	(f) Traveller's diarrhoea
	(g) Muscle soreness
	(h) Jaundice

2. Select the most appropriate answer for the following:
   (a) Large masses of food cooked for later use should be rapidly cooled to this temperature before it is refrigerated
      (i) 60°C
      (ii) 45°C
      (iii) 30°C
      (iv) 15°C
   (b) Communicable diseases may be transmitted by
      (i) contact transmission
      (ii) vehicle transmission
      (iii) vector transmission
      (iv) air-borne transmission
      I. (i), (ii) and (iii) only
      II. (ii), (iii) and (iv) only
      III. (i) and (iv) only
      IV. (i), (ii), (iii) and (iv).
   (c) Frozen foods should be thawed at
      (i) 0°C
      (ii) 10–15°C
      (iii) 60°C
      (iv) 80°C
   (d) The toxin produced by *Staphylococcus aureus* is a
      (i) neurotoxin
      (ii) enterotoxin
      (iii) hepatotoxin
      (iv) aflatoxin
   (e) Which one of the following food-borne hazards is the most common cause of food-borne disease
      (i) microbial action
      (ii) allergic reaction
      (iii) naturally occurring poison
      (iv) toxic metals
   (f) Milk is pasteurised in order to
      (i) sterilise it
      (ii) improve its taste

(iii) increase its shelflife
(iv) kill harmful bacteria

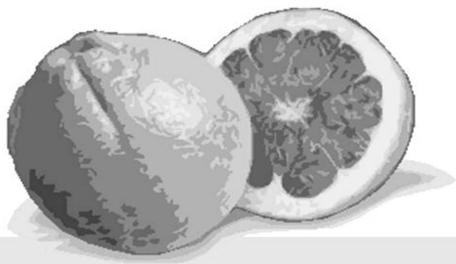
(g) Which two pairs of microorganisms are mainly responsible for food-borne illnesses
(i) bacteria and viruses
(ii) yeast and moulds
(iii) algae and fungi
(iv) protozoans and nematodes

3. State whether True or False. If False, write the correct statement below.
   (a) Allergic diseases occur in some people only because of hypersensitivity to certain foods.
   (b) Compared to bacteria, bacterial toxins require a higher temperature for their destruction.
   (c) In bacterial food poisonings, illness results from toxins and presence of living bacteria is not necessary.
   (d) Frozen peas, once thawed, should not be refrozen.
   (e) Ill persons are not allowed to prepare food but may serve food.
   (f) An infestation means a severe viral disease.
   (g) Communicable diseases are caused by microorganisms and animal parasites.
   (h) A food handler transmits disease germs through his gastro-intestinal system and respiratory tract only.
4. List five ways by which diseases are transmitted through food indirectly.
5. Which of the following foods are at a high risk of sewage contamination? Give reasons for your answer.
   (a) roasted cashewnuts
   (b) mint chutney
   (c) apple pie
   (d) green salad
   (e) river fish
6. List the four most common symptoms of a food-borne disease.
7. As a food handler, write down the basic precautions you will take to prevent an outbreak of food poisoning in your establishment.
8. What are the symptoms of Botulism? Outline simple measures to prevent its occurrence.
9. Specify the three factors which determine the severity of a bacterial food infection or intoxication.
10. Why must coriander leaves be washed thoroughly before use?
11. Who is a carrier? List the different types of carriers of disease.
12. Tabulate the differences between
    (a) food infection and food poisoning
    (b) cross-contamination and direct transmission
    (c) incubation and convalescence
13. What is a high risk food?
14. List two commonly occurring food-borne illnesses and specify which foods are commonly implicated in these illnesses.
15. Describe how *Bacillus cereus* food poisoning may be transmitted.
16. Waste products of metabolism of microbes are called __________ or __________ and they produce symptoms of disease.

Part II

HYGIENIC FOOD HANDLING

- Purchase and Storage of Food
- Sanitary Procedures while Preparing, Holding, Serving and Displaying Food
- Special Food Operations



5

- Important points to be observed while receiving and inspecting deliveries
- Food storage
- General guidelines for food storage
- The dry food store
- The refrigerated store
- The Freezer store
- Storage of specific foods

Purchase and Storage of Food

INTRODUCTION

In the previous chapters we have studied how easily foods spoil by action of microorganisms and other agents of contamination. Food can get contaminated before or during delivery to the food service establishment.

The food handler should understand that all rules for proper food handling aim at preventing contamination and spoilage of foods.

In the food service establishment, it is the responsibility of the catering manager to ensure that the quality of the food served is wholesome. For any institutional purchase, there is a policy, procedure and purchasing process which needs to be followed. The methods of purchasing undertaken are vendor contract, open market purchase and wholesale purchase. As it is the catering manager's duty to select high quality commodities which are available in the market, sanitation during harvest, transport and market storage conditions are not dealt within this chapter.

To prevent food from spoilage or from causing illness, the following principles of proper food handling should be observed during purchasing, storage, preparation and service of food.

The golden rule to be observed while purchasing food, is to buy only from reputable suppliers and spot check the foods for obvious signs of contamination.

IMPORTANT POINTS TO BE OBSERVED WHILE RECEIVING AND INSPECTING DELIVERIES

1. *Meat and poultry*: This should be purchased from a plant which has an inspection certificate and inspection mark on all products to be certain that only healthy animals have been slaughtered, and that the meat has been stored, handled and transported in a sanitary way.
2. *Fish*: All fish and shellfish should be from unpolluted water.
3. *Eggs*: Eggs must be at least grade B and should have clean intact shells.
4. *Milk*: Milk should be pasteurised and from an approved source.
5. *Canned foods*: Cans should be obtained from a plant having a licence. All cans should have the date of processing, code and licence number on it. When opening cans, always open the uncoded end.
6. *Cereals and pulses*: These should be checked for the presence of contaminants like presence of mud, stones, unwanted grains, mouldy grains and insects or insect droppings. Damaged and eaten grains or grains of uneven size should not be selected.
7. *Fruits and vegetables*: These should be checked for bruises and damage by insects. Only wholesome items at the correct stage of maturity should be purchased.
8. *Spices, nuts and dry fruits*: These should be checked carefully for insect contamination. All packets should be intact.

Make sure food supplies are properly labelled. Discard any containers with missing labels.

Always select food of good quality and visit the suppliers occasionally to check on sanitary practices. Seasonal and non-seasonal availability of foods have to be considered while planning

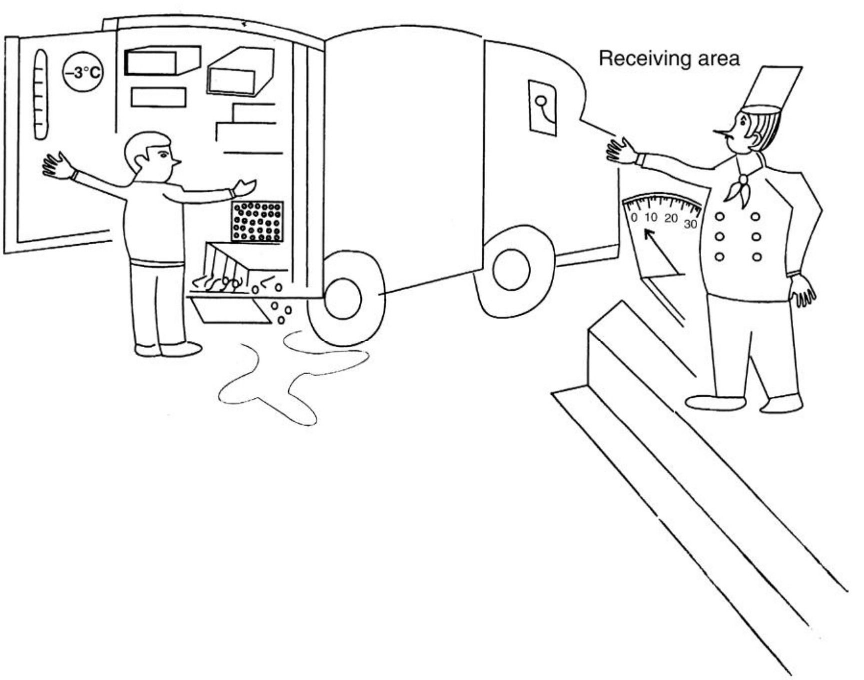


Fig. 5.1 *Do not accept frozen foods if temperature is more than –15°C*

the menu to ensure high quality products. Another important consideration is price fluctuation. These are specially important for non-profit catering operations. The economy of purchasing bulk packs and quantity purchased needs to be considered. The method of delivery also has an effect on quality and shelf-life of food. Insist on proper transport of all items. Reject food if packages are open or frozen foods are not solidly frozen and delivered at temperatures above −15°C.

FOOD STORAGE

All catering establishments, irrespective of the volume of business handled, should have adequate, temperature-controlled storage facilities to protect food from any kind of spoilage. Temperature-controlled storage facilities include a dry food store, refrigerated stores and deep freezers. Storage space required depends on quantity purchased.

These facilities will prevent the entry and multiplication of microorganisms and preserve the quality and palatability of food. Food will thus remain wholesome till it is consumed.

However, food cannot be completely free from microorganisms because of their ubiquitous nature. Complete sterilisation of food is therefore, neither practical nor necessary. What is needed is control over the duration and temperature of storage to prevent growth of microorganisms. This can be achieved by ensuring that food is not left in warm and moist places for indefinite periods of time. The golden rule for storing any kind of food is to keep it clean, covered, cool and whenever applicable, dry.

The three major storage areas to hold large stocks or for bulk supplies are:

1. the dry food store for non-perishables (short-term holding) 10 to 21°C
2. the refrigerated store for perishables (short-term holding) 1 to 4°C
3. the freezer store for perishables (long-term holding) −6 to −25°C

The stores should ideally be located in the north-east part of the building. This will prevent it from getting heated by the sun and will help in keeping it cool and well lit. It should be near the goods receiving area. The kind of storage facilities and amount of storage space required depends on many factors like the menu, the number of covers served daily, purchasing policies and frequency of deliveries.

The stores should not be humid or damp and should be pestproof.

GENERAL GUIDELINES FOR FOOD STORAGE

1. Wash items that need washing and prepare food for storage. Wipe cans.
2. Check frozen items to ensure that they are in a solidly frozen state before putting them in the freezer.
3. Rotate food supplies using the 'first-in, first-out' (FIFO) method. Goods should be placed in the order received. Date goods on receipt and place new deliveries in the rear of the store. The 'Best before' or 'Use by' date should be marked on products.
4. Store foods in areas designed for storage only and not in the kitchen and larder. Each storage area should be separate.

5. Keep all goods in clean wrappers or containers. Dirty wrappers attract pests and contaminate food. Use waterproof and airtight material. Check packets before storing them.
6. Keep storage areas clean and maintain a regular cleaning schedule.
7. Keep vehicles used for transporting food within the establishment clean.
8. Access to the food store should be restricted to prevent pilferage and to control stocks.
9. Periodic inspection and turnover of foods is necessary to check their condition.
10. Maintain appropriate temperature depending on the type of storage.
11. Avoid overcrowding of stored food and overstocking. Adequate air circulation and ventilation is necessary.
12. Food should be stored in the appropriate storage area to remain in a sound state, for example, if bananas are refrigerated, their skin darkens and they become unacceptable.
13. Food should be used as soon as possible because even under ideal conditions of storage there is loss in nutritive value, flavour and freshness.
14. Goods must be stored as soon as they are purchased. Potentially hazardous food items should not be left in the open yard or receiving area. They should be refrigerated or frozen immediately.
15. Separate areas should be made available for storage of equipment, cleaning materials and empty cartons/packaging materials.

THE DRY FOOD STORE

The dry food store should be airy, well lit, clean, protected from pests and from excessive moisture. All foods that do not spoil at room temperature are stored here, for example, whole cereal grains, pulses, flour, sugar, jaggery, oil, hydrogenated fat, canned foods and some fresh fruits and vegetables like apples, mangoes, roots and tubers, pumpkins and preserves like jams, jellies, papads and pickle.

The temperature in the store should range from 15 to 21°C (60 to 70°F). Ideal temperature for maximum shelf life of commodities is 10°C (50°F) and a relative humidity of 50 to 60 per cent.

The Store Plan

The floors and walls should be made of materials which are easy to clean. The walls should be tiled or enamel painted. Cracks and crevices in the walls and floor should be closed to prevent dust from accumulating and pests from hiding.

Cupboards and racks for storing containers should be of simple design—shelves should be adjustable and removable. Fats and oils require special shelves of marble or tile. Papayas and pineapples should be placed on rings.

Shelves should be slatted to improve air circulation and should be made of non-corrosive material. They should be placed 5 cm away from walls and 15 cm above the floor level. This helps in eliminating hiding places for insects, protecting food from dampness, keeping food containers clean and in routine cleaning of the stores.

Doors should be self-closing and windows should have frosted glass to keep out light which would otherwise change the colour of spices and turn fat and oil rancid.

The containers used for storage of dry ingredients should be in good condition. They should be easy to clean, impervious and made of non-corrosive and rust-proof material. If galvanised or enamelled, they should not be chipped. Each container should have a metal scoop in it. Lids should be tight-fitting, moisture-proof, preferably hinged and self-closing. Large storage bins should have castors. All stocks should be inspected once a week. Damaged goods should be discarded at once to prevent further spread of damage.

THE REFRIGERATED STORE

The term 'refrigerated store' includes the domestic refrigerator, the reach-in refrigerator, the walk-in chiller, the cold room and refrigerated display cabinets.

Storage of foods at refrigeration temperatures retards bacterial growth but cannot undo any damage already done.

Perishable foods like raw meat, poultry, fresh fish, stocks, soups, gravies, milk and milk products, ground masala pastes, cooked cereals and some fruits and vegetables can be held for short periods in the refrigerator. The cabinet temperature should not exceed 4°C.

The temperature range is normally one to 4°C in this store. The double door refrigerator with a separate deep freezer has a wider temperature range of −18 to 5°C. It has the advantage of maintaining a steady temperature because the number of times the refrigerator door is opened is reduced as there is a separate door for the freezer. This keeps frozen foods fresh for a longer time with minimum temperature fluctuations in the freezer. Nowadays, three or four- door refrigerators are also available to store perishable items separately. The advantage of having three or four separate cabinets for food storage is a wider temperature range, lesser chances of cross-contamination and absorption of odours, and a steady temperature.

The deep freezer of the domestic refrigerator has the lowest temperature and the crisper has the highest temperature. Bacteria, yeasts and molds grow more slowly at refrigerator temperatures as compared to room temperature, so although foods will spoil when they are refrigerated, the rate of deterioration is much slower because generation time is longer.

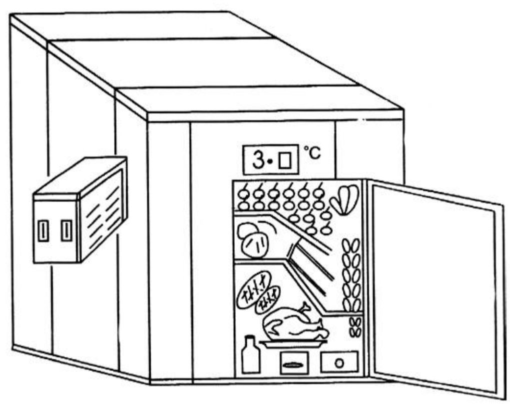


Fig. 5.2 *A walk-in refrigerator*

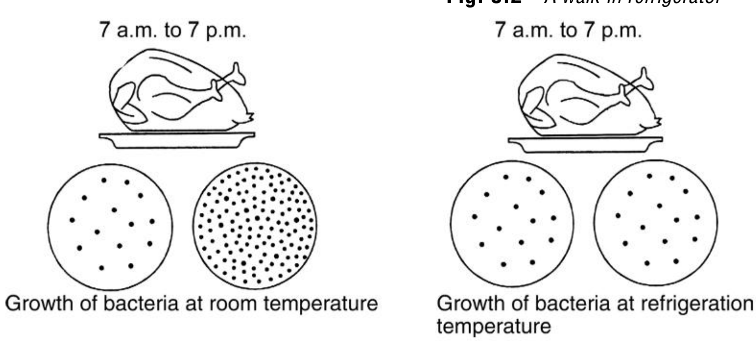


Fig. 5.3 *Effect of time and temperature on bacterial growth*

The maximum storage time in the refrigerator at ideal refrigeration temperature for some perishable foods

Shellfish	1 day
Raw fish	2 days
Minced meat	1–3 days
Cooked fish	3 days
Poultry	2–3 days
Eggs	14 days
Meat	3–5 days
Milk	3–7 days
Curds	5–15 days
Paneer	5 days
Cream cheese	2 weeks
Processed cheese (open)	3–4 weeks
Cream	3 days
Egg white	3 days
Egg yolk	3 days

Ideal refrigeration temperature for specific foods

Fish	–1° to 1°C
Meat and poultry	0° to 2°C
Dairy products	3° to 4°C
Fruits and vegetables	4° to 7°C

The temperature of the refrigerator should be checked regularly by placing a thermometer in the warmest part of the refrigeration unit. If temperatures below 5°C are not maintained, it needs to be checked. The likely reasons for this inadequate cooling could be:

1. opening the refrigerator door very often
2. leaving the door open for long
3. placing hot foods in the refrigerator

The refrigerator should be cleaned inside out. Cleaning should coincide with defrosting. The time for cleaning should also coincide with the time when the refrigerator is relatively empty. This makes the task easier and minimises chances of contamination of food. All shelves and trays should be removed and washed in a warm soda solution, dried and replaced. The floors and walls of the cold room should be mopped and brushed. This cleaning should be done weekly for large refrigerators and fortnightly for smaller ones, to prevent foods stored in it from developing a fridge odour.

Operating Procedures

1. The refrigeration unit should be placed in an airy and well-ventilated place, away from any source of heat.
2. It should not be overcrowded as this hampers the circulation of cold air.
3. Milk and milk products should be tightly covered to prevent absorption of odour and should be kept away from foods with a strong odour.
4. Prepared food should be stored above and not below raw food, to prevent cross-contamination. Liquid from raw food may drip onto food which will not be cooked again (for example, fresh cream pastries).
5. Food stored in glass or metal containers should be stored in the lower part of the refrigerator to prevent condensation drippings from affecting other food items.

Fig. 5.4 *The refrigerator should be regularly defrosted and should not be overstocked*

6. The refrigerator should be opened for the shortest possible time and the door should not be left open.
7. Liquids, meat, fish and poultry should be placed in the coldest part of the refrigerator closest to the coils. Foods to be stored for the longest time should be stored at the coldest temperature.
8. Food should be stored in clean covered containers and not in their original pack or can. Covering food protects it from cross-contamination, drying out and from absorbing odours. Aluminium foil and cling film are useful in covering food which has to be stored. Food should be wrapped only after it has cooled.
9. Do not use refrigerators to cool foods which are at high temperatures. The escaping steam will not only increase the frost formation on the coils but will increase the temperature inside the refrigerator, thus favouring growth of dormant microbes.
10. In walk-in coolers, store foods away from the walls and floor. Hang meat and poultry on hooks for better air circulation.

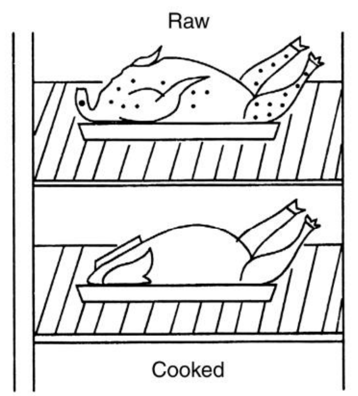


Fig. 5.5 *Store cooked and raw meats separately, not near or on top of cooked meat*

11. Do not refrigerate canned and bottled foods unless specified on the label.
12. The refrigerator should be defrosted regularly to prevent ice building up on the refrigeration coils. Additional ice on the coils reduces the efficiency of the refrigerator.
13. Green leafy vegetables and mushrooms should be stored in perforated polythene bags in the crisper to prevent spoilage by moisture accumulating in the bag. Extra moisture accelerates the growth of microorganisms.
14. Never use a sharp instrument to remove frost from the coils or frozen food that is stuck to the coils, as this can damage them. Use a tray of warm water instead.

Chillers

Chillers are necessary in large catering establishments to reduce the temperature of large portions of food to 15°C or lower in a short time of 1½ hours. Once chilled, the food can be promptly refrigerated. The walk-in chilling room contains a refrigeration unit and a fan to circulate cold air.

THE FREEZER STORE

The term 'freezer store' includes the commercial deep freezing cabinets, walk-in freezers, open top display freezers, blast freezers and the frozen food storage compartment of the domestic refrigerator.

The freezer store is used for preserving food for longer periods than the refrigerator, the temperature being so low that food turns into ice and is maintained in that state. This preserves the colour and flavour of food better than the refrigerator, especially if the food is blast frozen.

Most bacteria can survive the freezing process and remain dormant for many months or years in frozen foods. Only fresh, high quality food should be frozen because freezing cannot improve the quality of contaminated food. When frozen food is thawed and the temperatures reach the danger zone, the dormant bacteria start multiplying rapidly. Therefore, food should be thawed properly before being cooked.

Foods to be stored in the deep freezer should be at room temperature and wrapped in moisture-proof material to prevent dehydration and to keep odour and contaminants away. The wrapping should be airtight. All packets should be labelled and dated before being frozen.

The temperature of the deep freezer varies from −6 to −25°C or lower, as in the case of blast freezers. In blast freezers, it may be lower than −35°C.

The function of some freezers, like the frozen food storage compartment of the refrigerator, is to hold already frozen foods.

The true freezer is capable of freezing fresh food and at the same time maintaining the temperature of the already frozen food kept in the freezer. The temperature range is –18 to –25°C (0 to –15°F) and at these temperatures foods can be stored from one to 12 months, depending on the nature of the food. Such freezers have four star rating.

A star rating system has been prepared on the basis of the temperature in a freezer or frozen food compartment of the domestic refrigerator. Refer Table 5.1.

Table 5.1 **Rating of Commercial and Domestic Freezers**

Temperature of freezer	*Time for which food can be stored*	*Rating*
−6°C (21°F)	one week	*
−12°C (10°F)	one month	**
−18°C (0°F)	three months	***
−18°C to –25°C (0° to −15°F)	three months to one year	****

Guidelines for Freezer Storage

1. The temperature should be maintained at –18°C to keep the food safe and the thermostat and thermometer should be checked regularly.
2. Each time the food is thawed, microbes start growing and this damage cannot be rectified by re–freezing.
3. When thawed food is refrozen, the process of refreezing is relatively slow and results in the formation of large ice crystals which affects the texture of food when it is thawed again.
4. Frozen food should be well-packed to prevent freezer burn, cross-contamination and absorption of odour and flavour. Freezer burn is caused due to very low temperatures and results in discolouration and dehydration of the exposed food.
5. The temperature at which frozen foods are delivered should not exceed –15°C.
6. The freezer, unlike the refrigerator, should be tightly packed with frozen food as cold air circulation is uneconomical. In the open-top display freezer, food should not be stored above the freezer load line as temperatures here are higher than in the main freezer compartment.
7. In case of power failure or breakdown of the freezer, the freezer door should not be opened and the food should be left inside. A well-stacked freezer can keep food frozen for a day or more. If the surface temperature of the food is below 5°C, the food is safe. It is better to cook foods which have thawed and then refreeze them.
8. Lengthy freezer storage influences the taste, colour and texture of foods and increases the possibility of spoilage and contamination. The flavour of foods with a high fat content deteriorates faster than other foods.
9. Frozen foods should be put in the freezer immediately after delivery and only the quantities required should be removed.
10. The freezer should be adequately insulated, well lit and doors should have proper gaskets.

Blast Freezing

This is a method of rapid deep freezing of packed cooked or uncooked foods by a continuous blast of cold air in a tunnel or chamber at temperatures as low as –40°C. Because of the very rapid method of freezing, the quality of the product, i.e., its freshness is preserved. Quick freezing produces very tiny ice crystals in food which do not damage the cells. Once frozen, food should be stored at –20 to –30°C.

Slow freezing forms large ice crystals which damage the cells and cause cell juices to drain out. This results in loss of flavour, colour and nutrients.

The freezer is used to store raw meat, fish, poultry, pork, vegetables like green peas, fruit and fruit pulp, ice cream, etc.

Nowadays, frost-free refrigeration units are becoming popular as they do not require defrosting and can maintain the temperature at –20 to 20°C (0 –60°F). Horizontal, vertical and table top models are popularly used in catering establishments like hotels, restaurants and industrial canteens, ice-cream parlours and fast food centres.

Table 5.2 Recommended Food Storage Temperatures

Temperature	*Types of Food/Storage*
−18°C to −21°C	Frozen foods
−1°C to +1°C	Fresh fish
−1°C to +2°C	Fresh meat poultry, offals and sausages Cured raw and cooked hams, bacon and sausages Cooked meats for slicing
−1°C to +3°C	Cook-chill and sous vide products
+1°C to +4°C	Refrigerated storage, frost top tables
+2°C to +5°C	Cooked meats Pastries Raw and pasteurised dairy products — milk, cream, yoghurts, soft cheeses, cut hard cheeses, butter Eggs Margarines and fats Flour confectionery containing cream, artificial cream, custard, jam Raw pastry, dough and pizzas
+3°C to +8°C	Meat pies Whole hard cheeses Salad vegetables and fruits (except those damaged by low temperatures) Prepared salads (except those containing mayonnaise)
+13°C	Wines
+5°C to +10°C	Vegetable store
+10°C to +15°C	Dry store

STORAGE OF SPECIFIC FOODS

1. Meat and meat products should be refrigerated soon after delivery at zero to 2°C (32 to 36°F). This temperature minimises and controls bacterial growth if meat is contaminated. Raw meat should be wrapped loosely for better air circulation. Cooked meat should be wrapped tightly. Frozen meats should be wrapped and sealed in moisture-proof paper or containers to prevent freezer burn. Cooked and raw meat should be stored separately. Larger cuts of meat should be hung in the cold room and nothing should be stored below. Trays which collect blood drippings should be washed regularly (once a day).
2. Poultry is more perishable than meat and should be stored at zero to 2°C. Whole dressed birds may be loosely wrapped in wax paper or aluminium foil and refrigerated for three days. Frozen poultry is stored at a temperature of –18°C and should be cooked soon after thawing. It should be used within six months after processing.
3. Eggs should be stored at 4 to 7°C (39 to 45°F). Always refrigerate eggs. Eggs stored in the refrigerator can stay fresh for two weeks as against three days at room temperature.

   They should be stored with larger end up. At 2°C, eggs may be stored for 9–10 months. Treatment with pure, colourless, odourless mineral oil increases shelf life by several months.
4. Seafood should be stored at 0°C (32°F). Fresh fish covered with ice may be stored for three days. Crushed ice should be used as larger pieces bruise the flesh and enhance spoilage. If kept at 0°C without ice, then fish should be used within 24 hours.
5. Dairy products include milk, evaporated and condensed milks, butter, cheese, cream, etc. They readily absorb odours and should be kept away from strong smelling foods.
   (a) Fresh milk should be stored in the cold room or refrigerator. Tops and sides of bottles and packets should be washed before storing. Lids of milk urns should be replaced after drawing the required stock. Milk kept at room temperature should not be poured back into refrigerated cartons. Milk should be stored at 3 to 4°C for five to seven days.
   (b) Milk powder should be stored at 10 to 21°C and can be stored up to one year if not opened. It should be refrigerated after opening.
   (c) Butter and other fats (margarine) should be stored at 3 to 4°C for two weeks.
6. Vegetables should be stored at a temperature of 4 to 7°C. Onions and potatoes should be stored in ventilated containers in a cool, dry, dark place. Potatoes and other root vegetables should be stored in sacks if purchased in bulk. As vegetables respire, they require ventilated storage. They should be stored on wire racks adequately above ground level. Cabbage and leafy vegetables should be used as soon as they are received or else emptied on the racks and refrigerated. They should be checked thoroughly if they are to be held for a day or two.

Table 5.3 **Storage Time and Temperature for some Vegetables**

Vegetable	*Temperature*	*Time*
Sweet Potatoes and Onions	15°C Room temperature	12 weeks, one to two weeks
Potatoes	7 to 10°C Room temperature	12 weeks, one to two weeks

Contd...

Table 5.3 (Contd)

Vegetable	*Temperature*	*Time*
Other vegetables	4 to 7°C	five days
Cabbage	4 to 7°C	two weeks

7. Fruits should be stored in a cool, dry, well-ventilated place which has adequate circulation of air around the fruits. Apples and citrus fruits should be stored separately as they spoil other foods.

   Berries, cherries and plums should not be washed before refrigeration. This is because moisture increases mold growth. Inspect fruits frequently due to their susceptibility to spoilage by mold.

Danger Zone

The food handler should always remember that food cannot be stored indefinitely as all food will ultimately spoil.

Bacteria are present everywhere. Even if one is careful and all attempts are made to prevent contamination, some bacteria will still find their way into food and contaminate it. It is therefore necessary to prevent multiplication and contamination at every step of food preparation with the help of appropriate time-temperature control.

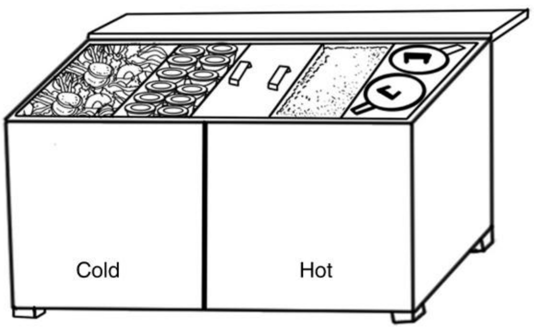


Fig. 5.6 *Keep food hot (above 63°C) or cold (below 5°C) until it is ready to be served*

Bacteria multiply over a wide range of temperature. The range of 5 to 63°C (41 to 145°F) is called the "danger zone" because the hazard of bacterial growth is great within this range. The golden rule of food protection is called time and temperature principle. It requires that all potentially hazardous food be kept at an internal temperature below 5°C (41°F) or at an internal temperature above 63°C (145°F) during display and service. If, during periods of preparation, potentially hazardous or high risk foods must be exposed to temperatures between 5 to 63°C, this exposure time must be kept to an absolute minimum. The longest period for which food may safely remain in this zone is four hours, but food should not be in the 15 to 49°C range for longer than two hours.

SUMMARY

To ensure that wholesome food is served, it is necessary to protect food from contamination at all stages from purchasing, storing, pre-preparing, preparing and serving it. By selecting wholesome food from approved suppliers and checking commodities for signs of contamination, we can ensure that the food is safe when we receive it. Storage of food is an important factor which needs to be considered if the emphasis is on serving high quality products. Depending upon the nature of food, it may be stored in the deep freezer, refrigerator, dry food store or it may be held at high temperatures during the service period. Only high quality products should be purchased and used on a first-in, first-out basis. Food stores should be kept scrupulously clean and food should not remain in the danger zone for more than four hours.

KEY TERMS

Bains-marie Open wells of water used for keeping food hot. Heat is by steam, gas or electricity and generally used as a serving counter in dining areas.

Blast Freezing Freezing food rapidly in a blast of cold air blown by fan at –32°C to –40°C in approximately 75 to 90 minutes depending on how food is packaged.

Chillers Specially designed equipment to rapidly bring the temperature of cooked food down to safe levels. They are of two types:

1. Blast chillers that use rapidly moving cold air to chill the food evenly and rapidly.
2. Cryogenic batch chillers that spray liquid nitrogen, which absorbs the heat from food and gets converted to nitrogen gas.

First–in, first–out (*FIFO*) A rotation method in which items held in inventory the longest are the first to be issued and newly purchased items are stored behind or under items already in the store.

Food contact surface A surface of equipment or a utensil with which food normally comes into contact with food or from which food may drain, drip or splash into a food.

Grading of Eggs Hen's eggs are graded as grade A, B or C. Grade A eggs are naturally clean, fresh, internally perfect with intact shells and an aircell not more than 6 mm in depth. Grade B eggs have an aircell up to 9 mm in depth or are internally imperfect or cracked or have been cleaned are graded as B. Grade C eggs are fit for use in food but cannot be sold in their shells.

Holding Keeping items on the menu either hot or cold after cooking and before service. An important critical control point in food processing.

Inspection mark A quality mark on meat etc which shows that high standards of food safety have been observed in the slaughter house. The lion quality mark is used on eggs and egg boxes abroad.

Non-perishable foods Food products which have a long shelf life of and resist spoilage unless they are improperly handled and stored such as flour, sugar, pulses, spices etc.

Perishable foods Food products which spoil readily unless specially processed or preserved and include most of the ingredients used daily in catering establishments sush as milk and milk products, meat, fish, poultry, most fruits and vegetables.

Rapid Thawing cabinet Used to defrost containers of frozen meals before they are reheated from –20°C to 3°C in approximately 4 hours.

Receiving A step in operations that involves checking the quality, quantity and price of the products which have been purchased and are delivered to the catering establishment before they are sent to designated storage area/department.

Relative Humidity The percentage of moisture in the air as compared with the maximum amount that the air could contain at the same temperature.

Semi-perishable foods Food products which have a shorter shelf-life than non-perishable foods and should be used within a few weaks to a few months such as ground into, potatoes, onions, apples etc.

REVIEW QUESTIONS

1. Select the most appropriate answer in the following.
   (a) Blast freezing is preferred to slow freezing because
      (i) large ice crystals are formed in food
      (ii) very small ice crystals are formed
      (iii) food freezes gradually in a blast of cold air
      (iv) food can be stored indefinitely in the refrigerator
   (b) The ideal temperature in a refrigerator should be in the range of
      (i) 40°C to 60°C
      (ii) 37°C to 20°C
      (iii) 10°C to 5°C
      (iv) 4°C to 1°C
   (c) Canned food should be stored in the
      (i) kitchen
      (ii) dry food store
      (iii) refrigerator
      (iv) deep freezer
   (d) A refrigerator should be defrosted
      (i) daily
      (ii) weekly
      (iii) monthly
      (iv) bimonthly
   (e) Which of the following temperatures should be ideal for a deep freezer with a 3 star rating
      (i) 0° to −5°C
      (ii) −6° to −10°C
      (iii) −12° to −16°C
      (iv) −17° to −19°C
   (f) Food cooked for later use should be ideally cooled and refrigerated within
      (i) half an hour
      (ii) one and a half hours
      (iii) four hours
      (iv) eight hours
   (g) In the refrigerator most harmful bacteria
      (i) grow and multiply rapidly
      (ii) form spores
      (iii) remain dormant
      (iv) are killed
   (h) If frozen poultry gets thawed accidently it should be
      (i) refrozen immediately
      (ii) refrigerated for future use
      (iii) cooked and used in a short while
      (iv) discarded at once
2. State whether True or False.
   (a) The refrigerator should be well stacked with food in order to reduce power consumption.
   (b) Refrigerators are used for long-term storage of perishable foods.
   (c) Food may get contaminated at any stage of processing.
   (d) In the refrigerator it is not necessary to cover the milk container.
   (e) All tinned foods should be refrigerated.
   (f) Food spoilage occurs due to bacterial action only.
   (g) If fresh food is refrigerated it can remain wholesome indefinitely.
   (h) Bloated or rusted cans should be discarded unopened.
   (i) Bananas should not be stored below 13°C.
   (j) Tropical fruits are ideally stored at 10°C.
3. Fill in the blanks with appropriate answers.
   (a) Food which is to be served hot should be kept at a temperature above __________.
   (b) Food stored in the freezer for long periods should be wrapped to prevent __________.
   (c) Food stored at a temperature just above freezing point is known as __________ food.
   (d) Raw meat should not be stored __________ cooked or ready to eat foods.

4. Why are proper storage facilities necessary in a catering establishment?
5. Enumerate the rules to be followed to ensure maintenance of optimum temperature in a refrigerator?
6. Why are refrigerator shelves slatted?
7. Why are strawberries refrigerated unwashed?
8. Where would you store a joint of meat which is to be used after two weeks?
9. What should be the ideal temperature of deep frozen foods when they are purchased?
10. What is UHTS milk? Where should it be stored and for how long?
11. With respect to optimum hygienic conditions, what properties should the following have in a dry food store
    (a) shelves
    (b) containers
    (c) floor
    (d) walls
12. (a) Where should the food store be located?
    (b) Why is it necessary to maintain optimum relative humidity and ventilation in a dry store?
13. Where should cleaning materials be stored and why?
14. List the three groups into which foods are divided for storage reasons.
15. Explain the importance of
    (a) FIFO
    (b) regular defrosting
    (c) protective display of food

6

- Procedures to minimise microbial load
- Preparation of specific foods
- Common faults in food preparation
- Basic rules to be observed during food service
- Special rules for dining room waiters and busboys
- Special rules for bartenders and bar waiters
- Protective display of food: hot foods; cold foods
- Protecting foods in cafeterias and fast food counters
- Single service items

Sanitary Procedures while Preparing, Holding, Serving and Displaying Food

INTRODUCTION

Despite careful selection and storage of food, and good personal hygiene on the part of the food handler, outbreaks of food-borne illnesses can occur if unsafe procedures are followed in preparing and mixing food and if temperature is not controlled during preparing and holding food.

Sanitary procedures are very important during preparation, cooking and holding of food for the following reasons:

1. even if wholesome food is selected, microorganisms are still present in and on food
2. not all food items served on the menu are cooked, for example, salads
3. normal cooking procedures destroy most pathogens but not necessarily spores or toxins
4. heating foods to safe temperatures is not always feasible as some foods may spoil at high temperatures, for example, hollandaise sauce
5. food can get recontaminated during preparation, mixing or holding
6. the internal temperature of cooked foods may not reach the safe temperature level
7. during preparation, food may get contaminated by other poisonous or harmful substances

We have read in the previous chapters that some bacteria are likely to be present and will multiply rapidly when ingredients are mixed and their basic needs of (a) moisture, (b) nutrients, (c) temperature and (d) time are met.

In the kitchen, most preparations provide microorganisms with sufficient moisture and nutrients. The temperature in a hot, steamy, poorly ventilated kitchen is around 35°C the ideal temperature for microorganisms to grow—and if food is kept at this temperature long enough, microorganisms will multiply and spoil food. Once spoilage occurs, it cannot be rectified by freezing or pressure cooking.

The majority of cases of food poisoning reported each year are caused by inadequate refrigeration of perishable foods. In Indian climatic conditions, perishable foods left at room temperature for even three hours is at great risk as the ambient temperature is higher as compared to western countries. It is necessary to follow the time–temperature principle, especially when preparing perishable foods. The food handler must observe two basic rules when food is to be held:

1. keep food hot (at an internal temperature above 63°C (145°F))

   or

2. keep food cold (at an internal temperature below 5°C (41°F))

During preparation, food should be exposed for a minimum possible time to temperatures between 5°C to 63°C. This is the danger zone and rapid bacterial multiplication takes place in this temperature range.

PROCEDURES TO MINIMISE MICROBIAL LOAD

Preparing Food

Procedures in Food Preparation The procedure to be followed will depend to a large extent on the food being prepared. Some common procedures which affect the microbial count are as follows:

1. *Cleaning:* Cereals and pulses are picked before they are milled or cooked, to remove grit, mud, stones, husk, mouldy and insect-infested grains. Green leaves are separated from the inedible roots and tough stalks.
2. *Washing:* Most foods need to be washed before preparation with potable cold water. Washing removes extraneous matter like surface dirt, soil and preservative and pesticide residue.

   Fruits and vegetables to be consumed raw should be washed in a solution of 50 ppm chlorine for five minutes or in a dilute solution of potassium permanganate. Leafy and salad vegetables should be washed thoroughly.

In case of suspected insect or worm infestation, soak fresh vegetables like cauliflower in cold salted water for twenty minutes. If insects are present they will rise to the surface.

Wash the body cavity of poultry well. Let all washed items drain well.

3. *Pre-preparation:* This step includes peeling, trimming and soaking. Potable water must be used for pre-preparation and cooking. Fruits and vegetables need to be peeled, trimmed and cut to remove inedible or spoilt parts. Grains are soaked for sprouting. Potable water should be used for all pre-preparations. No food or food container should be placed on the floor as the floor is heavily contaminated. Keep all food on racks or shelves.
4. *Thawing:* Frozen foods should be thawed completely before cooking, unless the manufacturers instructions are otherwise. Thawing large portions of food, joints and poultry takes time. Freezing only prevents bacteria from multiplying, it does not kill them. When a food is thawed, these dormant microorganisms start multiplying rapidly once again.

If food is cooked while it is partially or totally frozen, a large amount of heat will have to travel to the centre of the food to melt the ice. The food may get cooked on the surface, but internal temperatures will not be high enough to kill bacteria. The food is thus likely to reach a temperature within the danger zone which is favourable for bacterial growth.

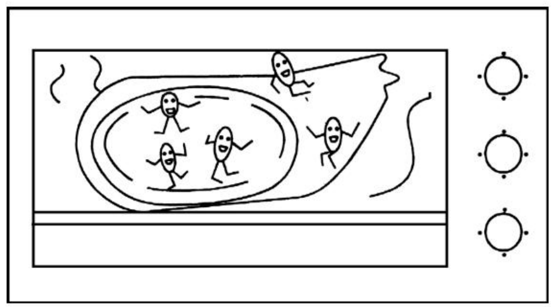


Fig. 6.1 *Always thaw frozen food completely before cooking it*

Meat may be thawed in a special thawing cabinet at a temperature of 10 to 15°C. The advantage of such a cabinet is that cross-contamination is prevented and thawing is faster and safer at a cool temperature of 15°C. A refrigerator may be used instead of a thawing cabinet. Care should be taken to prevent any liquid from raw meat dripping in the refrigerator and contaminating other foods. Raw meat can contaminate any and everything it comes in contact with in the kitchen, like hands, work table, chopping board, meat block, knives, cutters, utensils, dish cloth and dusters. These articles can further contaminate other foods.

Never thaw meat by immersion in warm water or near heat as the microorganisms on the surface will grow rapidly while the centre is still defrosting. Thawed meat should be cooked immediately or kept in the refrigerator for maximum 24 hours before cooking. Never refreeze meat which has once thawed. If it has to be refrozen, then cook and freeze.

Rules for Thawing Food Thaw or defrost food in any one of the following ways:

1. in the refrigerator below 4°C (39°F)
2. in a thawing cabinet at temperatures between 10–15°C
3. in potable running water at 21°C or below while it is still in the packet
4. in a microwave oven, only when it has to be cooked immediately
5. as part of conventional cooking, for example, certain frozen foods like frozen vegetables and ready-to-eat chicken preparations are cooked in the frozen state and quickly thaw when they are cooked.

Table 6.1 Safe Temperatures for Cooking Animal Products

Product	*Internal minimum cooking temperature*	*Other cooking requirements and recommendations*
Poultry	165°F (74°C) for 15 seconds	Poultry should be cooked more thoroughly than other meat
Stuffing, stuffed meats/ casseroles and dishes combining raw and cooked food	165°F (74°C) for 15 seconds	Stuffing acts as an insulator, preventing heat from reaching the meat's centre. Cook stuffing separately
Potentially hazardous foods cooked in microwave like meat, poultry, fish, eggs	165°F (74°C) let food stand for 2 minutes after cooking	Cover the food. Allow the food to stand covered for 2 minutes after cooking. Check the internal temperature in several places
Ground or flaked meats, hamburger, ground pork, flaked fish, ground game animals, sausages	155°F (68°C) for 15 seconds	Thorough cooking is a must
Pork Pork chops	145°F (63°C) for 15 seconds	This temperature is high enough to destroy **Trichinella Larvae** that may have infested the pork
Beef and pork roasts	145°F (63°C) for 3 minutes	Alternative minimum internal cooking temperatures for roasts
Beef steaks, veal, lamb, commercially raised game animals	145°F (63°C) for 15 seconds	
Fish Food containing fish	145°F (63°C) for 15 seconds 145°F (63°C) for 15 seconds	Stuffed fish should be cooked to 165°F (74°C) for 15 seconds. Fish that has been ground, chopped or minced should be cooked to 155°F (68°C)
Shell eggs for immediate service	145°F (63°C) for 15 seconds	Egg dishes must be cooked to 165°F (74°C)

Note: These are the minimum temperatures that the internal or centre section of the specific foods must reach. It is extremely important that these temperature requirements be followed. Otherwise, the large numbers of bacteria that are present will not be destroyed.

Cooking Food

Food may be served uncooked, rare or medium cooked, or well-cooked depending on the foodstuff and the recipe.

Cooking reduces the number of bacteria present in food. The food handler should realise that *conventional cooking procedures do not necessarily kill all bacteria and spores or inactivate their toxins.* Hence, even cooked food should be handled very carefully.

Food is a poor conductor of heat and for large pieces, longer time is needed for heat to reach the centre of the food being cooked. Generally, there are more bacteria on the surface than inside the food, unless it has been mashed, minced or rolled. In such foods, bacteria present on the surface get distributed throughout the food and it is necessary for the centre of the food to reach a temperature of at least 70°C for two minutes while it is being cooked. Internal temperatures can be checked with the help of a probe thermometer. Wipe the probe with a sanitising solution or isopropyl alcohol after every use.

Most harmful bacteria present on the surface of a food are destroyed when food is cooked.

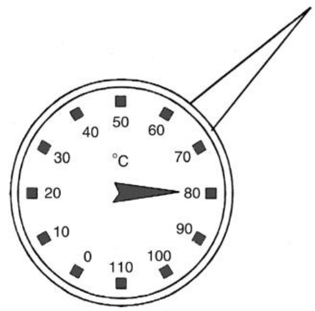


Fig. 6.2 *A probe thermometer*

Stuffed Preparations While cooking any stuffed preparations, like stuffed chicken or turkey, it is advisable to cook the stuffing and then stuff the bird. This is because stuffing slows down heat penetration and sometimes even if the bird is cooked, the temperature in the centre may not be high enough to kill bacteria.

Food poisoning is more likely to occur from stuffed foods because

1. bare hands may be used to stuff the food
2. heat transfer is slow, permitting bacteria to remain in the danger zone for a longer time
3. adequate heat may never reach the centre of the food while externally the food may be cooked to the desirable stage

Although a final temperature of 63°C (145°C) is considered sufficient to prevent microbial growth, the following temperatures are recommended for various meats (Table 6.2).

Table 6.2 **Ideal Cooking Temperatures for Various Meats**

Food stuff	*Internal temperature*	
	°C	*°F*
1. Rare roast beef	54	130
2. Pork and pork products	63	145
3. Stuffed meat	74	165
4. Pork (gray stage)	77	170

The larvae of *trichinella* are killed at 63°C (145°F). As a precaution, it is recommended that pork be cooked to the gray stage. It is preferable to cook or reheat food to at least 74°C provided culinary quality is not affected.

Coated Preparations Many food items are coated with a protective covering before they are fried. This coating helps in retaining the juices and flavour of food and keeps excess fat out. They are usually coated with batter or dipped in egg and covered with bread crumbs before they are cooked. These coverings act as good heat insulators and reduce the transfer of heat to the food being cooked. They may also add to the bacterial population. This can happen when

1. the batter is mixed by hand
2. food is repeatedly dipped in batter by hand
3. microorganisms from the raw food may contaminate batter
4. if batter is stale
5. dry bread crumbs favour microbial growth when they are moistened with beaten egg and are left unused at room temperature. Excess batter or bread crumbs should either be discarded or refrigerated.

Mixing Raw and Cooked Ingredients When raw and cooked ingredients are mixed and the product is not refrigerated or consumed immediately, it can lead to food poisoning. Special care should be taken while preparing salads and sandwiches which are made from highly perishable foods like egg, meat and poultry. They should be stored at refrigeration temperatures immediately. In sandwiches, the bread acts as a heat insulator and prevents the filling from cooling fast. Preparing trifles, sandwiches, etc. a day prior to use should be avoided.

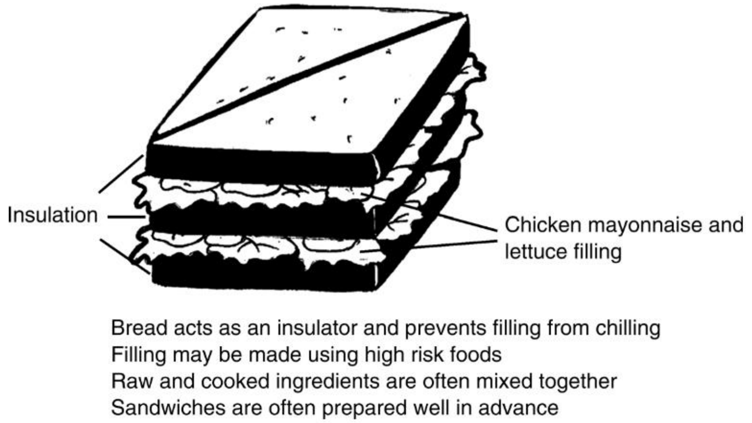


Fig. 6.3 *Bread acts as an insulator in sandwiches so they should be quick chilled by stacking in layers of two*

Eggs may be contaminated with *Salmonella* which are destroyed only at 66°C (150°F). This temperature may not be reached while preparing meringues, souffles, egg nog, soft cooked eggs and scrambled eggs. In such cases use clean, whole shell eggs instead of dried or liquid eggs.

Microwave Heating

The microwave oven is used for thawing, cooking and reheating food. Heating is faster than conventional heating. When foods are placed in an electromagnetic field in the microwave oven, heat is generated by the molecular friction produced in the free water molecules in the food, which heats and cooks the food.

The microwave oven has a defrost programme to thaw frozen foods evenly. This is achieved by exposing the frozen food to microwaves for short periods and turning microwaves off for longer periods, thereby allowing the heat to be conducted to the ice and melt it.

While cooking foods in the microwave oven, the time required for cooking depends on the type of food, its shape, size and cooking temperatures desired. Microorganisms present in food are destroyed at high cooking temperatures.

Whether microwaves are lethal to microbes is a debatable question. However, microorganisms have a large percentage of water in them and bacteria present in food are destroyed when exposed to high cooking temperatures. Many tests conducted confirm the findings that the sterilising effect of microwaves is due to the heat generated by microwaves and not because of microwave radiation. While cooking raw animal products, few precautions need to be taken while cooking food in a microwave oven to ensure that pathogenic microorganisms are destroyed because of uneven distribution of heat.

1. Rotate or stir food in-between while it is being cooked.
2. Cover and cook so that surface moisture is not lost.
3. Heat food to an additional 14°C (25°F) above usual cooking temperatures.
4. Allow food to stand covered for two minutes after cooking to obtain temperature equilibrium.
5. Use roasts weighing 2 kg or less.
6. Check the temperature of the roast at several locations and if temperature is less re–cook the meat.
7. Cook pork to a temperature of 76.7°C (170°F) in all parts of the product to destroy the cysts of *Trichinella spiralis*. Cook covered and ensure that the temperature of 76.7°C is reached for at least 10 minutes. Keep roast covered with aluminium foil and allow it to stand.

Hot Holding of Food

In most commercial kitchens food service continues over a period of three to four hours during the busy lunch hour. In such cases it is more convenient to store food hot at temperatures above the danger zone, instead of cooling and reheating it everytime before serving. For this purpose, a bain-marie or a hot cupboard is used. These equipments are heated by gas or electricity. Care should be taken that the internal temperature of the food should be above 63°C to prevent growth of bacteria. They should be pre–heated before placing hot food in them. They are not suitable for reheating cold foods as this process would take a lot of time to reach the safe temperature of 63°C and food would remain in the danger zone till then, permitting rapid multiplication of bacteria.

Cooling Food Any perishable food which is not to be consumed immediately should be kept outside the danger zone. Cold preparations like desserts should be cooled as soon as possible to 15°C and stored in the refrigerator. Food should not be refrigerated while it is still hot, otherwise the maximum internal temperature in the refrigerator of 4°C would increase and favour spoilage of other foods stored in the refrigerator. Food must be cooled prior to refrigeration in the coolest part of the kitchen. Large volumes cool faster when divided into smaller portions or when kept in shallow containers. Cooling can be hastened by keeping food containers in ice–cold water or in quick-chill units. Food cools faster when the container is placed in water, as water is a better conductor of heat than air.

Stirring food occasionally brings about a uniform drop in temperature and faster cooling.

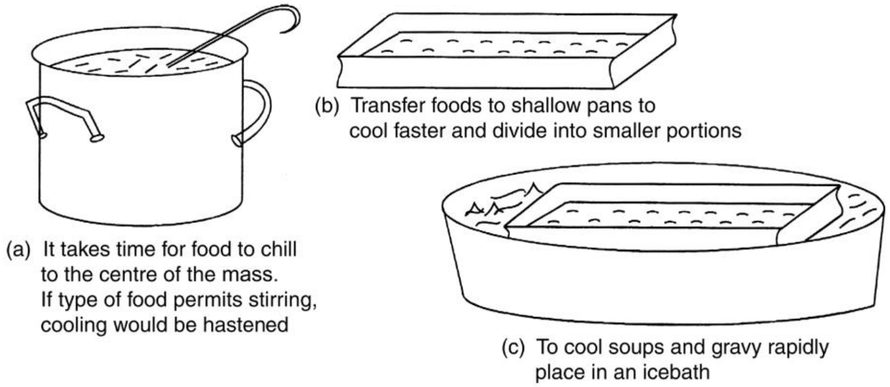


Fig. 6.4 *Cool food quickly*

Other factors which influence the cooling process are

1. the type of food
2. the temperature in the refrigerator or quick-chill unit
3. the container used—size of container, material it is made of and covering if any.

Cooked food which is not to be consumed immediately, should be refrigerated within 1½ hours at 4°C or below. If refrigerator space is inadequate, it is wise to purchase a quick-chill unit or extra bain-maries for ice chilling. Large catering units should have walk-in chillers for rapid cooling of cooked food.

Hot Foods To maintain high culinary quality, food should be prepared when it is needed and served as soon as it is prepared. But this situation is not feasible in most catering establishments as the volume of production is enormous and volume of sales cannot be accurately predicted. To serve hundreds of lunches in a two-hour lunch break, calls for preparing most of the items on the menu in advance. Foods which have to be served over an extended lunch hour can be held hot with the help of a bain-marie, double boiler, steam table or chaffing dish. The food handler should understand that *these gadgets are not meant for reheating food but only for hot-holding of foods.* If used for reheating, food will remain in the danger zone for a longer time.

The temperature at which food remains in the hot-holding equipment is very important and should not be less than 63°C. If this temperature is not maintained, it is likely that food spoilage will occur rapidly. Before keeping food in any of these equipments, it should be heated to 74°C (165°F) and transferred immediately.

The following precautions should be taken during hot holding of foods:

1. keep food covered to prevent heat loss
2. check temperature with a thermometer and not by just touching it with hand
3. stir food occasionally for even heating as lower surfaces get heated and upper surfaces get cooled by air
4. use proper serving equipment like long-handled ladles and scoops to minimise hand contact. Keep ladle in a clean place when not in use
5. prepare and keep only required amounts as extended heating will affect flavour and quality
6. dry preparations like *chappatis,* fried items and baked items may dry further or get overcooked during hot holding

Reheating Equipment Cook–chill meals, left over food or food that needs hot–holding can be heated in any one of the following equipment, depending on the nature of the food, before it is served. Cook-chill meals and cook-freeze meal can be reheated in combination ovens, steamers, microwave ovens or infra-red ovens. Liquid based foods that need reheating can be heated on gas burners or hot plates. Cook–freeze meals require a rapid thawing cabinet to defrost the meal before it can be placed in the oven to be reheated. Such cabinets are capable of bringing down the temperature of frozen food from −18°C to 3°C in about four hours.

Leftover Food All food items have to be stored safely till they are consumed.

Leftover food or surplus prepared food includes all items that have been

1. displayed but not sold during meal time
2. items prepared but not used in functions
3. items produced in more than required quantities

Leftover food which has not been served and is left in the hot-holding equipment during the entire lunch break is exposed to additional contamination. Leftovers, which are highly perishable in nature and have been in the danger zone for more than two to four hours (depending on the nature of the food), should not be served. Most foods can be kept for a day if they are not handled much and are stored at the correct temperature and reheated adequately. Foods which are usually contaminated with spores, like *Bacillus cereus* in rice and *Clostridium* in meat, require proper reheating. These foods are responsible for a number of cases of food poisoning. Conventional cooking practices do not destroy spores and as food is cooked and enters the danger zone, these spores germinate and bacteria begin to multiply and continue to do so till food is refrigerated or reheated. They remain dormant in the refrigerator and when food is reheated and passes through the danger zone, they multiply once again.

To control bacterial growth in leftover foods, the caterer should keep leftovers to a minimum and *highly perishable or high risk foods should not be reheated more than once.* With each reheating, the bacterial population increases. See Fig. 6.5.

Surplus food should be reheated thoroughly to destroy all vegetative bacterial cells. Just warming up a dish before service would be doing it more harm than good as bacterial growth would be favoured.

Food prepared too far in advance can cause embarrassment to the caterer, who may be tempted to use rather than throw it away. It may be recalled that such food is one of the main causes of food poisoning. Careful planning can minimise over–production.

To prevent surplus food from causing food poisoning, the following points should be noted:

1. All food prepared but not used should be stored at or below 5°C.
2. The caterer should judge the quality of leftover food and then decide whether it is to be used or not.
3. It is considered fit for consumption if it has not been handled excessively or exposed to high temperatures for long periods.
4. Surplus cold food should be returned to the chilled storage at or below 5°C until required.
5. Surplus hot food must be cooled as quickly as possible and refrigerated below 5°C until it is to be reheated for service. It should then be heated to 74°C and kept at a temperature above 63°C until it is served. It should be reheated only once.
6. Surplus hot food like roast joints which have been held at or below 5°C can be served as cold food over the next two days, provided they are held at 5°C until required for service.

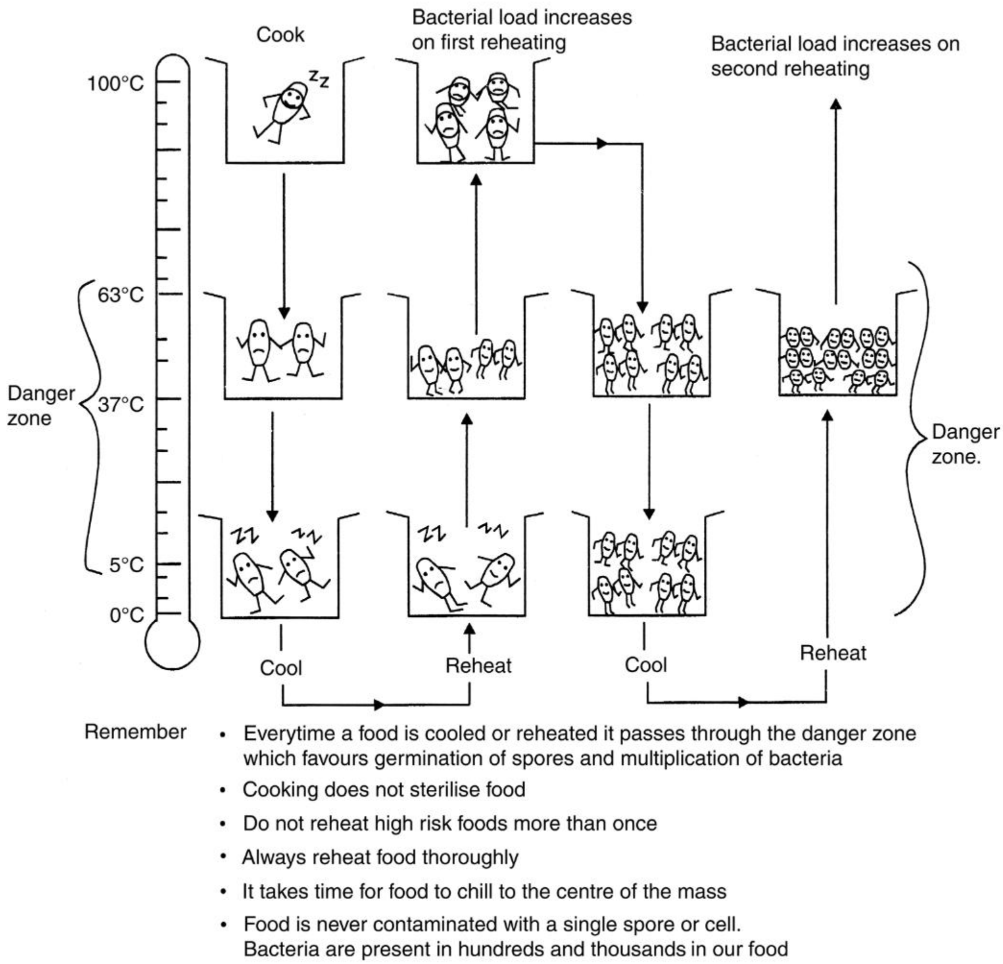


Fig. 6.5 *The number of bacteria increases everytime a food is reheated*

7. Leftover food should be handled carefully to avoid contamination through dirty knives, chopping boards, equipment, etc.
8. It should not be mixed with fresh food.
9. It should be carefully covered and stored away from fresh and raw foods to avoid possible risk of cross-contamination.
10. All excess food should be sorted into various categories and refrigerated as soon as possible and stored accordingly.

The management should look into the amount of overproduction and keep it to a bare minimum. If large quantities of leftovers are present, the food should be cooled, covered and labelled before returning the food to the refrigerator. The label should also record the date before which the food should be used. Such cases arise only when a function is cancelled or very few people turn up for a function because of bad weather, etc.

When deciding whether or not to use leftover food, always remember—'if in doubt, throw it out'.

Storage Temperature of Prepared Foods The Food Hygiene (Amendment) Regulations, 1990 and 1991 have introduced a complex set of controls over the storage temperatures of prepared foods. Foods are divided into two categories, some of which should be kept at 8°C or less and some that should be kept at 5°C or less. All hot foods must be kept above 63°C. There are exemptions from temperature control for limited periods of time for foods freshly prepared on site or on display for sale in catering outlets. The 5°C temperature requirement became effective on 01 April, 1993.

Though chilling helps in extending the shelf life of food products, it can be effective only when high standards of hygiene are observed. The caterer should store all perishable products below 5°C as soon as possible. The same chilled storage temperatures is applicable to food in large delivery vehicles. Small vans making local deliveries are allowed to operate to a standard of 8°C for all foods, even those in the 5°C category. Caterers should check temperatures on receiving deliveries. An allowance of 2°C in the temperature is given for up to two hours for the following:

1. defrosting of equipment
2. breakdown of refrigeration equipment
3. during cold food preparation in the kitchen
4. when food is moved around on the premises

Exemptions for certain foods from temperature control

1. Certain foods are processed in such a way that it prevents the growth of pathogens, for example, sterilised canned food. Canned foods which have been only pasteurised should be refrigerated and this should be indicated on the label.
2. Sandwiches with perishable fillings can be held at 8°C or below for a period of 24 hours only.
3. *Mawa* or *Khoa* should always be refrigerated and used within 24 hours.

PREPARATION OF SPECIFIC FOODS

Meat

Meat is a highly perishable food and gets contaminated from various sources by the time it reaches the kitchen. It should be washed and trimmed if required before it is cooked.

Separate knives, cleavers and chopping boards should be used for raw and cooked meat to reduce chances of cross-contamination.

Bacteria from raw meat may remain on improperly washed equipment and if the same equipment is used for cutting ready-to-eat meat, like cold cuts which are eaten without further cooking, the chances of food poisoning occurring become very high. The bacteria on the raw meat are likely to get destroyed once meat is cooked. After handling raw meat, wash hands well before touching cooked meat or any other ready-to-eat foods which are not going to be heated again.

In the butchery, work table surfaces should be made of impervious material which is easy to clean. The chopping block can be made of hardwood and should be light enough to be removed for cleaning, scraping and rinsing after every use. While deboning meat and making rolled joints, chances of contamination increase. Such joints should be cut into small portions and cooked well to kill microorganisms that may be present in the centre of the cut.

Minced meat is at a higher risk than meat because microorganisms present on the outer surface of meat get distributed throughout the entire mass of mince. Minced meat is also handled more and spoils much faster, leading to discolouration and foul odours and may cause food-borne illnesses. To reduce the chances of spoilage, the following precautions should be taken:

1. mince the quantity required for the day only
2. cook mince thoroughly at sufficiently high temperatures
3. surplus mince should be cooled rapidly in small portions
4. refrigerate surplus immediately
5. reheat mince thoroughly before serving
6. if root vegetables like potatoes, carrots or onions are cooked along with mince, clean them thoroughly to remove heat-resistant soil organisms.

Fish

The best way to prepare fish is to place a stone slab long enough to fit across the sink used for fish preparation and about two-third the width of the sink. Place a hard wood board on it for cutting fish. This arrangement allows a continuous flow of clean water with the wash water going down the drain of the sink.

Fresh Fruits and Vegetables

Vegetables should be thoroughly washed to remove all traces of soil. If necessary, root vegetables may have to be soaked for some time and scrubbed clean as soil may contain *Clostridium perfringens* and *Escherichia coli* along with other intestinal pathogens. Some vegetables, like carrots and ginger, may be scraped, fruits should be washed well and peeled if required before they are served. Peeling helps in reducing microbial load and preservative or pesticide residue if any.

Green leafy vegetables should be washed under running water. Lettuce should be broken up and washed. Leaves should be drained well. A separate sink should be allotted for vegetables and fruit preparation. Spoilt, inedible portions should be removed.

When food is handled carelessly it is likely to get contaminated or spoilt and may result in food poisoning.

COMMON FAULTS IN FOOD PREPARATION

The ten most common faults responsible for outbreaks of food poisoning are:

1. food prepared much before serving time
2. storing perishable food at room temperature beyond four hours
3. slow cooling of food in the kitchen at room temperature before refrigerating it
4. inadequate storage facilities and reheating of leftover food
5. cooking frozen meat or poultry without thawing it completely
6. cross-contamination from raw to cooked food and use of cooked food contaminated with bacteria

7. undercooking meat and poultry
8. holding hot food below 63°C during service
9. infected food handlers
10. surplus food production and use of leftovers without checking quality.

BASIC RULES TO BE OBSERVED DURING FOOD SERVICE

A number of diseases can be spread due to unsanitary practices while serving food. These diseases can be avoided by following certain basic rules of sanitation.

Protecting food during service is very important. Food should be protected at all times from contamination by people, dust, flies as well as changes in temperature.

1. Practice personal hygiene.
2. Avoid handling food with your bare hands. Bread rolls, *chappatis*, *papad*, sugar cubes, salads, cold cuts, cheese, ice and even garnishes should not be touched. Always use a pair of tongs, spoon or plastic glove to pick up these foods.
3. Maintain temperature control. Food which is to be held during a long lunch hour should be kept at temperatures outside the danger zone. Potentially hazardous or high risk foods may remain in the danger zone for a maximum period of four hours, after which they should be held outside the danger zone.

   The temperature of food in the bain-marie or hot cupboard should be above 63°C and the temperature of food held in the refrigerated case should be 5 to 8°C or lower, depending on the nature of the food.
4. Foods held on buffet tables must be kept at proper hot or cold holding temperatures. Check the temperature of all foods with a probe thermometer.
5. Do not re-serve leftovers that have been displayed on buffets. Foods on buffets remain on the table for several hours and are exposed to contamination by customers who may have coughed, sneezed or touched the food during the meal hour. The top portion of cold foods may get warmed by air and spoilage may begin. Therefore, after a buffet closes, consider all food articles on display contaminated and discard them.

   However, in a poor country like India this rule is not practical and, therefore, the food handler should follow proper temperature control.
6. Food which has once been served to a customer should never be re-served, for example, breadrolls, leftover butter, etc. Only foods that are not potentially hazardous and are packed or wrapped may be served again.
7. Handle dishes and utensils in a sanitary manner. Plates should be held by the bottom or edge, cups by handles or bottoms, silverware by handles. Avoid touching the eating surface of crockery and cutlery.
8. Single service items should be dispensed in such a way that customers remove one item at a time without touching other items.
9. Before food service begins, all service personnel should check serving dishes for any signs of soil or improper cleaning.
10. Do not serve food in chipped or cracked dishes.

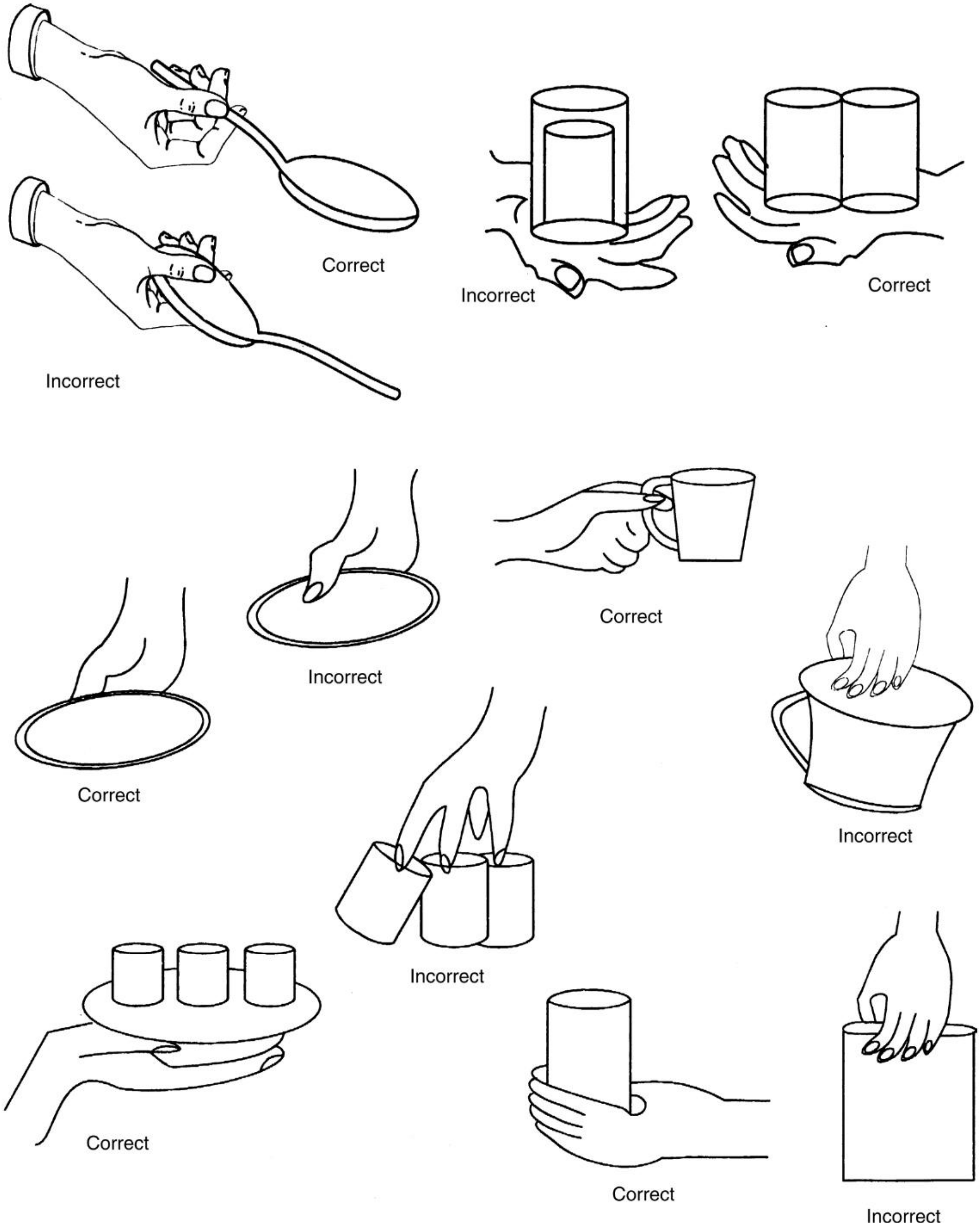


Fig. 6.6 *Mouth and food contact surfaces should not be touched with bare hands*

SPECIAL RULES FOR DINING ROOM WAITERS AND BUSBOYS

1. Avoid cross-contamination: Food and clean utensils may get contaminated by dirty plates and utensils if separate stations are not maintained for clean and dirty items. The waiter stations are reserved for clean utensils and food being served to customers, while side stands are reserved for used cutlery, crockery and garbage.

   Contamination may also occur when waiters serve food without washing their hands after wiping tables and bussing soiled dishes. These practices are harmful and workers must be made aware of the hazards.
2. Clean and organise your waiter stations and do not use them to store personal belongings.
3. Minimise handling of foods with your hands. Do not re-arrange food on the plate unnecessarily.
4. Avoid touching the food or mouth contact surface of utensils as bacteria from the fingers are easily transferred to food. Pick up utensils by the bottom, side or handles. Never pick up glasses or cups by putting your fingers inside.
5. Clean and sanitise all service utensils like plates, glasses, silverware, etc. Do not wipe it dry with a cloth but allow it to air dry. Wiping with a towel or cloth will contaminate the wares.
6. Store all service utensils correctly after they are sanitised. Flatware and serving utensils should be placed face down. Place silverware in baskets with the eating ends down.

SPECIAL RULES FOR BARTENDERS AND BAR WAITERS

1. Store and handle all drink mixes and food items properly. Keep drink mixes and cream refrigerated or on ice. Avoid handling cut fruit and cherries with bare hands. Wear plastic gloves while cutting fruit and use toothpicks to place the cut fruit in glasses. Keep fruit covered.
2. Clean and sanitise glasses, cutting boards, containers, scoops and spoons properly.
3. Clean and sanitise all equipment, bar tops, counters, shelves, refrigerators, etc. properly.
4. Keep the ice used for drinks clean. Store ice in clean covered ice bins. Use scoops or tongs for removing ice. Do not use the ice which has been used to chill cans and bottles in any drink.

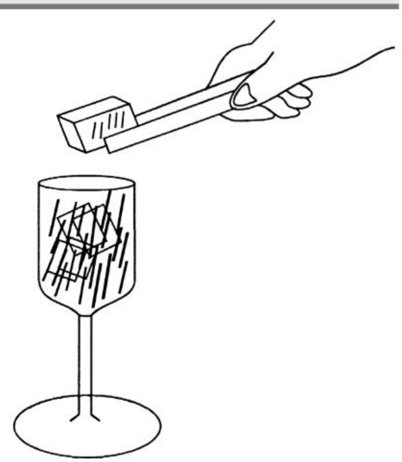


Fig. 6.7 *Use ice made from potable water only and use tongs for adding ice*

PROTECTIVE DISPLAY OF FOOD

Food is often displayed for consumption in catering outlets on a self service counter, assisted service counter, cheese board, sweet trolley or a pub display counter awaiting service to customers.

In such cases, it is exposed to contamination by customers, staff, wind-borne dust, dirt and flies. It can be spoilt by bacteria multiplying in it.

The caterer should take care that food on display remains safe to eat.

Prevention of Multiplication of Microorganisms

Food which is to be held for long periods in cafeterias, canteens and messes should be outside the danger zone. Bacterial growth can be controlled if hot foods are kept hot and cold foods are chilled or frozen.

Hot Foods 1. Food intended to be served hot can be held below 63°C for a maximum period of two hours. Thereafter, the food must be brought above 63°C for service and hot-holding equipment should keep food at a minimum temperature of 63°C throughout holding.

2. The temperature of food should be at least 74°C when placed in heated holding units like the bain-marie or hot cupboard.
3. Items like fish cakes, mutton cutlets, hamburgers, meat patties and croquettes that receive much handling followed by light heating in routine cooking, should be consumed within a short time. This requires staggered preparation to keep food safe.
4. Never reheat high risk foods more than once.

Cold Foods 1. Food that is chilled or frozen and intended to be served cold, may be held at temperatures above 5°C or 8°C for a maximum period of four hours after preparation then a temperature of 5°C to 8°C and below should be reached as soon as possible. The following factors that affect rate of cooling should be kept in mind:

(a) liquids cool faster than solids
(b) small batches cool faster than larger ones
(c) shallow layers cool faster than deep ones
(d) items cool faster if refrigerator temperatures are well below 4°C
(e) cooling is hastened if the container is placed in ice or cold water

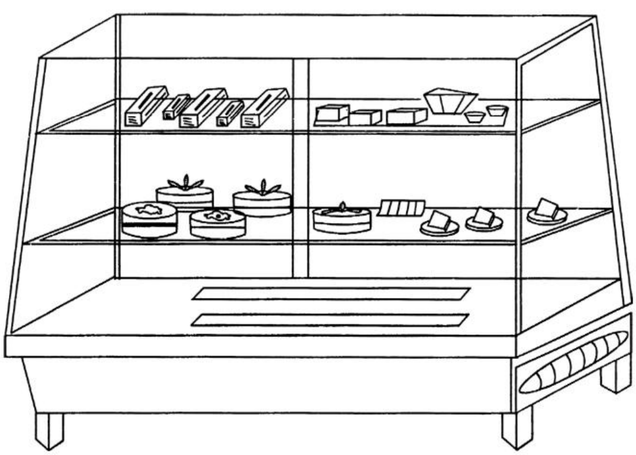


Fig. 6.8 *Food to be served cold is displayed in a chilled display cabinet*

2. Menu items like milk and milk drinks, cream, yoghurt, seafood, cold cuts, meat, poultry, sausage, salad, sandwiches, dessert with milk, eggs, etc., are high risk or potentiallyhazardous foods and must be kept constantly chilled as they are not likely to be reheated.
3. Cold foods to be consumed chilled, like desserts and cream cakes, must be kept at temperatures below 5°C or 8°C, when displayed. A chilled self–service show case could be used. It is necessary to check temperatures inside the cabinet as sunlight or tubes used for lighting the display cabinet may increase the temperature.
4. Ice creams should be stored in open-top display freezers during sale. It should not be stored above the freezer load line as temperatures are not sufficiently low here.

PROTECTING FOODS IN CAFETERIAS AND FAST-FOOD COUNTERS

Displayed food should be protected from contamination by customers, flies, air-borne dust, dirt and bacterial growth. All food items that are displayed should be wrapped in transparent wrapping or in disposable containers covered with cling wrap. Food which is pre-wrapped must be fresh, hygienically packed, handled as little as possible and stored at the correct temperature. The wrapping should be very clean. All disposable or single-service items should be stored carefully and not used a second time. Used thermocol or paper cups, cartons, plates, paper napkins and plastic spoons and forks and straws should be disposed in a bin specially kept for this purpose.

The amount of food displayed should be limited so that no perishable item is kept at room temperature for more than four hours. Perishables should be replaced daily. Food should never be left exposed to air. It should be covered with wire mesh covers to keep away flies. Metal covers are preferred as they keep away dust, keep food warm and prevent infected droplets from coughs and sneezes from falling on food. Plastic tongs or forks should be used to pick up foods. The use of bare hands should be discouraged. Self service areas and display counters should have sneeze guards or food shields to protect customers from one another's germs.

All counters, fittings, display cabinets, containers, tables and chairs should be made of easily cleanable material and kept clean throughout the day. Accidental spillages should be mopped up immediately. Counter tops should be wiped clean. This helps in keeping pests away. Overflowing ashtrays should be emptied regularly. A high standard of cleanliness should be maintained.

SINGLE-SERVICE ITEMS

Single-service or disposable items must be used in food service establishments that do not have adequate cleaning and sanitising facilities. These articles should be stored in closed cartons to prevent contamination of any kind. As these articles are discarded after using only once, they occupy more space in the garbage bin. Apart from paper, thermocol and plastic plates and glasses, leaf plates and leaf cups are widely used in India.

SUMMARY

Sanitary procedures in the kitchen are necessary to prevent outbreaks of food-borne illnesses. While preparing food, utmost care must be taken in following the time–temperature principle, especially in the case of highly perishable foods. The ingredients used for various preparations are not sterile and contribute significantly to the microbial population in food. Foods provide essential factors for growth like nutrients and moisture. Factors which need to be controlled are time and temperature if microbial load and food spoilage is to be checked.

All perishable foods should be stored above 63°C or below 5°C, i.e. outside the danger zone, during display and service. Routine procedures in food preparation include cleaning, washing, thawing, cooking, cooling, hot-holding and storage and use of leftover food. Storage temperatures are crucial in determining the shelflife of foods and should be checked often. Surplus food must be handled carefully as such food has already been handled once. Meat and fish are highly perishable and are often responsible for cross-contamination. Vegetables carry spore-bearing soil bacteria and need special cleaning. If the common faults in food preparation are overcome, food will be much safer to consume.

A number of diseases can be transmitted to food by the service personnel through poor personal hygiene, touching food or mouth contact surfaces, cross-contamination and by not following temperature control measures.

The service hour varies in most establishments, making it necessary to hold foods at the correct temperature to keep them safe.

A clean, orderly and well planned service helps in ensuring a safe food service.

Food displayed for service should be held at the appropriate temperature and protected from dust, dirt, flies, unguarded sneezes and contaminated hands. Flatware, hollowware and single service articles should be stored in such a manner, so as to prevent contamination.

KEY TERMS

Busboys A waiters assistant who sets and clears tables.

Cooling foods These are quick–chill units that help in bringing down the temperature of cooked food that is to be used at a later date to 10°C within 1½ hours. Walk-in chillers are used in large catering establishments. Cook-chill meals should reach a temperature of 0–3°C within 1½ hours.

Leftover food This is the food that was prepared in excess and remains after food service is over. Surplus food needs special attention if it is to be re-used.

Single service items Or use and throw one time use disposable rockery cuttery made of food grade plaste, thermocole, paper or foil.

Sneeze guards Guards used for displayed food items to protect food from droplets from unguarded coughs, sneezes or talking.

Thawing A process for defrosting of frozen foods is the point at which the ice crystals are converted to free water. A step which is necessary before preparation or use of foods which are presesved by freezing. It should be done at refrigiration temperatures or in a thawing cabinet.

Thawing cabinets Specials cabinets that help defrost frozen food and use a temperature of 10°C.

REVIEW QUESTIONS

1. List any five points to be observed while using single service items.
2. As a caterer how would you ensure that food on display in the cafeteria does not get contaminated.
3. Explain how you would handle crockery and cutlery in a sanitary manner.
4. State whether True or False.
   1. Bartenders should wear disposable gloves while handling cut fruit.
   2. The ice used to chill cans and bottles in the bar can be used in drinks if it has been made from potable water.
   3. Potentially hazardous foods are not likely to be reheated.
   4. Disposable thermocol cups can be re-used if they are washed.
   5. Food shields protect the food from unguarded coughs, sneezes, dust and pests.
   6. Leftover bread rolls and butter that has not been consumed may be re-served to another customer.
   7. Chipped or cracked crockery should not be used to serve food.
   8. Contamination can occur when waiters serve food without washing hands after wiping tables and bussing soiled dishes.

7

- **Mobile food units**
- **Temporary food service establishments**
- **Vending machines**
- **Outdoor catering**
- **Transport catering**
- **Street foods: three categories of operators, the consumer, the food handler**
- **Street side foods and diseases**

Special Food Operations

INTRODUCTION

The food service industry has changed with time and helps food reach innumerable customers in the most way off places where there had never been any sign of a kitchen earlier.

One of the simpler changes in this industry is the setting up of fast food restaurants in a number of established hotels.

The other less obvious changes are the outdoor caterers who take catering orders for special events and occasions and for parties at private homes.

Temporary food service stalls supply food to the crowds that gather to cheer sporting events, religious occassions and exhibitions.

Hawkers peddle food from door to door while mobile units disburse food collected from a commissary or central kitchen to selected areas.

Handcart operators sell snacks, soft drinks and fruit slices to the public in crowded places or tourist spots and vending machines are installed at various locations to supply instant hot or cold foods at the drop of a coin.

All these operations require special consideration because of their unusual nature. The food handler or operator should realise that food should be protected irrespective of how it reaches the consumer. The basic rules of sanitation are applicable to all these special food operations, though some rules may be added on while others may be waived or modified for certain types of food operations.

MOBILE FOOD UNITS

The mobile units or vans collect food from commissaries where all sanitary requirements should be adequate. Proper facilities should be provided at the commissary for

1. storage of food
2. potable water supply and storage tank for drinking water
3. solid and liquid waste disposal
4. washing and sanitising food and equipment
5. restroom facilities

If these facilities are not available at the commissary then only single service items should be used and the mobile unit should sell pre-packed food and drinks like popcorn, wrapped cakes and cookies, soft drinks and hot beverages from a dispenser or urn.

All mobile units should return to the central commissary everyday. A separate area should be earmarked for unloading, cleaning, maintenance and repair, cleaning waste tanks and disposal of liquid sewage from the mobile unit. This area should be well away from the food preparation and loading area of the commissary.

A portable water system should be provided in the mobile unit if cooking is to be done. An adequate supply of hot and cold water under pressure is necessary for cleaning, sanitising and for washing hands. The unit should have sufficient storage facilities for perishable goods.

Solid and liquid waste should be stored separately. Liquid waste is collected in a permanently installed tank which should

1. be 50 percent larger than the water supply tank
2. not leak when the vehicle is moving
3. have no connection with the drinking water tank or pipes

TEMPORARY FOOD SERVICE ESTABLISHMENTS

Temporary food service establishments are set up for a single special event such as fairs and festivals or celebration and normally operate in one location for not more than a fortnight.

If adequate facilities are not available, highly perishable foods should be served only in original container as individual servings to minimise handling. Potentially hazardous food should never be prepared in a temporary establishment. Such food must be transported and stored outside the danger zone till it is served. It is not advisable to hold such food in direct contact with ice or water.

As these establishments are often set up in open grounds, insects and dust may pose problems, and all precautions should be taken to protect food and all surfaces in contact with food. Ice used for chilling bottles should not be consumed.

Ice used must be prepared from potable water. The equipment should be of simple design and should be easy to clean.

Floors should be kept clean and water should not be allowed to accumulate. If the floor is dirty it can be covered with removable, cleanable wooden platforms or duck boards. Walls and ceilings are necessary for protection against weather, dust and flies.

Water Supply and Waste Disposal

Because of the temporary nature of the establishment, rigid standards cannot be followed. However, potable water should be used. It should be stored in clean tanks. If necessary, water should be treated to purify it.

Temporary toilets and hand washing facilities should be provided to keep surroundings clean. Each toilet should have a bucket of water, soap and towels. Water should not be allowed to stagnate in the vicinity. Low cost mobile toilets made of fibre and iron rods with a water storage tank on top and a collection tank for faecal matter, fluorescent lighting facility and a water tap should be installed at fairs and festivals.

VENDING MACHINES

Vending machines are increasing in popularity in food service establishments as well as in other public places. They are used for dispensing one or more foods like juices, soups, ice creams, tea, coffee, sandwiches, etc. These machines may be operated manually or by coins.

It is the responsibility of the caterer to instal equipment which meets public health standards. Food dispensed through these machines should be purchased from reliable sources. It should be prepared, stored and transported in a sanitary manner. All food contact surfaces should be protected from contamination.

Perishable foods and made up dishes displayed in a vending machine should be kept at a temperature of 4°C (39°F) or less for a maximum period of 24 hours, after which they should be discarded. A thermometer is a must for temperature control. All food stuff in the machine should be protected from contamination and should be used on a first-in, first-out basis. Strict time-temperature control is necessary during preparation, storage, transportation and while vending, as many items dispensed are of a highly perishable nature.

Location

The machine should be located in clean surroundings away from harmful contaminants like overhead sewer pipes and excessive dust. A sufficiently large bin should be placed nearby for disposal of trash. This bin should be large enough to prevent overflowing.

Other Accessories

Items like bottle openers, salt and pepper cellars and sauce bottles should be conveniently located and kept clean.

Cleaning

The machine should be cleaned daily as per manufacturer's instructions. To clean the machine, all multi-use containers that come in direct contact with potentially hazardous foods, should be removed and cleaned and sanitised everyday. This rule may be overlooked if food contact surfaces are maintained outside the danger zone below 5°C (41°F) or above 63°C (145°F) while holding food in the machine. The vending operator should maintain a cleaning record for each machine showing the cleaning schedule for the past 30 days at least.

Sanitary Aspects

Like all other equipment, the sanitary aspect of design and construction is important. It should be easily cleanable both externally as well as internally. The machine should withstand repeated cleaning and sanitising treatment.

Vending Cold Food Items

Many high-risk foods like ice creams, pastries, salads, sandwiches, puddings and milk are dispensed through machines. A maximum temperature of 4°C (39°F) is recommended for low temperature items and food should reach this temperature in the shortest possible time. Most foods are dispensed in individual packs made of plastic, paraffined cartons or tin.

Vending Hot Food Items

High-risk foods should be held at a temperature not lower than 63°C (145°F) and the machine should have a thermostat to maintain the desired temperature. An efficient machine should be capable of heating food from 5°C (41°F) to 63°C (145°F) within two hours. Thermometers should be installed for maintaining accurate temperature.

Sometimes hot food does not reach the desired temperature of 63°C (145°F) in the maximum specified time of two hours. This increases the risk of food poisoning as food remains in the danger zone beyond the safe time limit. One way to overcome this problem is to dispense hot food in the chilled state and provide microwave oven facilities for reheating food just before it is served.

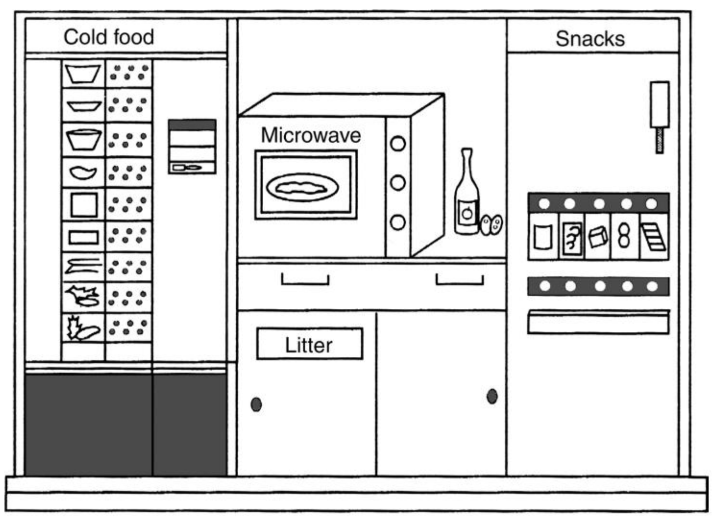


Fig. 7.1 *A vending machine vending cold food and a microwave oven to heat*

Problems with Vending Machines

The following problems may be encountered with vending machines:

1. malfunctioning of machines
2. power failure
3. faulty processing and mishandling of food, prior to putting it in the machine

As the temperature of vending machines is thermostatically controlled, if there is mechanical trouble or power failure, dispensing should automatically stop till it is serviced. The food operator should understand that utmost care is necessary in selecting food and beverages to be dispensed through a machine.

OUTDOOR CATERING

Orders for supplying meals for special functions and celebrations are accepted by outdoor caterers. These caterers organise parties and meals at any selected venue and make all necessary arrangements for the preparation and service of foods. Outdoor catering orders may be accepted by well-established restaurants or by private caterers. The food to be served may be prepared in a restaurant kitchen or a catering outlet and transported to the venue. Private caterers who do not own a catering outlet may prefer to hire the necessary equipment and set up a complete temporary kitchen at the venue itself. The venue may be a well-constructed hall or an open ground where food will be protected by a tent or *shamiana* erected for the occasion.

If food is prepared in a licensed restaurant with all basic facilities, then care needs to be taken to protect food during transport to the venue and while serving it.

The private caterer who does not have a licensed catering outlet may be faced with additional problems and has to take extra efforts while handling perishable food, especially if adequate facilities are not available at the venue.

Problems Faced in Outdoor Catering

1. Corporation water supply through taps may not be available and water from a bore well or tank may have to be used which may be non-potable.
2. Food is cooked in the open and is exposed to the environment.
3. As casual labour is hired on daily wages, their medical fitness it not assured.
4. Infrastructural facilities needed for maintaining basic sanitation may be lacking.
5. Equipment, utensils, crockery and cutlery may need to be hired. The supplier may not be a catering professional and may not be particular about cleanliness and maintenance. Usually only breakages and damages are checked and brass utensils supplied are not plated properly.
6. To cut down on expenses, the caterer may not hire sufficient utensils, especially crockery and cutlery which has to be frequently reused without satisfactory cleaning.
7. Most items are placed on the ground and are prone to contamination from dust, pests, etc.
8. Storage facilities are totally inadequate as no refrigeration is available. Commercial ice, which is unhygienic, is used for cold preparations. Pre-preparations are made much in

advance to ensure timely service of meals. Perishable foods may remain in the danger zone for more than four hours.

Catering orders may be accepted for a single meal or for all meals for a few days. Leftover food which is perishable in nature and has been in the danger zone for more than four hours should not be reused.

The caterer has to take special efforts in planning the work so that food served on such occasions is safe to consume. As food is generally prepared and consumed on the same day, cases of bacterial food poisoning are low. Metal poisoning can occur if food is cooked in brass or copper containers which are not properly tin-plated. The food gets a metallic taste and could cause vomiting. Grinding stones which have been just roughened for better grinding could make food gritty, if used immediately without proper cleaning.

TRANSPORT CATERING

Airline Catering or In-flight Catering

Airline catering is a specialist operation and is the most extensive food production operation in the catering industry. Leading air caterers have a vast capacity of producing up to 75,000 meals per day during peak season. They use state of the art technology in software that streamlines the entire chain of operations from purchasing to delivery. These information management systems help in optimum resource utilisation by monitoring and controlling inventory, integrating the storage, refrigeration and transport facilities. At high altitudes of 30,000 feet, cabin pressure, humidity and temperature has an effect on the taste and quality of food. Hence meals served on board an aircraft are limited. International Standards of Food Safety and Quality are strictly adhered to by most air caterers such as HACCP and ISO Standards. Regular sampling of food and related items is carried out.

Food is a physical need and passengers reporting for an international flight three to four hours before departure depend on the airline for serving safe, wholesome food specially on long haul flights.

Air catering has made tremendous progress from snack boxes that were served initially to very elaborate First Class Service, which makes the need for high standards of hygiene mandatory. The type of meal to be served would depend on the time duration of the flight, time of the day, the passengers biological time and meals served on a previous sector as well as the galley facilities, for example, heating appliances on the aircraft.

Although hotels could easily meet food requirements of airline passengers, the need to have separate flight kitchens was felt because the catering establishment should be located near the airport.

Preparing tasty, nutritionally balanced and hygienically cooked food should be their first priority, unlike hotels whose core business and source of revenue is from room sale.

Serving hygienic food is vital because there is no medical help available at 35,000 ft and there is a big gap between preparation process to the time food is consumed. This gap is further widened if there is a flight delay or on long haul flights with a second sector.

Airlines have the responsibility of serving meals on board to the millions of passengers travelling across the globe be it on short distance flights of about an hour to a long distance nonstop flight of 16 hours or more. Since meals cannot be prepared on board the aircraft but can only be reheated before service, flight caterers need to observe the highest standards of hygiene with regards to food and beverage service and flight attendants should follow time and temperature control accurately. All leftover meals and unused food is to be discarded once the flight lands and no food item is left in the galley.

Food poisoning cases have been reported occasionally by passengers after a flight, but such cases are often not known because the passenger may have landed in another country and by the time he/she recovers from the illness and is fit to report the case, many days would have lapsed and because of hectic schedules, cases are not reported.

Flight caterers need to be extra cautious because of the following reasons:

1. Meals are often prepared well in advance and stored chilled/frozen.
2. The time gap between production and service is often very large.
3. Flights are sometimes delayed because of inclement weather, technical snags, etc. which further increases the time gap.
4. Meals are prepared in a central commissary, stored under temperature controlled after portioning and packing, transported to the airport, stacked in trolleys and reheated and served to passengers.

Meals served on flights are handled by many people.

Many items are 'high risk' foods or potentially hazardous foods.

Since foods go through a long chain, any break in the chain with respect to temperature or time can have serious repercussions. Meals packed by the kitchen department are once again exposed to higher temperatures during tray setting operations. Any time–temperature abuse or improper handling during tray set-up or dispatch can endanger the wholesomeness of the meal.

Guidelines to be followed

- Good personal hygiene specially hand hygiene. More than 90% of sanitation problems in the food industry are caused by poor personal hygiene and improper hand hygiene accounts for more than 25% of all food borne diseases.
- Proper food hygiene for the entire system of operations to prevent spoilage or contamination.
- Temperature of 15°C should be maintained in the tray set-up area.
- Chilled food items should not be kept outside refrigeration temperatures for more than 30 minutes.
- Do not touch food that is ready to serve or the internal food contact surfaces of dishes and casseroles with bare hands. Use disposable gloves.
- Temperatures in the holding room should be at 1°C to 5°C.
- Immediately after tray set-up, meal carts should be kept open in the holding room for three to four hours to facilitate chilling and internal temperature of meal reaches below 5°C.
- All meal carts should be closed before they leave the holding room.
- The Hi-loaders used for transporting meals from catering unit to the aircraft should have been cleaned and sanitised.
- Temperature of meal during transportation should not exceed 8°C and if transportation time exceeds 30 minutes, dry ice should be provided.
- Once meal carts have been off-loaded, the Hi-loader should be washed and cleaned well and shutters should be kept closed in transit and when not in use to prevent contamination.
- Airport employees who look after cleaning or catering functions should ensure that all food waste is disposed in properly closed containers to prevent attracting birds to the airport as they are a major threat to flight safety.

Flow chart of Basic Activities carried out by In-flight Caterers

Airline informs caterer about Expected Time of Arrival (ETA) and number of passengers on the flight (PA × load) by e-mail, telephone, fax etc. Caterer informs all concerned departments immediately.

↓

Catering order sheet tells production department what to produce and how much.

↓

Meals are prepared and portioned into the respective Airlines equipment (casseroles, bowls, trays, etc).

↓

Portions are packed and taken to tray set-up area.

↓

Tray set-up orders are arranged on trays and bulk orders are assembled in one place.

↓

Meal carts are loaded and chilled in Holding rooms.

↓

Meal carts are checked and systematically lined up for loading.

↓

Loaded in Hi-loader, sealed and transported to aircraft.

↓ *Maximum time 25 minutes*

Offloading/loading from Hi-loader and aircraft galley

↓

Signing of Delivery Challan, Bond Requisition, Meal Checklist by Airline crew.

↓

Hi-loader with off-loaded equipment returns to In-flight caterer to off-loading bay of dishwashing department.

↓

Soiled catering equipment is washed in respective area—Trolley washing, glass and cutlery washing and Bulk dishwashing.

↓

Hi-loader is thoroughly cleaned and sanitised for next flight.

↓

Cleaned and sanitised equipment is inventoried and recycled in kitchen and operations for next flight.

Sea Catering

Cruise ships are floating luxury hotels that observe the very high standards in hygiene. Food is served in traditional restaurants, deck barbeques or theme buffets at the poolside. Food and beverage requires careful management. Food hygiene and safety should meet both UK standards as well as US standards. Staff work for long hours, seven days a week while at sea and need to be in good health. Instead of a weekly off, they are given extended time off before sailing again.

Food hygiene plays a crucial role on board a ship as any food borne disease would be difficult to control at sea. All food stocks are collected at the port of embarkation and only in case of a shortage, food items would be collected from the next port.

Fresh fruits and vegetables are used up first followed by frozen food, while canned foods are used last because of their long shelflife.

Garbage is segregated and stored separately in the garbage room. As per the international policy, nothing can be dumped into the sea except for soft wet food waste that is passed through a pulper and discarded into the sea as fish food.

Solid wastes like onion peels, egg shells, pineapple tops, ground coffee and meat fat are not passed through the pulper, but are collected in the red bin.

Soft drink cans and tins are compacted and collected in a blue bin to be recycled. Similarly plastic, paper, broken glass and chinaware are segregated and collected separately to be recycled.

Gray water or waste water from the toilets and bathrooms is treated before it is released into the sea at a specified distance from the shore.

The galley is cleaned by the three bucket systems. The red bucket has soap water at 32°C to 43.5°C for washing, the grey bucket has warm water for rinsing and the white bucket has 100 ppm chlorine for sanitizing. All other kitchen and personal hygiene measures and temperature controls are observed.

Every country has its public health authorities that are authorised to inspect any vessel at any given time, for example, the UKPH and USPH Department. Port authorities come on board to inspect the food, water and sanitation observed and grade the ship out of 100 points. While strict hygiene is observed on board the ship, case of food poisoning are often reported when crew members break rules and purchase food items when the ship docks at any port. These food items are stored in their cabins and have been implicated in food poisoning cases. Time and temperature controls are strictly followed to prevent the occurrence of food borne diseases.

Railway Catering

Passengers travelling by trains depend on the railway authorities for providing meals, snacks and beverages. Some trains have a pantry-car. The space in a restaurant-car kitchen is limited and service becomes difficult because of constant movement. Other passengers depend on the catering facilities available on the platform that varies widely from one station to another. Few high grade trains like the Eurostar provide airline catering standards on board the train for premier class passengers.

In India the Indian Railway Catering and Tourism Corporation (IRCTC) is working towards providing high quality food and beverage to travellers and maintaining hygiene and sanitation in trains and on platforms. Licensed vendors, 24 hour multi-cuisine food plazas at important railway stations, on-board catering on trains all over the railway network, packaged drinking water—Rail

Neer are some examples. Luxury trains like the Palace on Wheels, Deccan Odyssey, etc., have five star facilities for food and beverage.

Delayed running of trains and inadequate facilities specially in terms of temperature controlled storage along with poor knowledge of sanitation by food vendors, filthy platforms and re-use of single service items are some of the reasons for unsafe food during rail travel.

Hospital Food Service

This is a type of welfare catering where costs are minimised by achieving maximum efficiency, the objective being to help the nursing staff in speedy recovery of the patient. Food served to the patient needs to be of good quality, cooked and prepared to retain maximum nutritional value, easy to digest and at the same time appetising and attractive. Sometimes meals need to be modified in texture, consistency and nutritive value.

Hygiene is of paramount importance as patients have low immunity and are more prone to catching infection. In hospitals, food may be cooked in traditional kitchens from where it is sent to the wards, it may be purchased chilled or frozen (Refer Chapter 3 on Food Preservation) or it may be outsourced. In either case it should be ensured that the quality, presentation and portion size of meals meets the nutritional requirements. In large hospitals, food needs to travel long distances and reach in time, hence modern trolleys are needed to keep food hot. When meals are outsourced, hygienic practices followed by the caterer need to be ascertained. Regular medical checkup of all hospital staff is also necessary.

Case study–Mary Mallon

Take-away Meals and Home Deliveries

Many commercial catering outlets are offering take-away meals and home deliveries because of customer demand. These establishments offer a limited choice of popular foods at a reasonable price with little or no waiting time and offer free home deliveries within a specified distance. Packaging is an important consideration and needs to be spill–proof fitted with tight fitting lids, water–proof, non-tainting and disposable. Packaging material should be stored hygienically to prevent contamination from dust, pests or hands of the food handler. Single portion packs, complete meal packs and bulk packs are available. These packs are made of plastic, aluminium foil and cardboard plastic laminates. Some containers allow for freezing and reheating. Orders are taken on telephone and production time is short as most items are partially cooked and just need last minute cooking. These meals are popular but if not consumed immediately, the quality deteriorates.

STREET FOODS

From the earlier chapters it is clear that the simplest way to prevent wastage of food and spread of food-borne illness is to handle food in a sanitary manner. Rapid urbanisation and industrial development in Indian cities, has compelled labour from villages to shift to cities in search of employment. It is estimated that in the next 10–15 years, 50 per cent of the world's population will be living and working in urban areas. Most of these people, especially young workers and students, cannot afford the prices charged in restaurants or hotels and look for cheaper substitutes which are readily available.

To fulfil the need of supplying reasonably priced meals and snacks, a large number of eating places have been started, ranging from hawkers, roadside stalls and community kitchens to small restaurants. These joints prepare and serve quick meals and snacks at competitive rates throughout the day.

These foods are sold mainly on the streets in crowded public places, outside parks and gardens, in markets and schools, at the railway station or bus-stand, in cinema halls and auditoriums as well as in places of tourist interest.

These meals form a significant part of the daily diet of students and the working community in urban areas and thus have a major influence on health and well-being. The nutritive value and hygienic aspect are totally neglected. Poor selection of food due to ignorance or limited resources leads to malnutrition, lowered resistance to infections and diseases and this vicious cycle continues leading to further malnutrition and ill health.

The street-side food operator keeps two basic principles in mind. First of all the food served should be relished by the consumer and secondly, the operator should be able to make a good profit. That contamination is likely to occur is totally overlooked by both the seller as well as the buyer.

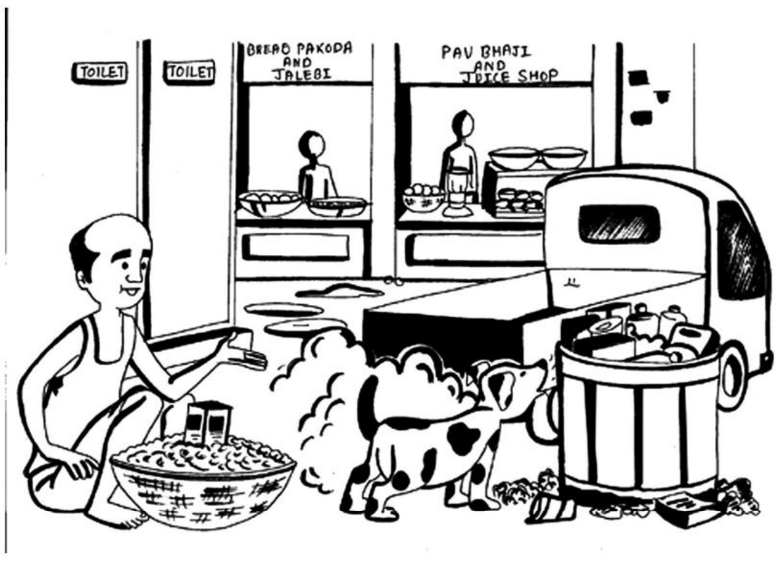


Fig. 7.2 *Unauthorised food stalls in filthy surroundings should be closed down*

Foodstuff sold on the streets can be broadly categorised into three groups:

1. street-side food stalls run by trusts, for example, Indira community kitchen, Zunka Bhakar Kendra, etc. with an aim to provide reasonably priced food to the public. This scheme is based on the 'no-profit-no-loss' principle
2. street-side food stalls managed by individuals under a licence: municipal corporations issue licences to sell food in corporation areas. The licence holders are allowed to put up stalls, sell food on foot or bicycle, or use stationary carts on a seasonal, temporary or permanent basis

3. an appreciable number of vendors sell food without any permit or licence. Their number varies according to the season, time of the day and place of business. Usually they have never undergone a medical checkup or had their premises inspected

The Food Handler

Most of the street-side food operators run their own business, which they find quite profitable. Usually, the entire family is involved in the business and the same methods of preparation, distribution and storage are carried on for generations. All family members help in some way or the other. There is no separate kitchen for preparing food, it is either prepared at home or on the stalls.

Like the consumers, the street-side food operators also come from poorer socioeconomic backgrounds.

In a study conducted on street-side food vendors in Pune, the following observation were made:

1. *Education level*: Some street-side food operators have a very low literacy level which may be the reason for not understanding the value of hygiene and sanitation (Refer Fig. 7.3).
2. *Personal hygiene:* (a) 25–30 per cent of the people handling food on the stalls had unclean nails and hair; (b) only 40 per cent wore clean clothes, 20 per cent filthy clothes and the remaining wore partially clean clothes.
3. *Habits:* (a) 75 per cent of the food handlers do not wash their hands with soap and water before handling food; (b) 70 per cent serve food with bare hands; (c) 60 per cent carry water glasses for service by dipping their fingers in the glass.
4. *Surroundings and premises:* (a) approximately 90 per cent were located in crowded areas; (b) 70 per cent were in dusty areas; (c) In 40 per cent of the places, flies were sitting on food; (d) 25 per cent were near garbage dumps; (e) 12 per cent were close to public toilets (Refer Fig. 7.2).
5. *Utensils:* (a) 13 per cent of brass utensils used were not tin-plated (b) 30 per cent of the vendors washed all plates, cups, spoons, etc. in one bucket (c) 60 per cent of the plates, spoons, etc. used for service were dirty.
6. *Water and ice:* (a) 25 per cent of the water samples were contaminated (b) 75 per cent of the ice samples were contaminated.

From the health and hygiene point of view these foods are at a high risk because of the following reasons:

1. They are usually prepared under very poor sanitary conditions and can cause various food-borne illnesses.
2. Food selection by the consumer is made on the basis of cost, appearance and satiety value and not on nutritive value or hygiene.
3. A large percentage of food handlers (both the seller at the stall as well as family members who help behind the scene) are illiterate and do not understand the basic principles of hygiene.
4. The quality of ingredients used may be substandard. Cheaper non-nutritive additives or additives that have been banned, like artificial sweeteners, colour, etc., may be used.
5. Food may be distributed from a central kitchen to various centres, increasing the chances of contamination because of more handling.

150 hit by food poisoning in city

EXPRESS NEWS SERVICE

PUNE

AT least 150 persons, including several children, were removed to the hospital on Saturday evening due to suspected food poisoning after they had a feast at Landge Aali in Bhosari.

None of the victims was serious. However, the children who suffered from acute dysentery and vomiting were kept under observation at the Yeshwantrao Chavan Memorial Hospitai (YCMH).

According to the police, a 'pooja' was organised at the residence of Shankarrao Anantrao Londhe at Landge Aali on Saturday afternoon as a ritual for his son's marriage which was held a few days ago. The 'pooja' was followed by a feast attended by 150-odd invitees.

Around 3.30 p.m. some of the invitees started suffering from dysentery and vomiting. By late evening almost all of them complained the same and were removed to the nearby Pooja Nursing Home. Some others were rushed to Chavan Hospital, Anand Hospital and Mankikar Hospital.

At the Chavan Hospital, victims were treated at the outpatient department and were allowed to go. Only children were kept back for observation, police said. The Bhosari police have taken note of the incident and inspector Vasant Bhoibar is investigating.

Vada paos, samosas lay school kids low

EXPRESS NEWS SERVICE

BOMBAY – A hundred and fourteen students of the K K Popat School, a private school in Juhu, were admitted to the R N Cooper hospital in Andheri when they exhibited symptoms of food poisoning after consuming eatables from the school canteen, here on Thursday.

The students, who were admitted to the hospital at about 11 am, had all eaten *vada pav* and *samosas* from their school canteen during their 15-minute break at 10 am. Immediately thereafter, many of them started feeling giddy, and complained of stomach ache and a burning sensation in the throat.

Twelve-year-old Jamanullah Khan, a student of the fifth standard said, "I had eaten two *vada paos* during the recess. After about ten minutes I felt a burning sensation in my throat, and my stomach started paining."

Many of the affected students went and complained to the headboy of the school, Rajesh Pawar, a XIth standard student. Rajesh too had consumed the *vada pao* and had vomited "eight times in the school premises itself." He went to the Supervisor of the school Suja Zaidi and brought to his notice the fact that many of the students who had eaten canteen food were complaining of stomach pains, giddiness and sore throats.

Zaidi immediately called an assembly and announced that

८० शालेय विद्यार्थ्यांना दुधातून विषबाधा

कुर्डूवाडी, दि. २१ (लो. वा.) - कुर्डूवाडी येथून जवळच असलेल्या मौजे कव्हे येथील जिल्हा परिषद शाळेत ८० विद्यार्थ्यांना दुधातून विषबाधा झाल्याची घटना सोमवारी सकाळी घडली

याबाबतचे वृत्त असे - सकाळी नऊच्या सुमारास शाळेतील १२० मुला-मुलींना दूधवाटप करण्यात आले. दूध प्याल्यानंतर अर्ध्या तासानेच यापैकी ८० जणांना उलट्या होऊ लागल्या. तसेच काहीजणांना जुलाबही झाले. हा प्रकार घडल्यानंतर शाळेत एकच हाहाकार माजला. दरम्यान, शिक्षकांनी व ग्रामस्थांनी तातडीने मिळेल त्या वाहनांनी विषबाधा झालेल्या मुलामुलींना कुर्डूवाडीच्या दवाखान्यात दाखल केले.

दाखल केलेल्या ८० पैकी दहाजणांची प्रकृती थोडीशी गंभीर स्वरूपाची असून, तीस विद्यार्थ्यांना उपचारानंतर घरी पाठविण्यात आले. इतर चाळीस विद्यार्थ्यांवर प्राथमिक आरोग्यकेंद्रात डॉ. महमद साचे व डॉ. अशोक मेहता हे उपचार करीत आहेत.

इडली खाल्ल्यामुळे २० जणांना विषबाधा

(आमच्या बातमीदाराकडून)

अंबरनाथ, ता. २४ - येथील ऑर्डनन्स फॅक्टरी वसाहत, एम टाईप/ ४ बी येथे राहणारा शैलेंद्रसिंग रावत याचे काल लग्न होते. लग्न समारंभात सकाळी नाश्ता म्हणून घरातील लोकांनी इडली व चटणी खाल्ली. त्यातील २० जणांना उलट्या व जुलाब झाले. चक्कर येऊ लागली. सर्वांना हॉस्पिटलात दाखल केले आहे. भावेश राणा (५ वर्षे) यांची प्रकृती चिंताजनक आहे.

Vada paos, samosas lay school kids low

▶ p 1 Col 8

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Chunk of junk

Before you head for the nearest food van for your favorite spring rolls, or keep your daily date with the *chatwallah*, take a break, for these are the breeding grounds for microbes, says **Menaka Jayashanker**

15 students die of food poisoning

JEYPORE (Orissa), Nov 20: At least 15 school children died after consuming food served to them at an ashram school run by the Orissa Government's tribal welfare department at Kolarsingh village in Koraput district yesterday, a delayed report received here today said.

Several other students were admitted to the primary health centre here on a critical condition.

Koraput chief district medical officer and the district superintendent of police and other senior district officials have rushed to the spot. Police said all the 15 students had died of suspected food poisoning.

Official sources said since the village was located in the cut off areas bordering Andhra Pradesh, the fate of other students was not immediately known.

Most of the dead students were tribals and were staying in the ashram school run by the tribal welfare department. At least 7 children were still struggling in the Padwa primary health centre. Details are awaited. (UNI)

Fig. 7.3 *How safe are foods sold from streetside stalls, kitchens run by trusts or unauthorised vendors*

6. Inadequate cooking and reheating may not destroy all microorganisms and sufficient heat may not reach the centre of the food. As food is prepared in bulk, large volumes of food take longer time to cool, so food remains in the danger-zone beyond the safe limit of four hours. Although foods are prepared in advance, storage facilities are inadequate. The time lapse between preparation and service, favours spoilage.
7. Food displayed on carts or stalls is open to contamination by dust, dirt, flies, customers, etc.
8. Indian climatic conditions favour spoilage of food as ambient temperature is ideal for maximum growth of microorganisms. In three hours time a marked increase in bacterial count is observed.
9. Unpotable water is frequently used for preparing food and the quality of ice used is poor.
10. Crockery and cutlery is cleaned by just dipping it in a bucket of water and the same water may be used throughout the day. Single service items are seldom used; if used, they are likely to be re-used.
11. There is no proper system for waste disposal.
12. Raw ingredients are not washed well, especially salad vegetables and coriander leaves, which may be grown on sewage-fertilised soil.

Table 7.1 **Bacteriological Investigation of Food Poisoning Incidences in Maharashtra Reported in 1991, 93 and 94**

Food stuff	*No. of persons affected*	*Causative agent detected*
Rice	186	*Bacillus cereus*
Pulao	25	*Bacillus cereus*
Masale bhat	25	*Bacillus cereus*
Bajri bhakri		*Ergot*
Sandwich		*Staph. aureus*
Dal		*Bacillus cereus*
Chiwda	01	*Bacillus cereus*
Rassa	08	*Bacillus cereus*
Tilgul	71	*Bacillus cereus*
Gulab Jam		*Staph. aureus*
Shira	470/29	*Staph. aureus/Bacillus cereus*
Barfi	1/5	*Bacillus cereus/Staph aureus*
Malai barfi	6	*Bacillus cereus*
Pedha	7	*Staph. aureus*
Basundi	193	*Staph. aureus*
Khoa	64	*Staph. aureus*
Milk	641/18	*Staph. aureus/Bacillus cereus*

Contd...

Table 7.1 (Contd)

Food stuff	*No. of persons affected*	*Causative agent detected*
Milk cold drink	46	*Bacillus cereus*
Raw milk	46	*Bacillus cereus*
Water	76	*E. coli*
Ice candy		*Bacillus cereus/E. coli*

How Safe are Foods Sold on the Streets?

Microbiological and chemical testing of various food items sold on the streets for the presence of harmful organisms or chemical contaminants reveals, that street foods are not always safe.

Consumers often suffer from diarrhoea, vomiting, stomach ache, indigestion, acidity and throat infections after consuming unhygienically prepared and handled foods. The ice and water used is very often contaminated. Even cooked foods having low moisture content which should normally not contain microorganisms, are found to be contaminated. The presence of microorganisms in food cooked by application of adequate heat indicates contamination after preparation, i.e. by unhygienic handling and storage after cooking.

Table 7.2 **Microbial Contamination of Snacks in Descending Order (Based on Total Microorganisms Present)**

1. *Bhel*	6. *Paneer pattis*
2. *Ragda pattis*	7. *Misal*
3. *Pani puri*	8. *Bhajia*
4. *Dahi sev batata puri*	9. *Dahi wada*
5. *Idli chutney*	10. *Dahi puri*

Table 7.3 tells us which foods are safe and why and how food contamination takes place.

Table 7.3 **How Safe are Foods Sold on the Streets?**

S.No.	*Food stuff*	*Reason for contamination if any*	*Safety level*
1.	*Cereals* (a) Rice (Boiled rice, *biriyani* and *pulao)*	Rice grains not washed well; when rice is cooked in bulk, large quantities cool slowly	Boiled rice gets most contaminated
	(b) Other cereals *(Thalipeeth, methi paratha, dosa* and *uttappam)*	These are not usually contaminated because they are prepared fresh and served hot, and there are no leftovers. Dosa batter has high levels of copper from brass vessels used for preparation and which are not tin-plated	Comparatively safer than rice

Contd...

Table 7.3 (Contd)

S.No.	Food stuff	Reason for contamination if any	Safety level
2.	*Snacks* (a) *Bhel*	No cooking involved, mixed by hands, raw contaminated ingredients used like green chutney, tamarind chutney, garnish	Highest microbiological contamination
	(b) *Ragda pattis*	Potatoes not washed well. Potato *pattis* prepared in advance, unhygienic storage, coriander chutney	High microbial count
	(c) *Pani puri*	Method of service is unhygienic, spices are stuffed in *puris* by hand and dipping hands in tamarind water container, dirty hands and contaminated water	High microbial count
	(d) *Misal*	Unwashed chopped raw vegetables, sprinkling water on vegetables to keep them fresh	Moderately contaminated
	(e) *Pav-wada*	Stale and contaminated *pav, wadas* prepared in advance and stored unhygienically	Moderate contamination
	(f) Curd-based snacks *(dahi wada, dahi puri)*	Acidic nature of curds is protective, metallic contaminants because of brass vessels that are not tin-plated	Less contaminated by microbes
	(g) Boiled egg, tender coconut	Natural protective covering prevents contamination	Safe
	(h) Vegetable sandwich	Green chutney, cucumber and tomato slices cut in advance and sprinkled with water	Moderate contamination
3.	*Sweet meats* (a) Milk-based sweets	Unhygienic preparation, processing, storage, handling and packaging	Heavy microbial count
	(b) *Jilebi* and *boondi laddu*	Toxic artificial coal tar colours like metanil yellow and orange II	If stored covered, low microbial count
4.	*Beverages* (a) Bottled soft drinks, tetrapack	Prepared, processed and stored hygienically	Safe
	(b) Sugarcane juice	Ice, flies, dirty hands	High level of contamination
	(c) Other soft drinks and Juices	Ice, fruit washed in dirty water, dirty utensils, non-permitted artificial sweeteners	Unsafe

Contd...

Table 7.3 (Contd)

S.No.	*Food stuff*	*Reason for contamination if any*	*Safety level*
5.	*Ice cream* Ice cream, *Kulfi,* ice candy, ice-lolly and pepsi-cola	Unpasteurised milk, unclean equipment; dirty cones, cups, sticks and wrappers; contaminated hands and ice; dirty containers or moulds	Unsafe, very poor bacteriological quality
6.	*Water*	Stored in unclean storage tanks which have no tap; any container dipped in water adds to the contamination; water supply may be contaminated in remote areas	Heavy contamination
7.	*Fruits* (a) *Whole fruits* mulberry, jamun, figs, strawberries, kalimaina	Perishable nature; poor sanitary conditions during transport, storage, distribution; cross-contamination on roadside stall/ handcart	Highly contaminated
	(b) *Cut fruits* water melon, pineapple, jack fruit and musk melon	Unclean knife, dust, flies, use of polluted water for washing fruit or for sprinkling on cut fruit to retain freshness	Highly contaminated
	(c) *Whole fruits* apple, banana, citrus fruit, ber (zizyphus or Indian plum) and custard apple	Not contaminated because of thick protective peel	Safe

Water

Heavy contamination of faecal origin is likely to cause diarrhoea and dysentery. Thirty per cent of the water samples collected from storage tanks of street-side food sellers in Pune, India in 1986 did not meet the standards set by WHO for potable water. These samples were also found to have a coliform count of more than 16 per 100 ml water. Fifteen per cent of the samples had high faecal coliform counts. *E. coli* and *Salmonella* were also detected. Water used by hawkers is not always safe, unless piped water supply is available and is stored in clean, covered containers fitted with a tap.

STREET SIDE FOODS AND DISEASES

A high level of contamination is seen in almost all types of ice creams, *kulfis* and ice candy sold by unlicenced manufacturers. This is one reason for the outbreaks of gastroenteritis among street children.

Fig. 7.4 *Hawker selling kulfi—equipment and food is exposed to dust and pests*

Apart from frozen foods which are popular in summer, snacks, soft drinks and fruits are the most popular street foods. They form a part of the daily diet of consumers.

As many food handlers and consumers are ignorant about basic sanitation and hygiene, it is not surprising to note that diseases are prevalent in the country. In the street foods studied in Pune, organisms which cause food-borne disease like *E. coli*, *Bacillus cereus*, *Salmonella* sp. and *Staphylococcus aureus* were detected in some samples.

Suggestions for Improving Street Food Practices

To keep food safe is a global public health problem. Listed below are some valuable suggestions:

1. Hawkers and other street-side food sellers should not be allowed to handle food without a permit or licence.
2. All food handlers should have a free medical check up every six months in a corporation hospital. This should be made compulsory otherwise their permit should be cancelled.
3. All food handlers should be educated on matters related to personal hygiene, basic health and hygienic handling of food. For this purpose, use of media and consumer organisations should be sought. Overall literacy level should be increased.
4. All stalls located near garbage dumps, urinals or any other insanitary place should be closed down.
5. Proper disposal of wastewater and solid matter is necessary. A bin should be kept for disposal of garbage. A larger bin would be required if single service items are used.
6. Only potable water should be used. Water should be stored in a clean, covered tank or drum fitted with a tap. Hands or any utensil should not be dipped in the source of water. A special long handled scoop should be used for removing water. To disinfect water, it should be chlorinated.

7. Ready-to-eat foods should be stored hygienically at appropriate temperatures and should be well protected from flies, dust, wind and contamination from consumers.
8. Ready-to-eat foods should not be handled with bare hands. Instead, disposable gloves, tongs, spoons, etc. should be used. Handwashing facility should also be available.
9. Plates, spoons, cups and glasses and any other item that comes in contact with the lips or with food, should be washed with detergent and clean hot water. Mouth and food contact surfaces should not be touched with bare hands.
10. Water sprinkled on vegetables and fruits to keep them fresh should be potable. Even water used for washing ingredients and equipment should be potable.
11. A ban should be imposed on the sale of exposed food products, cut fruits and vegetables and other items which have been displayed uncovered or for long periods of time.
12. All items that are served raw should be handled very carefully, for example, coriander chutney, tamarind chutney and coconut chutney served with snacks as well as raw ingredients like chopped onion, tomato, coriander leaves, etc. used as garnish in snacks. Raw vegetables should be washed in a solution of sodium hypochlorite or potassium permanganate.
13. Ice used in sugarcane juice and other beverages should be manufactured from drinking water only. Ice should be protected from contamination from flies, dust, dirty saw dust and sacks. Ice used to chill soft drink bottles should not be added to any beverage.
14. Special emphasis on regulation, control and inspection is necessary to provide pure wholesome food.
15. A change in the system of issuing and renewing licences would help. Granting a licence should be based on successful participation in a short-term course on food hygiene and sanitation.

SUMMARY

Special food operations have been set up to keep pace with the changing times and to supply meals to people according to their convenience and budget. They cater to the needs of people from all walks of life and include mobile units, temporary establishments, vending machines, outdoor catering, hawkers and hand cart operators, roadside stalls, community kitchens, transport caterers and small restaurants serving fast foods.

The food handler in all these operations should be made to understand that food needs to be protected irrespective of how it reaches the consumer. Mobile food units may collect food from a central kitchen or food may be cooked in the unit itself. Food is supplied to selected areas in this way. Temporary food service establishments are set up for a single event for a short duration. Vending machines are used for dispensing hot or cold foods and may be operated manually or by coins. Outdoor caterers cater for home parties or special functions at any selected venue.

To supply quick meals mainly to the students and the working community, street foods have gained popularity. These meals are readily available, affordable and look attractive and appetising. However, they may not always be safe. The food handlers are often illiterate and unclean. They put up stalls in filthy surroundings without proper water supply. The consumers supposedly overlook these factors and relish the food being served. It is not surprising to note that the number of cases of food-borne illnesses is on the increase.

Microbiological analysis of street foods has revealed that some of these foods are highly contaminated with harmful microorganisms. These foods have a high bacterial count and the presence of coliform organisms indicates faecal contamination. The water and ice used is also heavily contaminated in many cases.

To keep food safe, the food handler should be medically fit, have a valid licence, should be educated in matters related to personal and food hygiene and should practice safe food handling and service. The local health authority should lay special emphasis on clean food practices.

Transport catering or meals provided on trains, on cruise liners or by in-flight caterers also pose special hygiene and health related issues that need to be understood. With the number of travellers growing rapidly and the increase in work hours, people not only depend on meals served while travelling but look forward to purchasing reasonably priced take-away meals while returning home from work.

Hospital food service forms part of welfare catering operations and type of meals served differs from the commercial catering.

KEY TERMS

Commissary A large central kitchen that provides meals to other smaller kitchens, mobile vans, satellite kitchens etc.

Dry ice Carbon dioxide solidified and compressed into snowlike cakes that vaporise at –78.5°C without liquifying. It is used as a refrigerant.

Foot Candle Unit of light intensity measured with a light meter.
One foot candle = one lumen per sq.ft. A lumen is a measure of power equal to 0.0015 watt.

Galley The Kitchen in a ship.

Gray water Waste water from the toilets and bathrooms on board a ship that is treated before being released into the sea at a specified distance from the shore.

Hi-loader Transport used for transferring meals from the In-flight caterer to the airline galley and returning used equipment to the caterer.

In-flight caterers Special caterers who provide meals to passengers on airlines and carry out one of the most extensive food production operations using high standards of hygiene.

Mobile food unit A catering unit on wheels that operates in one or more locations like hand carts, catering vans, etc., which are designed specially.

Temporary food service establishment A food establishment set up for a single event or celebration and operates at a fixed location for not more than two weeks.

Three bucket system Cleaning carried out using three buckets for washing, rinsing and sanitising surfaces.

Welfare catering Catering for hospitals, schools, colleges, Armed forces, etc., where the focus is not profit making but to minimise cost and cover overheads through maximum efficiency.

REVIEW QUESTIONS

1. Select the most appropriate answer in the following.
   (a) The presence of *E. coli* in food indicates faecal contamination from
      (i) poor personal hygiene
      (ii) improperly washed vegetables
      (iii) overcooked food
      (iv) unpotable water used in cooking
         I. (ii) and (iv) only
         II. (iii) only
         III. (i) and (iii) only
         IV. (i), (ii) and (iv) only

(b) Curd-based snacks are safer to eat because
   (i) pH of curd is acidic
   (ii) milk is a buffer
   (iii) curd is easy to digest
   (iv) curd is always made from pasteurised milk

(c) *Kulfi* and ice candy sold by unauthorised vendors is harmful because
   (i) unsafe milk is used
   (ii) they are stored at freezing temperature
   (iii) cups, cones and sticks have a heavy load of microorganisms
   (iv) ice used is contaminated
      I. (i), (ii) and (iii) only
      II. (i), (iii) and (iv) only
      III. (ii) only
      IV. (iv) only

(d) Which one of the following containers should not be used in microwave ovens
   (i) glass
   (ii) chinaware
   (iii) silver
   (iv) plastic

(e) All food handlers should have a free medical check-up in a corporation hospital every
   (i) two years
   (ii) one year
   (iii) six months
   (iv) three months

(f) Ice is responsible for causing food-borne illnesses when
   (i) it is prepared from unpotable water
   (ii) it melts in the beverage
   (iii) it is contaminated by flies, dust and dirty sawdust
   (iv) it is used to set cold sweets instead of a refrigerator
      I. (i) and (iii) only
      II. (ii) and (iv) only
      III. (i), (ii), (iii) and (iv)
      IV. None of the above

(g) After consuming *idlis* and coffee, which one of the following is most likely to be responsible for causing diarrhoea
   (i) *idlis*
   (ii) coconut *chutney*
   (iii) *sambhar*
   (iv) coffee

(h) *Bhel* is easily contaminated because
   (i) it is mixed by bare hands
   (ii) coriander and tamarind *chutney* are added
   (iii) it is a mixture of raw and cooked ingredients
   (iv) all of the above

(i) Food prepared and served by unlicensed outdoor caterers is at a greater risk of contamination because
   (i) casual labour employed may not be medically fit
   (ii) food is unprotected during preparation and service
   (iii) potable water supply may be inadequate or unavailable
   (iv) cleanliness and maintenance of hired equipment is doubtful
   (v) all of the above

(j) Street foods have become popular because of all statements except one
   (i) easily available
   (ii) they are wholesome and nutritive
   (iii) rapid urbanisation and development
   (iv) they are reasonably priced

(k) A vending machine is used for
   (i) washing large pots and pans
   (ii) keeping food chilled
   (iii) washing linen
   (iv) dispensing food

(l) It is safer for mobile food units to
   (i) use single service items
   (ii) sell prepacked foods and beverages
   (iii) cook, serve and store their own food
   (iv) collect food from a central kitchen
      I. (i), (ii), (iii) and (iv)
      II. (i), (ii) and (iv)
      III. (ii), (iii) and (iv)
      IV. (i), (ii) and (iii)

(m) In temporary food service establishments common problems faced are
  (i) insects and dust
  (ii) insufficient clientele
  (iii) inadequate sanitary conveniences
  (iv) people carry their own meals
    I. (i) and (iii)
    II. (ii) and (iv)
    III. none of the above
    IV. all of the above

(n) To reduce the risk of food poisoning, perishable items dispensed from a vending machine intended to be consumed hot should be
  (i) heated to 63°C (145°F) within two hours in machine
  (ii) dispensed chilled and heated in a microwave oven
  (iii) heated to 63°C (145°F) within six hours in machine
  (iv) held at boiling point throughout the day
    I. (i) and (ii)
    II. (iii) and (iv)
    III. (i) and (iv)
    IV. (ii) and (iii)

(o) Which of the following statements are correct about special food operations
  (i) they need special consideration
  (ii) they serve only speciality cuisine
  (iii) they may cater to special events at far off places
  (iv) food served is highly priced and ill affordable

2. State whether True or False.
  (a) High risk foods which require elaborate preparations should never be prepared in temporary food service units.
  (b) All vending machines should be thermostatically controlled and have a thermometer fitted.
  (c) Presence of microorganisms in adequately cooked foods indicates unhygienic handling and storage.
  (d) The sale of food items which are displayed uncovered for long durations should be banned.
  (e) A large number of hawkers do not possess a permit to sell food.
  (f) Carriers can be allowed to handle food so long as they have no visible symptoms of the disease.
  (g) Sandwiches spoil mainly because of the nature of filling used.
  (h) Copper poisoning can occur when acidic foods are prepared in untinned brass vessels.

3. Fill in the blanks with suitable words.
  (a) __________ and __________ are toxic yellow colours added to sweetmeats but banned by law.
  (b) Foods with a __________ __________ like boiled eggs and tender coconut are safer to eat.
  (c) The microorganisms __________ and __________ are generally found in sugarcane juice.
  (d) Locally prepared (soft) drinks sweetened with __________ are harmful.
  (e) Vending machines can be operated __________ or by dropping a __________.
  (f) Vending machines can dispense both __________ and __________ foods.

4. List the different categories into which street foods are divided.

5. What are the adverse effects of consuming insanitary street foods?

6. From the hygiene and sanitation point of view, describe the street food operator.

7. Match the food items in Column *A* with microorganisms causing spoilage in Column *B*

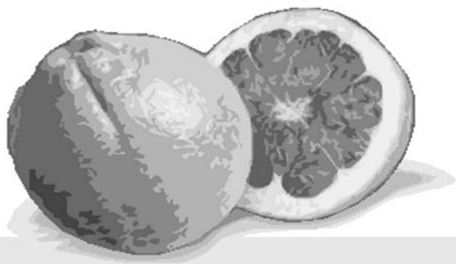
A	*B*
1. Rice	(a) mould
2. Milk and milk products	(b) *Escherichia coli*
3. Water	(c) *Bacillus cereus*
4. Canned food	(d) yeast
5. Soft drinks	(e) *Staphylococcus aureus*
6. Bread	(f) *Clostridium*

8. Why are street foods at a greater risk of spreading food-borne illnesses?
9. How should ready-to-eat foods be stored and served?
10. Give practicable suggestions for improving the hygienic quality of street foods.
11. How do cut-fruits get contaminated?
12. List four microorganisms commonly present in street foods.
13. What is the main function of a mobile food unit and what facilities should it have to serve safe food?
14. What is a commissary?
15. Why is hygiene of special importance to in-flight caterers?
16. How is waste disposed while at sea?
17. With the help of a flowchart explain the various steps in airline catering.
18. What points would you keep in mind while selecting packaging material for take-away food?
19. What is the government's role in improving railway catering?
20. How does hospital food service differ from commercial food service?
21. Why are patients at a higher risk of getting an infection?

Part III

SANITATION OF PREMISES AND ENVIRONMENT

- Location, Layout and Construction of Premises
- Equipment, Furniture and Fixtures
- Cleaning Procedures
- Pest Control
- Water Supply
- Storage and Disposal of Waste
- Environmental Pollution



8

- **Layout of premises**
- **Building interiors: floors, walls, ceilings, staircases, lifts**
- **Ventilation**
- **Enconditioning**
- **Lighting**

Location, Layout and Construction of Premises

INTRODUCTION

While selecting a location for starting a catering establishment, the proprieter usually considers the following:

1. the cost of land and construction of building, or the rent which will have to be paid for a ready site
2. overhead costs incurred
3. equipment, fittings, fixtures and furnishings required
4. number and type of potential customers

Apart from these considerations, it is necessary to give a careful thought to the hygiene aspect. This is crucial for the business to run successfully, otherwise a large portion of money would be spent on trying to maintain hygienic standards in the establishment.

Some of the important aspects which should not be neglected are listed below.

1. *Air:* The surrounding atmosphere should be free from pollutants like smoke, dust and fumes.
2. *Vicinity:* The area around the establishment should be clean. Garbage dumps and stagnant water in the vicinity encourage breeding of rodents, flies and mosquitoes.
3. *Water supply:* An adequate supply of potable water should be available round the clock and the premises should have sufficient storage tanks, wash basins and sanitary conveniences which are suitably located. Proper sewage disposal facilities should be available.

Fig. 8.1 *An untidy and poorly planned kitchen affects work efficiency and sanitation*

4. *Lighting and ventilation:* Natural light and ventilation is preferred in the premises. Dark and dingy rooms and passages should be avoided. Basement kitchens need special lighting and ventilation. Careful consideration while planning windows and drains is necessary to prevent contamination of food.
5. *Space:*
   (a) In the kitchen: The work area should be large enough to
   - ensure safety at work
   - provide convenience and comfort to the workers
   - prevent overcrowding
   - avoid criss-crossing of traffic lines
   - prevent queueing at sinks and wash basins
   - reduce unnecessary walking
   - ensure adequate work tables and storage space
   - keep cooked and raw food apart.

If the work area is not well planned, the employee may tend to overlook hygienic practices while handling food. A poorly set up establishment leads to wastage of time and energy, frustrations and difficulties, and increases the likelihood of accidents. In short, it affects the overall work achieved in terms of quality and quantity.

The kitchen and dish-washing area should generally be approximately half the size of the service area. Each worker requires 3 m^2 (33 sq ft) of floor area to enable him to work comfortably. The minimum size of the kitchen should be 9.3 m^2 (100 sq ft) and ceiling should be at a minimum height of 2.5 m (8 ft).

(b) In the service area:
- tables and chairs should be well spaced with no overcrowding
- waiters should be able to serve all customers, and clear and clean all tables comfortably. For a restaurant having a capacity of fifty covers, the space required is 1.4 m^2 (15 sq ft) per cover and 1 m^2 (12 sq ft) if capacity exceeds 50 covers.

LAYOUT OF PREMISES

A well planned and designed food service area is a prerequisite for maintaining high standards of sanitation. Premises should be planned to facilitate cleaning and all equipment should be designed and arranged to prevent accumulation of soil and contamination of food.

An ideal situation would be one where things move forward in orderly progression, beginning from receiving food in the stores to preparation, service and cleaning up. If food has to move through a shorter distance and if it is handled less, the chances of it getting contaminated will be greatly reduced.

While planning the layout it is necessary to understand the purpose of every piece of equipment and every room and avoid wastage of money and space by building unnecessary corridors or rooms of inappropriate sizes.

The Receiving Area

The receiving area is located near the stores. The stores should be so located that food is brought in by the shortest route. This entrance is separate from the customers entrance and opens into a cemented yard. Adequate space should be provided for delivery vans to stop in front of the door and deliver goods at the doorstep. The gas bank and garbage bins should be located in the yard.

The Storage Area

This includes the dry food store, the cold store and the frozen stores. All these areas are located near the goods receiving entrance. Each area should have a sink, a drain and a garbage bin. Specifications for each area have already been discussed in Chapter 6.

The Kitchen

The kitchen is divided into two areas—the hot kitchen and the cold kitchen. The kitchen is accessible only to kitchen employees and should not be used as a thoroughfare or a shortcut to reach other parts of the building. Depending on the size and type of establishment, the kitchen may be divided into separate rooms for separate activities or all sections may be included in one large room and different areas demarcated for different activities. The main point to be kept in mind here is that the flow of work should not be hampered.

While planning the kitchen layout begin with listing down the following:

1. different sections which are to be included
2. nature of work done in these sections
3. equipment which is to be installed

4. natural ventilation and lighting available
5. water supply
6. location of sinks and drains
7. furniture and fixtures needed

The kind and volume of equipment, furniture and fixtures required will depend on the type of establishment, volume of business and space available. If space is a constraint, it is advisable to utilise wall space. Built-in cupboards, fixed racks and shelves as well as folding or collapsible furniture do not use up floor space. All fixed equipment and shelves should be easy to clean. Other equipment should be arranged so that there is sufficient area for routine cleaning.

Cooking ranges can be placed in the centre of the room, away from doors, to keep dust and air draughts away. They should have a canopy or hood and an exhaust fan to remove fumes and odour from the kitchen.

Sinks should be placed against the external wall, closest to the drain. Each work table should ideally have a removable garbage bin fitted on a trolley placed under the table. All work tables should be movable and easy to clean.

The rice boiler and potato peeler should be located near a drain. It should be fitted with a strainer and a trap for catching the wastes. The dry preparation zone of the kitchen should have running hot and cold water sinks.

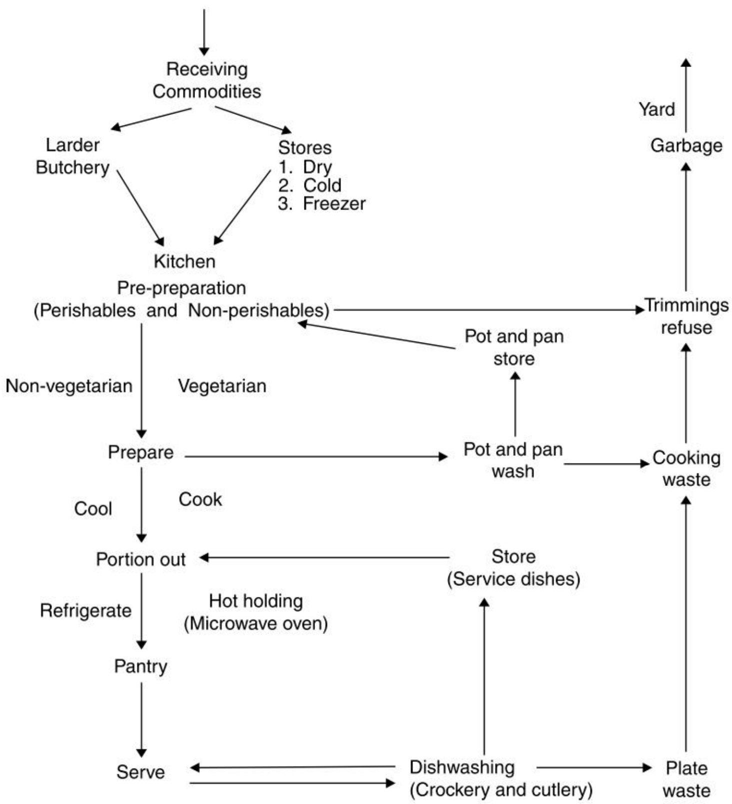


Fig. 8.2 *Layout of a kitchen ensuring smooth flow of work*

Sufficient storage space should be provided for other small equipment when not in use. Pots and pans should be stored upside down on racks or slatted shelves. Pots and pans with long handles should be stored on hooks. No utensils or food should be placed on the floor.

The refrigerator should be located in a cool place, as far as possible from any source of heat. Every kitchen should have freezer, chiller and cooling store facilities, even if all three are in the same unit.

Washing Up A separate washing up area should be available for (i) pots and pans, and should be located near the preparation area, and (ii) crockery and cutlery and should be near the pantry.

The wash up area should not be located near food preparation and storage areas. Sinks used for washing pots, pans and crockery should not be used for handwashing or washing foodstuff.

Washed and dried dishes should be stored in clean, dry cupboards located near both the kitchen and service area.

The crockery store should be protected from pests and dust. Plates can be stacked on drying racks and cups can be stored bottom upwards in wiretrays. Cutlery is stored in partitioned drawers or in partitioned covered boxes or trays.

The service linen cupboard should be closer to the dining area. The pantry should be located between the kitchen and dining area and should allow forward flow of food from kitchen to the restaurant or dining area. The restaurant should have two doors—one leading in from the pantry and one leading to the wash up area.

Staff Rooms

Changing rooms equipped with lockers should be provided for all employees. Lockers should be large enough to accommodate hangers. Protective clothes and outdoor clothes should be kept separately. The use of the kitchen as a changing room or staff room should be discouraged. Clothes hanging or drying in the food preparation area is not only unsightly but unhygienic as well. The changing rooms should have good washing facilities. A linen basket must be provided for dirty linen. Laundering, repair and replacement of worn out protective clothing is the responsibility of the management.

Sanitary Accommodation

Facilities should be adequate, convenient, hygienic and well stocked. Separate sanitary accommodation is necessary for employees and customers and should be readily accessible at a distance of 3 m. These rooms should be well equipped. Separate rooms should be provided for males and females and labelled accordingly. Sanitary towel disposers or bins should be fitted in the ladies toilets with instructions for use clearly mentioned, or they should be disposed by wrapping in disposable bags and discarding in a covered bin.

Toilets should be well lit and properly ventilated. They should not open directly into the food area. A well ventilated corridor or space between the toilet and food preparation area or service area is a desirable feature. Adequate toilets and wash basins should be provided. Wash basins should be made of porcelain or stainless steel and should be used for hand washing only. A continuous supply of hot and cold water should be ideally available at each wash basin. Soap should be kept in a suitable container. Each basin should have a foot operated bin for disposal of towels, etc. Alternatively, a warm air dryer can be provided. They are the most hygienic way of drying hands. Instructions for operating the hand dryer should be displayed near the machine.

BUILDING INTERIORS

Sanitation should be kept in mind right from the time when the building plan is being prepared. As far as possible built-in sanitation should be looked for in the construction design as well as in every piece of equipment, fittings, fixtures and utilities.

Apart from good appearance, the cleanability, life and maintenance required are important factors which have to be considered. Before selecting any material, the manager should review the following points.

1. Is the surface smooth or will it harbour dust, dirt and pests?
2. Can soil be washed off easily?
3. Will it withstand regular cleaning and use?
4. How long will it be of service or will it need frequent maintenance and replacement?
5. Can the surface finish be changed?

If all the above points are not thought about while selecting material for walls, ceilings and floors, the food service manager will be faced with a difficult and expensive task in maintaining a high level of sanitation desirable in the establishment.

Interiors chosen only on the basis of appearance and which are difficult to clean will look good for a shortwhile only. Once soiled, they will look much worse. Grease, dust, betelnut stains, food stains and cobwebs are often seen on floors, walls and ceilings, and if this is not completely removed the place will have a permanently dirty look.

Floors

The floors in work areas of catering establishments should be made of durable material because of the following reasons:

1. they have to withstand heavy traffic.
2. equipment used is heavy duty equipment which weighs a lot.
3. they are exposed to high temperatures.
4. water and grease is likely to spill on floors.
5. frequent cleaning is necessary.

The floors should be sturdy, easy to clean and resistant to the effect of hot water, sanitisers and detergents. They should be non-absorbent, grease resistant, dirt resistant, smooth, sealed and pest resistant. They should also be non-slippery and impervious. In areas where floors have to be washed regularly, like walk-in refrigerators, a drainage system and slope should be provided. Floors should be self draining. All drains should have a perforated removable metal cover and should be tiled underneath. Any spillage should be mopped up immediately to prevent falls.

Floors can be made from a variety of materials which may be natural or manmade. The manager should choose flooring on the basis of its quality and the budget available. Natural materials include a wide selection of quarry tiles such as Shahbad, Kota, Kadappa; marble; wood; concrete; granite; mosaic and ceramic.

Manmade materials include linoleum, vinyl, vinyl asbestos, rubber and cork.

Table 8.1 lists the characteristics of common flooring material.

Table 8.1 **Characteristics of Various Flooring Material**

S.No.	*Material*	*Composition source*	*Characteristics*	*Damaged by*	*Area where recommended*
1.	Asphalt	Tar-like substance obtained from petroleum, mixed with gravel, sand or cement	Inexpensive, dust-free, waterproof, jointless surface which can be easily coved to form skirting	Heavy weight, grease and soap, excessive heat	Kitchen
2.	Carpeting	Wool, jute, synthetic fibres—nylon, polyester	Attractive appearance, absorbs sound, shock; needs lot of maintenance; not used in food preparation areas; variety of textures available; resilient flooring	Spilt food and liquid	Dining area, office
3.	Ceramic tiles	Made from refined clay which is fired and glazed	Too slippery to use on floors; non-absorbent, grease resistant; cement between and under the tile is subject to maintenance; ideal for walls	Heavy equipment, steel wool leaves rust stains, paints	Toilet, bath walls, splash backs, kitchen walls
4.	Concrete	Cement, sand and gravel (burned lime, clay mixed with water, sand and gravel)	Inexpensive, highly porous; may be used in food preparation areas only if properly sealed and finished; can be covered with linoleum and used in service areas	Detergent, stains removed with difficulty	Stores
5.	Cork	Light, thick, elastic outer bark of oak, wood shavings, resins	Accumulates dust; cracks easily; has to be sealed; not fireproof or waterproof; used for acoustic tiles; not durable	Spills, heavy weight, water	Linen room, wall tiles
6.	Granite	Very hard, crystalline plutonic rock containing feldspar, quartz and minerals	Very durable resilient flooring; expensive, non-absorbent grey to pink in colour; easy to maintain; beautiful	—	Dining area, kitchen platforms

Contd...

Table 8.1 (Contd.)

S.No.	*Material*	*Composition source*	*Characteristics*	*Damaged by*	*Area where recommended*
7.	Granolithic	Concrete containing crushed or chipped granite or other stone	Inexpensive; can develop cracks; difficult to colour	Same as for concrete	Staircases
8.	Linoleum	Ground cork, wood, gums, linseed oil and canvas	Non-absorbent; inexpensive; easy to instal; resists temperature changes; resilient flooring	Develops holes by heavy concentrated load; alkali, excessive moisture	Dining area, stores
9.	Magnesite	Mineral occurring in white compact masses	Very durable; grease resistant; needs to be sealed every six months and dried after cleaning	Excessive water, strong acids and alkalis	Food preparation areas
10.	Marble	Kind of limestone	Very expensive, beautiful; easy to maintain	Gets discoloured; abrasives, acids and alkali	Dining area
11.	Mosaic	Grey cement with marble chips	Inexpensive (relatively); absorbs grease; cement grouting needs maintenance	Oil or grease stains, casters (small swivelled wheels enabling heavy equipment to move)	Dining area
12.	Quarry tiles (a) Kadappa (b) Kota	Natural stone quarries	Durable, non-absorbent; black colour ideal for work surfaces; easy to clean; Shades of grey; non-absorbent; comparatively expensive; very durable	Cement grout is subject to wear and tear	Platforms and shelves in the kitchen and stores. Food preparation floors and dining area

Contd...

Table 8.1 (Contd)

S.No.	*Material*	*Composition source*	*Characteristics*	*Damaged by*	*Area where recommended*
	(c) Shahbad		Inexpensive non–absorbent; grease resistant; very durable; polished or finished tiles are slippery		Kitchen, stores
13.	Rubber	Man-made	Resilient flooring; non-absorbent, waterproof, stain resistant; difficult to maintain	Grease, oil	Dining area/ bathroom area
14.	Terracotta	Baked clay	Hard, durable, usually unglazed; easy to mould; buff to brown red colour	Cracks by heavy weight	Decorative panels in the lounge, kitchen
15.	Terrazo	70 per cent marble chips set in 30 per cent white cement and polished.	Non-absorbent if sealed properly; durable, attractive, easy to maintain; slippery if polished; expensive	Alkali, acid, rust	Dining area
16.	Vinyl	Man-made	Grease and water resistant, very durable, attractive, easy to clean; water seepage can loosen tiles; single tile can be changed; resilient	Water seepage	Dining area
17.	Wooden (Hard wood)	Natural; In food establishments it should be treated with plastic	Expensive; slippery if finished; needs regular maintenance; used as foundation for other man-made floorings; joints should be sealed; hardwood should be impregnated with plastic	Abrasives, dust, insects, moisture, spills	Dining area

On the whole, flooring should offer complete unbroken surfaces. If jointed, the joints or grouts should be carefully made and well sealed.

Easily cleanable carpeting is also permissible in restaurants. Carpeting should be properly installed and only used in areas where no food or beverage preparation takes place. They create warmth, deaden sound and provide safety from falls and breakages as long as they are well installed. Carpets are made of wool, nylon, polyester, olefin and jute. They should be vacuum cleaned daily and shampooed regularly to remove food spillages, dirt and dust. If cleaning is a problem, granite can be used in restaurants. Although initial cost is high it requires little maintenance and looks beautiful.

Mats and duckboards should be used on slippery floors. They should be easy to remove and clean.

Areas which obstruct routine cleaning—like flooring behind fixed equipment, below tables and racks, at the junction of the floor and wall—need extra attention.

Walls

Walls should be smooth, durable, impervious, washable and light in colour. They should be rounded at junctions with floors and ceilings. They should be in good repair to prevent accumulation of dust, dirt and vermin and to make cleaning easy. All cracks and crevices should be sealed to prevent pests from entering and multiplying.

The best finish for walls in the kitchen and wash up area is ceramic tiles. If only the lower part of the wall is tiled, then it should extend till a height of 1.8 m (6 feet). Walls that are not tiled should be plastered.

Types of Wall Finishes

Dry distemper or coloured lime washed walls They will not stand frequent cleaning. Washable oil- bound distemper can stand regular washing but might pose a problem while removing absorbed grease. Grease marks can be rubbed off with the help of turpentine. Non-washable distemper rubs off easily and is not suitable for walls in a catering establishment.

Emulsion paints Emulsion paints can be used over distempered surfaces but they cannot be applied directly over gloss finished surfaces. These surfaces have to be roughened by rubbing down with sand or glass paper. A plastic finish can be applied directly over concrete, brickwork, wood, stone or galvanised iron. It can also be directly applied over painted or distempered surfaces. The advantage of plastic paint is that it does not crack or discolour and can withstand water and repeated scrubbing with acidic and alkaline cleaning agents. Other varieties of paints available for use are PVC, acrylic, enamel, epoxy and rubber paint. Textured paint finishes are not recommended. Lead-based paints are not suitable in food service areas as accidental flaking or chipping can cause food poisoning.

Wall paper It is not suitable for the kitchen where food is prepared as it tends to peel off with the high heat and humidity. Plastic coated papers can be used in dry areas. Paint should be used for the walls of the dry food store as it is easy to clean.

Splash plates, tiles and panels Walls behind cooking ranges, ovens and grills can spoil because of excessive heat, grease and steam of normal working. Walls in the kitchen, especially those near the sink and cooking equipment, should be able to withstand moisture, high temperature and physical damage. Splash plates or tiled surfaces should be provided near the equipment on the wall. Ceramic tiles should be evenly fitted and should have a smooth, waterproof and continuous grouting. Stainless steel is more durable than tiles and is a better option in areas where wear and tear is high.

Plastic tiles may be used in cool places but they are likely to lose their glossy surface even under light abrasive cleaning.

Glass panels are suitable for wall areas likely to become dirty and those that need frequent cleaning.

The ability to get cleaned is thus an important criterion in selecting wall finishes. Walls should help in noise reduction by absorbing sound. Light coloured walls show up dirt and improve distribution of light, which is why they are preferred.

Ceilings

All ceilings should be free from cobwebs, cracks and flaking. They should not harbour dirt, should be easily cleanable and should absorb moisture, especially in wet preparation areas. Suitable ceilings can be made of plaster with a smooth continuous lower surface. Insulation material like glass wool or fibre glass should be used in areas where a large amount of steam is generated. In such cases ceilings should be finished with hard gloss paint. If ceilings are not insulated, the absorbent material used may be plaster, which can be finished with a soft non-washable distemper. These surfaces should be renewed every six months. Absorbent surfaces will prevent steam from condensing on the surface and falling back onto food.

A high gloss will wear well and light colour will promote good hygiene. All other fittings at ceiling level, like lights, fans, vents and hoods, should be properly fixed leaving no space for dirt to accumulate or pests to breed. They should be easy to clean and well maintained. The ceiling should be free from unnecessary decorations which make cleaning difficult.

Doors

The kitchen, dining area and pantry should preferably have separate 'in' and 'out' doors.

All doors should be rodentproof and self closing. Full swing doors should have a transparent wired glass panel at eye level or should be strictly used for one-way traffic to prevent collisions. Simplicity in design, easy cleanability and well fitted joints are some desirable features for all doors. They should be fitted with a metal kick plate or easily cleanable finger plate. Sliding–door railings should be kept clean.

Windows

Windows should be flyproof. They should be so planned that there is adequate ventilation and light. Window sills should be waterproof.

Staircases and Service Lifts

Staircases should have banister posts and rails of simple design, which are easy to maintain and kept in good repair.

Service lifts should be cleaned every day and the entire lift should be cleaned thoroughly once a week, taking care to remove food particles and spilled liquids which would otherwise attract pests. The insides of the lift should be made of non-absorbent materials. Spillages, if any, should be mopped up immediately. The lift should be used only for sending cooked food from the kitchen and not for preparing or storing food. Each course should be placed in a separate horizontal compartment with liquids in the lower compartment.

Large food lifts are needed when the kitchen is not on the ground floor. The lift should not be used for carrying food and refuse at the same time. If food lifts have to be used for people or other goods also, then care should be taken to cover the food or carry it in closed containers. Lifts used for conveying food and refuse should be kept very clean.

VENTILATION

Ventilation is the science of maintaining atmospheric conditions which are comfortable and healthful to the human body.

Adequate ventilation is essential in every room, especially in the kitchen because in quantity food production many high pressure burners are used resulting in higher temperatures and large amounts of steam, fumes and smoke.

Ventilation helps in the following ways:

1. it makes the work place comfortable by cooling it.
2. it reduces chances of accidental fires due to accumulated grease.
3. it prevents water of condensation from settling on walls and ceilings, and dripping onto food.
4. it keeps the work area clean.
5. it prevents toxic fumes and gases from accumulating in the kitchen.

To maintain such conditions it is necessary to control the temperature, humidity, air currents and purity of air in the building as well as the surroundings. Foul air should be continuously removed and replaced by fresh air so that the environment is comfortable and free from health hazards.

Faulty Ventilation

In overcrowded and poorly ventilated rooms, the air gets polluted because of

1. an increase in level of carbon dioxide
2. increased relative humidity
3. rise in temperature
4. air-borne infective agents and other air pollutants like smoke
5. air remaining stagnant

The discomfort is felt not only because of an increase in the percentage of carbon dioxide, but mainly because of stagnant air, heat and humidity.

As air loses its cooling power less heat is lost from the surface of the body.

In a poorly ventilated, hot, stuffy, steamy kitchen atmosphere, the following symptoms may be observed in employees: headache, irritability, lassitude, poor concentration, drowsiness, loss of appetite, lowered resistance to respiratory tract infections and increased chances of accidents.

An ill-ventilated work place not only affects the health and work efficiency of the worker, but also promotes the multiplication of harmful microorganisms in food, leading to food spoilage and food poisoning.

Volatile Organic Compounds A group of hazardous chemicals that emanate from solvents, varnishes, paints, LPG stoves, pesticides, air fresheners, incense sticks and newly renovated buildings and include chemicals such as benzene, toluene, ethylene, xylene, carbon tetrachloride, etc.

VOC (*Volatile Organic Compounds*) are a cause of concern in the indoor air in poorly ventilated rooms. VOCs generally detected in indoor air belong to nine groups of compounds, most of which are used as solvents.

Sources of VOC Indoors

Benzene and Toluene from LPG stoves and cleansing solvents used in the kitchen and dining area. VOCs are present in thinners and solvents in paints, carpet cleaning solutions, lacquers and varnishes, moth balls and air fresheners, Indoor concentration of benzene, toluene and ethyl benzene is highest in shopping malls and second highest in restaurants.

Newly painted walls, new floor coverings and newly renovated buildings can emit VOCs for up to a few months. Photocopier machines, toner powder, laser printers, matrix printers, mosquito coil smoke, tobacco smoke incense sticks insecticides, dry cleaning, the concentration of xylenes is highest in offices.

Outdoor sources of VOC's are automobile exhaust and traffic related sources like garages, apart from industrial machinery in which hydrocarbons are incompletely burnt. They enter the building and add to the VOC content in air.

Because of a complex mix of health damaging pollutants that arise indoors and are trigged off by poor ventilation, it is necessary to understand the sources of these VOCs and their effect on health and work efficiency.

The indoor VOC concentration can be controlled by the following measures:

- Use of exhaust ventilation for high VOC sources.
- Use of low emitting materials to finish and furnish interiors.
- Use of low emitting cleaning products.
- Limiting usage of products that contain chemicals that are highly reactive with ozone.

Thus, adequate ventilation is a must in each room and all areas in the catering establishment.

Systems of Ventilation

There are two systems of ventilation—natural and artificial. Artificial ventilation includes exhaust or extraction systems, propulsion systems, and air conditioning systems.

Natural Ventilation Natural ventilation is achieved by diffusion of gases and by effect of differences in temperature by which hot air expands, becomes lighter and rises up and is replaced by cold air and action of wind currents.

Windows, doors and ventilators provide natural ventilation. Windows should be wire meshed to keep insects, dust and dirt away. The wire mesh should be regularly cleaned. The location of the windows in relation to the work areas is an important factor which needs careful consideration. Windows provide good natural ventilation when the weather is suitable. It is unbearable in extremely cold weather, ineffective by itself in very hot weather and unmanageable in very windy weather.

Natural ventilation is rarely satisfactory by itself for public places where there are a large number of people gathered or where many cooking ranges are being used. It is effective only when there is sufficient open space around the establishment and a large number of windows opening directly into the open, and not in the heart of crowded cities.

Natural ventilation is effective when the kitchen is located above the ground floor. However, in basement and ground floor kitchens, artificial ventilation is desirable. Louvres or air bricks are more suitable than windows in basement and ground floor kitchens. Ventilators are useful where the ceilings are high. Such rooms are easier to ventilate than rooms with low ceilings.

Disadvantages

1. Windows cannot be used for ventilation in certain types of weather, for example, in extreme cold, rainy, windy or stormy weather.
2. It may be impossible to position and arrange equipment so that windows can be used for ventilation, unless specifically planned.
3. Open windows used for ventilation allow dust, dirt, flies and other pests into the kitchen.
4. No form of natural ventilation can keep out bad odours and fumes from the external environment.

Advantages

1. If is cheap.
2. If windows and doors are placed opposite one another at the same height for cross-ventilation, it can be quite efficient.
3. It provides light during the daytime.

Ceiling fans, table fans and exhaust fans are extremely useful in hot, humid, close kitchens. Fans help agitate the air, cause evaporation and make one feel comfortable. They help circulate the air by forcing the foul air out. They are useful where humidity is high and air is still. However, ceiling fans and table fans cannot be used when the gas burners are on.

Artificial Ventilation This has to be resorted to where natural ventilation is not practical or where climatic conditions do not permit free use of open doors and windows and a large number of people work for a considerably long period. In such cases, mechanical means are used to facilitate renewal of air. They can be regulated according to the needs.

Ideally, ventilation of the kitchen should be separate from the rest of the building. The simplest form of artificial ventilation consists of an injector fan fitted with a filter which allows pure air to enter and an extractor fan at the other end of the room. The fans may be thermostatically controlled. The vent outlets should be as high as possible on the walls. The inlet should not be near the refuse dump, sanitary conveniences, coal chute or any dirty or dusty place. The vent outlets should not create a nuisance for other people. The vent pipe should be fixed away from the wall, so that cleaning is made easy.

Adequate artificial ventilation can be achieved by one of the following ways:

Exhaust or extraction system This method is based on mechanical suction or extraction of air out of rooms by creating a vacuum.

It is used to carry fumes away from the work place by exhaust fans which are either high pressure fans or low pressure fans. This system is popular in the *tandoor* and barbeque section of Indian kitchens.

Exhausts may be general or local.

1. *General exhaust:* It is recommended only for small operations involving little cooking. An exhaust fan is fitted in the wall to draw out foul air.
2. *Local exhaust* is done with exhaust hoods or ventilators. They are of two types:
   (a) Conventional hood which hangs at a height of 1.2 m (four feet) over the cooking range and is used for one or more units. This hood is fitted with an exhaust fan.
   (b) Ventilator hood which is usually attached to the unit and is used for that unit only.

Each piece of cooking equipment should be provided with adequate ventilation, in the form of suspended hoods, screens and ducts.

Ventilation hoods should be designed of hard smooth material like steel or galvanised iron or any metal which will not corrode or rust. It should prevent liquid or grease from collecting and dropping back onto food or food contact surfaces. The hoods should be easy to clean. The size of the hood will depend on the size of the equipment. Hoods are placed over steam tables, coffee urns, potwashers and dishwashers. The hood should be large enough to catch all smoke and steam.

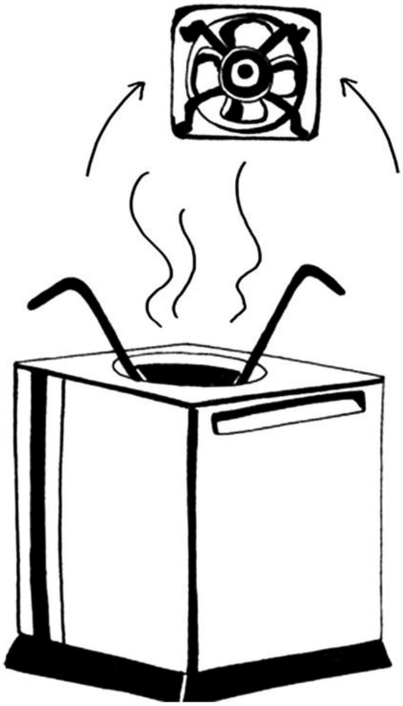


Fig. 8.3 *Exhaust fan near tandoor*

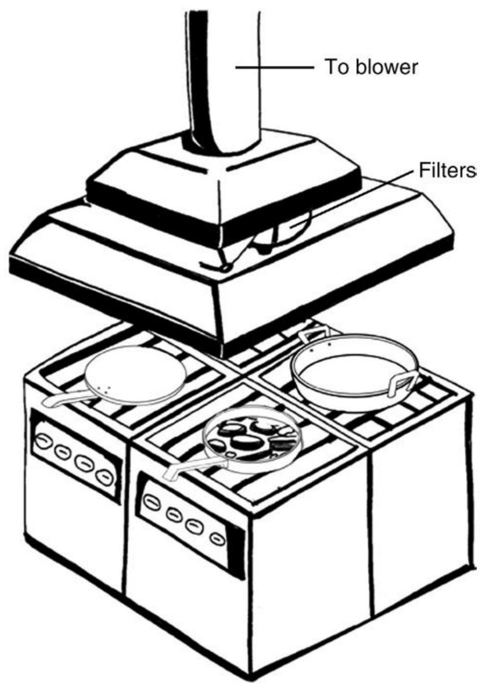


Fig. 8.4 *Conventional hood fitted over cooking ranges*

The air ducts should be large enough to allow air to pass freely. It should be placed at a height of 1.2 m (four feet) above the cooking surface. The hoods should be fitted with filters or grease extractors which are detachable. They should be cleaned regularly and inspected every three months. Special attention should be given to canopies over frying and grilling sections, where a lot of grease gets trapped. These filters should be cleaned or renewed at smaller intervals say, fortnightly to prevent fires. After trapping the grease, the duct carries foul air to the exterior of the building.

In this system, a vacuum is created and air which has been removed should be replaced without creating a draught. All incoming air must be screened to prevent insects and dirt from entering the premises.

Disadvantages

1. Extraction of air from all rooms is not uniform.
2. Although suitable inlets are provided, it is very difficult to regulate incoming air.
3. Air may be sucked in through undesirable places such as toilets, etc.
4. Heating and cooling of incoming air is not possible.

In many areas in the United States, clean air ordinances demand that exhausted air with high levels of smoke, grease and food odour should be purified before it is released.

Propulsion system Ventilation is achieved by propelling or forcing clean air into a room by using revolving fans or blowers under pressure.

The air which is forced in is washed, filtered, warmed or cooled and humified. The air, however, loses its freshness because it is treated. The inlets are installed at low levels near the floor. All doors and windows are kept closed. This system is not suitable for kitchens as undesirable fumes, steam and smoke are not removed. It can be used in restaurants and other public areas.

Air conditioning or combined system This is a combination of exhaust or extraction and propulsion system and is the most satisfactory method of artificial ventilation. This principle is made use of in airconditioners where air, under controlled conditions of temperature and humidity, is driven into the room by means of a fan through ducts at a height of about 2 m (seven feet) from the floor.

Used air is extracted from the room through an outlet at floor level. If this system has to work effectively, there should be no leakage of air through doors and windows. The temperature of air should be 21°C (70°F) and humidity should be 60 per cent in tropical countries.

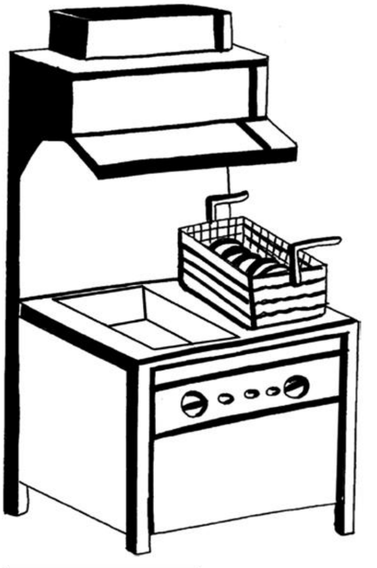


Fig. 8.5 *Ventilator hood attached to a deep fat fryer*

Advantages of artificial ventilation

1. Air can be filtered, humified, warmed or cooled before it is allowed to enter the building.
2. Air can be delivered at any level and the rate of air flow can be controlled.
3. When the level of pollution by smoke, gases or fumes is high, natural ventilation alone cannot be depended upon. It is then mandatory that each machine has an air extraction cover.

Disadvantages of artificial ventilation

1. It requires skilled supervision and maintenance.
2. The position of exhaust fans, vents and ducts should be included in the construction plans.
3. It is expensive.
4. A draught of fresh air is always more refreshing and invigorating.

ENCONDITIONING

This is a new concept to revive indoor air quality (IAQ). The air quality in closed spaces is known to be more harmful than open spaces and poorly ventilated rooms are known to spread respiratory infections, congestion, colds, flu, itchy eyes, headaches and sleeplessness.

To purify air in closed spaces, enconditioning technology was developed by National Aeronautics and Space Administration (NASA) to provide a pathogen and pollutant free environment. It is based on a photocatalytic oxidation system that is useful in commercial spaces.

1. In fruit and vegetable storage areas and in warehouses it can be used to extend the shelf life and curb losses due to decay by removing ethylene gas, which is produced during the ripening process, and which further hastens ripening.

2. All airborne microorganisms are destroyed by combining the effects of ultraviolet germicidal irradiation (UVGI) and photo catalytic oxidation (PCO). Titanium dioxide (TiO_2) is used as the photocatalyst. No filters are required and when TiO_2 is irradiated with UV right, strong oxidizing agents called hydroxyl radicals and super oxide ions are formed. The filterless technology traps particles and breaks it up into vapours leaving almost no residue. The technology is completely green as it is ozone free, and can keep the air 99.99% pure. It has been tested in various hospitals and guest rooms and has reduced infection causing viruses, bacteria, mould and fungi. It reduces bio-burden by 85% in 72 hours.
3. It cleans the air of contaminants, allergens and removes unpleasant odours from closed spaces.
4. It removes mould and mould spores that eat away expensive fabrics, upholstery, carpets, wall coverings and furnishings.
5. The air in cold storage units can be sterilised as it is effective at low temperatures of 5°C to 0°C, thus increasing the shelflife of raw, semi-processed and processed food.

In the hospitality industry, it could be used in cold storage areas, hotel rooms, restaurants, banquets and other public areas and can significantly reduce the level of harmful airborne pathogens, allergens, contaminants, ethylene gas and odours.

Airocide is one such enconditioner.

LIGHTING

Good *lighting* is essential in the kitchen and food storage areas because

1. It helps the workers to see what they are doing clearly
2. Dirt or spoilage becomes more conspicuous
3. It facilitates cleaning
4. It increases safety by preventing accidents
5. It improves overall quality and quantity of work.

Lighting may be natural or artificial. In most establishments artificial lighting is required to supplement natural lighting even during the day. There should be no gloomy corners or passages where dirt is likely to collect. Light coloured walls and ceilings reflect light and increase the amount of illumination. The window area should be one-fifth of the floor area to provide sufficient natural light in the room. Sinks and food preparation areas situated near or under windows get sufficient natural light during the day. Natural light should be made use of as far as possible as it is economical and good for health. The ultraviolet rays in sunlight have germicidal properties.

Artificial Lighting

Artificial lighting is of two types: light produced by combustion and light produced by an electric current.

Light Produced by Combustion Substances that burn with a flame give out light and heat. They use up oxygen from the air and contaminate it with waste substances. Nowadays, such lighting is used during power failure only or in remote areas where there is no electricity.

The common forms of this type of lighting are candles, paraffin lamps and gas lights.

Disadvantages

1. It causes blackening of walls.
2. Such lighting emits a slight smell because of incomplete combustion and there are chances of carbon monoxide formation. By-products are harmful.
3. More labour and maintenance is required for these lights.
4. The light is insufficient and the flame flickers.
5. It produces heat and there is the risk of fire.
6. More ventilation is required as oxygen is used up.

Advantage It is useful in emergencies like power failure.

Light Produced by Electricity Light produced by an electric current does not contaminate the air. As there is no combustion, oxygen is not used up and waste is not produced. It produces very little heat.

Advantages

1. It is convenient to use.
2. There is no fear of contamination.
3. No flicker is produced; the light is steady and uniform.
4. Minimum heat is produced.

Disadvantages

1. Power failure causes total blackout.
2. There is the risk of shock if electrical fittings and fixtures are not well maintained or are handled carelessly.

Electric lighting used in catering establishments is of three types: tungsten filament bulbs, fluorescent tubes, and sodium vapour lamps.

A tungsten filament bulb consists of a wire filament suspended in an inert gas. Such bulbs are available in clear as well as pearl or milky variety.

In a fluorescent tube, an electric current passes through mercury gas which acts on the fluorescent lining of the tube and causes it to glow. These tubes are cheaper and more efficient than tungsten filament bulbs. A tube lasts for up to 5,000 hours and a bulb lasts for only 1,000 hours. They are preferred because of economical consumption of electric energy. Tubes are suitable in the kitchen because they produce an even spread of shadowless light and very little glare. This light is comfortable to work in and increases work efficiency. Sometimes, fluorescent tubes may change the colour of the food. This problem can be effectively minimised by changing the tube or the shade or by adding more fixtures.

Sodium vapour lamps also last longer than tungsten bulbs. They use less energy but provide much more light than fluorescent tubes.

Location and Amount of Light

Light should be from a good source and adequate light should fall on all work areas especially food preparation tables and sinks. There should be no glare or flicker. A constant, uniform source of light with minimum shadow is desirable.

The location of lighting fixtures should be considered carefully. A number of small points of illumination usually produce less glare than one large point. Lights should give a clear view of the interiors of all equipment like cooking ranges, ovens, etc. Lighting is measured in terms of lux per metre, i.e., the amount of illumination falling on a surface of 1 m^2 at table height, approximately 75 cms (30 inches) above floor level.

The amount of lighting recommended in different areas is:

1. Food storage area: 150 to 200 lux
2. Food preparation, serving and wash-up areas: 200 to 500 lux
3. Dining or service area: as dim as desired, normally 200 lux

Indirect light is best reflected from the ceiling.

Light Fittings

In general, light fittings should be easy to clean and should be corrosion-resistant. All fittings should be well maintained and in good repair. Electric bulbs should be enclosed in unbreakable white translucent globes and tube lights should be protected with a protective sleeve or cover, to prevent broken glass from contaminating food or food contact surfaces. Electric wires should be placed or fitted in such a way that they do not harbour dirt or insects and are easy to clean. Switches and bulb holders should be made of plastic, as kitchen walls may be steamy and damp. Average lighting conditions require one to four watts per square feet area.

Faulty Lighting

Insufficient lighting reduces output and has several ill effects on health. A poorly lit room causes headache, eyestrain, bad posture, irritability and increases the chances of accidents. Workers are slack and untidy in their work. Thus, the total quality as well as quantity of work done is affected.

SUMMARY

Proper selection of a location is imperative, otherwise maintaining standards of sanitation in an improperly located and poorly planned establishment may prove to be an impossible task for the food service manager.

The arrangement or layout of every room and its intended purpose should be clear to avoid wastage of money and space. All areas should be well marked and should accommodate necessary equipment comfortably. Adequate staff rooms and sanitary accommodation should be included in the plans.

The interiors of the building should be constructed keeping cleanability in mind. Floors, walls, ceilings and staircases or lifts should be easy to clean and maintain. They should be made of durable and non-absorbent materials.

Adequate ventilation and lighting is necessary in all areas, especially the kitchen and wash up area to make work easier and prevent harmful microorganisms from multiplying. In most kitchens, artificial ventilation is usually required because of the vast amount of steam, fumes and grease produced while cooking food in quantity. Good lighting makes spoilage or dirt more conspicuous and facilitates the cleaning process.

KEY TERMS

Built-in Sanitation Cleanability, life and simple maintenance of the building interiors such as walls, ceilings and floors. Features which decide whether surfaces can be easily cleaned and will withstand regular cleaning, is pest proof and can be easily maintained and replaced.

Enconditioning A new green technology to revive IAQ based on a photocatalytic oxidation system and ultraviolet germicidal irradiation which removes microbes, allergens, unpleasant odours and harmful gases by trapping and breaking down particles without using filters.

Exhaust Hoods Hoods which have fillters or grease extractors and are made of hard smooth metal, fitted with exhaust fans to remove cooking fumes, vapour, steam and or smoke generated during cooking process. They are fitted over or form a part of kitchen and dishwashing equipment.

Indoor Air Quality (*IAQ*) The air quality in closed spaces specially poorly ventilated rooms, a major cause of concern because of pollutants and respiratory pathogens.

Ventilation The science of maintaining atmospheric conditions which are comfortable and healthful to humans either naturally or by artificial means.

Volatile Organic Compounds A group of hazardous chemicals that emanate from solvents, varnishes, paints, LPG stoves, pesticides, air fresheners, incense sticks and newly renovated buildings and include chemicals such as benzene, toluene, ethylene, xylene, carbon tetrachloride, etc.

REVIEW QUESTIONS

1. Fill in the blanks with suitable words.
   (a) Cooking ranges should be fitted with __________ to remove cooking fumes.
   (b) Each worktable should have a __________ fitted on a trolley placed under the table.
   (c) In a naturally ventilated kitchen there should be sufficient __________ for fresh air and __________ for foul air.
   (d) A poorly ventilated kitchen not only affects __________ and __________ efficiency of employees but also __________ food faster.
   (e) The two main factors to be considered while selecting coverings for walls and floors is their __________ and __________.
   (f) __________ is a combination of exhaust and propulsion system.
   (g) Hoods should be fitted with removable __________ to trap grease.
   (h) __________ light is economical and good for health.
   (i) Hoods should be placed at a height of __________ over cooking ranges.
   (j) Artificial ventilation by __________ is recommended in the *tandoor* section.
   (k) All air inlets should be __________ to prevent entrance of __________.
   (l) To prevent broken glass from contaminating food, bulbs and tubelights should be __________.
   (m) When natural light is used in a room, windows should occupy __________ of the floor area.
   (n) The air in a kitchen gets contaminated due to __________, __________, __________, __________.
   (o) A well-planned and designed food service is a __________ for

maintaining high standards of __________.

(p) The kitchen should be divided into different __________ for different activities.

(q) The __________ should be located near the goods receiving area.

2. State whether True or False. If false correct the statement.

   (a) The rice boiler and potato peeler should be located near a drain.

   (b) While planning the kitchen, the location of windows and ventilators is important.

   (c) The inlet for fresh air should not be located near the garbage bins or sanitary conveniences.

   (d) Large catering establishments in cities should depend only on natural ventilation.

   (e) Sinks used for dishwashing should also be used for washing food and hands.

   (f) For the convenience of employees the staff toilets should open directly into the food preparation area.

   (g) Ceilings in wet preparation areas should be non-absorbent.

   (h) In small catering establishments the kitchen could be used as a staff changing room.

   (i) Full swing doors should have a glass fitted at eye level.

   (j) Lifts can be used to carry food and garbage at the same time provided food is kept covered.

   (k) The goods receiving entrance and the customers entrance should be the same.

3. Select the most appropriate answer in the following.

   (a) The most suitable surface for walls in the wash-up area is
      (i) wood
      (ii) ceramic tiles
      (iii) cement
      (iv) oil-bound distemper

   (b) Which one of the following is incorrect with respect to lighting needs
      (i) interiors of all equipment should be visible
      (ii) one large powerful point of illumination is preferred
      (iii) there should be no glare or flicker
      (iv) minimum shadows should be cast

   (c) The most hygienic way of drying hands is by using
      (i) a warm air drier
      (ii) a hand towel
      (iii) the dish cloth
      (iv) the apron

   (d) For adequate ventilation, the factors which need to be controlled are
      (i) temperature
      (ii) humidity
      (iii) air currents and purity of air
      (iv) all of the above

   (e) The ideal covering for a kitchen floor would be
      (i) carpeting
      (ii) wood
      (iii) ceramic tiles
      (iv) quarry tiles

4. Match the wall finishes in Column *A* with the suitable area from Column *B*

A	*B*
1. Emulsion paint	(a) Dining area
2. Ceramic tiles	(b) Dry store
3. Stainless steel splash plates	(c) Kitchen walls
4. Wallpaper	(d) Dishwashing

5. While selecting a suitable location for a catering establishment, which of the following are undesirable
   (a) adequate ventilation and light
   (b) basement kitchen
   (c) municipal garbage dump nearby
   (d) stagnant water
   (e) well planned kitchen
   (f) potable water supply round the clock
   (g) leather factory nearby
6. What information should you gather before planning the kitchen layout?
7. List five important qualities for a kitchen flooring.
8. What are the ill effects of working in a badly ventilated place?
9. Why are wooden surfaces not recommended in food preparation areas? How can such surfaces be improved?
10. Why is cleanability of special importance in the food industry?
11. List the advantages and disadvantages of artificial ventilation?
12. Describe the types of artificial lighting with their advantages and disadvantages.
13. What features would you look for in ventilation hoods?

9

- **General guidelines for cleaning equipment**
- **Installation and arrangement of equipment**
- **Food preparation surfaces**
- **Materials used for making large and small equipments**
- **Equipment requiring special attention**

Equipment, Furniture and Fixtures

Equipment, utensils and all food contact surfaces should be smooth, easy to clean, durable, non-toxic, non-absorbent, corrosion resistant and well maintained. They should be able to withstand continuous contact with food, water, cleaning agents, sanitisers and heat. Meat blocks, chopping boards and tandoors are an exception and will be dealt with separately.

While selecting equipment, certain standards need to be kept in mind.

1. *Functional:* It should do the job for which it is intended with maximum efficiency. It is desirable if there are less number of parts required for efficient functioning of the equipment.
2. *Easy to clean:* It should be easy to disassemble and reassemble. All parts should be accessible for cleaning. The parts should be easily reached and so constructed that dirt, food residue and cleaning material do not get logged in them.
3. *Durable:* The material used should not dent, buckle, pit or chip and should be able to withstand heavy wear and tear. Stainless steel and kadappa are most durable and ideally suited for work surfaces in catering establishments.
4. *Smooth and sealed surfaces:* Cracks, crevices, open spaces and holes are likely to hide microorganisms, pests, dirt, and food particles, and allow liquids to accumulate. Such surfaces are practically impossible to clean. All joints and seams in utensils, equipment, food areas and wash up areas should be sealed, for example, hollow handles on pots and pans and faulty insulation in urns is undesirable.

5. *Closed:* In non-food areas, all openings should be closed, i.e. an opening of 0.8 mm or less is considered closed. This opening is not large enough to harbour pests or collect dirt.
6. *Rounded corners and edges:* Internal corners or edges should be coved or rounded off and external surfaces should have closed, soldered corners or edges.
7. *Non-toxic:* Coating material used on food contact surface should be non-toxic. Lead-based paints and some sealers are not permitted in the food area. Coating material should be hardy. It should not chip or crack by normal handling. Single service articles, plastics or disposables should be made from non-toxic, food grade material.

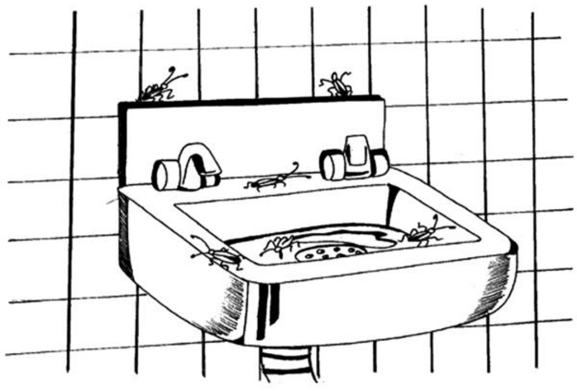


Fig. 9.1 *All joints and seams should be sealed or closed to prevent insects and dirt from entering and accumulating*

8. *Non-absorbent:* Material used should not impart taste, colour or flavour to food and should not react with any food ingredient or cleaning agent. Old equipment may become absorbent, and may retain food odours.
9. *Safe:* Electrical fittings should be well protected, sealed, water and shockproof and should not trail across floors or gangways.
10. *Corrosion resistant:* Material used should maintain its original quality and appearance in–spite of repeated exposure to food, liquid, cleaning material, sanitisers, etc.
11. *Conformity:* It should always meet the standards set by the regulatory agencies.

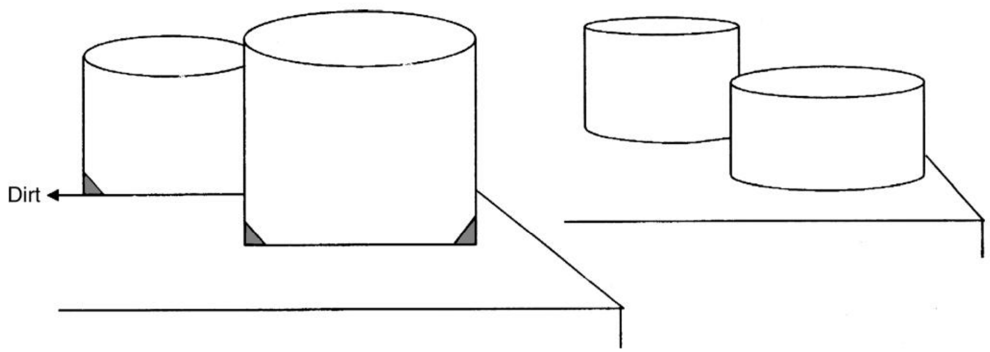


Fig. 9.2 *Equipment with internal angles of 90° accumulate dirt and are difficult to clean*

Cleanability of Equipment and Utensils

This depends on the following features:

1. nature of material used in construction
2. general construction features
3. ease of dismantling and reassembling

GENERAL GUIDELINES FOR CLEANING EQUIPMENT

For all stationary equipment, follow the manufacturers instructions for disassembling and cleaning the machine.

Some stationary equipment is designed for cleaning–in–place by pumping a detergent and sanitising solution through them.

Although each piece of equipment in the catering establishment will need specific instructions for operating and cleaning, a list of general instructions is given below. From the safety and sanitation aspect it is essential that all employees using the equipment should be familiar with these procedures before cleaning or handling the machine.

1. Read the instructions for operating the equipment as well as the cleaning procedures displayed on the plaque fitted near the machine. It is the responsibility of the management to display all instructions in a prominent place.
2. Turn the switch to off position and let the unit cool after shutting off gas or electricity.
3. Drain off or remove all leftover food.
4. Remove plug from socket.
5. Disassemble parts for cleaning. Immerse small parts in hot detergent solution and wash in the dishwashing machine if practicable or use suitable cleaning agents and tools. Remove adjustable shelves. Wash, rinse and sanitise all parts to remove all traces of soil by three bucket method. The three bucket method is explained in Chapter 11 under the three methods to wash, rinse and sanitise food contact surfaces.
6. Start cleaning from the top. Use a dry cloth and polish metal surfaces. Clean legs and casters of movable equipment.
7. Dry all parts thoroughly to prevent rusting, shock or microbial growth.
8. Reassemble all cleaned and dried parts.

INSTALLATION AND ARRANGEMENT OF EQUIPMENT

Equipment should be arranged in such a way that it is easy to operate, does not hamper the flow of work, facilitates easy cleaning as well as protects food from any nearby source of contamination like soiled dishes, garbage bins, etc.

Large Equipment

Large or heavy duty equipment is either permanently mounted on the floor or is mobile with casters fitted underneath. Mobile equipment is gaining popularity because it can be moved by one person and simplifies the cleaning of walls and floors near the equipment. It also permits a change in the overall arrangement. It should be easy to disconnect. Utility connections should be flexible and long enough to permit movement while cleaning.

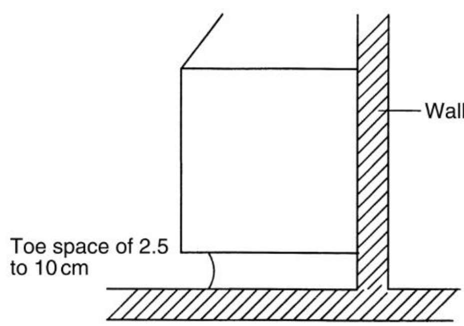


Fig. 9.3 *Kitchen platforms and wall mounted furniture should be sealed to the wall and/or floor leaving adequate toe space*

Free standing equipment or equipment that is immobile, requiring a number of people to shift it, should be mounted at least 15 cm (six inches) off the floor or permanently fixed on a well constructed cemented platform, leaving no gaps for pests and dirt. It may also be sealed to the wall or to other equipment. Sufficient space should be left between the equipment and the wall to permit easy cleaning and create no obstruction in work. If equipment is sealed to the floor, a 2.5 cm (one inch) to 10 cm (four inch) toe space should be left to prevent stubbing toes.

Wall Mounted Equipment

Alternatively, equipment may also be mounted on the wall, supported by a sturdy bracket, leaving the floor space clear. A suitable gap should be left between the wall and equipment to allow easy cleaning. The size of the gap will vary with the size of the equipment, and ranges from 15 cms to 45 cms (six to eighteen inches) for floor mounted equipment.

Small or Portable Equipment

It is placed on table tops or counter tops. Equipment which is occasionally used, can be stored on racks when not in use. Such equipment is generally light in weight and should be shifted often to keep the gap between rack and equipment clean.

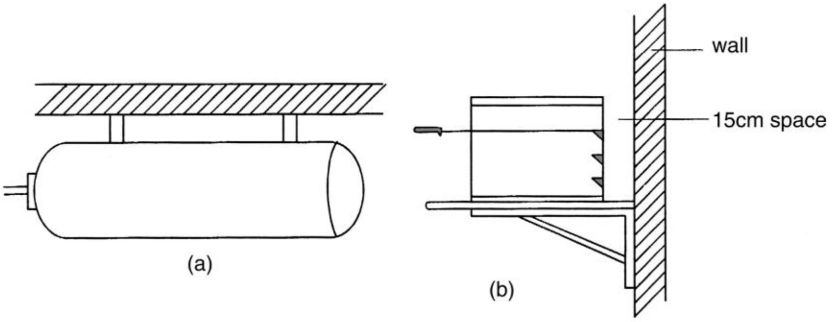


Fig. 9.4 *Wall mounted equipment. Keep sufficient space between the equipment and the wall to permit cleaning (a) a boiler (top view) (b) a salamander mounted on angles (side view)*

Heavy counter top equipment should be mounted on legs leaving a 10 cm (four inch) clearance between the base of the equipment and top of counter for ease in cleaning.

FOOD PREPARATION SURFACES

Work Tables and Platforms

Food preparation surfaces should be impervious and smooth and so designed that thorough cleaning is possible. Wooden surfaces are not recommended for preparation of food because it is difficult to maintain.

Wood absorbs stains and odours and holds moisture and swells. It encourages the growth of microorganisms and pests, and the surface gets cracked and chipped easily.

Wooden surfaces should be covered with Formica.

Aluminium top tables get dented and pitted and are not as durable as steel.

Stainless steel top tables on mild steel stands are recommended. Tables should not be placed against a wall. They should preferably be free standing. Naturally occurring stone, such as kadappa, granite or marble platforms and work table tops are ideal. They are durable and easy to clean. Platforms built into the wall should have edges covered and sealed. The supporting structure of all tables should be easy to clean.

MATERIALS USED FOR MAKING LARGE AND SMALL EQUIPMENTS

Stainless steel: This is an alloy of iron, chromium and nickel. It is relatively non-corrosive and is recommended for use in the kitchen. The thickness or gauge of the stainless steel sheet used will depend on the wear and tear that the equipment or the surface will be subjected to. It is used for table tops, cooking ranges, sinks, urns, etc. and a wide variety of small equipment.

Galvanised steel and iron: This is steel treated with zinc. It has poor wearability and sanitary quality as it rusts easily and gathers soil.

Mild steel: This is an alloy of iron and carbon. It is used in supporting stands for equipment. Galvanised iron is used as a substitute for mild steel.

Cold rolled steel: This is non-corrosive because it has a porcelainised steel coat.

Cast iron: It is ideal for equipment that is to be heated like grills, skillets, griddles, chappati puffer and woks.

Aluminium: It is relatively non-corrosive, non-porous, smooth, light weight and strong. As it is light it is suitable for mobile equipment. It is a good conductor of heat and is used for cooking utensils like pots, pans and griddles. ISI grade aluminium is permitted for food containers.

Hindalium: It is an aluminium alloy with chromium or nickel and is used for making utensils.

Aluminium alloys are used for making legs, racks and hoods on equipment. It is not recommended for ovens and cooking ranges as it is not very durable.

Copper: It is an excellent conductor of heat, hence, it is used on the outer surface of utensils in contact with the flame or source of heat. Because of its attractive appearance it is used for food service. In such cases, it should be tin-plated on the inner surface. Acidic foods in contact with copper can poison food.

Brass: It is a good conductor of heat. It is an alloy of copper and zinc. All food contact surfaces should be tin-plated. It is used for making large pots and pans. Maintenance is costly.

Wood: It is popular as a chopping surface as it does not harm the knife blade. It is also used for making pushers for grinding machines. It is light in weight. It has poor wearability and sanitary quality because it absorbs stains, odours and holds moisture.

Polypropylene: It is gradually replacing wood and is used in making meat blocks, chopping boards and as pushers in wet grinders. It does not absorb moisture or retain stains and odours.

Polypropylene boards are available in different colours. To prevent cross contamination, select a specific colour for a particular section; for example, blue for fish, orange for butchery, white for fruit etc. The knives used should also have a colour tag.

All polypropylene chopping boards should be sanitised by immersing in a solution of 200 ppm chlorine for fifteen minutes.

EQUIPMENT REQUIRING SPECIAL ATTENTION

1. *Cleaning-in-place equipment:* Some equipment is so designed that it can be cleaned by circulating a cleaning and sanitising solution through the entire system. The solution cleans all food contact surfaces. This equipment should be self-draining and should leave no residue of cleaning liquid inside the machine. Some hand-operated beverage dispensers and automatic ice-making machines are cleaned in this way.
2. *Microwave ovens:* They should be checked to ensure that no excessive high frequency emission is occurring, as this could be an invisible health hazard. Food to be heated should not be placed in metal containers or left indefinitely in the oven.

   Microwave ovens are also used to thaw frozen foods. Once thawed, such foods should be cooked immediately. Cleaning procedure should be strictly as per manufacturers' instructions.
3. *Refrigerators and freezers:* They should be so constructed that they are easy to clean. Cleaning procedures are explained in Chapter 5 under 'Refrigerated Store'.
4. *Dishwashers, sinks, ware tables and drain boards:* Dishwashing machines should work efficiently and should also be easy to clean and maintain. Piping to and from machines should be short in order to prevent loss of heat. The machine should be installed at least 15 cm (six inches) above the ground to facilitate easy cleaning beneath the machine.

   Sinks, ware tables and drain boards should have a slope of 1 cm (1/8th inch) per metre to prevent collection of water and hasten drying. Other details have been discussed in Chapter 11 under Manual and Machine dishwashing.
5. *Vending machines:* These machines should be cleaned daily as per manufacturers' instructions. They have been explained in Chapter 8 under 'Vending Machines'.
6. *Chopping boards and meat blocks:* They are traditionally made of absorbent materials like wood. Wooden boards and blocks develop cracks, criss-crosses on the surface and rough edges and they may chip. All such surfaces can harbour microorganisms and contaminate the food being chopped. Particles of wood may also get into food. To prevent this from occurring, the surface should be evened regularly and the wood used must be of a hard non-absorbent variety. It should not contain toxic substances or impart any odour or taste to food. It should also be seamless. Wooden blocks and boards are being replaced by hard rubber and polypropylene.

   Wooden boards and blocks should be cleaned immediately after use. The surface should be wiped clean, brushed with a wirebrush and scrubbed clean with cleaning solution. The sides and under surface should be cleaned and wiped with a hot damp cloth. Sanitiser solution should be poured over the block surface and it should be wiped dry. Wooden boards and blocks should not be soaked in water. Rubbing common salt on the surface of wooden blocks, helps in keeping the block dry.

7. *Tandoor:* Also called the clay oven, it should be fitted with a hood and exhaust fan to remove smoke and prevent soot from collecting. It can be tiled with ceramic tiles on the outside for easy maintenance. As it is traditionally operated on coal, all accumulated ash should be removed daily. It needs to be replaced every three to four months as cracks develop inside the tandoor and it may break.

SUMMARY

Equipment should be functional, easy to clean, durable, with smooth sealed surfaces which do not harbour dirt or vermin, made of non-toxic and non-corrosive material and safe to use. While cleaning equipment which is fixed, manufacturers instructions should be followed. Equipment should be easy to disassemble for cleaning and reassemble after drying. It should be so installed that it is convenient to use and easy to clean.

All food surfaces should be durable, easy to maintain, impervious and smooth. Suitable material should be selected depending upon the purpose.

Some equipments require special methods of cleaning. Operating and cleaning instructions should be strictly followed to prevent contamination of food and any accidents arising due to misuse.

The food service manager should understand that a well planned and designed food service is a prerequisite for maintaining high standards of sanitation.

KEY TERMS

Cleaning-in-place Equipment which needs to be cleaned by circulating a cleaning and sanitising solution through the entire systems so that all food contact surfaces are cleaned and sanitised.

Heavy duty equipment Large equipment either permanently mounted on the floor or fitted with casters or wheels underneath. If permanently mounted or unmobile should have sufficient space between floor/wall for easy cleanability and prevent stubbing of toes.

REVIEW QUESTIONS

1. State whether True or False. If false correct the statement.
   - (a) Brass pots and pans should be lined with tin.
   - (b) Equipment such as automatic ice-making machines can be cleaned-in-place.
   - (c) Chopping boards should be made of materials which can withstand continuous contact with food and water.
   - (d) Stainless steel is most suitable for making kitchen equipment.
   - (e) The advantage of having casters on large equipment is its mobility.
   - (f) Equipment which is sealed to the floor should have a toe space of at least six inches.
2. Select the most appropriate answer in the following.
   - (a) Equipment should be cleaned
     - (i) as soon as you finish using it
     - (ii) before you go home
     - (iii) according to a fixed schedule
     - (iv) as soon as you arrive

(b) Instructions for operating a machine should be
   (i) distributed as handouts
   (ii) displayed on a plaque near the machine
   (iii) pasted on the machine
   (iv) explained verbally when the machine is purchased

(c) Cleanability of equipment and utensils depends on
   (i) material used for construction
   (ii) design
   (iii) ease of dismantling
   (iv) all of the above

(d) How would you place heavy counter-top equipment?
   (i) mounted on legs with a 10 cm gap
   (ii) mounted on legs with a 1 cm gap
   (iii) directly on the counter
   (iv) on the floor beneath the counter

(e) Immobile equipment should be
   (i) placed 15 cm off the floor
   (ii) permanently fixed on a cement platform
   (iii) fitted with casters
   (iv) in direct contact with the floor

      I. (i) and (iv) only
      II. (i), (ii) and (iii) only
      III. (ii), (iii) and (iv) only
      IV. (iii) and (iv) only

3. (a) Match the material in Column A with the equipment in Column B

A	*B*
1. Cast iron	(a) Cutlery
2. Mild steel	(b) Tandoor
3. Copper	(c) Chappati puffer
4. Aluminium	(d) Stands
5. Polypropylene	(e) Outer surface of cooking utensils
	(f) Dishwashing sink
	(g) Chopping boards
	(h) Mobile equipment

4. What precautions should be taken while operating a slicing machine?
5. Why should kitchen equipment be colour coded?
6. Why are copperbottom pans superior to ordinary pans?
7. Why should metallic spoons not be used in aluminium pans?
8. Outline the points to be borne in mind while selecting equipment.
9. List the general guidelines for cleaning equipment.
10. What do you mean by food contact surfaces?
11. What is the first step to be taken while cleaning electrical grinders, mincers, etc.
12. Why should iron griddles and kadhais be dried after they are washed?

10

- **Cleaning and sanitising**
- **Necessity for an efficient cleaning programme**
- **Types of soil, water, cleaning agents and equipments**
- **Types of cleaning equipment—manual and mechanical**
- **Three methods to wash, rinse and sanitise food contact surfaces: three bucket method; 1, 2, 3 sink method; dishwashing machines; equipment required and procedures**
- **Post cleaning storage**
- **Dish cloth**
- **Cleaning of premises and surroundings: the cleaning schedule**

Cleaning Procedures

INTRODUCTION

Proper procedures must be followed to clean and sanitise dishes and equipment in the kitchen and service area to enable the caterer to prepare and serve food in a clean and hygienic manner. A cleaning schedule for all areas and departments should be planned to maintain clean surroundings.

CLEANING AND SANITISING

Before we discuss the procedures it is important to understand the difference between cleaning and sanitising.

Cleaning is the removal of matter from a surface on which it is not acceptable. For effective cleaning, the soiled surface should be in contact with a cleaning agent for adequate time and sufficient pressure should be applied if required, to remove the soil. Cleaning involves two steps: a wash step and a rinse step.

Sanitising is a reduction in the number of diseases causing bacteria to safe levels. This is achieved through the use of heat or the application of chemical compounds. It involves one step only: a sanitise step.

NECESSITY FOR AN EFFICIENT CLEANING PROGRAMME

Both cleaning and sanitising form the basis of food service sanitation.

The main purpose of cleaning and sanitising dishes is to remove visible surface dirt and reduce the number of bacteria to a safe level so as to

1. reduce health hazards by avoiding contamination
2. prevent spoilage of food
3. control odour
4. create a pleasing appearance

Before any cleaning programme is implemented, it is necessary that all food service workers understand the importance of cleaning procedures. It is the duty of every employee to ascertain that all dishes and utensils used in the catering establishment are clean. Dishes are handled by various people like waiters, busboys, cooks and dishwashers. Dishes cleaned and sanitised by dishwashers may be mishandled and contaminated after washing. They may collect dust or get covered with a greasy film if they are not stored or handled properly.

An act of carelessness on part of one person, can cancel the painstaking efforts of others and result in wastage of costly detergents, money invested in machines, labour, etc.

It is important to note that no matter how well food is prepared and served, it is unacceptable if served in improperly cleaned dishes or accompanied by unclean crockery or cutlery, or crockery which retains the smell or remanents of the food served in it earlier.

Cleaning removes visible soil, sanitising reduces microbial load to a safe level.

All utensils, equipment, tableware and other food contact surfaces used in the food service operation must be cleaned and sanitised after every major use or at least once a day. Any utensil or equipment used in the storage, preparation and service of food and which touches the food directly, is a food contact surface. Pots, pans, dishes, glasses, cutlery, trays, mixer bowls, slicing machines, chopping boards, work platforms and stainless steel table tops are food contact surfaces.

Surfaces which do not touch the food directly are non-food contact surfaces like the top of the refrigerator, the bottom of work platforms and tables, floors, etc. These surfaces need to be cleaned regularly and sanitised occasionally.

TYPES OF SOIL, WATER, CLEANING AGENTS AND EQUIPMENTS

A basic requirement for cleaning and sanitising any food contact surface is a separate washing area away from the kitchen. For any cleaning operation to be successful, it is necessary to know the following before the cleaning operation starts:

1. type of soil to be removed
2. quality of water available
3. varieties of cleaning agents in the market
4. kind of equipment required or method of cleaning to be used

Food Soil

Types of food soil to be removed according to increasing degree of difficulty in removing them are:

1. *New loose dirt or food residue*: Freshly deposited food soil is the easiest to clean as it is the remains of food after a meal and can be removed immediately.
2. *Food residues and grease left after ineffective cleaning*: Such pots and pans should not be used, but sent back to the wash up area. If used for cooking, the soil will become more difficult to remove as it will adhere to the utensil.
3. *Thin film*: A thin porous film is deposited or gradually builds up on dishes. The dishes lose their lustre or sparkle and get stained. Pots and pans feel unclean to the touch and retain the smell of food prepared in them.
4. *Built-up deposits*: If dishes are not cleaned well, then deposits build up and become more permanent. Such deposits are hard and difficult to remove. These are dried food deposits left after several unsuccessful attempts at washing.
5. *Baked deposits*: These are heavy crusty deposits which are difficult to remove as they are baked on to the utensils.
6. *Burned deposits*: Food may get scorched during cooking and form a stubborn deposit which is difficult to remove.

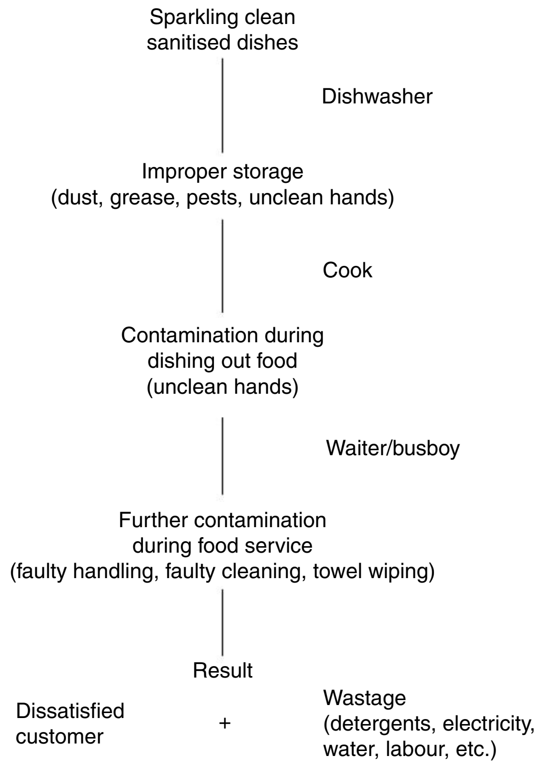


Fig. 10.1 *Sanitised dishes may be recontaminated in a number of ways*

The last four require extra care while cleaning.

Stained and dried food soil is easier to remove if the dishes are soaked in detergent solution. Dishes which need soaking prior to cleaning should be kept in a large container placed on the floor in the wash up area. Silverware should also be soaked to loosen food soil and remove tarnish easily.

Water

Water is very important in the cleaning process. It is used to dissolve detergents and sanitisers and activate them. It is also used for cleaning and at the correct temperature and pressure, it can be used as a sanitising agent. Water used for cleaning should be soft as the effectiveness of the detergent will depend on the wash solution. In soft water, detergents dissolve, spread and wash off well.

Hard water contains mineral salts which interfere with the cleaning action of the detergent. The minerals are generally calcium and magnesium. Some detergents contain certain chemicals which have the property of making these salts insoluble. This creates a problem in washed dishes. A dull coating or film remains on dishes, water spots remain on glassware and a deposit is formed inside the sink or machine. A good dishwashing compound should be able to keep mineral salts dissolved in water rather than allowing them to be thrown out of solution and finally getting deposited on dishes.

True *soft water* is an excellent dissolving agent and contains no dissolved solids. Dishes washed in such water would be spotlessly clean. But dishes and interiors of machines constantly exposed to soft water would age faster as soft water is also an excellent dissolving agent.

If hard water is the only source of water available for dishwashing, it is necessary to use a compound which has water softening properties without allowing the dissolved mineral salts to be thrown out of solution as unwanted solids. Water can also be softened by special water softening equipment. Water is softened by running it through a softener, boiling it or treating it with chemicals.

Some chemicals lower the surface tension of water and allow water to spread evenly and come in contact with the entire surface to be cleaned. It will gain entrance into deposits of food soil on the dishes and push on under the soil to loosen it from the dishes.

In other words, these chemicals increase the wetting power of water and help in the cleaning procedure. These chemical compounds have another important function to perform. They break up fats and oils into fine droplets which are evenly distributed throughout the wash water and do not form greasy smears on the washed articles.

Rinse additives or chemical drying agents lower the surface tension of water, allowing it to spread evenly and in a thin film over the dishes. This layer dries faster and does not leave any spots or stains. Such dishes need no drying by towels and can be reused much faster. Dishes which are machine washed are at a temperature of 82°C (180°F), which makes the drying process still shorter.

The temperature of water used for cleaning is important. Hot water cleans better because it activates the cleaning agent making its action more efficient and it dissolves fat. Wash water temperature should be at least 52°C (125°F) to enable removal of grease as the melting point of fats is 50°C or (122°F).

For manual dishwashing, the temperature of water should be 44 to 52°C; for machine dishwashing, it should be 55 to 60°C; and for sanitising dishes, it should be 77 to 82°C (170 to 180°F).

For proper dishwashing, an ample supply of hot and cold water is necessary. It should be chemically and bacteriologically safe.

Cleaning Agents

Water alone is not sufficient to remove dirt, grease or stains from food contact surfaces. For effective cleaning, certain cleaning agents should be used. Cleaning agents include all materials that are required to effectively clean surfaces, dishes, utensils, equipment and machines in the kitchen. They include soaps, detergents and other chemical substances such as sanitisers and disinfectants. Cleaning tools like scrubbers, scourers, steel wool, brushes, etc., aid in the action of the cleaning agent.

Table 10.1 **Types of Cleaning Agents**

S.No.	*Cleaning agent*	*Particulars*	*Advantages*	*Disadvantages*
1.	Soaps	Powder, flakes, cakes, liquid, strips	1. Good cleanser 2. Good for handwashing	1. Poor rinsing quality; lot of water required for rinsing 2. May form insoluble precipitate with hard water 3. Not recommended for dishwashing
2.	Synthetic detergents or dishwashing compounds	Powder, solid, liquid	1. Remove dirt, grease and food soil 2. Effective in hard water 3. A number of ingredients can be blended for better cleaning 4. Useful for manual and machine dishwashing and cleaning food contact surfaces 5. No undesirable action on hands	1. Ineffective against rust and firmly attached food deposits
3.	Acid cleaners	Used for special cleaning purpose only	1. Remove salt deposits in sinks and machines 2. Removes water spots 3. Used for removing rust stains 4. Removes tarnish from metals like copper and brass and brings back the glow	1. Harsh on the hands 2. Should be used with caution as they can damage the surface being cleaned
4.	Abrasive cleaners	Made of finely ground silica compounds or feldspar	1. Removes soil which acidic and alkaline cleaners cannot, e.g. firmly attached, scorched, baked-on deposits 2. Can clean rusty metals and worn pitted porcelain 3. Cleans badly soiled floors	1. May roughen surface and increase chances of future dirt accumulation 2. Along with soil, some of the articles surface is also removed 3. Not advised for normal cleaning of food soil from food contact surfaces

Function of Cleaning Agents

1. They loosen soil from the surface of the object.
2. They keep soil suspended to prevent redeposition.

They should be safe, non-corrosive to hands or equipment and suitable for the purpose required.

Types of Cleaning Agent Cleaning agents used for cleaning are detergents, which includes soaps and synthetic detergents, acid cleaners and abrasive cleaners.

Hot water and chemical sanitisers are used for sanitising.

Detergents Detergents are powerful dirt-removing chemical cleaning agents that help in removing dirt, grease and food soil from dishes, utensils, equipment and other surfaces. All detergents are surfactants (wetting agents) and are generally mildly alkaline.

A good detergent helps in getting rid of a high proportion of microorganisms. They do not, however, kill bacteria.

Detergents used in dishwashing include a number of ingredients blended and proportioned so that cleaning can be carried out quickly, effectively and efficiently. This blend of chemicals is also referred to as a dishwashing compound and is used both for manual and machine dishwashing.

The cleaning action of detergents may need to be supplemented by friction applied by use of cleaning tools or the cutting action of water sprays.

Properties of a dishwashing compound A good dishwashing compound should have the following properties:

1. wetting ability
2. ability to break up food soil into particles which remain suspended in wash water
3. soluble in water
4. effective at low temperature
5. effective in varying degrees of hardness of water
6. emulsifying ability
7. non-toxic
8. non-corrosive
9. easily removable from a surface with minimal amount of residue
10. safe on hands, eyes and uniforms

General guidelines for use of dishwashing compounds

1. Use the specified amount only. Excess may leave a film on the item and is a waste of money.
2. Control the foam and suds formation. The presence of grease and dirt in the wash water increases the level of suds and the need for frequent changes of wash water. This can be prevented by adequate soaking and pre-rinsing.
3. Prevent spotting and staining by following the first two rules and by adding a rinse additive and bleaching agent as well.

Sanitisers All food contact surfaces must be cleaned first and then sanitised as any kind of dirt interferes with the action of chemical sanitisers. Sanitising is achieved by using chemical sanitisers or hot water. The effectiveness of any sanitiser depends on:

1. concentration—the higher the concentration, the greater the disinfecting power
2. time of contact—this varies from one minute to 30 minutes
3. temperature—the effectiveness of the disinfectant increases with a rise in temperature

Chemical disinfectants or sanitisers may be inactivated by hard water, organic material or soil, incompatible combination with detergents, e.g., cationic disinfectants and anionic detergents, dilution and time. Dilute chemical disinfectant solutions deteriorate with time and may become a source of infection because of bacterial growth.

***Table 10.2* Effect of Dishwashing Compound on Various Metals/Materials**

S. No.	*Material*	*Problem faced*	*How to overcome*
1.	Stainless steel	Bluish tinge	Mildly acidic dip
2.	Aluminium	Corrosion of surface, rough white patches, black smudges	Change detergent and wash separately
3.	China	Loss of glaze, cracks and chips (because of excessive use and careless handling), film forms and stains develop	Discard
4.	Silverware (sterling silver and silver plated)	Dark tarnish	Soak in bleach solution. Use aluminium foil if tarnish is because of sodium hypochlorite used as sanitising agent, use iodophors
5.	Plastics	Staining	Use detergents containing bleach or chlorine
6.	Glassware	Water spotting or staining, dull coating or film	Use chemical drying agents or rinse additives; water softeners
7.	Copper	Greenish tarnish	Acidic dip, clean with tamarind and salt
8.	Brass	Loss of shine, dark tarnish	Acidic dip, clean with tamarind and salt

A good sanitiser should have the following properties:

1. toxic to microorganisms but not to man
2. non-corrosive
3. water soluble
4. deodorising
5. does not impart odour or taste
6. does not react with food
7. effective
8. easy rinsing
9. easily available
10. reasonably priced

Table 10.3 Sanitising Procedures

S.No.	Using chemicals	Conc. (ppm)	Temp. °C	Contact time	Advantages	Disadvantages
1.	Halogens (a) Chlorine and its compounds Hypochlorites Available chlorine Chloramine	 100 50 200	 24 24 24	 60 sec 60 sec 60 sec	1. Most widely used 2. Inexpensive 3. In proper dilution, kills bacteria, spores and bacteriophages 4. Leaves little remanent taste or smell 5. Removes stains from crockery 6. Used on grinders, meat block etc.	1. Comparatively destructive to cloth 2. Corrosive to certain metals if improperly and repeatedly used 3. Irritates the skin 4. Easily inactivated by food particles as food particles increases the pH
	(b) Iodine and its compounds Iodophor Available iodine	 25 12.5	 24 24	 60 sec 60 sec	1. Less irritating to the skin 2. Less affected by hardness of water 3. Effective against a wider variety of bacteria 4. Used on equipment, dishes and utensils	1. Less sporicidal than hypochlorites 2. More costly 3. Discolours equipment and dishes 4. Bad odour emanates if used at temperature above 49°C 5. Causes off flavour in dairy items 6. Inactivated by organic matter above pH 6; very effective at pH 4

Contd...

Table 10.3 (Contd)

S.No.	*Using chemicals*	*Conc. (ppm)*	*Temp. °C*	*Contact time*	*Advantages*	*Disadvantages*
2.	Quaternary Ammonium compounds (QUATS)	200	24	60 sec	1. Highly soluble 2. Colourless, tasteless and odourless 3. Low toxicity and corrosiveness 4. Effective at high pH 5. Rinsing is not necessary at dilutions below 200 ppm	1. Ineffective against bacteriophages 2. Cannot be used in hard water 3. Incompatible with certain synthetic detergents 4. *E. coli* and psychrophils which thrive at low temperature take longer to destroy
3.	Phenolic compounds Cresol Phenol				1. Good antimicrobial activity 2. Less easily inactivated by organic materials	1. Powerful smell 2. Inactivated by plastic and rubber 3. Irritating to humans at effective levels
4.	Chloroxylenol (dettol)				1. Used to disinfect hands	1. Poor germicidal action; not recommended for sanitising
	Using hot water					
1.	Hot water at		66 77 82	10 min 1 min 15 sec	1. Most reliable 2. Preferred to using chemicals 3. No smell, taste, toxicity, etc. 4. Dishes dry faster when sanitised at 82°C	1. Temperature should be constantly checked and time adhered to
2.	Steam Steam under pressure	 16 psi 20 psi	above 100 above 100	30–40 min 20 min 15 min	1. Useful for sterilising equipment which is stationary and in cleaning-in-place operations	1. Should be used only if steam can be trapped inside

(**Note:** psi indicates pounds of pressure per square inch.)

Guidelines for optimum sanitisation

1. Choose hot water or heat for sanitisation wherever possible.
2. Use a chemical disinfectant only when the application of heat is impossible.
3. Clean equipment and surfaces well before sanitisation by heat or chemical solution.
4. Choose a chemical disinfectant which is effective against a wide range of bacteria.
5. Ensure use of fresh preparation of chemical disinfectant everyday.
6. Use the disinfectant effectively. Check the strength of the solution, as it gets used up in trying to kill microorganisms.
7. Sanitise either by immersing the object in the correct concentration of sanitiser for one minute, or rinse, swab or spray double the recommended concentration of sanitiser on the surface to be sanitised and let the surface dry.

TYPES OF CLEANING EQUIPMENT — MANUAL AND MECHANICAL

Whether clearing dishes or cleaning premises, there has been a gradual perceptible shift from manual cleaning to mechanised cleaning machines. Dishwashing machines have the following advantages and disadvantages

Advantages

They can clean faster.

Lessen day to day financial expenditure.

Disadvantages

Initial investment is high.

Trained personnel are required.

Both manual as well as machine cleaning have their own advantages and disadvantages and a wise facilities manager will weigh the pros and cons of both before taking a decision.

THREE METHODS TO WASH, RINSE AND SANITISE FOOD CONTACT SURFACES

There are three methods to wash, rinse and sanitise food contact surfaces—the three bucket method, the sink method and the dishwashing machine method. The method to be used will depend on many factors, such as the surface to be cleaned and the size and nature of the food service establishment.

Even if all dishes are machine washed, workers should be trained in manual methods as well. All methods listed above follow three basic steps, namely, wash, rinse and sanitise. All these steps are necessary for proper cleaning and sanitising.

The Three Bucket Method

This method is used to clean and sanitise equipment which is too large to place in a sink or dishwashing machine or is stationary. Three separate buckets, containing a wash, rinse and a sanitising solution, are required. All buckets should have different colours.

Procedure for the Three Bucket Method

1. *Wash*: Remove food scraps from the surface to be cleaned. In the first bucket, mix detergent in warm water. Scrub surface with a scourer to loosen food, grease and dirt.

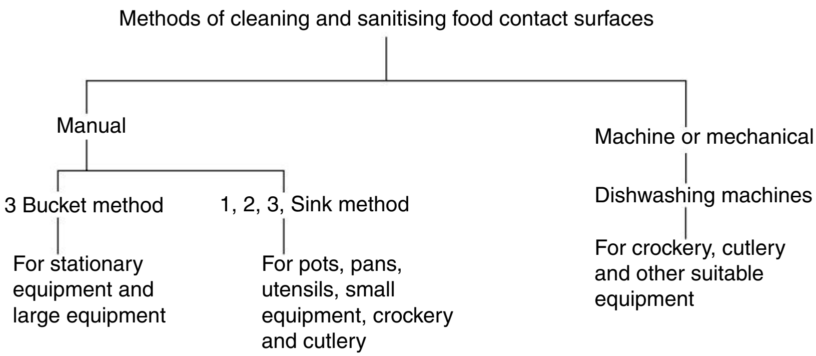


Fig. 10.2 *Methods of cleaning and sanitising food contact surfaces*

2. *Rinse*: Take clean warm water in the second bucket. Wipe the surface with a sponge to remove loosened soil and detergent till surface is clean. If surface does not look and feel clean, repeat these two steps.
3. *Sanitise*: Add chlorine in the correct concentration to warm water in the third bucket. With a clean sponge, wipe the entire surface lightly and allow solution to air dry. Do not dry surface with a dishcloth. Large equipment is sanitised by rinsing carefully with boiling water, or live steam from a hose in case of equipment in which steam can be confined.

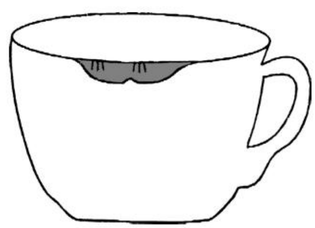


Fig. 10.3 *Lipstick marks on a cup after washing indicates inadequate cleaning*

Dishwashing

Dishes are washed in sinks or in the dishwashing machine. Dishwashing is one of the most important tasks in any food service establishment. Unfortunately, it is one of the most neglected areas. The job is usually assigned to the lowest grade of employees who are inexperienced, unskilled and do not understand the importance of using the right amount of detergent, water or time for this work. It is the responsibility of the management to select correct methods of dishwashing and train employees accordingly.

The Sink Method Dishes, pots, pans, chopping boards, containers, knives, spoons and other small utensils are washed and sanitised in sinks. Sinks should ideally have three compartments so that washing, rinsing and sanitising can be done in separate sinks. A one or two compartment sink is not very hygienic as all steps are carried out in the same sink.

Equipment required 1. Sinks: Two or three compartments with a hot and cold water supply are required. The sinks should be large enough to hold washing baskets and allow dishes to immerse completely in wash solution. They should be made of a non-toxic, non-corrosive, smooth material like stainless steel or vitreous enamel. Galvanised iron sinks are recommended for washing large pots and pans. The sink should have an overflow pipe to remove excess water. The pipe should be fitted with a strainer and funnel to remove food residue and prevent clogging. There should be a slope near the drain for self-draining. The number of sinks required depends on the number and variety of meals served. Separate sinks should be used for crockery and cutlery and for pan washing.

Waste pipe traps should be removable, smooth, easy to clean and easily fitted. Plastic, which is acid and hot water resistant, is preferred. A spray hose fitted to the sink is a desirable feature to wash down the sink and the draining boards.

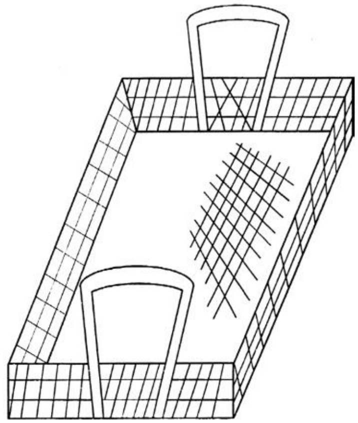


Fig. 10.4 *A long-handled ware washing basket*

2. *Drains:* They should be 10 to 15 cms (four to six inches) in diameter to remove all waste water without the risk of flooding. Grease traps should be cleaned regularly.

3. *Ware tables and drain boards:* They are necessary to hold soiled dishes before washing and to hold clean dishes after washing. They should be large enough, self-draining and should be so placed that they do not interfere with washing procedures.

4. *Ware washing baskets:* They are used for immersing soiled ware in the rinse and sanitising compartments. They should have long handles and be large enough to handle the normal load of wares. They should ensure complete immersion of items and prevent contamination of cleaned and sanitised items by human hands.

5. *Booster heaters*: They should supply hot water between 74 to 82°C for sanitisation. They should ideally be located under the final rinse sink to prevent water temperature from dropping.

6. *Thermometers*: They are meant for dishwashing and should be portable and accurate to within 2°C.

7. *Clock*: It is necessary to check immersion time during sanitisation and the clock should have a seconds hand.

8. *Cleaning tools*: Bristle brushes, scourers and abrasive pads in a good state of repair should be placed in a convenient place. Sponges should be avoided as they encourage the growth of microorganisms.

Procedures for three sink method Check that sink is properly clean before starting work.

1. *Scrape and pre-rinse*: This is to remove loose soil from dishes and keep wash water cleaner and free from bacterial build-up. A scraper or squeegee is used and food residue is transferred to a garbage container. Sometimes, soaking may be necessary to remove more stubborn residues.
2. *Washing*: The first sink contains a hot detergent solution at 43.5°C to 52°C. Dishes are washed in this sink with the help of cleaning tools. All visible soil is removed from the surface of dishes. As more and more articles are washed, the effectiveness of the detergent is reduced. The detergent solution is no longer effective when a scum or grease layer forms on water and should be changed. Brushes and scourers should be cleaned, sanitised and dried. Grease is removed at 52°C.

3. *Rinsing*: The second sink contains water at 40°C to rinse dishes till washing solution or other material is removed and dishes are clean to sight and touch. Rinse water should be changed when it becomes dirty. If a basket is used, dip the entire basket until all traces of detergent are removed. A basket must be used to sanitise dishes because (a) it reduces hand contact with eating surfaces of dishes and (b) temperature of water needed for sanitisation is too high for the use of hands.

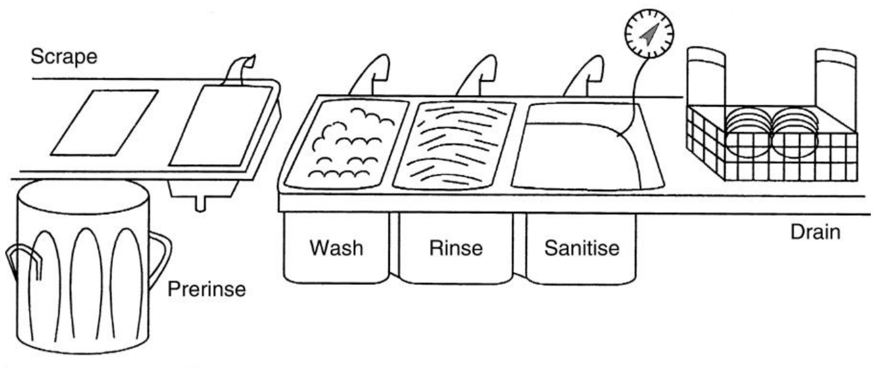


Fig. 10.5 *The three sink method*

4. *Sanitising*: This step removes any soil and microorganisms that remain after rinsing and has a bacteriostatic effect. Sanitisers used may be chemicals or water at specific temperature and pressure. The concentration and duration of immersion should be strictly followed.
5. *Drying*: No item should be touched on the food or mouth contact surface. All items should be air dried to retain the effects of sanitisation. They can be left in the baskets to dry. Glasses should be inverted on a well ventilated drain board. Towel or dish cloth drying is not recommended.

Mechanical Dishwashing A dishwashing machine is used to clean and sanitise all plates, glasses, cups, saucers, knives, forks and spoons which are used in the dining area. Other equipment and utensils that fit in the machine can also be cleaned and sanitised. The machines work automatically and are extremely useful where quantity food preparation and service takes place, as both time and labour are saved. For effective cleaning, it is necessary to follow the manufacturer's operating instructions carefully and to maintain the equipment in good working condition.

Before selecting a machine it is essential to have the following details

1. type of ware
2. volume of dishes to be washed
3. type of food service establishment
4. space available for dishwashing

Types of dishwashing machines Dishwashing machines are basically of two types: stationary machines and conveyor machines.

1. *Stationary machines*: These machines have a single tank. The articles to be washed are suitably placed in the rack and the racks are lifted and placed in the machine. The rack of dishes stays in one place while the wash and rinse solution circulates around the dishes. The timing is automatically controlled in most machines.

2. *Conveyor machines*: In the conveyor machine, the dishes move on a conveyor belt through the different cycles of washing, rinsing and sanitising. The dishes are either placed in racks on the conveyor belt or directly on the pegged conveyor belt.

   Conveyor machines may have

   (a) a single tank where dishes are cleaned by the wash solution at one end and conveyed to the clean end of the machine where it activates fresh water at 82°C (180°F). Water is sprayed from nozzles above and below the dishes.

   (b) two tanks or multiple tanks: the first tank, i.e. the wash tank, contains the detergent solution. After the wash cycle, the rack is conveyed through the power rinse tank to rinse the dishes free of most of the detergent solution. The rack then passes through the final rinse for sanitisation. The racks are transported through the machine on a pretimed conveyor at a speed set by the manufacturer. These machines are recommended for larger establishments.

Loading of dishes may be done from the top or side of the machine, depending on the model. Dishes are cleaned in a machine either by a jet or spray of hot water and detergent, forcefully sprayed to remove soil; by revolving brushes that scrub soil off the dishes; or by mechanically agitating the detergent solution to help in removing soil.

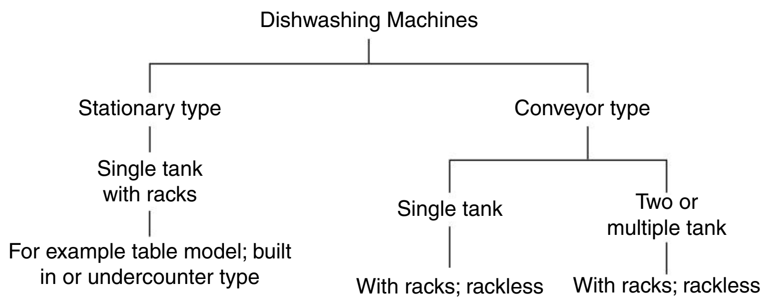


Fig. 10.6 (a) *Types of dishwashing machines*

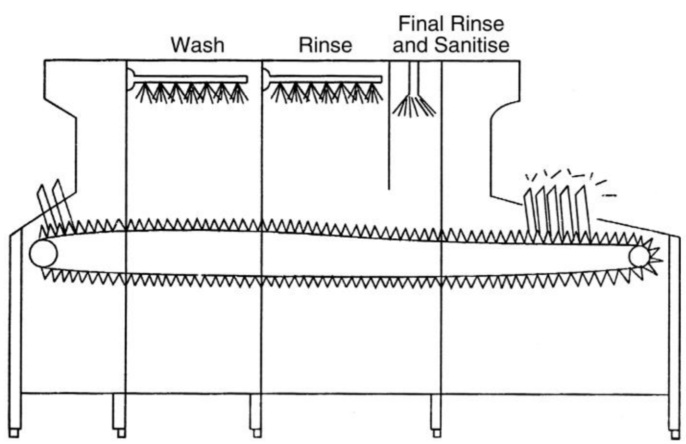


Fig. 10.6 (b) *Multiple tank dishwashing machine with a pegged conveyor belt*

Steps in dishwashing Before beginning the cleaning operation, it is essential that the machine, dish tables and work area is clean. Some preliminary steps which should be checked are:

1. Check the insides of the machine to ensure that no food soil, broken dishes or other foreign objects are present.
2. Overflow pipes should be free of debris.
3. Spray arms should be clean and properly installed.
4. Inspect final rinse nozzles and see that they are not blocked.
5. Make sure sufficient detergent is present in the dispensers.
6. Keep scrap bins and strainers in place.

Operating procedure The following steps should be adhered to for successful cleaning:

1. *Sorting*: Set aside any dishes that require special handling, as well as heavily stained dishes which will not get cleaned by the routine cleaning process in the machine.
2. *Preliminary scraping and pre-rinsing*: Remove excessive loose food particles with the help of a rubber scraper. The purpose of scraping is
   (a) to prevent the clogging of spray nozzles with food particles
   (b) to avoid frequent changes of wash water
   (c) to reduce bacterial contamination of wash water
   (d) to remove as much grease as possible prior to washing
   (e) to wet the soil remaining on the dishes
   (f) to facilitate easy cleaning
   Manual pre-rinsing is not required if the machine has a power pre-rinse attached.
3. *Soaking*: This may be necessary for dishes on which soil has hardened or dried, especially flatware may need soaking for some time to loosen the soil. Soaking can be done in tubs placed under the counters or ware tables.
4. *Racking*: In this step, the dishes are arranged either in racks for conveyance through the machine or on a pegged conveyor for travel through it. It involves proper placement of dishes to permit the wash and rinse solution to come in contact with all surfaces to be cleaned.

   Cleaning is most effective and breakages are reduced to a minimum when
   (a) there is no overcrowding of dishes
   (b) similar sized objects are racked together
   (c) cups, glasses and other deep dishes are placed open end down to prevent water accumulation

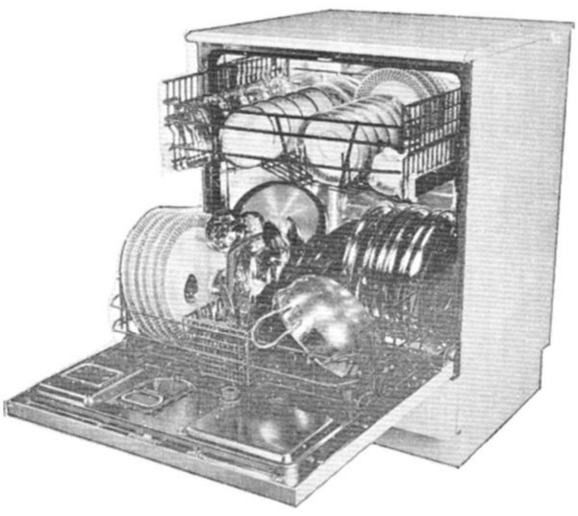


Fig. 10.7 *Dishes should be properly racked to ensure adequate cleaning*

5. *Washing*: The purpose of washing is to remove all food soil from the dishes and dissolve the grease on dishware. This requires clean water, with correct proportion of detergent at the right

temperature and pressure, in contact with the dishes for the proper amount of time. The detergent solution circulates at a specific rate as the dishes pass through this tank. The temperature of the washing solution will vary according to the type of the machine and its specifications.

6. *Power rinse*: It completely removes most of the detergent-laden water and permits effective sanitisation. Because of the build-up of heat, it hastens the drying process. Hot pumped rinse water is sprayed over the dishes in the correct volume and with sufficient pressure to rinse.
7. *Final rinse and sanitisation*: At this stage, any remaining detergent is removed and the dishes are sanitised. If water is used as a sanitiser, then it should be sprayed in adequate volumes and at a correct pressure with temperatures varying between 77 and 82°C. Ideally, as it leaves the nozzles it should have a temperature of 82°C. However, it should not exceed 90 to 93°C, as the water at that temperature under pressure would atomise and become vapour.

   If chemical sanitisers are used, dishes should be immersed for at least one minute at concentrations mentioned in Table 10.4.

   The hotter the water used for sanitising, the faster the drying and lesser chances of water spotting. A drying agent may be injected in this cycle.

Table 10.4 **Wash Water Temperatures during Different Cycles of Machine Dishwashing**

Cycle	*Type of machine*	*Temperature of water*	
		°C	*°F*
Pre-rinse		43 to 55	110 to 130
Wash	Single tank stationary	60 to 74	140 to 165
	Single tank conveyor	71	160
	Multiple tank conveyor	66	150
Power rinse		71 to 77	160 to 170
Final rinse and sanitise		77 to 82	170 to 180

8. *Drying*: Crockery and utensils must be left in racks to drain and air dry.

Although dishwashing machines are a boon to us, they can create problems if not selected well. Some of the common causes of failure are:

1. machines located in the wrong place
2. improper plumbing
3. machines are too small
4. untrained employees
5. water is not adequately hot
6. water pressure is low
7. wrong selection of detergent

While selecting a new machine the following points should be kept in mind:

1. select a machine from a reliable, standard company
2. two small machines are better than one big one. During slack periods only one machine can be operated, or if one machine breaks down, the other can be used
3. number of operators required and the kind of technical knowledge they must possess to operate the machine
4. whether servicing the machines needs outside technicians or can it be serviced by available staff

5. the power consumption
6. cleanability and durability of the material used and the design
7. whether the machine is silent or noisy when switched on
8. whether large trays and glasses can be washed in it
9. whether it has a detergent feeder fitted in
10. whether there is a strainer pan to collect food debris

POST CLEANING STORAGE

Dishwashing operators must take the greatest care while removing sanitised dishes, utensils and equipments from racks, baskets or the conveyer itself. Contamination of cleaned and sanitised ware should be avoided.

General Rules for Hygienic Storage and Handling

1. There should be clean place for storage of cleaned and sanitised ware. Store all items either on clean dry shelves or in cart racks. Dusty or dirty shelves will quickly resoil cleaned and sanitised items.
2. Handle items as little as possible, taking care not to touch food or mouth contact surfaces.
3. Storage area must be dry and above the floor. Splashes from mopping solutions or food spillage, exposure to dust or floor dirt from sweeping must be avoided.
4. Pans or containers stored on low shelves should be placed inverted or covered.
5. Utensils etc. should be hung in a self-draining position on hooks or racks.
6. Glasses and cups should be inverted on racks or on shelves.
7. Silverware should be placed in perforated plastic containers to dry. Cutlery should be picked up by the handle.

DISH CLOTH

Drying cloths should be used only when necessary. They should be changed frequently and washed and boiled each day. The dish cloths themselves carry many germs and the wise operator will realise that the germs may be passed back onto cleaned and sanitised crockery and utensils. The use of diposable absorbent paper for final drying can be considered, if affordable. Cloths for mopping should, if used, be boiled frequently or soaked overnight in a disinfectant solution.

CLEANING OF PREMISES AND SURROUNDINGS

The Cleaning Schedule

Cleanliness is an essential part of the daily routine in all areas and departments in any catering establishment. It is the key to good health and efficient work. The cleaning schedule should be carefully planned so that the premises, all equipment, furniture and surroundings are thoroughly cleaned everyday. The cleaning schedule should not interfere with or hamper the regular working in the establishment. The cleaners should be familiar with the work programme and should strictly adhere to the time-table. Any spillage or accidental mess should, however, be cleaned up promptly. This will prevent accidents and grease spots forming on floors.

A surface is clean when it is free from dust, dirt, grease, stains, cobwebs or any such unacceptable element.

To remove soil from any surface it is necessary to select the proper cleaning technique. This will depend on the type of soil present.

Soil can be removed by

1. Sweeping.
2. Dusting or damp dusting with a cloth tightly wrung in a multipurpose cleaning solution.
3. Washing with water and a cleaning agent.
4. Friction using an abrasive agent.
5. Suction using a vacuum cleaner or wet pick-up machine.
6. Pressure using a scrubber or polisher.
7. Force by using water or air.
8. Solvents for removing grease and stubborn stains.

Fig. 10.8 *Keep food away before sweeping the kitchen*

The cleaning schedule should be prepared for daily, weekly and monthly cleaning. Special cleaning, like outside windows, light fixtures, walls which require white-washing, polishing, distempering and painting of surfaces, is carried out a couple of times a year. The general rule for cleaning is that there should be no large-scale sweeping and cleaning while food is being prepared, as sweeping raises dust laden with microbes which contaminates food.

Floors Floors in areas where traffic is heavy, as in kitchens, bakeries, pantries, dishwashing rooms, walk-in refrigerators, corridors, dining rooms, washrooms and toilets, should be cleaned everyday. Floors in areas where traffic is light can be cleaned weekly.

All washable floor surfaces should be washed. Wooden floors should be waxed or polished. Hot water, soap or detergent, a scrubbing brush and a mop is needed. Before cleaning the floor all movable light equipment and furniture must be shifted. The floor is best washed at the end of the day. Floors in the pantry, larder, dry food store and vegetable store should be swept daily and washed at least once a week. Fixed carpets and matting in dining rooms, passages, stair ways should be brushed or swept every working day, preferably by a vacuum cleaner. Loose mats and rugs should be vacuum cleaned or taken out into the open and beaten at least once a week. Carpets should be shampooed or drycleaned at least once a year.

Walls and Ceilings Walls and ceilings should preferably be non-porous and in good repair. This helps the cleaning procedure and prevents pests from breeding in cracks and crevices. While cleaning the walls and ceiling, follow the principle of cleaning the uppermost areas first. Walls, ceilings and fixtures should be cleaned at least once a week. Areas within reach should be dusted everyday. The method of cleaning will depend on the surface to be cleaned. Ideally, walls should be washed with warm water and a detergent. The ceilings should be brushed and swept. The girders, piping, electric fittings, etc., should be dusted. Dusting should be done carefully so that dirt is not shifted from one place to another. The best way of removing dust is by using a vacuum cleaner or by damp dusting as it prevents dust from flying about. All walls must be dusted. Walls that become heavily soiled or spattered daily should be washed. All walls should be free of dust, moisture, grease, cobwebs, grime and mildew. Light coloured walls make dirt more visible. Painted walls should be repainted regularly and papered walls should be kept in a good state of repair with no loose paper.

Kitchen Tables, Counters and Preparation Slabs Kitchen tables, counters and preparation slabs should be washed at least once a day. All surfaces coming in contact with food should be cleaned after each service by the three bucket method. All metal surfaces should be cleaned with hot water, a non-scratching detergent and by a hand swab. Wooden and marble surfaces should be scrubbed with a scrubbing brush, hot water and detergent. The surfaces should be rinsed well and wiped with a clean cloth everytime they are used. Such cloths should be washed well and boiled. They should not be used for wiping dishes. All parts of tables, including the framework and underside, all areas of the counter, like the hot cupboard, and all preparation areas including chopping boards and pastry slabs should be cleaned at least once a day. The bain-marie (hot food serving counter) should be turned off and the water drained off. It should then be cleaned inside and outside with hot detergent water, rinsed and dried everyday.

Shelves and Cupboards Shelves and cupboards that are constantly in use should be tidied and cleaned once a week. Shelves and cupboards are mainly used for storing ingredients or utensils. They should be first emptied and then swept or dusted. The upper surfaces of the shelves should be scrubbed and lower surfaces should be dusted. While cleaning, always start with the topmost shelf. Cupboards which are used for storing reserve crockery, linen, etc. i.e. long-term storage cupboards, should be cleared out and cleaned at least once a month.

Cleaning of Surroundings and Drainage The entire working premises should be thoroughly cleaned once a week. This should be done after the dining area is closed. All edible items should be covered and put away. All easily movable articles should be removed. This procedure helps in putting things back in place and prevents accumulation of rubbish. Cleaning is thus made easier.

All furniture should be thoroughly dusted at least once a day and table tops scrubbed clean. If table cloths are used, they should be changed. Walls, ceilings, fittings and fixtures should be swept or dusted at least once a week.

All passages and staircases, whether used to carry food or used by customers, should be cleaned frequently, and any spillage should be mopped up at once. All nooks and corners should be swept out and cleaned thoroughly once a month.

Any open space outside the building should be swept and washed everyday. No rubbish should be allowed to collect in the drains or else drains will get blocked, give off foul odours and encourage pests.

Drainage Drains should be adequate to remove all wastewater without being overloaded. Each drain should have a water seal or trap which will prevent unpleasant odours rising from the pipe into the room. Drain pipes should have a diameter of 10 to 15 cms and should be cleaned regularly. They get blocked mostly because food accumulates on the sides and blocks the pipes. Blockages can be cleared by using a rubber water plunger. If not cleared then the cleaning eye at the bottom should be opened. The drain can be cleaned with a flexible wire or a cleaning liquid especially available for blocked drains.

Grease traps are necessary because they prevent grease from congealing in the drainpipes. The grease tray should be removed regularly and washed out.

SUMMARY

Cleaning and sanitising form the basis of food service sanitation. Cleaning is the removal of matter from a surface on which it is unwanted. Sanitising is carried out after the cleaning operation and results in a reduction in the number of harmful bacteria to safe levels. The importance of both these steps should be explained to all food service workers. Before any cleaning operation begins, it is necessary to know the type of soil to be removed, quality of water available, varieties of cleaning agents and their effectiveness and the kind of equipment available.

Cleaning of dishes and other utensils can be done manually or by machine. The basic steps in the cleaning operation include removal of food residue, washing with hot water and detergent, rinsing to remove free dirt and detergent, sanitising, drying and storage. A wide variety of dishwashing machines are available in the market and a number of factors should be considered before selecting a machine. For manual dishwashing, at least two sinks, preferably three, should be used to wash, rinse and sanitise dishes. If adequate cleaning and sanitising facilities are not available, disposable items, called single service items, must be used. These should be stored carefully to prevent contamination.

A cleaning schedule should be prepared so that the premises, equipment, furniture and surroundings are thoroughly cleaned everyday. Some areas are cleaned weekly, others monthly

or six monthly, for example, by distempering or painting. The cleaning schedule should not hamper the regular working of the establishment. The method of cleaning will depend on the surface to be cleaned. Cleanliness is an important part of the daily work schedule in the establishment and is necessary from the health and hygiene point of view.

KEY TERMS

Antiseptics They are chemical substances that retard growth and multiplication of microorganisms. They have a bacteriostatic effect and do not destroy bacteria. They are used on the skin. Disinfectants in low concentrations have an antiseptic effect.

Chlorine based sanitisers pathogen destroying compounds that are inexpensive and can be used in hard water that are active against all microorganisms and spores in a concentration of 50 to 100 ppm. They do not leave any residue but are unstable and have a characteristic chlorine odour.

Disinfectants They are chemical substances that kill the majority of bacteria present on a surface, but do not kill spores. All harmful or resistant bacteria may not be destroyed, but are reduced to a safe level. They are effective only when grease and food residues have been already removed from the surface by proper washing and rinsing. Disinfectants have a bactericidal or germicidal action. They are used on inanimate objects.

Iodophors These are iodine-based sanitisers that are stable, have a long shelflife and are capable of destroying most bacterial cells excluding spores. Although they do not leave a residue the disadvantages are that they may leave stains, are costly and take time to act. They are non-corrosive, do not irritate the skin and are to be used in a concentration of 12.5 to 25 ppm for at least 60 seconds at temperatures of 24°C to 49°C. (75°F to 120°F)

Phenolic compounds Pathogen destroying compounds that are used to disinfect floors, drains and non-food contact surfaces. They act as deodorizers and are most effective at pH6 and pH7.

ppm This is an abbreviation for parts per million, which is a measure for concentration. 200 ppm chlorine means there are 200 parts chlorine and 999,800 parts water.

1,000,000 – 200 = 999,800. It also means that 200 mg of chlorine is mixed with one kg of water (1 kg = 1,000,000 mg).

QUATS Quaternary ammonium compounds stable sanitizers that destroy most microorganisms and leave a film that controls bacterial growth. Long shelf life, non-corrosive, non-irritating, control odours and work best at pH9 to 10. They are incompatible with common detergents, are costly and take time to destroy certain microorganisms.

Sanitisation The destruction of disease causing microorganisms that survive the cleaning process. This step follows cleaning and is important as cleaning does not necessarily destroy all microorganisms Sanitization reduces microbial count to a safe level.

Sanitisation Means the application of cumulative heat or chemicals on cleaned food contact surfaces to reduce the level of pathogenic microorganisms to safe levels, i.e., 99.999 % reduction.

Sanitising Sanitising is the process of destruction of microorganisms that remain on the surface after washing and rinsing. The purpose of sanitising is to reduce the microbial count to a safe level.

A *safe level* of microorganisms has been defined as a plate count of not more than 10 microorganisms per square inch.

Sanitisers These are chemical compounds that contain chlorine, iodine, QUATS or phenolic compounds that destroy microorganisms that remain on a surface after cleaning and rinsing process.

Sterilisation Sterilisation destroys all microorganisms present on the surface, whether in the vegetative state or as resistant spores, while *Sanitisation* brings about a reduction in the number of microorganisms.

Sterilisation of dishes or surfaces is not normally necessary nor practical in food sanitation.

What is required is suitable conditions which will prevent the growth of spores and a gross reduction in the level of vegetative cells. This can be brought about by disinfection.

Sterile The term 'sterile' means free from all living organisms. The lowest temperature recommended is 121°C for 20 minutes at 15 pounds pressure. This is achieved in an autoclave by moist heat. For dry heat sterilisation, time required is one hour at 170°C.

Sterilisation A process that destroys virtually all microorganisms and their spores. Food to be preserved is sterilised by heating under pressure for a specified time and temperature, which depends on the food product and its type of packaging.

REVIEW QUESTIONS

1. Select the most appropriate answer in the following.
   (a) Rinsed dishes and silverware should be placed in baskets and sanitised because
      (i) it is easier to handle ware in baskets
      (ii) the temperature of water is too high for the hands
      (iii) unnecessary handling of mouth and food contact surfaces is avoided
      (iv) all of the above
   (b) Hot water is useful while cleaning because
      (i) it increases chemical activity of the detergent
      (ii) it melts fats
      (iii) it has a sanitising effect
      (iv) all of the above
   (c) To remove congealed grease while manually washing dishes, the temperature of wash water should be
      (i) 79°C (175°F)
      (ii) 52°C (125°F)
      (iii) 38°C (100°F)
      (iv) 24°C (75°F)
   (d) A thin film build-up on dishes is undesirable because
      (i) they lack lustre and feel unclean to touch
      (ii) they accumulate flavours of food
      (iii) they may permit microbes to survive
      (iv) all of the above
   (e) Who should understand the importance of cleaning procedures?
      (i) the customers
      (ii) the food service manager
      (iii) all food service workers
      (iv) the dishwashing staff
   (f) The main purpose of cleaning and sanitising dishes is
      (i) to remove surface dirt
      (ii) to reduce number of microbes to a safe level
      (iii) to control odour
      (iv) all of the above
   (g) The temperature of water required for sanitising should be
      (i) 82°C for 15 seconds
      (ii) 77°C for 60 seconds
      (iii) none of the above
      (iv) all of the above
   (h) To simplify cleaning of utensils used for cooking starchy material, they should be
      (i) allowed to air dry
      (ii) soaked in cold water
      (iii) soaked in warm water
      (iv) soaked in hot water

(i) Which of the following is incorrect if hard water is used for dishwashing
  (i) a dull film forms on dishes
  (ii) water spots are left on glassware
  (iii) dishes and machine interiors age faster
  (iv) deposits are formed inside sinks and machines
(j) Equipment should be cleaned
  (i) as soon as you finish using it
  (ii) before you go home
  (iii) according to a fixed schedule
  (iv) as soon as you arrive
(k) The most hygienic way of drying hands is by using
  (i) a warm air drier
  (ii) a hand towel
  (iii) the dish cloth
  (iv) the apron
(l) Instructions for operating a machine should be
  (i) distributed as handouts
  (ii) displayed on a plaque near the machine
  (iii) pasted on the machine
  (iv) explained verbally when the machine is purchased
(m) Cleanability of equipment and utensils depends on
  (i) material used for construction
  (ii) design
  (iii) ease of dismantling
  (iv) all of the above
(n) How would you place heavy counter-top equipment?
  (i) mounted on legs with a 10 cm gap
  (ii) mounted on legs with a 1 cm gap
  (iii) directly on the counter
  (iv) on the floor beneath the counter
(o) Immobile equipment should be
  (i) placed 15 cm off the floor
  (ii) permanently fixed on a cement platform
  (iii) fitted with casters
  (iv) in direct contact with the floor
    I. (i) and (iv) only
    II. (i), (ii) and (iii) only
    III. (ii), (iii) and (iv) only
    IV. (iii) and (iv) only

2. State whether the given statements are True or False. If false, correct them.
(a) Dishwashing compounds are made up of a combination of chemicals, each having specific functions to perform.
(b) Adequate scraping is unnecessary when a good detergent is used.
(c) As long as dishwashing staff realise the importance of the cleaning process, clean dishes can be guaranteed
(d) Aluminium utensils should be cleaned with washing soda.
(e) All dishes and food contact surfaces should be sterilised.
(f) When cleaning a room, always clean uppermost areas first.
(g) The waterseal in the drain prevents foul odour from rising upwards.
(h) Rinse water in the second sink should run continuously and be allowed to overflow.
(i) Only food and mouth contact surfaces of a dish need to be cleaned well.
(j) Dishes should be washed and sanitised in the kitchen sink.
(k) Pre-rinsing dishes helps in keeping dishwater cleaner.
(l) Ample water supply is essential for effective cleaning, irrespective of whether it is hard or soft.
(m) Cracked and chipped crockery is difficult to wash and sanitise.
(n) Dishes of intricate design and shape are difficult to clean in a dishwashing machine.
(o) In small catering establishments the kitchen could be used as a staff changing room.
(p) Brass pots and pans should be lined with tin.

3. Fill in the blanks with suitable word/words
(a) If equipment and utensils are not cleaned well, it is likely to cause food __________.

(b) Oils and melted fats are removed from soiled dishes and form a __________ in the wash solution.

(c) Water used for dishwashing should be tested to ensure that it is __________ and __________ safe.

(d) The surface tension of water can be reduced by using detergents which contain __________ __________.

(e) The cleaning action of detergent may need to be supplemented by friction from __________ or cutting action of __________.

(f) A __________ dish cannot be cleaned and sanitised effectively.

(g) Dishes with dried or cooked-on deposits should be __________ prior to washing.

(h) For manual dishwashing a __________ compartment sink should ideally be used.

(i) __________ water contains __________ which interfere with the cleaning action of detergent.

(j) Water can be softened by using __________, __________ it or running it through a __________.

(k) A plate count of not more than 10 microorganisms per square inch is called __________.

(l) Moist heat sterilisation needs a minimum temperature of __________ °C, __________ minutes time and a pressure of __________ pounds.

(m) Dishwashing machines are broadly classified as __________ machines and __________ machines.

(n) __________ removes visible soil while __________ reduces microbial load to a safe level.

(o) Water at the correct __________ and __________ can be used as a sanitising agent.

(p) Silverware should be __________ to loosen food soil and remove __________ easily.

(q) Dishes can be sanitised either by using __________ or by applying __________ __________.

(r) Both __________ and __________ form the basis of food service sanitation.

(s) A well planned and designed food service is a __________ for maintaining high standards of __________.

(t) The kitchen should be divided into different __________ for different activities.

(u) The __________ should be located near the goods receiving area.

4. Match the following functions and water temperatures used in the three sink method of manual dishwashing.

Sink	*Function*	*Temperature*
I	Sanitise	40°C
II	Wash	77°C
III	Rinse	49–52°C

5. (a) Match the cleaning agent in Column *A* with its properties from Column *B*

A	*B*
1. Acid cleaners	(a) Dry dishes faster
2. Wetting compounds	(b) Emulsifying agent
3. Soap	(c) Sanitising effect
4. Rinse additives	(d) Dissolves mineral salts
5. Abrasive cleaners	(e) Make mineral salts insoluble
6. Water softeners	(f) Contain finely ground silica compounds
	(g) Removes metal tarnish
	(h) Poor rinsing ability

(b) Match the material in Column *A* with the equipment in Column *B*

A	*B*
1. Cast iron	(a) Cutlery
2. Mild steel	(b) *Tandoor*
3. Copper	(c) Chappati puffer
4. Aluminium	(d) Stands
5. Polypropylene	(e) Outer surface of cooking utensils
	(f) Dishwashing sink
	(g) Chopping boards
	(h) Mobile equipment

6. What properties should a good sanitiser possess?
7. What are the three methods by which dishes are cleaned in a dishwashing machine?
8. Which four basic details should be known before you purchase a dishwashing machine?
9. What are the basic steps involved in any dishwashing process?
10. List problems which commonly arise when dishes are washed mechanically.
11. What type of soil would you find on dishes in an Indian restaurant.
12. Differentiate between
    (i) Sterilise and sanitise
    (ii) Halogens and quats
    (iii) Disinfectant and antiseptic
    (iv) Sanitising and cleaning
13. How should cleaned and sanitised dishes be stored?
14. What are single service items and what advantage do they have ?
15. What criteria should be considered while selecting dishwashing equipment?
16. Enumerate precautions to be taken for mechanical dishwashing.
17. How and when should work surfaces be cleaned?
18. Specify the other areas in catering establishments that require cleaning and briefly outline the procedure and frequency of cleaning.
19. What are the functions of a good detergent?
20. What kind of pots and pans require acid cleaners?
21. List the types of soil seen on kitchen equipment and explain how you would proceed to clean them.
22. List the types of dishwashing machines available in India.
23. What precautions should be taken while operating a slicing machine?
24. What information should you gather before planning the kitchen layout?
25. Why are copperbottom pans superior to ordinary pans?
26. Why should metallic spoons not be used in aluminium pans?
27. Outline the points to be borne in mind while selecting equipment.
28. List the general guidelines for cleaning equipment.
29. Why are wooden surfaces not recommended in food preparation areas? How can such surfaces be improved?
30. Why is cleanability of special importance in the food industry?
31. What do you mean by food contact surfaces?
32. What is the first step to be taken while cleaning electrical grinders, mincers, etc.
33. Why should iron griddles and *kadhais* be dried after they are washed?

11

- **Importance of pest control**
- **Classification of pests: rodents, insects, animals and birds**
- **Pesticides: nature, effect on pests, method of application, precautions to be taken**

Pest Control

INTRODUCTION

Pests have been a nuisance to mankind from time immemorial. With the advancement of science, there is now a better understanding of the various sanitary practices, chemical treatment and better facilities are available to enable effective pest control. A vigilant food service worker can play an important role in protecting food from contamination and wastage and in maintaining the reputation of the catering establishment. Proper understanding of why pest control measures are needed is essential.

IMPORTANCE OF PEST CONTROL

1. *Contamination* Contamination of food leading to food poisoning and other serious diseases in humans, is a major hazard of a pest infestation. This is so because pests move from dirt to food and transfer harmful microorganisms to it.
2. *Legal Requirement* According to the Prevention of Food Adulteration Act (1954), if any food article consist either wholly or in part of any filthy, putrid, rotten, decomposed or diseased animal or vegetable substance or is insect infested or is otherwise unfit for human consumption it is deemed to be adulterated. Serving adulterated food is punishable by law.

3. *Wastage and Destruction* Ten per cent of the world's harvested cereals are destroyed by rodents and insects, which if saved could feed 260 million people. Rodents are known to destroy pipes, insulation and cables. Termites and textile pests cause grave damage to the woodwork and upholstery. Beetles, weevils and warehouse moths destroy commodities, making them unfit for consumption. Rodents contaminate much more food with their hair and droppings than they actually eat.
4. *Reputation* The reputation of any catering establishment depends largely on the prevailing hygienic conditions. Flies hovering over uncovered food and insect body parts and droppings found in food can be very repulsive to the consumer, thus damaging the establishment's reputation. Hence, proper sanitary practices and pest control measures would go a long way in building up goodwill among customers and in turn will improve financial gains.

CLASSIFICATION OF PESTS

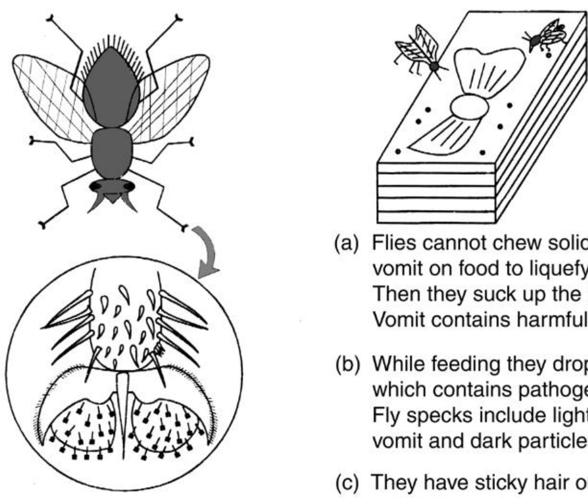
Pests commonly found in a catering facility can be divided into the following categories:

Insects which include houseflies, fruitflies, cockroaches, silverfish, firebrats and stored grain insects.

Rodents which include rats and mice; and animals and birds which include cats, dogs, crows, sparrows and pigeons.

Housefly

The housefly is one of the filthiest of pests and is found all over the world. It has a hairy body, three pairs of legs, each having a pad with glandular hairs. Secretions from these pads enable dirt and germs to stick to it, which is later transferred to food, equipment or any other surface it lands on.



(a) Flies cannot chew solid food so they vomit on food to liquefy it. Then they suck up the liquid. Vomit contains harmful microbes.

(b) While feeding they drop excreta which contains pathogens. Fly specks include light drops of vomit and dark particles of excreta.

(c) They have sticky hair on their limbs which helps them carry bacteria from one place to another.

Fig. 11.1 *Do not let the fly have its meal before you*

Flies spread diseases of the intestine and nose and throat. Serious illnesses like tuberculosis typhoid, cholera, etc. are a result of poor sanitary conditions.

While feeding on solid foods like sugar, sweets and fruits, the housefly regurgitates a fluid from its mouth. This softens the food, making it into a solution which the fly sucks up. While feeding, it defecates after every two to three minutes. The regurgitated fluid, together with the fly's body waste, contains numerous microbes and the cysts and eggs of intestinal parasites.

A single fly can carry 280,00,000 bacteria in its alimentary canal and 50,00,000 bacteria on its hairy body and feet.

The fly has a powerful sense of smell and is attracted to uncovered garbage, dirty toilets, food waste, empty food packets, cartons, used single service items, etc. It breeds close to its source of food in damp, filthy areas. The fly is most active at temperatures between 26 and 32°C. Flies are attracted to light and being winged insects, are affected by wind currents.

Control Measures

1. Environmental sanitation can be achieved by proper disposal of garbage, decaying food and animal carcasses and other wastes.
2. All food wastes should be held in tightly covered bins and preferably refrigerated to reduce decay and fly activity. Clean garbage containers thoroughly.
3. Protective display of food using flyproof cupboards, wire gauze covers, etc., should be practised.
4. Adequate flyproofing of doors and windows of kitchens and food service areas helps prevent their access to food. Self-closing doors and windows prevent their entry.

   Air currents or curtains protect the establishment from the entry of insects and dust. They are mounted outside and above the door.

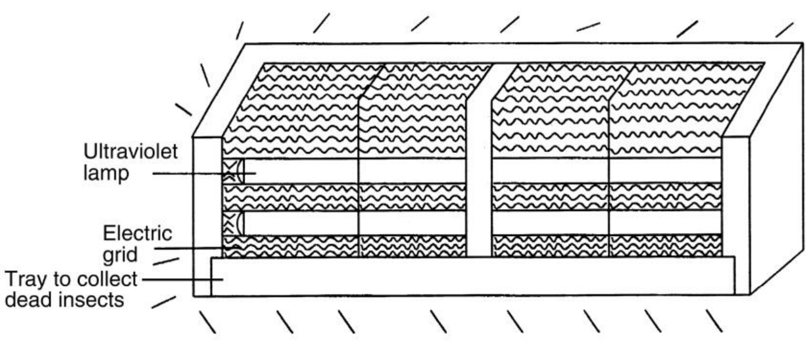


Fig. 11.2 *An ultraviolet electrical fly killer or insecticutor*

5. Destruction of flies could be brought about by the following means
   (a) Various insecticidal sprays, aerosols and pellets are effective in controlling fly populations in kitchens and food service areas.
   (b) Poisonous baits and fly strips are a combination of an insect–attracting food like sugar and an insecticide. Since they are poisonous, they should be used and stored with care. They are recommended for outdoor use.
   (c) Swatting with fly swatters is not recommended in preparation, storage or service areas. Swatters are contaminated and spread dead insects and their body parts when they are used.

(d) Insect Light Traps (ILTs) - All species of flies are naturally attracted to UV-A light. This property is made use of in attracting and trapping flies. ILTs are designed to attract houseflies by emitting UV-A light and are popularly used at food handling facilities like restaurants, kitchens, factories and warehouses. Two models are available. The insecticutor is an electric fly trap that is very effective. The ultraviolet light is strongly attractive to insects. It is set in an electrified grid which immediately kills any insect flying through it. Dead insects fall in a pan which should be regularly emptied.

(e) The flying insect catcher also attracts insects by emitting UV-A light but traps them onto two glue boards; one placed at the back of the trap and a second at the bottom of the trap. They are useful in areas where the fly population is less so that the glue boards do not get filled quickly, and maintenance cost of replacing glue boards is lower.

The traps should be placed at a height of five feet or lower, at a distance of 25 feet from the other traps and perpendicular to entrances. The UV-A tubes should be replaced every year and collection trays cleaned/replaced once full.

A clean environment, without fly attracting odours or damp dirty places, is the most important preventive measure in fly control. Unsanitary conditions could render insecticide application ineffective and also make flies resistant to insecticides.

Fruit Fly

These are seasonal, coloured and smaller than the housefly. They are most attracted to overripe and decaying fruit. These pests are not attracted to sewage and other wastes, hence transmit less number of microorganisms.

Their larvae eat their way through different fruits and spoil them.

Control Measures

1. Check fruit supplies for signs of infestation.
2. Get rid of decaying fruit and other fermenting foodstuffs.
3. Use screens, wire meshes and air currents to prevent their entry.
4. Electric fly traps, to a certain extent, are useful in exterminating them.

Blow Flies and Flesh Flies

Blow flies are large flies seen specially during warm summer months. They are also called bottle flies and have a metallic blue or green colour. They breed on animal and bird carcasses, meat scraps, animal excrement in the environment or in garbage bins and are attracted by a foul smell. These flies play an important role in nature in the decay process of animal carcasses.

They lay their eggs where they feed, and eggs hatch quickly into young larvae, called maggots. The larvae are scavengers and feed only on rotting carrion. The proteolytic enzymes in their excreta and mechanical grinding by mouth hooks, helps to breakdown meat proteins. Blowfly maggots have recently been adopted by some physicians to treat gangrenous wounds as some species will only eat dead tissue.

Flesh flies like blow flies also breed in carrion, dung or decaying material. Flesh flies are also large and gray or black in colour. They also eat decaying vegetable matter and excrement and may be found around compost pits and pit latrines. They can carry leprosy bacilli and can transmit intestinal pseudomyiasis to people who eat the flesh-fly larvae.

Control Since blow flies and flesh flies breed in rotting flesh and garbage, sanitation is the most important step in controlling them.

Control Measures Since flies breed in rotting organic waste and garbage, sanitation is the most effective and important step in controlling them.

1. Eliminate all potential breeding places such as mulch, manure, garbage and animal excrement.
2. Garbage should be drained and wrapped in garbage bags before being placed in garbage bins. This will reduce odours that attract egg laying flies.
3. Use adequate screens of 10 mesh on doors and windows to prevent the entry of flies.

Screen doors should open outwards and have fitted springs for tight closing. A double set of doors is recommended in fly infested areas.

In food preparation and service areas, to keep flies away, use 50 watt high pressure sodium vapour lights or dichrome yellow non-insect attractant light instead of a 100 watt mercury vapour light (ultraviolet energy) so that flies are not attracted.

In case of heavy fly populations, it is best to call the pest control agency.

Cockroaches

The cockroach is another resilient pest known to man. It is filthy and gives off a foul odour. Cockroaches contaminate unprotected food, utensils and other surfaces. They travel from sewers to garbage dumps. En-route, they collect numerous disease-causing microorganisms on their bodies and in their stomachs. Uncontrolled cockroach infestations could spread diseases such as diarrhoea, dysentery, typhoid fever, intestinal worms and food poisoning.

Cockroaches may go undetected unless there is a heavy infestation. They prefer to venture out at night as they are sensitive to light. They are found almost everywhere in buildings, cracks and crevices, food containers, and uncleared garbage. They breed in dark, damp, undisturbed places. Besides the nauseating odour they emit, discarded egg capsules, body wastes and body parts are the sure signs of a cockroach menace in a catering facility. Cockroaches appearing during the day-1 time indicate a heavy build-up.

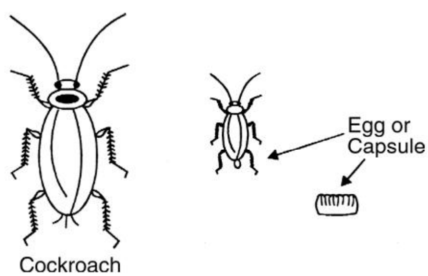


Fig. 11.3 *Cockroaches*

Control Measures

1. Persistent efforts at maintaining good sanitary conditions is the key to cockroach control. Covering dustbins at night, keeping food service areas free from dirt and food particles as well as prompt garbage disposal are essential.

2. All cracks and crevices should be properly sealed.
3. Good lighting and ventilation prove to be a deterrent to pests favouring dark, damp places to rest and breed.
4. Protect food from contamination by proper storage. Scrutinising bags and sacks for insect eggs and body parts, helps check the entry of these pests into the premises.
5. Permitted insecticides should be applied to cracks and crevices, undersides of tables, cupboards, equipment, behind sinks and other areas likely to harbour these pests.
6. Cockroach traps should be installed over drains.

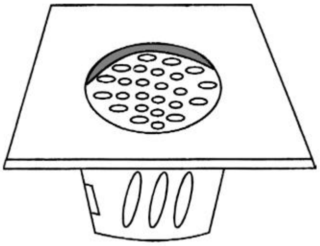


Fig. 11.4 *A cockroach trap fitted over a drain*

Ants

These common but annoying pests are known to mechanically transmit diseases from excrement to food. Ants cause immense wastage of food by eating some of it, thus making the food unfit for human consumption. They are known to destroy crops and also eat into wrappers.

These social pests are so called, as they exist in groups or colonies and live and work together. Their nests, which may contain thousands of ants, are found in spaces between walls, under floors and in undisturbed litter outside buildings.

Ants prefer sweets and fatty foods. While some like meats, other are even known to eat into wood and weaken building structures. They can be harmful as they bite and sting. They attract other pests like cockroaches. The appearance of ants in a food service department indicates poor hygienic conditions.

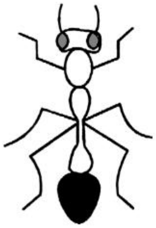


Fig. 11.5 *Ant*

Control Measures

1. Good sanitary practices should be followed.
2. Food should be kept covered.
3. Suitable pesticides should be applied.

Silverfish and Firebrats

Silverfish are found in cool but damp places such as areas around wet kitchen floors and sinks and in cracks in walls. Firebrats like warm and dry places found in bakeries around ovens. Both prefer sweets and starchy food stuffs. *Firebrats* cause most damage in bakeries. Silverfish damage articles made of paper, like food wrappers and single service articles.

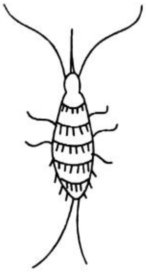


Fig. 11.6 *Firebrat*

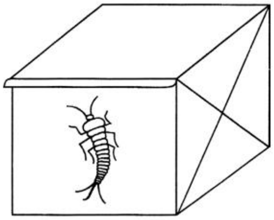


Fig. 11.7 *Silverfish*

Control Measures

1. Thorough cleaning under floors, along walls and in areas surrounding the building will get rid of their breeding places.
2. Pesticides should be used in case of persistent occurrence.

Stored Grain Insects

Some of the insects in this group include: flour beetle, rice weevil, granary weevil, the Indian-meal moth, saw-toothed grain beetle, lesser grain borer and angoumois grain moth.

These insects are like beetles with a long snout. They attack and destroy stored grains. The female grain weevil punctures the grain with her snout and lays an egg in each hole. The grub or larva burrows into the grain and eats away a part of the grain. They cause heavy losses and damage to the quality of the grain.

The flavour, taste, hygienic quality and acceptability of the remaining grains is low. Nutritive value is adversely affected.

Food stuffs contaminated with these insects are unfit for consumption and are repulsive to customers. Tiny holes in these commodities along with powdery substance are the signs of this infestation. Thus, they destroy food grains, spices, nuts, dry fruits and impart an unpleasant odour to processed food products like breakfast cereal, semolina, gram flour, refined flour, etc.

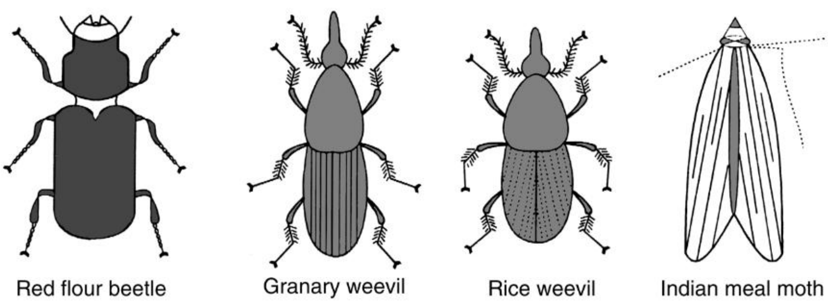


Fig. 11.8 *Some stored grain insects*

Control Measures

1. All food items should be properly inspected before entering the storage area, for weevils, larvae, webbing or agglutinated grains and damaged packaging.
2. Thorough cleaning and drying of all containers before storing fresh food articles is necessary.
3. Discard contaminated food.
4. The rule first-in-first-out should be followed for all commodities.
5. There should be good ventilation, ensuring that storage areas are kept dry and cool.
6. Insect-proofing of bags: a solution containing insecticides is sprayed on the outer surface of the gunny bags in which grains are stored. This remains effective for six to eight months.

Rodents

It is mainly the rats and mice belonging to this group that trouble human kind. Equipped with a pair of sharp, chisel-like teeth, they gnaw into plastic, cardboard and other thin food containers. Rats are voracious eaters and are known to destroy food grains and standing crops. They devour eggs, attack poultry and their burrowing habit causes structural damage to buildings.

In India, the roof rat, the sewer rat and the common house mouse cause maximum damage in homes and establishments. They reproduce very rapidly—a pair of rats, if left unchecked, can turn into an army of rats.

Rodents are host to many disease causing ectoparasites and endoparasites. The rat-flea found on rodents helps spread the dreaded bubonic plague among the rodent population and eventually to humans. Various diseases are spread to humans, like Typhus fever, Salmonellosis and Amoebiasis through rodents.

Knowledge of the habits of rats and mice would render rodent-control more effective.

Rats share food and water and venture longer distances (about 30 m (100 feet)) from their nesting places. They are suspicious of new surroundings, changed floor plans, rearranged furniture and equipment and new feed articles.

Consequently, a single bait, left undisturbed over a period of time would suffice to control a large number of rats. They need to drink water often, thus removal of their water supply would make the environment less favourable to them.

Mice, however, do not share their food and nests, venture only up to 3–4.5 m (10–15 feet) from their nests and can do without water for long periods of time. They constantly nibble at food and are not suspicious of unusual food articles and new surroundings. Hence, many traps are required to be set up. Also, doing away with their water source will not necessarily control the mice-menace.

Rodent infestation can be detected by:

1. Odours which emanate from their urine.
2. Marks left behind from gnawing and their claws. Their presence can also be ascertained by their foot marks in spilt flour, dust, etc.
3. Sounds they make while eating and scurrying about. Their presence during the day is a sign of a heavy infestation, as they are otherwise sensitive to light and prefer to come out in the dark.
4. The 'runs' are runaway marks they make from their breeding places to the source of food and water. These pathways are dark and greasy due to the grease found on the rodent's body. Finding these trails helps in placing baits and traps near the breeding places.
5. Excrement in the form of droppings are a sure sign of their presence. In fact, the size of the droppings helps determine a rat or a mice infestation.

   The rat stool is larger (20 mm or 3/4 inch) than the mouse stool (6 mm or 1/4 inch). Fresh shiny stools confirm their presence in the establishment.
6. Burrows which are seen in places surrounding the building, like fences, spaces in the foundation and pathways, also indicate their presence.
7. The presence of rodent carcasses is an indication of a prevailing rodent menace.

Control Measures Effective rodent-control is possible only if the food handler is made aware of all the steps involved and the sequence in which prevention and elimination should be carried out.

Rodents are intelligent, agile and can easily adapt to a changed environment. The rate at which they breed can prove to be economically damaging to any catering establishment. Besides, the fact that they carry and transmit many serious diseases, makes rodent control and elimination all the more essential. For this, active cooperation of all food service personnel and, if necessary, even assistance from pest control agencies is required.

Preventing rodent infestation

1. *Deny entry*: Rodents gain entry through open drains, doors, windows, ventilators, openings around water pipes, sewers, by burrowing around weak construction points and faults in the foundation. Good planning, designing and engineering at the time of construction would deny rats entry. Special care should be taken to ensure that doors and windows are tight fitting, drains are fitted with wire meshes, spaces around pipes, at points where they penetrate the wall of buildings, are closed with concrete to prevent burrowing.
2. *Deny breeding space*: Store rooms and kitchens provide perfect sanctuaries for rats and mice. Rodent's preferences for dark, dirty, undisturbed places would imply that ample lighting, good housekeeping and high standards of tidiness could get rid of their breeding areas. Here again, good building design, properly installed fixtures and fittings and placement of bins and equipment above ground level to facilitate cleaning would ensure effective control. Keeping the surroundings clear of unwanted foliage and unwanted material together with protected garbage and its prompt disposal, will deny rats places to rest and multiply.
3. *Making the environment less attractive to rodents*: This can be achieved by protecting the food supply using wire meshing and by keeping sacks of flour off the floor and away from the wall. Floors and work surfaces should be properly cleaned to remove dust, scraps of food, crumbs and wastewater, in order to cut off the food and water supply to rodents. Locating, destroying and sealing burrows with cement and wire meshes will also help.

Killing the rodents Destruction of rats and mice is brought about by trapping and poisoning them. Trapping rodents seems preferable to poisoning them as poisoned rodents return to their nesting places to die. The decaying carcasses give off a foul odour and also attract other pests and germs. Immediate disposal of these dead rats in essential.

Fig. 11.9 *A dirty kitchen attracts rats, mice and other pests*

1. *Trapping*: using traps is an effective method of eliminating a rat population. Using a number of traps, locating their 'runways' and placing two traps in opposing directions and at an angle of 90° to the wall to catch them moving to and from their nests, ensures the trapping of maximum number of pests. Various types of traps available are:

(a) the snap-type or break-type trap in which only one rat can be caught at a time

(b) Glue traps, the rat-sticker or adhesive pad where rodents get stuck or entangled.

The latest innovation in trapping rats and mice and other insects and reptiles is the non-poisonous, non-hazardous and environment-friendly glue traps and boards. These trays that contain a non-dry glue are secured to the floor. The glue instantly catches the rodents, reptiles and roaches once they make contact with the glue. This is a clean and environment-friendly way of trapping pests.

Glue may also be applied on strips and ribbons to catch flying insects.

(c) the cage which traps a number of rodents alive

After the traps are set up, the baits used to draw rats and mice to these traps, should be inspected from time to time. Old, dried or rotting bait is to be replaced. Once the rodents are caught and killed, they should be promptly disposed off, preferably along with the trap. This step minimises handling.

The most effective bait can be determined by trial and error. Solid foods like vegetables, fruits, bread, *pakoras,* burnt coconut, fish heads and dough, are found to be useful baits.

2. *Poisoning*: after ascertaining the rodents food preferences by 'pre-baiting', prepared baits should be placed along walls in runaways. Depending on how severe the infestation is, a number of baits should be used at regular intervals. Covering these bait stations with metal or cardboard covers prevents them from getting accidentally mixed up with food and also gives a sense of security to the 'suspicious' rodents. Once the baits are in place, all other sources of food and water should be inaccessible to these pests. Using gloves while handling baits and thorough washing of hands after the operation should not be neglected.
3. *Other methods*: Besides trapping and poisoning, ultrasound devices too are used to keep rats away from the premises.

   Fumigation is another method of extermination. It is used to kill them in their burrows and in warehouses where food articles are not likely to be stored. Chemosterilants help to keep down the rat population in establishments where rodents are always present. These act by sterilising the rats so that they cannot breed.

Other Pests

Animals and birds, whether pets or stray, should not be allowed to enter an area where food is prepared, stored or served. Cats, dogs, crows, sparrows and pigeons may present problems for the catering establishment.

Domestic animals are carriers of ticks and mites and enteric pathogens like *Staphylococcus aureus* and *Salmonellae.* Like humans, *Staphylococci* are found on the skin and nose of dogs and cats. Their presence is indicated by their droppings and signs of rubbish strewn around garbage bins.

Birds carry mites and many harmful microorganisms. They peck at food and damage packages. The presence of bird droppings and loose feathers in or near food is obnoxious.

They can be controlled by

- installing screens on windows, doors and ventilators
- discouraging the entry of animals in the premises
- discouraging the practice of feeding leftovers to animals in the premises
- proper storage and disposal of garbage

PESTICIDES

These include insecticides and rodenticides. They are substances which have certain pharmacological effects on insects and rodents, either as poisons or as repellants. Pesticides that are reliable, easily available, have a prolonged residual effect and are not highly toxic to humans are preferred. Pesticides can be categorised on the basis of the nature of the substances, their effect on pests, and method of application.

Nature of the Substances

1. *Inorganic pesticides*: these are natural chemical substances, for example, sulphur dust, arsenic, hydrogen cyanide and Paris green.
2. *Organic pesticides*: these are mainly plant extracts. They are least harmful to humans and are also least effective against insects, for example, pyrethroids. They have a quick 'knock-down' action but little residual effect, hence repeated applications are necessary.
3. *Synthetic pesticides*: as the name implies, these are manmade chemicals, are highly dangerous and should be stored away from food preparation areas. They include chlorinated hydrocarbons like lindane, Dichloro Diethyl Trichloroethane (DDT) and chloropyriphos; organo-phosphates like malathion, phosphine and diazinon and carbamates like carbandazim, aldicarb and carbaryl.

Their Effects on Pests

1. *Stomach poisons*: these are applied to plants and ingested by insects while they feed on these plants, for example, arsenic, fluorides.
2. *Contact poisons*: these are applied directly to pests. They penetrate and damage the insect body wall, for example, DDT, BHC (benzene hexachloride) and Indiara.
3. *Residual poisons*: these are applied to surfaces. Insects touching them pick up a lethal dose, for example, DDT and BHC.
4. *Systemic poisons*: these are applied to plants and animals. These poisons are absorbed and translocated to all parts of the organisms, so that insects feeding on them acquire a lethal dose.
5. *Repellants*: these keep insects and other pests away from a given area, due to the odour they emanate, for example, Dimethyl phthalate (DMP), Dibutyl phthalate (DBP) and *Tulsi* leaves.
6. *Fumigants*: these poisons are inhaled by pests and cause death, for example, hydrocyanic acid gas and sulphur dioxide.

Method of Application

1. Sprays, for example, lindane, pyrethrum.
2. Pellets, for example, boric acid, naphthalene.
3. Chalk coated or impregnated with insecticidal powder or dust.
4. Dusts, for example, BHC, DDT.
5. Meals, for example, zinc phosphide, warfarin.

6. Vapours, for example, lindane, DDVP (dichlorvos), hydrocyanic acid.
7. Lacquers, for example, insecticides mixed with lacquers, paints, varnishes; these are effective for at least a year.
8. Liquids, for example, kerosene, mineral and tar oils.
9. Aerosols: They contain liquified gas, for example, Freon, under pressure, which when released after the valve of the dispenser is opened, lets off the insecticidal solution mixed with it, for example pyrethrins, DDT.

Precautions to be Taken while Handling Pesticides

All pesticides are toxic to humans. Food service workers need to be adequately instructed regarding the hazards involved and should be trained to avoid them.

These are some of the precautions needed:

1. Using gloves and masks while handling these chemicals is essential.
2. Wash hands thoroughly after use.
3. Never use sprays when food is openly displayed.
4. Storage of insecticides away from food articles. Holding these poisons in a separate area with their proper labels is important to avoid accidental poisoning. Also, they are to be kept away from heat and open flames.
5. Knowledge of the type of pesticides banned and the specific residual limits permissible in food commodities as laid down by the Government of India is essential.
6. First-hand knowledge of antidotes to various poisons is necessary for food service workers.

Pesticides Banned by the Government of India

1. Aldrin	8. pentachloron-nitrobenzene
2. Chlordane	9. methyl parathion
3. heptachlor	10. nitrofen
4. dibromo-chloropropane	11. paraquat dimethyl-sulfate
5. toxaphene	12. nicotine sulphate
6. PCP	13. tetradifon
7. PMA	

Use of DDT in agriculture and BHC on vegetables, fruits and oilseed crops and in preservation of grains have also been banned because their safety is doubtful.

Table 11.1 Pesticides Recommended for use in the Kitchen

Pest	*Pesticide recommended*
1. Cockroaches	Pyrethrum extract, malathion, Indiara
2. Flies	Pine oil, cypermethrin, Indiara
3. Ants	Cypermethrin, malathion, Indiara

Contd...

Table 11.1 (Contd)

Pest	*Pesticide recommended*
4. Silverfish	Cypermethrin, malathion
5. Stored grain insects	Ethyl dibromide (EDB), mercury tablets, castor oil, neem guard, boric acid, *tulsi* leaves
6. Rats and mice	Warfarin, bromadiolone

The non-poisonous nature of organic pesticides (Indiara, neem guard) call for their extensive use in kitchens and foodgrain stores. Recent studies have indicated that pesticides like Indiara with a composition of diallyl disulphide, isothiocyanate, allylpropyl disulphide is non-toxic and non-poisonous. Also, neem oil, castor oil and ginger paste used as repellants and which are easily available in a catering facility, are recommended as replacements for the more toxic insecticides.

Green Pest Management (GPM)

GPM is a pest control strategy using organic or plant based materials or materials of natural origin. It is an extension of integrated pest management and is looked upon as an eco-friendly pest management system. Sometimes non-organic substances are also used in GPM if they are non-toxic and do not have a polluting effect on the environment, for example, insect bait stations that have synthetic active ingredients may be termed green. This is because the process of applying the product is also important in GPM.

GPM is a proactive mode of controlling pests unlike conventional pest control that focuses on use of pesticides. Exclusion of pests, environmental changes and physical trapping are some of the non-pesticide measures used. GPM is considered to be the most advanced form of IPM and includes continuous training of technicians on common pests, inspection or identification of pests, latest developments in pest control measures, understanding its habits and biology, diagnosing and correcting pest friendly conditions, effect use of new products and sealants, proper inspection of the building and rectifying inlets.

GPM strategies work with a long-term vision and finding more permanent solutions to pest control while minimising the use of toxic pesticides and educating the public that green products are not necessarily very costly, but are beneficial in the long run.

SUMMARY

Rodents and insect infestations have been a nuisance to humankind and have destroyed and contaminated food at all stages of food production and service. The presence of pests, their body parts or droppings in food served will not only result in contamination and spread of disease but can ruin the reputation of any catering establishment. Pests commonly found in catering establishments are flies, cockroaches, ants, stored grain insects, rats and mice and animals and birds.

The key to any effective pest control programme is patient and persistent sanitary measures. Having understood the immense economic loss, wastage and health hazards which can occur as a consequence of a pest infestation, it is imperative that this aspect of pest eradication is not neglected in any catering operation. Using professional help could prove beneficial for short periods of time. It is up to the food service worker to maintain the premises pest free.

KEY TERMS

Air curtains Prevents insects and dust from entering food establishments by sweeping air down over door openings. The air curtain is created by a fan mounted outside and above door openings.

Baits Use sugar or other foods to attract insects and an insecticide to kill them. Baits are also used in rat traps.

Basic environmental sanitation An approach to keep pests out of catering establishments by removing food and shelter or making facility pest resistant.

Green Pest Management (GPM) System of pest management using non-toxic substances for pest control that do not pollute the environment.

Residual insecticides Insecticides which are effective for an extended period of time and not only at the time when they are applied.

Pesticides are substances which poison or repel pests such as insects and rodents. They include insecticides and rodenticides.

Insect light Traps (ILTs) A non-toxic contraption that emits light to attract flying insects and electrocutes them in the metal grid through which a high voltage low amperage current is flowing. Dead insects fall into a tray which needs to be emptied at intervals.

Integrated Pest Management (IPM) Economical, effective and safe pest management which includes several methods together to control pests using environmentally sound techniques. It includes inspections for signs of pests done both formally and informally, high standards of cleanliness and cleaning schedules, physical and mechanical control devices for trapping pests and minimal use of pesticides and other chemicals in the management of pests.

REVIEW QUESTIONS

1. List five pests commonly found on food premises.
2. How do rodents contaminate food? What are the main signs of a rodent infestation?
3. What precautions should employees take to keep pests away from the catering establishment?
4. List four major reasons why pest control is essential in a catering establishment.
5. Why should flies be kept away from food?
6. How do pesticides destroy pests? How are they used?
7. Why have certain pesticides been banned by the Government of India? Name five pesticides which are banned.
8. Fill in the blanks with a suitable word.
   (a) Windows and ventilators in the kitchen should be __________ to prevent pests and birds from entering.
   (b) Electric flytraps attract flies by their_________and rat traps attract rats by their_________.
   (c) __________ bore into cereals, pulses, nuts, etc. and leave a fine powdery deposit and impart an unpleasant odour.
   (d) Overripe and decaying fruit mainly attracts __________.
   (e) Organic pesticides like neemguard and Indiara are preferred because they are __________.
9. Select the most appropriate answer in the following.
   (a) A cockroach infestation can be detected by
      (i) damaged crates and sacks
      (ii) a foul smell
      (iii) feet marks in dust
      (iv) tunnels in grains

(b) Which one of the following areas is unsuitable for a housefly to breed
  (i) garbage pile
  (ii) stagnant water
  (iii) animal and human excreta
  (iv) rotting food

(c) Which one of the following is the best way to keep flies away from food
  (i) keep garbage bins covered
  (ii) keep food on a high shelf
  (iii) keep food covered with cling wrap film
  (iv) keep cooked food away from raw food

(d) Paper articles like single service items and wrappers are damaged by
  (i) silverfish
  (ii) fruit flies
  (iii) house-flies
  (iv) firebrats

(e) Which one of the following diseases is not transmitted by rats?
  (i) malaria
  (ii) salmonellosis
  (iii) endemic typhus fever
  (iv) plague

(f) The best way to eliminate a heavy rat infestation is to
  (i) set up traps
  (ii) call the pest control agency
  (iii) remove the rats food supply
  (iv) ratproof the building

(g) The housefly transmits disease germs to foods through
  (i) regurgitating on food
  (ii) defaecating on food
  (iii) its hairy body and sticky feet
  (iv) all of the above

10. Which of the following pests can damage the structure of a building
  (a) cockroaches
  (b) rats
  (c) fruit flies
  (d) silverfish
  (e) ants
  (f) house-flies

11. (a) Match the pests in Column *A* with an effective pesticide in Column *B*

A	*B*
1. Stored grain insects	(a) malathion
2. Rats and mice	(b) ethyl dibromide
3. Cockroaches	(c) cypermethrin
4. Flies	(d) warfarin
	(e) D.D.T.
	(f) aldrin

(b) Match the pests in Column *A* with signs of infestation in Column *B*

A	*B*
1. Weevils	(a) urine trail
2. Cockroach	(b) fly specks
3. Rodents	(c) egg capsule
4. Housefly	(d) clumping of grains

12. State whether True or False. If false, correct the statement.
  (a) Ratproofing a building is one of the surest ways to control rats.
  (b) Ants are commonly implicated in the transmission of food-borne diseases.
  (c) A liberal use of insecticides and rodenticides is a good substitute for a sanitation programme.
  (d) The presence of cockroaches during the daytime indicates a heavy infestation.
  (e) The best way to eliminate rats is to ensure that they get nothing to eat or drink and no place to breed.
  (f) Cats should be encouraged in the kitchen as they kill rats and mice.

13. Explain the beneficial effects of GPM.

12

- **Sources: rain, land surface, ground**
- **Contamination of water: hardness of water, impurities (natural pollutants, artificial pollutants)**
- **Hazards of water pollution: biological, chemical**
- **Purification: natural methods, artificial methods, large-scale purification (slow sand filters, rapid sand filters, chlorination, test for chlorination), small-scale purification**
- **Criteria for judging water quality**
- **Water quality standards**
- **Water supply for catering establishments: storage tanks, hot water, problems encountered in city supply, ice**
- **Sewage and contamination of water supply**

Water Supply

INTRODUCTION

Water is the lifeline of the catering industry. The purpose of serving delicious, nutritious meals prepared and served under hygienic conditions is totally lost if the water served along with it is contaminated. If safe drinking water is not available for consumption, it results in ill health. In India, 80 per cent of all diseases originate from water. Therefore, providing a safe and adequate water supply to all catering establishments and the community at large should be given top priority by the concerned authorities.

Water meant for human consumption should be safe, clear and wholesome. Such water is referred to as potable water. It can be defined as water which is free from pathogenic agents, harmful chemical substances, odour and unpleasant taste, and suspended particles; and which can be used for domestic purposes.

Water which contains industrial or domestic waste, infective or parasitic agents, or poisonous chemical substances is termed as non-potable, contaminated or polluted water. Such water should never be used unless it is treated and bacteriologically and chemically tested before consumption.

In the catering industry, water is required for drinking, cooking, dishwashing, laundry, general cleaning, gardening, etc. Water used for these purposes may be from the same or different sources.

SOURCES

Water is available from rain, land surface or from under the ground. This water is recycled by nature and in this water cycle it is likely to get contaminated from the atmosphere, soil, domestic and industrial wastes, etc. Thus, water found in nature is generally unsterile. This makes it necessary to check the water source and treat water before consuming it, to ward off water-borne illnesses.

Rain

Rain water is a relatively unimportant source of water. It is clear, bright, sparkling and chemically very soft. Impurities which could enter through the atmosphere include dust, soot and gases like carbon dioxide and ammonia.

Land Surface

Water obtained from the land surface originates from rain water. Most of the water we consume is supplied from these sources. Surface water contains more organic matter than underground water and supports microorganisms better.

Impounded Reservoirs Also called artificial lakes, these are used for storage of large quantities of surface water. Dams may be built across rivers and streams to create such reservoirs.

Water from these lakes is usually soft and free from pathogenic organisms. It is clear, palatable and of good quality.

Contaminants from human habitation and animals grazing near catchment areas can pollute such water.

Rivers and Streams Water from rivers and streams may be grossly polluted and unfit for consumption. It should be treated before use.

It is turbid during monsoons, may contain dissolved or suspended impurities and may have a high bacterial count. Impurities from sewage water, industrial wastes and drainage from agricultural areas are generally present.

Although self purification may occur through dilution, sedimentation, aeration, etc., large-scale purification is required.

Tanks They are large excavations where surface water is stored. They may be full of silt, colloidal matter and other contaminants, hence, are an extremely dangerous source of water, if consumed untreated.

Sea Water Sea water contains a large percentage of dissolved salts, mainly 2.5 per cent sodium chloride. It cannot be used for drinking unless it is demineralised.

Ground Water

Ground water is the cheapest and most practical source of water. The soil acts as a filter and removes many contaminants from surface water. As water percolates deeper, it becomes cleaner.

It is superior to surface water because it is effectively filtered.

Advantages

1. It is likely to be free from pathogenic agents
2. It usually requires no treatment
3. The supply from deep wells is likely to be certain even in the dry season.

Disadvantages

1. It may have a high mineral content, for example, the presence of calcium and magnesium may render it hard.
2. It requires pumping out of the water source.

Types of Ground Water Sources Types of ground water sources include:

1. *Wells:* They may be shallow, i.e., located above the impervious layer or deep, i.e., where the water penetrates through the first impervious layer and is tapped from the layer beneath this layer (i.e., second porous layer) (see Fig. 12.1).

   Shallow wells are liable to pollution from sources of contamination like drains, manure, etc. Deep wells may be a health hazard if they are left open and not protected against contamination.

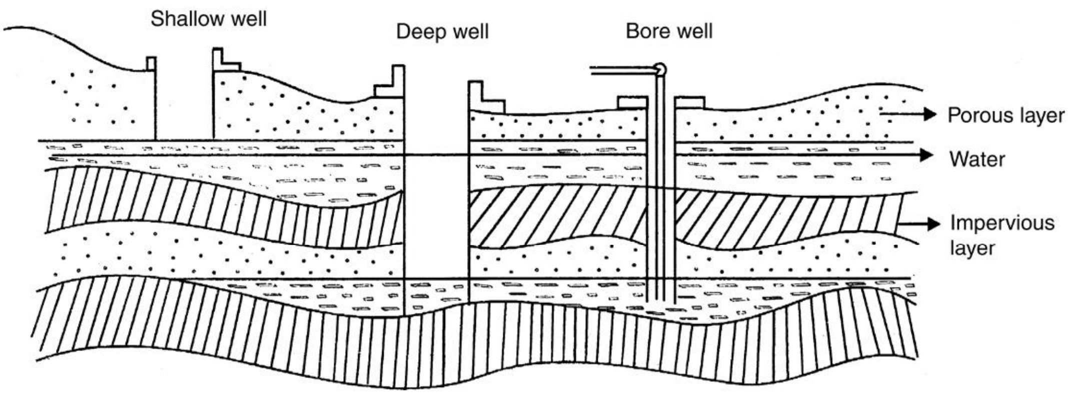


Fig. 12.1 *Types of wells*

2. *Tube wells:* These yield water which is bacteriologically safe. The well consists of a galvanised iron pipe which is sunk into the water–bearing stratum and fitted with a strainer at the bottom and a handpump at the top.
3. *Springs:* Ground water that finds its way to the surface is called a spring. It is a relatively unimportant source of water.

CONTAMINATION OF WATER

The growth rate of most microorganisms slows down in pure water and they eventually die, although spores may survive for months or years in water. Pathogens and viruses do not multiply in pure water. Water which has been freshly contaminated, or possesses a continuous source of pathogens, is very harmful to health. Natural waters have a capacity to assimilate and transport waste. But these days, heavy water pollution has made self purification a difficult process.

Water can get contaminated:

1. at the source itself
2. by the addition of impurities during transit from source to reservoir
3. during distribution, through lead pipes conveying water or through cracks and joints in the piping. Water pipes should always be at a safe distance from sewage and gas pipes
4. when water is stored in underground or overhead storage tanks, barrels or containers
5. when innumerable or unclean containers are dipped in the water container
6. during service, if unclean glasses are used to serve water or by faulty methods of holding the glass

Unpotable water can contaminate dishes, vegetables, etc. washed with it or ice made from contaminated water may render cold drinks harmful to health.

Hardness of Water

Water is considered soft if it forms a lather with soap which lasts for at least five minutes. Water is considered hard when soap does not lather easily in it. This hardness is caused mainly by compounds of calcium and magnesium dissolved in it.

Hardness in water is further classified as carbonate and non-carbonate hardness. Carbonate hardness was earlier called temporary hardness and is due to the presence of calcium and magnesium bicarbonate. Non-carbonate hardness was earlier referred to as permanent hardness and is due to the presence of calcium and magnesium sulphates, chlorides and nitrates. Iron, manganese and aluminium compounds also cause hardness.

Water is termed soft or hard depending on the level of hardness. Hardness in water is expressed in terms of milliequivalents per litre (mEq/l). One mEq/l of hardness producing ion is equal to 50 mg calcium carbonate (50 ppm) in one litre of water.

Table 12.1

Degree of hardness	*Amount of dissolved compounds*	
	mEq/l	*mg/l*
1. Soft	Less than 1	<50
2. Moderately hard	1–3	50–150
3. Hard	3–6	150–300
4. Very hard	more than 6	over 300

In the hospitality industry, the type of water used directly affects food service, preparation, dishwashing, laundry and the maintenance departments.

Water used for consumption should be moderately hard. However, if hardness exceeds 3 mEq/l then softening of water is recommended because:

1. the quantity of soap and detergent needed is greater in hard water
2. the colour and appearance of food is preserved in soft water
3. the carbonates in water precipitate out when water is heated and cause furring or scaling in boilers. This reduces their efficiency, increases fuel consumption and may sometimes cause boiler explosions.
4. the life of pipes and fixtures is shortened as they may rust
5. fabrics washed with soap in hard water wear out faster—they turn gray in colour and lose their texture.
6. when soluble soap is added to hard water a sticky insoluble curd is formed which gets deposited on bathtubs, buckets, etc. and is difficult to rinse off.

Removal of Hardness Hard water can be softened by boiling, addition of lime or addition of sodium carbonate, the base exchange process and by demineralising it.

1. Boiling is done to soften water on a small scale. Boiling removes temporary hardness of water. Carbon dioxide is expelled in this process and the insoluble calcium carbonate precipitates out

$$Ca(HCO_3)_2 \xrightarrow{\text{heat}} CaCO_3 + H_2O + CO_2 \uparrow$$

2. Addition of lime removes temporary hardness of water and can be used for softening water on a larger scale. The insoluble calcium carbonate precipitates out and the carbon dioxide formed is absorbed by lime.

   In Clark's method of softening water, for each degree of hardness, one ounce (approx. 30 g) of quicklime is added to every 700 gallons of water.

$$Ca(OH)_2 + Ca(HCO_3)_2 \rightarrow (2CaCO_3) + 2H_2O$$

3. Addition of sodium carbonate or soda ash removes both temporary and permanent hardness.

   Temporary hardness

$$Na_2CO_3 + Ca(HCO_3)_2 \rightarrow 2NaHCO_3 + CaCO_3$$

   Permanent hardness

$$Na_2CO_3 + CaSO_4 \rightarrow CaCO_3 + Na_2SO_4$$

4. In the ion exchange process or zeolite process, hard water is passed through a tower which is packed with zeolite or ion exchange material. The sodium cations in the zeolite are exchanged for the calcium and magnesium ions in water and water is softened. The process continues till all sodium ions are used up and water is totally soft.

   The ion exchange material should be flushed at intervals with a concentrated solution of sodium chloride to replace the sodium that has been lost. The calcium and magnesium chloride that is formed is washed away. The soft water produced is remixed with a part of hard water to achieve the desired level of hardness.

Water softening units are fitted into the main water system near the point where water enters the premises.

5. In the demineralising process, hard water is passed through a bed of synthetic demineralising resin. Softening of water is carried out in two steps.

   In the first step the hydrogen ions in the resin combine with the chloride, carbonate and sulphate ions and converts them into their respective acids, i.e., hydrochloric, carbonic and sulphuric acid.

   In the second step the acids formed are absorbed by the demineralising resin and pure soft water is obtained. This process is used to soften sea water.

Impurities

1. Natural pollutants
   (a) suspended impurities like clay, silt, sand and mud
   (b) dissolved gases like carbon dioxide and ammonia
   (c) dissolved minerals like calcium and magnesium salts, lead
   (d) microscopic plants and animals
2. Artificial pollutants
   (a) sewage which contains decomposable organic matter and pathogenic agents
   (b) industrial wastes, for example, toxic agents including metals, salts and complex organic chemicals
   (c) agricultural pollutants, pesticides and fertilisers
   (d) physical pollutants, for example, radioactive substances

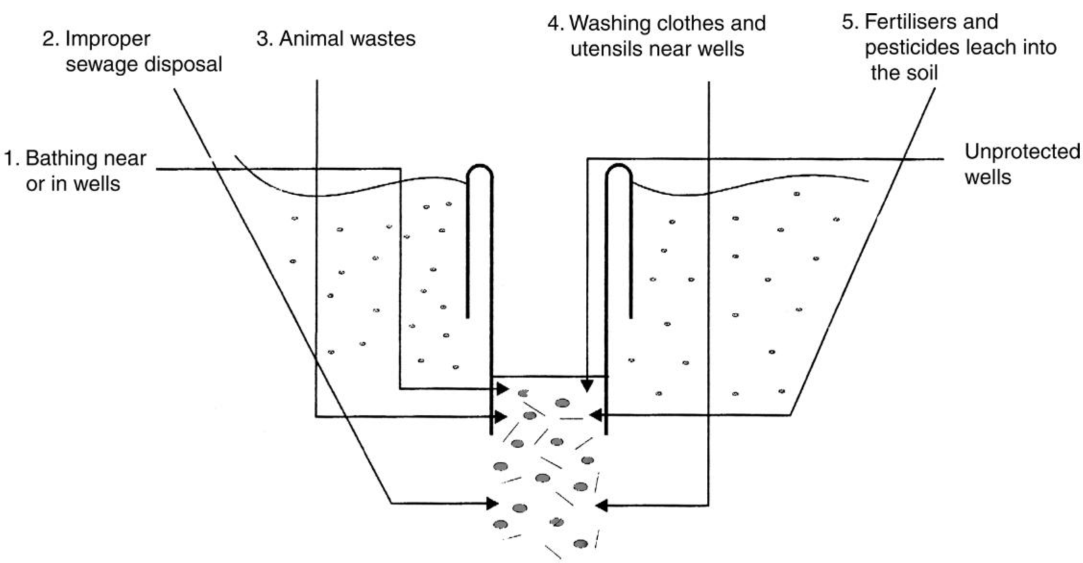


Fig. 12.2 *How surface pollution contaminates ground water*

HAZARDS OF WATER POLLUTION

The health of an individual is affected by the consumption or use of contaminated water.

Biological Hazards

Water-borne diseases can be caused by infective agents that could be present in the water, for example,

1. *viruses:* viral hepatitis and poliomyelitis
2. *bacteria:* cholera, typhoid, paratyphoid, bacillary dysentery, gastroenteritis, infantile diarrhoea
3. *protozoa:* amoebiasis, giardiasis
4. *helminthic infective organisms,* for example, ova of roundworm, whipworm and threadworm

Chemical Hazards

These include pollutants derived from industrial and agricultural wastes, for example, detergents, heavy metals, solvents, minerals, organic acids, nitrogenous substances and other toxic compounds.

PURIFICATION

Naturally occurring water is seldom sparkling clear, free from bacteria or without any odour or objectionable taste. It needs to be purified before use. Impure water may be purified by either of the following methods:

1. *Natural method:* (a) impounding or storage, (b) oxidation and settlement
2. *Artificial method:* (a) physical: distillation, boiling, (b) chemical: precipitation, disinfection or sterilisation, (c) filtration: slow sand filtration, rapid mechanical filtration, domestic filtration.

Water may be purified at two levels: large-scale purification and small-scale purification.

Large-scale Purification of Water

It basically consists of three stages of operation: storage and sedimentation, coagulation and filtration, and chlorination.

Storage and Sedimentation Water is impounded in artificial or natural reservoirs.

1. Ninety per cent of suspended impurities settle down in 24 hours thus making the water clearer.
2. The amount of free ammonia is reduced and that of nitrates increases because aerobic bacteria oxidise the organic matter.
3. There is an approximately 90 per cent reduction in bacterial count in the first five to seven days. Optimum period is 10–14 days. If water is stored for a longer duration there is a chance of algal growth giving rise to a foul smell and colour change of water.

4. Rate of sedimentation may be enhanced by the use of alum or ammonium sulphate which produces a sticky flocculant precipitate.

Coagulation and Filtration This is done through sand filter beds: 98–99 per cent of bacteria and other impurities are removed.

Sand filters are of two types: Slow sand or biological filters and rapid sand or mechanical filters.

Slow sand or biological filters Filter beds are watertight rectangular masonry tanks or reservoirs usually arranged side by side and ordinarily kept open. They are 2.7 to 3.6 m deep and have a constant head of water (supernatant water) above the sand bed. The sand bed has two layers of bricks placed one above the other on their edges and arranged in the form of drains and channels for the passage of filtered water. The next layer consists of gravel, broken stones or pebbles, 15–30 cm high, followed by a 15–30 cm layer of coarse sand. Above this is a 90 cm layer of fine sand and a waterhead of 90 cm from the settling tank.

The action of the slow sand filter is three fold.

1. mechanical straining of suspended impurities by the upper layer of the filter.
2. chemical action as organic matter is oxidised by presence of air and nitrifying microorganisms in the sand.
3. real biological action in the vital layer. The vital layer is formed after a few days of use of the filter. It is a slimy gelatinous layer consisting of algae, plankton and bacteria which remove organic matter, oxidise ammoniacal nitrogen to nitrates and help in yielding bacteria-free water. This layer retains all the bacteria of the water, so it should not be disturbed. It may extend for 2–3 cm into the top portion of the sand bed. This layer converts the mechanical filter into a biological one.

   Percolation takes two hours or more and for efficient filtration, the rate of flow should not exceed 0.1 to 0.4 $m^3/hr/m^2$ surface area.

   Water should be tested bacteriologically every week to ensure that filters are working efficiently. Adequately filtered water should not contain more than one or two coliform organisms per 100 ml.

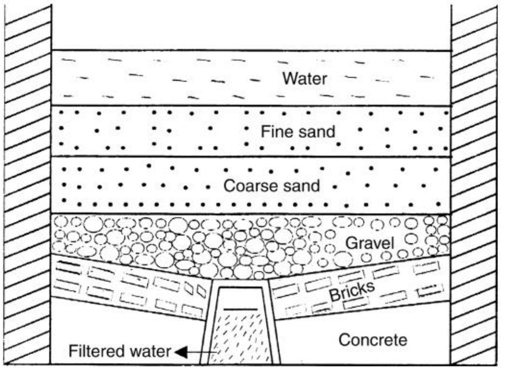


Fig. 12.3 *Slow sand filter*

Advantages of slow sand filters

1. simple to construct and operate
2. cheap
3. physical, chemical and bacteriological quality of water, is very high. Total bacterial count is reduced by 99.9 to 99.99 per cent and *E.coli* is reduced by 99 to 99.9 per cent.

Rapid sand or mechanical filters These are less expensive, simple and easy to manipulate and require a very small area of space. They are small and fixed inside a covered shed. The wooden, iron or concrete cylinders are 2 m deep and have a 1.2 to 1.5 m thick filtering media. They filter water at a very high rate. The steps involved are:

1. *Coagulation:* raw water is treated with a chemical coagulant, for example, alum or aluminium sulphate.
2. *Rapid mixing:* this allows quick and thorough distribution of alum throughout water.

3. *Flocculation:* this is a slow and gentle stirring for 30 mins which results in a flocculant precipitate of aluminium hydroxide.
4. *Sedimentation:* water is kept for two to six hours to allow the flocculant precipitate, impurities and bacteria to settle down. At least 95 per cent of the bacteria need to be removed before the water enters the rapid sand filters.
5. *Filtration:* the size of the sand grains is from 0.6–2 mm. Rate of filtration is 5–15 $m^3/hr/m^2$ area. The alum flocculant, which is held back, forms a slimy layer which adsorbs bacteria and also causes oxidation of ammonia. The suspended impurities may clog the filters which are then subjected to a washing process called back washing, i.e., reversing the flow of water.

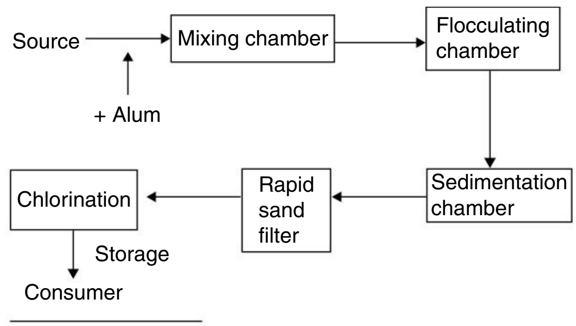


Fig. 12.4 *Steps in rapid sand mechanical filters*

The disadvantage with such filters is that only 98–99 per cent bacteria are removed.

Advantages of rapid mechanical filters:

1. no preliminary storage of water necessary
2. filter beds occupy less space
3. filtration is 40–50 times faster than in slow sand filters
4. washing of filter is easy
5. there is more flexibility in operation

Chlorination This supplements sand filtration. Chlorine kills pathogenic bacteria but has no effect on spores and certain viruses except in high doses. It also oxidises iron, manganese and hydrogen sulphide, helps in coagulation, controls the growth of slime producing organisms and algae and it destroys constituents which contribute to odour and taste.

When chlorine is added to water, two acids are formed, namely, hypochlorous acid and hydrochloric acid. The disinfecting action of chlorine is mainly due to the effect of hypochlorous acid and partly due to hypochlorite ion which forms when hypochlorous acid ionises. Hypochlorous acid is 70–80 times more effective than hypochlorite ions. Chlorination is most effective at a neutral pH because hypochlorous acid is formed at this pH. At a pH of 8.5, about 90 per cent of the hypochlorous acid formed ionises to hypochlorite ions. The efficiency of chlorine as a disinfectant is doubtful at this pH. However, the pH of water is at 6 to 7.5, so chlorine can be safely used as a germicide.

The hydrochloric acid formed is neutralised by the alkalinity of the water.

$$Cl_2 + H_2O \longrightarrow \underset{\text{hypochlorous acid}}{HOCl} + \underset{\text{hydrochloric acid}}{HCl}$$

$$HOCl \xrightarrow{\text{ionises}} \underset{\text{hydrogen ion}}{H^+} + \underset{\text{hypochlorite ion}}{OCl^-}$$

Rules for chlorination

1. Water should be clear and free of turbidity as it impedes effective chlorination.
2. Chlorine demand of the water should be estimated.

The chlorine demand is equal to the amount of chlorine added less the amount of residual chlorine remaining at the end of 60 minutes of contact at a given temperature and pH. Therefore, it is the amount of chlorine required to destroy bacteria and oxidise organic matter.

The breakpoint is when the chlorine demand of water is met, after which further addition results in the formation of free residual chlorine.

3. A contact period of at least one hour is required to kill all bacteria and viruses.
4. Minimum recommended concentration of free residual chlorine is 0.5 mg/l for one hour. It provides a margin of safety for subsequent microbial contamination.
5. The sum of the chlorine demand of the water and free residual chlorine of 0.5 mg/l gives the correct dose of chlorine applied.
6. The chlorine demand for water depends on the source of water, degree of contamination and the season, etc.

Tests for chlorination *The orthotolidine test*: a simple test called the OT (Orthotolidine) test is conducted to check whether the correct dose of chlorine has been added to water.

This test accurately and quickly determines both free and combined chlorine present in water. When the OT reagent is added to water containing chlorine (0.1 ml reagent to 1 ml of water), a yellow colour develops. The intensity of the colour varies with the concentration of chlorine present and is matched against a suitable standard colour. OT reacts immediately with free chlorine and the reading is taken within 10 seconds. The second reading is due to the action of both free and combined chlorine and is taken after 15–20 minutes, as combined chlorine takes more time to react with OT.

Chlorine test paper: The concentration of chlorine in sanitising solutions can be determined by using chlorine test paper. The strip is dipped in the solution to be tested for one second and the colour is compared with a standard colour code as follows:

Colour	*Concentration*
Very light gray	10 ppm
Gray	50 ppm
Darker blue gray	100 ppm
Very dark gray black	200 ppm

Forms of chlorine

1. *Chlorine gas:* It is cheap, quick in action, efficient and easy to apply.
2. *Chloramine:* It is produced by the action of ammonia on chlorine. It generally does not leave a chlorinous taste and gives a more persistent type of residual chlorine. However, it is slower in action than chlorine.
3. *Perchloron:* Also called high test hypochlorite (HTH), it is a calcium compound containing 60 to 70 per cent available chlorine.

Other Disinfecting Agents

1. *Ozone:* It eliminates undesirable odour and taste, has a strong viricidal effect and is a powerful oxidising agent. The disadvantage is that it has no residual germicidal effect.

2. *UV rays:* They are effective against most viruses and microorganisms. UV radiation has following disadvantages: (a) more expensive, (b) no residual germicidal effect, (c) colour and turbidity of water reduces its effectiveness.

Small-scale Purification

Boiling Water must be boiled vigorously for five to ten minutes. This kills all spores, cysts and ovas and yields relatively sterilised water. It also removes temporary hardness of water. The disadvantage is that it offers no residual protection and hence, organisms may recontaminate after cross-contamination.

Chemical Disinfection

1. bleaching powder ($CaOCl_2$) contains 33 per cent available chlorine when fresh. It is unstable but retains its strength when mixed with excess of lime.
2. five per cent solution of chlorine
3. perchloron or HTH
4. chlorine-tablets: one tablet of 0.5 g is sufficient to disinfect 20 litres of water.
5. iodine: two drops of two per cent ethanol solution of iodine is sufficient for one litre of water.
   A contact period of 20–30 minutes is required. Iodine remains active over a wide range of pH and persists longer than chlorine. The disadvantages are: (a) high cost, and (b) it is a possible factor in malfunctioning of the thyroid glands.
6. potassium permanganate: it kills the cholera vibrio but is not effective against other organisms. It alters the colour, smell and taste of water.

Filtration Water is filtered through ceramic filters that consist of a candle that holds back bacteria but not viruses. The candle may be made of unglazed porcelain or infusorial earth or coated with a silver catalyst. The candle needs to be cleaned by scrubbing with a hard brush under running water and should be boiled at least once a week. Pores may increase in size after repeated use and brushing and make the filter ineffective.

Basic Steps in Purification of Water

1. *Storage and sedimentation:* water is stored in large reservoirs for about two weeks. Suspended impurities settle down. Sunlight, air, algae and fish begin purification.
2. *Filtration* is carried out by either of two methods:
   (a) slow sand or biological filters
   (b) rapid sand or mechanical filters
   In the slow sand filter, water slowly passes over sand grains and gravel covered with a slime layer of algae and bacteria. These microorganisms purify the water.
   In the rapid sand filter, alum or aluminium sulphate is added to hasten flocculation. This precipitates out the impurities which are filtered off through a bed of sand.
3. *Chlorination:* chlorine kills the remaining pathogenic organisms and makes the water pure. A minimum level of 0.2 ppm to 0.5 ppm residual chlorine is recommended for drinking water.

CRITERIA FOR JUDGING WATER QUALITY

For hygienic purposes the examination of water is generally done along the following lines:

1. *Physical Qualities*
   (a) Turbidity is measured on the Jackson candle turbidity meter. It should be less than five units.
   (b) Colour is measured in a colorimeter and should be less than five units.
   (c) It should have no disagreeable odour.
   (d) It should be palatable and free from disagreeable taste.
2. *Chemical Qualities*
   (a) *Chlorides:* maximum permissible limit is 600 mg/l but the standard is 200 mg/l of water.
   (b) *Hardness:* total hardness should not exceed 300 mg/l water.
   (c) Free and saline ammonia should not exceed 0.05 mg/l.
   (d) Albuminoid ammonia is a measure of decomposable organic matter that is to be oxidised. It should not exceed 0.1 mg/l.
   (e) Nitrites should be zero.
   (f) Nitrates should not exceed 1 mg/l. It indicates old contamination.
   (g) The amount of oxygen absorbed is an approximate test for the amount of organic matter present. Oxygen absorbed at 37°C in three hours should not be more than 1 mg/l.
   (h) Dissolved oxygen should not be less than 5 mg/l.
   (i) Toxic substances like arsenic, selenium, cadmium, lead and mercury should not exceed the prescribed limits.
3. *Bacteriological Qualities or Indicators*: It is based on organisms indicating faecal contamination.
   (a) *Coliform organisms* include all aerobic, facultative and anaerobic gram negative, non-sporing, motile and non-motile bacteria capable of fermenting lactose at 35 to 37°C in less than 48 hours. This group includes the faecal group (example, *E. coli*) and non-faecal group (example, *Klebsiella aerogenes*).

   The bacteriological quality of water is assessed on the basis of the coliform test. Water samples are collected in screwcapped sterilised bottles. The test measures the most probable number (MPN) of coliform bacteria in 100 ml of water. A measured amount of water is inoculated on culture media and on the basis of this test, water is classified as shown in Table 12.2.

Table 12.2 **Classification of water**

S. No.	Coliform count per 100 ml water	Grade/Class	Remarks
1.	0 – 1	Class 1	Highly satisfactory
2.	1 – 2	Class 2	Satisfactory
3.	3 – 10	Class 3	Doubtful
4.	more than 10	Class 4	Unsatisfactory

Table 12.3 **Water Samples Analysed in Maharashtra State for Bacteriological Quality and found Contaminated (1994)**

S. No.	Particulars	Rural	Urban
1.	Total samples received for analysis	3,96,353	2,42,795
2.	Number of contaminated samples (Coliform count more than 10 per 100 ml water)	1,57,628	23,011
3.	Percentage contamination	39.76%	9.47%

Source: State Public Health Laboratory, Pune

Reasons for using coliforms as indicators

(i) They do not normally occur in water. They are excreted in large amounts from the human intestines, hence, their presence in water is indicative of faecal contamination.
(ii) They are easily detected in culture media.
(iii) They survive longer than other pathogens.
(iv) They have greater resistance to purification procedures.

(b) Faecal *Streptococci* is an important confirmatory evidence of recent faecal pollution of water.
(c) *Clostridium perfringens:* presence of spores indicates faecal contamination. Their presence in the absence of coliform group of organisms suggests faecal contamination which could have occurred at some remote time.

WATER QUALITY STANDARDS

The WHO International Standards, 1971, relate five water quality variables:

1. *Microbial pollutants:* standards for bacterial quality of treated water are
   (a) throughout any year, 95 per cent of the samples should not contain any coliform organisms in 100 ml of water
   (b) no sample should contain *E. coli* in 100 ml of water
   (c) no sample should contain more than 10 coliform organisms in 100 ml water
   (d) coliform organisms should not be detectable in 100 ml of any two consecutive samples of water
2. *Toxic substances:* arsenic not more than 0.05 mg/l, cadmium not more than 0.005 mg/l, lead not more than 0.05 mg/l, mercury not more than 0.001 mg/l, selenium not more than 0.01 mg/l.
3. *Specific substances* that may affect health, like fluoride levels, should vary between 0.5 to 0.8 mg/l.
4. *Characteristics affecting acceptability:* the acceptability of water is affected by substances that cause discolouration, odour, taste, dissolved salts and affect the pH. All these should be within desirable limits set by the WHO.
5. *Radioactive substances:* pollution of water by radioactive substances is on the rise and the WHO has set standards for acceptable limits.

Table 12.4 **Water Sample Examined Bacteriologically at District Public Health Laboratories (DPHL) in the State of Maharashtra During the Month of January 2009 to December 2009**

S. No.	District	Rural			Urban			Total		
		Recd.	Cont.	%	Recd.	Cont.	%	Recd.	Cont.	%
1.	Kokanbhavan	0	0	0	12742	958	8	12742	958	8
2.	Thane	5756	1189	21	10376	548	5	16132	1737	11
3.	Raigad	7183	2224	31	3661	173	5	10844	2397	22
4.	Ratnagari	6335	840	13	2408	78	3	8743	918	10
5.	Pune	9350	2407	26	8133	560	7	17483	2967	17
6.	Satara	8335	583	7	3337	183	5	11672	766	7
7.	Solapur	7334	2307	31	6478	362	6	13812	2669	19
8.	Nashik	5950	2244	38	11741	575	5	17691	2819	16
9.	Dhule	4832	1256	26	2295	65	3	7127	1321	19
10.	Nandurbar	1099	398	36	1081	24	2	2180	422	19
11.	Jalgaon	2187	543	25	5875	192	3	8062	735	9
12.	Ahmadnagar	3523	690	20	5293	507	10	8816	1197	14
13.	Kolhapur	3418	568	17	5791	788	14	9209	1356	15
14.	Sangali	1886	219	12	5015	81	2	6901	300	4
15.	Sindhudurg	4729	1153	24	1251	17	1	5980	1170	20
16.	Aurangabad	7710	2855	**37**	8934	594	**7**	16644	3449	**21**
17.	Jalana	7161	2702	**38**	2227	194	**9**	9388	2896	**31**
18.	Parbhani	2578	1032	40	4170	243	6	6748	1275	19
19.	Hingoli	533	202	38	1687	288	17	2220	490	22
20.	Latur	3126	1351	43	3328	188	6	6454	1539	24
21.	Beed	5470	1977	36	4054	54	1	9524	2031	21
22.	Nanded	4259	2276	53	4290	324	8	8549	2600	30
23.	Osmanabad	4715	1090	23	4891	234	5	9606	1324	14
24.	Nagpur	7528	952	13	24017	4967	21	31545	5919	19
25.	Wardha	5282	659	12	3345	71	2	8627	730	8
26.	Bhandara	6792	2280	34	3207	91	3	9999	2371	24

Contd...

Table 12.4 (Contd)

S. No.	District	Rural			Urban			Total		
		Recd.	Cont.	%	Recd.	Cont.	%	Recd.	Cont.	%
27.	Gondia	2655	616	23	1326	40	3	3981	656	16
28.	Chandrapur	4742	809	17	4564	191	4	9306	1000	11
29.	Gadchiroli	8442	712	8	3004	42	1	11446	754	7
30.	Akola	2879	1277	44	4410	753	17	7289	2030	28
31.	Washim	2020	818	40	1416	18	1	3436	836	24
32.	Amaravati	10022	1944	19	11788	356	3	21810	2300	11
33.	Yeotmal	9875	3300	33	4047	324	8	13922	3624	26
34.	Buldhana	1913	828	43	4261	370	9	6174	1198	19
	Total	169619	44301	26	184443	14453	8	354062	58754	17

WATER SUPPLY FOR CATERING ESTABLISHMENTS

Water supply should be adequate and hot and cold running water should be available in the kitchen just next to the work area. Water for personal use, drinking, food preparation, dishwashing and for cleaning pots and pans or surfaces in contact with food directly or indirectly, should come from a safe tested source.

Food service establishments in towns and cities usually have no problem in getting a safe water supply. Before it is distributed, it is purified and treated on a large scale by the water supply board which is under the control of the local health authority. It is tested at regular intervals. This water is distributed through underground pipelines and supplied through water taps.

If tapwater is unavailable, water from other sources, like wells and tubewells, should not be used in the kitchen unless it is potable. Non-potable water can be used for washing premises, gardening or for cleaning garbage bins. If water from other sources like wells, tubewells, rivers, etc. is the only available source of water, it should be tested for bacteriological and chemical quality by the local public health laboratory and treated, if necessary, before it is used.

Water Taps

1. *Drinking water taps:* water supply is received directly from the main water supply and is used for drinking and cooking. It is connected to the water cooler.
2. *Tank water taps:* this water is also from the main water supply but it passes through two storage tanks before it reaches the tap. The storage tanks are the underground storage tank and overhead storage tank.

The potability of this water depends largely on the cleanliness of the water tanks. This water is used for all washing and flushing purposes. The hot water tap supplies tank water.

The underground storage tanks should be waterproof from the insides to prevent seepage of subsoil water. They should be kept covered as they are liable to contamination from pests, insects and animal and vegetable matter. They are easy to examine.

Overhead storage tanks are situated on the roof to create sufficient water pressure. They should be kept covered, checked regularly and cleaned out at least once in six months. They are likely to get contaminated from the atmosphere and dust.

All tanks should be accessible for cleaning operations.

Hot Water

All sinks and wash basins should have taps. Hot and cold running water under pressure should be provided in food preparation and dishwashing areas. Hot water is required throughout the year. Solar water heaters can be used for heating water. Hot water in the dishwashing area should be at a temperature of 77°C for proper sanitisation of crockery and cutlery. The temperature of water should be checked at regular intervals to ensure this. An insufficient supply of hot water increases the work load without increasing output.

Hot water pipes should be insulated to conserve heat and cut down on fuel consumption.

Problems Encountered in City Supply

Water supplied by municipal corporations is checked and treated regularly before it is distributed. However, the following problems may be encountered with city water supply:

1. *Drop in water pressure:* with a reduction in water pressure, automatic spray type dishwashers will not clean dishes well.
2. *Cut in water supply:* this is generally due to repairs at water works. In an emergency, water is transported by tankers from an approved source. Avoid contamination from insanitary containers and faulty handling during collection and storage.

When potable water is unavailable in a particular area, the health authority should be consulted. Adequate amounts of potable water should be hygienically transported, stored and used.

Non-potable water may be permitted for use in airconditioning plants and for fire protection in some establishments. Care should be taken to prevent it being used for food or drink. Faulty plumbing may contaminate the potable water supply pipes.

Ice

Ice for any use in the kitchen should be prepared from water from an approved source. It should be manufactured, stored, transported and handled in a sanitary manner.

Ice used in contact with food should meet bacteriological requirements for potable water. Addition of antibiotics, namely, chlortetracyline and oxytetracycline for fish and seafood storage is approved.

Ice may be contaminated at the factory or during delivery. No licence should be given unless water used for manufacture of ice is pure and wholesome. Personal hygiene is very important and workers should be medically fit and in clean uniforms.

Food stuffs or drinks should be chilled by keeping them in an ice box which has two separate compartments, one for ice and the other for food. The use of ice in direct contact with food or added to drinks is debatable as there is a possibility of pollution even in well maintained establishments and a number of ice samples checked were found to be contaminated.

SEWAGE AND CONTAMINATION OF WATER SUPPLY

Sewage consists of human faecal matter diluted with water and other waste waters from the kitchen sinks and drains, dishwashers, laundry, wash basins, bathroom drains and wastewaters from mopping, washing floors and garbage bins. It is approximately 99 per cent water and contains a large number of microorganisms, mainly bacteria from the intestinal tract and soil. Sewage contamination is harmful as it is a potential source of human pathogens, especially those that affect the intestinal tract. Persons who suffer from acute intestinal disorders excrete millions of virulent pathogens into sewage. Healthy people and carriers also contribute significantly to this microbial load. Sewage contamination can result in severe, widespread epidemics of communicable diseases. It can contaminate both food and water.

Food gets contaminated when untreated sewage is used as a fertiliser in fields where vegetables are grown. Root vegetables, green leafy vegetables, salad vegetables, coriander leaves, celery and parsley are at a greater risk. This risk increases further when vegetables are not washed well, not peeled or are consumed raw in salads or as garnish. Coriander leaves used in green chutney has been responsible for the outbreak of several food-borne illnesses.

When untreated sewage is discharged into a body of water, the pathogens present contaminate the water and the food found in such waters. Improperly treated or untreated sewage spoils water because of the large number of microorganisms and high percentage of organic matter present in sewage. The microorganisms in sewage oxidise the organic matter. For the process of oxidation, oxygen from water is used up and the level of dissolved oxygen is reduced. Normally, water contains 7–8 ppm of free oxygen. This level promotes and maintains all forms of aquatic life.

When the level of oxygen falls to 3 ppm, anaerobic conditions develop which do not favour aquatic life. Fish cannot survive in low levels of oxygen and they either leave or die. Foul smelling products are produced by putrefaction and fermentation brought about by anaerobic microorganisms. This spoils the water and makes it cloudy, malodorous and unfit for human use.

The drinking water supply in cities and towns may get contaminated with sewage in many ways. Sewage contamination may occur through a leak in pipes or water from sewage disposal tanks may seep into the soil and contaminate other sources of water.

A leak in sewer connections and improper plumbing in the food service establishment may be the cause of contamination of otherwise clean, and wholesome food and potable water.

If water supply is inadequate or a water carriage sewage disposal system is not available—which may be the case in temporary food service establishments, at fairs or at remote tourist spots—some type of sanitary conveniences are necessary. They should be located well away from the kitchen and should have hand washing facilities. Various types of water closets may be used, like the chemical closet. It should have a cover and should be kept as clean as possible. These problems may also arise in villages, isolated buildings and small remote catering establishments.

Water samples should be sent for testing to the nearest public health laboratory before using water for consumption. Water can be purified by boiling and should be stored in clean containers and kept covered.

Chlorine can also be used effectively in the form of gas, solution, bleaching powder or tablets.

Regular checking and treatment of water being supplied, as well as conserving water that is available, can go a long way in preventing the spread of water-borne diseases.

SUMMARY

An adequate supply of potable water is required for every catering establishment to prevent the spread of water-borne diseases. Water is the lifeline for the catering industry and is needed for a wide variety of activities apart from drinking and cooking food. It is obtained from different sources. In cities and towns, it is supplied through underground pipelines and is purified and checked before it is distributed.

Water can get contaminated at the source itself or at any of the stages it has to go through before it is served to the consumer. Contamination during service is likely to occur due to faulty practices in serving water. Ice added to cold drinks is responsible for many diseases, if prepared from non-potable source or stored and transported unhygienically.

Impure water may be purified in a number of ways. In cities, water is purified by rapid sand filtration and then chlorinated to kill pathogenic microorganisms. Water quality is assessed by the presence of coliform organisms which indicates sewage contamination. Water quality standards have been formulated by the World Health Organisation.

KEY TERMS

Chlorination A step in large scale purification of water which supplements sand fittration, by killing pathogenic bacteria, oxidising iron, manganese and hydrogen sulphide, destroying taste, odour and lime organisms and aids coagulation. Chlorine demand of water is measured and is added in quantities to ensure some free residual chlorine as a margin of safety.

Chlorine demand of water It is the amount of chlorine that is needed to destroy bacteria and oxidise all organic matter present in water and is measured by calculating the difference between the amount of chlorine added to water and the amount of residual chlorine remaining after 60 minutes at a given temperature and pH of water.

Coliform organisms Coliform organisms include all aerobic, facultative and an aerobic gram negative, non-sporing, motile and non-motile bacteria which are lactose fermenting and are present in abundance in the human intestine. Their presence in water indicates faccal contamination/sewage contamination of water.

Hard water Water which contains compounds of calcium and magnesium dissolved in it which hamper lather formation and cause furring or scaling in equipment and needs to be softened before use. Moderately hard water is acceptable for consumption and use.

Non-potable water Also termed polluted or contaminated and contains any one or more of the following like pathogenic agents, harmful chemical substances, suspended impurities, colour, odour and unpleasant taste and is unfit for consumption.

Potable water Safe, clear and wholesome water which is free from pathogens, harmful chemical substances, colour, odour and unpleasant taste, and suspended particles and is fit for consumption.

Purification Treating raw water on a large or small scale to ensure that it is safe and wholesome. Large scale purification involves storage, sedimentation, coagulation, filtration and chlorination or disinfection.

Sewage Human faccal waste matter diluted with water and other waste waters from kitchens, dishwashing, laundry, bathrooms etc. which contains large number of microorganisms from intestinal tract and soil and needs to be treated before it it dispersed.

WHO World Health Organisation, a directing and co-ordinating authority for health within the United Nations System and has a six–point agenda to improve public health. This global health organisation was set up in 1948. WHO has set International standards for water quality in 1971. *www.who.int*

REVIEW QUESTIONS

1. Select the most appropriate answer.
   (a) Potable water is
      (i) water stored in a pot
      (ii) water taken from a reservoir
      (iii) water which is safe, clean and wholesome
      (iv) water passed through a muslin cloth
   (b) The most practical and cheapest source of water is taken from
      (i) land surfaces
      (ii) tanks
      (iii) ground water
      (iv) artificial lakes
   (c) Presence of coliform bacteria in water implies that water has been contaminated by
      (i) toxic substances from industrial wastes
      (ii) silt, clay and sand
      (iii) microscopic plants and animals
      (iv) sewage
   (d) Drinking water taps receive their water supply from
      (i) underground storage tanks
      (ii) directly from the main water supply
      (iii) overhead storage tanks
      (iv) water coolers
   (e) Water can be purified on a large scale by
      (i) storage, self purification and oxidation
      (ii) distillation, boiling and ultra violet light treatment
      (iii) storage, flocculation and sedimentation
      (iv) coagulation, filtration and chlorination
2. State whether True or False.
   (a) Water should be clear and free of turbidity to ensure effective chlorination.
   (b) Chlorination for a duration of 5–10 minutes is sufficient to kill all bacteria and viruses.
   (c) Sand filtration is not necessary if chlorination of water is carried out on a large scale.
   (d) Residual or free chlorine in water is hazardous to health.
   (e) Addition of chlorine to water to give a residue of 0.5 mg/l kills harmful bacteria but not their spores and viruses.
3. Fill in the blanks with appropriate answers.
   (a) Hardness of water is caused by the presence of ____________.
   (b) The purpose of serving meals under hygienic conditions is totally lost if water served with it is ____________.
   (c) Water which contains industrial or domestic waste is termed as ____________.
   (d) Water from natural sources is likely to get contaminated from the ____________, ____________, ____________ and ____________.

(e) Adequately filtered water should not contain more than ________ coliform organisms/100 ml.

(f) Overhead water tanks are likely to get contaminated from the ________ and ________.

(g) In cities, water is purified by ________ and ________.

(h) Non-potable water may be used for ________, ________, ________.

(i) Turbidity renders chlorination ________.

(j) Ice used in contact with food stuffs or cold drinks should meet the ________ requirements for potable water.

(k) Food-borne illnesses could occur due to consumption of salad vegetables fertilised with ________.

(l) Hot water pipes should be ________ to conserve heat and minimise fuel consumption.

4. Enumerate the steps required in the large-scale purification of water.
5. Describe the different 'layers' which make up a slow sand filter bed.
6. Differentiate between slow and rapid sand filters.
7. Name four chemical disinfectants used in purification. What are their advantages and disadvantages?
8. Describe the filter used in small-scale purification of water. How should they be cleaned to ensure effective purification of water.
9. What remedial measures are to be taken if only unpotable water is available for use?
10. What protective measures are required to ensure safe storage of water in storage tanks?
11. How do microorganisms from sewage contaminated water make the water source foul smelling and unfit for human use?
12. Mention five measures to be taken to maintain potable water supply at village fairs or remote catering establishments.
13. Match the following.

A	*B*
1. Natural pollutants	(a) metal salts
2. Sewage	(b) pesticides
3. Industrial wastes	(c) silt
4. Agricultural pollutants	(d) radioactive substances
5. Physical pollutants	(e) pathogenic organisms

13

- **Solid wastes: definitions (garbage, swill, refuse), collection of garbage, storage, garbage bins, methods of disposal (land filling, burial, composting, incineration, mechanical disposers, vermiculture, biogas plants, recycling)**
- **Liquid wastes: sewage (collection, treatment and disposal), plumbing**
- **Gaseous wastes**

Storage and Disposal of Waste

INTRODUCTION

Cleanliness and sanitation of catering establishments and premises includes not only maintenance of clean and well sanitised surfaces of all equipment in contact with food but also good housekeeping practices and adequate treatment and disposal of wastes.

Adequate treatment and proper disposal of all wastes arising from the catering industry is directly or indirectly the responsibility of the management. The management should ideally ensure that wastes are disposed without causing any danger to human life, without damaging plant and animal life and without polluting any part of our environment.

In the food industry, wastes must be disposed of regularly and efficiently to prevent contamination of any food product. Wastes arising from catering establishments are broadly classified into three groups: solid wastes (garbage and refuse), liquid wastes (sewage) and gaseous wastes (smoke and fumes).

Solid wastes in the form of refuse and garbage is the major waste which arises from the catering industry. They pose a problem in disposal to the caterer. Liquid wastes are normally disposed through sewers provided by the municipality in towns and cities and gaseous wastes are expelled into the atmosphere where they get diluted by diffusion and air currents.

It is essential to collect and dispose of all types of waste separately as they are easier to deal with if they are kept separate.

SOLID WASTES

Apart from the usual trash and litter like empty cartons, tins and boxes, solid wastes from the food industry include agricultural wastes like unusable portions of plant and animal foods resulting from food production. Solid wastes should preferably be sorted into biodegradable and non-biodegradable wastes, and stored separately. They may be compacted or concentrated before disposal. Agricultural wastes can be used as feed or fertiliser after appropriate treatment.

Garbage or *swill* is the waste matter resulting from the preparation, cooking and consumption of food. It includes all inedible, spoilt and useless scraps of food, which need to be disposed of. Waste matter from preparation will include vegetable and fruit peels and trimmings, rotten food stuffs, spoilt canned food, etc. Cooking wastes include peels, skin and bones, charred preparations and spoilt food. Sometimes food is wasted after it is served. Plate waste also accounts for a large portion of garbage.

Refuse refers to any waste material, either non-food or swill. Non-food waste from the kitchen includes all cans, bottles, paperbags, polythene bags, lids, cardboard cartons, etc. From the service area, single service items, papernapkins and straws, toothpicks, etc. also contribute significantly to the overall solid waste matter.

If waste is allowed to accumulate it is dangerous to health.

This is because of the following reasons:

1. Organic portions of solid waste ferments and gives off foul odours
2. Piled up waste favours the breeding of insects and rodents, especially flies
3. Pathogens present in waste may be conveyed to humans through pests and dust.
4. It may pollute the water supply.
5. There is a risk of air pollution in case of accidental or spontaneous combustion of rotting refuse because of the production of gas.
6. Hogs, cattle and dogs feed on garbage and spread it still further.
7. Heaps of refuse lying around is an unattractive sight.

Fig. 13.1 *Work table fitted with a garbage bin*

It is therefore necessary that the refuse from catering establishments is properly collected, stored and disposed of in a sanitary manner. If it is not disposed of immediately, then it should be stored in proper containers in a cool place. Garbage should always be kept well away from food, utensils and food preparation, storage and service areas.

Collection

Refuse should always be collected from the place where it is produced, i.e. near pre-preparation tables, meat blocks, kitchen sinks, dishwashing area, pantry table, etc. It can be collected in small bins or swill bowls. Nowadays, modern work tables are fitted with garbage bins on a trolley placed underneath the table. The waste can be immediately pushed off the table into the bin.

All small bins must be emptied into a large bin outside the kitchen at least twice a day or whenever the bins are full.

Storage of Garbage

It is important to store garbage correctly before it is disposed of. It should not be left overnight near the kitchen area. The kitchen area is warmer than the other areas and decay is faster near the kitchen. The ideal storage area is in a yard behind the premises. Garbage should be filled in bins and these bins should be kept in the coolest place. Care should be taken to ensure easy cleaning and absence of pests. The garbage storage area should be large enough for the amount of garbage that will accumulate.

In large establishments and places where it is not disposed off frequently, it is stored in the basement at low temperatures.

The Garbage Bin

The garbage bin should have the following characteristics:

1. it should be made of metal, preferably galvanised
2. stoutly constructed and durable
3. painted or treated with bitumen to prevent rusting
4. unridged
5. covered with tightly fitting lids, preferably with a clip to prevent the lid from blowing off.
6. leakproof
7. pestproof
8. easy to clean
9. of the correct size
10. adequate in number

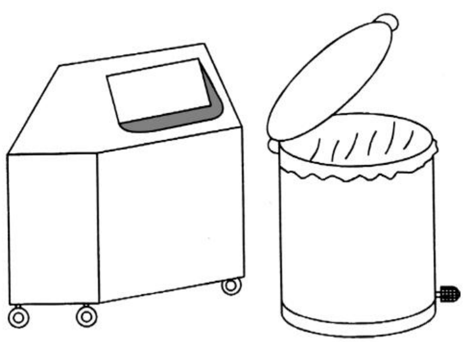


Fig. 13.2 *Garbage bins should be self closing or foot operated and should be lined with wet strength bags*

The bins may be lined with plastic or wet strength bags. The bins should be kept dry. This will prevent or reduce bacterial growth, spoilage and putrefaction and the resultant foul odours. To control pathogens and keep down odours, cover garbage with bleaching powder, lime or chlorine.

The bins should be placed on cemented platforms approximately 35 cm (14 inches) to 45 cm (18 inches) above the ground and 23 cm (9 inches) away from the wall. This will prevent legged pests from reaching the bin.

The top of the platform should be slatted to avoid accumulation of moisture around the base of the bin. The bins should not be exposed to the sun or rain.

Ideally, there should be separate bins for swill and rubbish. They should be adequate in number and size to ensure that there will be no overflow. If trolleys are available to carry the bins to the garbage truck, the work of lifting the bins is reduced.

Cleaning the Bins Garbage bins may be used in rotation. They should be cleaned often. A tap, a pipe and a drain should be provided near the disposal area. After the bins are emptied they should ideally be rinsed with warm water and scrubbed with a long handled brush using soap and disinfectant. The floors of the disposal area should be clean and free from any spilt refuse.

Kitchen waste and plate scrapings should be collected in closed containers or a strong polythene bag or disposable cartons. To check pilferage, transparent bags may be used.

After the bag is full, it should be tied up.

These can be directly emptied into or placed in the main bins at regular intervals. This waste should never be carried through the dining areas. The containers should always be covered and cleaned thoroughly as soon as they are empty.

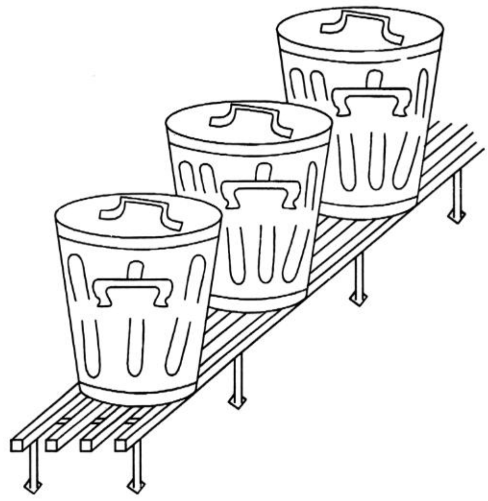


Fig. 13.3 *Storage of garbage bins on slatted stands*

Methods of Disposal

After refuse is collected, it is important to dispose it off in such a way that it does not create any nuisance.

The variety and quantity of waste products to be disposed off has increased tremendously with improvement in the standard of living and the population explosion.

Waste arising from catering establishments is mainly composed of biodegradable or organic matter (biomass). This waste needs prompt disposal because it is highly perishable and decomposes rapidly, giving rise to foul odours and encouraging the growth of microorganisms and pests.

Before selecting a method for proper disposal of wastes, it is necessary to understand the value of the waste matter which is to be disposed off and the nuisance it is likely to cause if improperly disposed.

Table 13.1 **Types of Waste and its Disposal**

S.No.	*Methods of disposal*	*Types of waste*	*Precautions*
1.	Landfilling (dumping and controlled dumping)	All types of solid waste	Select low lying site at least 45 m away from habitation, start filling at one end, garbage should be properly compacted and covered with earth.
2.	Burial	Dry garbage, wet garbage, dead pests	Dig deep trenches, cover garbage with soil, deposit garbage daily.

Contd...

Table 13.1 (Contd)

S.No.	*Methods of disposal*	*Types of waste*	*Precautions*
3.	Incineration	Dry garbage, dry leaves, soiled cotton, dirty rags, outdated pesticides	Burn away from building
4.	Composting	Garbage, toilet waste or sludge, dry plant matter	Area should be located away from habitation; use composite manure in fields
5.	Mechanically disposing (pulpers, compacters)	Soft food waste, dry bulky waste, i.e., cartons, cans	Food residue which remains in the pulper should be disposed of with garbage; store dry and wet wastes separately
6.	Vermiculture	Food waste, sewage	Crush or shred food waste and spread it in layers
7.	Biogas	Toilet waste, agriculture waste, dung	Amount of water used should be controlled
8.	Recycling	Paper, cardboard cartons, plastic, polythene, glass, metal, waste food	Store each type separately; do not mix with wet garbage; process waste food adequately to kill pathogens
9.	Sewers and drainpipes	Wastewater, sewage, crushed soft food waste	Drains should not get blocked; drains should have a grease trap; sewers should have no leakage
10.	Soakpits	Wastewater from kitchen, bathroom and wash up area	The container which receives the wastewater should be cleaned fortnightly
11.	Exhaust fans and ventilator hoods	Strong fumes, smoke, food odour and grease	Exhaust fumes discharged into the air should not cause a nuisance; filter on hoods should be cleaned regularly

When biomass is incinerated, plant nutrients like nitrogen and phosphorous are lost into the air. If biomass is not incinerated and is allowed to decompose, it is acted upon by bacteria and fungi. Under properly controlled conditions, these organic wastes can be converted into essential resources like fuel and manure, at the same time preventing environmental pollution caused by rotting garbage or incineration. However, some organic wastes like soiled cotton, tissue papers and dirty rags are best incinerated. Plastic, paper, polythene, glass and packaging material should be collected separately and recycled, to prevent unsightly heaps in and around the city.

The methods of disposing garbage may be broadly classified as follows.

Landfilling, burial, composting, incineration, mechanically disposing, biogas plants, vermiculture and recycling.

Landfilling

Dumping Refuse is dumped in low lying land or in land depressions like pits and hollows for reclaiming low lying land. This is the easiest method of disposing of dry refuse. Bacterial action reduces the volume of the refuse and gradually converts it to humus. This method however, has the following disadvantages:

1. loose refuse may be dispersed by wind
2. garbage is exposed to flies and rodents
3. it is unsightly in appearance and produces an unpleasant smell
4. surface water as well as ground water may get polluted

Controlled dumping If dumping is done during the dry season and under proper supervision, it is called controlled dumping. It is used to fill land depressions, disused quarries and empty pits. The land selected should be outside town limits, at least 45 m (150 feet) away from the nearest habitation. The work of filling up should start at one end of the depression. Refuse is dumped, adequately compacted and covered with earth at the end of the day or after a maximum period of 72 hours. The refuse is deposited in uniform layers up to 1.8 m (6 feet) in height. Each layer is sealed with a mud cover of at least 23 cm (9 inches) in thickness. Dumping is done till the level reaches 60 cm (2 feet) above ground level to allow for subsequent settlement. This made soil should be used for cultivation for 10 years and only then used as residential land.

Burial This method is suitable where the volume of garbage produced is small. A trench is prepared to collect the garbage. At the end of the day the refuse is covered with 20 to 30 cm of earth. Alternate layers of refuse and earth are formed. When the trench is filled up till it is only 40 cm deep, it is filled with earth and sealed. A new trench is then dug. Chemical, bacteriological and physical changes occur in the buried refuse. It takes approximately four to six months for complete decomposition of organic matter into an innocuous mass. Temporary food service establishments set up in open areas should dispose of garbage by this method.

Composting This is a method of combined disposal of refuse and sludge. Sludge is the solid precipitate in the sewage tank which settles at the bottom.

Animal and plant wastes are rich in nitrogen and phosphorous which can be returned to the soil by composting. Wastes of biological origin contain high amounts of water and are digested anaerobically by microorganisms in the absence of air. The waste is decomposed and stabilised by bacteria and fungi to form a humus like material called compost. Compost is rich in nutrients and fertilises the soil.

During this breakdown carbon dioxide, water and heat are produced. The heat produced is over 60°C for several days. This destroys larvae and eggs of flies and other pathogenic organisms.

Incineration It is a hygienic method involving burning of refuse and converting it into harmless waste. It is burned in a specially constructed incinerator. The incinerator should be maintained in perfect working condition.

The incinerator should have a tall chimney and sufficient draught of air for efficient combustion, without creating a smoke nuisance.

Disadvantages

1. If refuse does not burn properly, too much offensive smoke is produced which, in turn, pollutes the air.

2. Organic nitrogen which could have been returned to the soil is converted into inorganic nitrogen and is returned to the atmosphere.
3. This method cannot be used during the rainy season or if the refuse is wet.
4. Although incineration is ideal from the sanitary point of view, it is costly compared to other methods and the fuel and fertiliser value of the waste is lost.

Any presence of fine ash makes burning difficult and therefore dust or ash should be stored separately. In this method no manure is formed.

The volume of refuse is reduced to one-fourth its original weight. The residue is a mass of hard material called clinkers and is used for road making. The cost of transporting refuse is minimised. This is one of the best methods of garbage disposal.

Mechanical Disposers Mechanical disposers include pulpers or disintegrators and mechanical compactors.

These can be installed in catering establishments and are useful because they help in reducing the volume of garbage and the number of garbage bins required. These methods require access to a drain, water for cleaning and a power source.

Pulpers or disintegrators The latest way of disposing kitchen waste as soon as it is produced is through an automatic garbage disposal machine. This is also the quickest and most hygienic way of garbage disposal.

These machines are fitted under the existing sink or may be purchased as a self-contained unit. The pulper or disintegrator grinds food waste into tiny particles which is then flushed with water. When the machine is switched on, the waste from the sink drops into the pulper and gets finely cut or ground, it is flushed into the kitchen drain and disposed of along with sewage. The ordinary drainage system can thus dispose soft refuse like fruit and vegetable trimmings and peels, soft bones and mutton trimmings. If any solid wastes remain, they have to be discarded with refuse.

This machine is useful because it helps in preventing accumulation of soft, wet garbage which would otherwise decay very quickly.

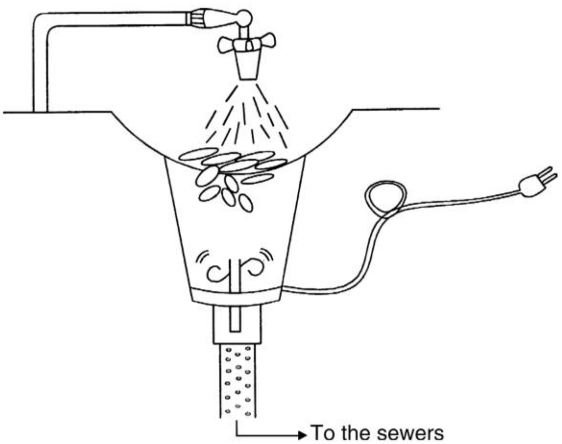


Fig. 13.4 *Automatic garbage disposal machine*

Mechanical compacting Dry bulky wastes which occupy a large volume of space in the garbage bin, such as cartons and cans, could be reduced in volume before disposal. By this method, the volume of garbage can be reduced to one-fifth its original volume.

It is the responsibility of all employees to see that garbage is collected, stored and disposed of properly without creating any nuisance to the public and the environment.

Disposal of Biodegradable Wastes

Bacteria act on organic matter and decompose it either aerobically or anaerobically. In aerobic decomposition complete combustion of organic matter takes place. This happens in vermiculture.

In anaerobic decomposition incomplete combustion takes place and is accompanied with the production of methane gas. If anaerobic conditions are created in garbage heaps, ponds or septic tanks, a foul odour emanates because of gas formation. This principle is made use of in the production of biogas.

Vermiculture Vermiculture is a cheap, practical, innovative technology which conserves the humus content of the soil. This is achieved with the help of the earthworm *Pheretima olongata.* Aerobic bacteria multiply in the gut of the earthworm and decompose waste like sugars, starch, cellulose and protein into humus and simpler forms which can be easily assimilated by plants. The burrowing action of the worm tills the soil ten times deeper than the traditional plough. It increases porosity and aeration by breaking up the soil.

The worm feeds on garbage and excretes it as manure, known as vermicastings, which is a highly enriched kind of biofertiliser and contains hundreds of tiny earthworm cocoons to continue the process. It restores fertility to degraded soils and wastelands.

Vermiculture can be done in a garbage bin in the kitchen. All food waste is chopped or crushed and spread in a layer in the bin, or on the soil in garden beds or special beds to which vermicastings have been applied.

Sewage can also be treated by vermiculture, and the water released in the process can be reused for gardening, flushing, etc. Soils treated with vermiculture yield bumper crops and return the plant nutrients to the soil (refer Fig. 13.5).

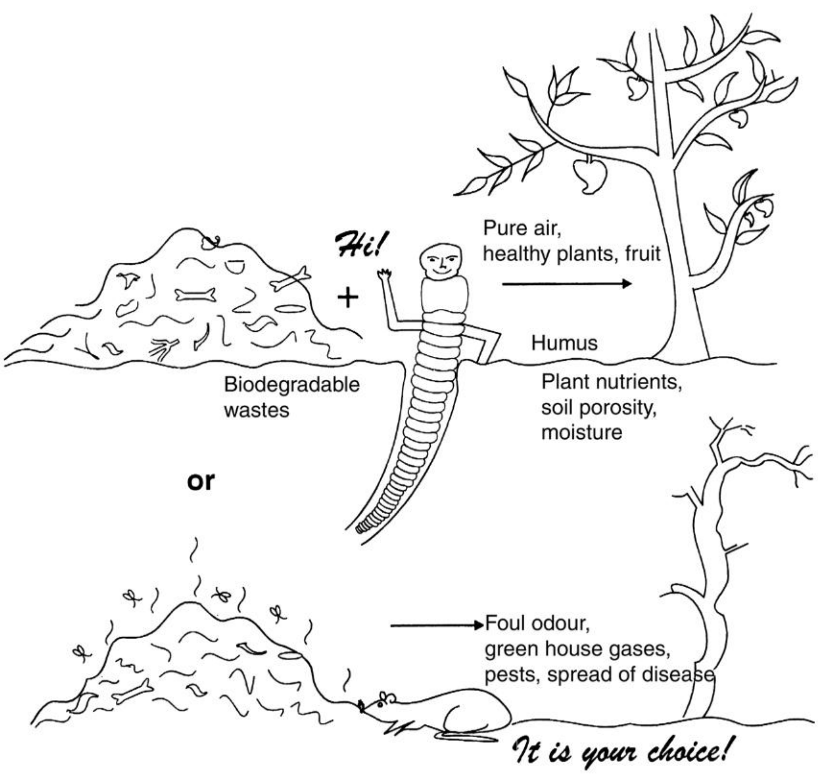


Fig. 13.5 *Vermiculture*

Biosanitizer

The biosanitizer along with garden waste is yet another way of converting wet biodegradable waste arising from kitchens into rich organic manure. It has been proven to be the simplest, most cost effective, least labour intensive and most environmentally friendly method of converting biodegradable waste into useful good quality manure. This can be done on a large scale in bins or on a smaller scale in a pot or in one corner of the garden.

All garden waste such as garden sweepings, cutting and leaf mulch should be collected in one corner of the garden. The biosanitizer plant consists of seven bins. The size of the bin depends upon the amount of waste generated. Each bin ideally admeasuring 8 ft length × 3 ft height × 4 ft breadth should be constructed at a suitable site at ground level. Bins should be marked for each day of the week, i.e. Monday, Tuesday, etc. The bins should have drainage provision and need not be plastered from inside. The base of each bin should be covered with brickbat and plain soil. The biodegradable waste should be spread evenly on the floor of the first bin with a rake. This waste is sprinkled with the dry biosanitizer crystals, taking care to cover the entire waste. The biosanitizer is then covered with a thin layer of garden waste. The biosanitizer crystals are a natural granular biocatalyst that help in breaking down organic matter rapidly. These three layers are then sprinkled with five litres of water containing Sujala, the packet of Sujala is permanently suspended in the watering can. Sujala contains necessary factors for proper breakdown of waste. The entire process is repeated in the next bin on the next day and so on.

Advantages

1. The biosanitizer is to be used only once when the bin is started.
2. Sujala is also put in the watering can only once.
3. No turning of waste is required.
4. Rich manure can be harvested once a year and the same bin can be re-used.
5. The cost of biosanitizer and Sujala is a one-time investment and is affordable.
6. Garbage can be treated at the source where it is generated and there is no dependency for its storage and disposal.
7. Enriched, organic manure is obtained instead of allowing garbage to spread and rot in the bins or on streets.

An additional bin for collecting garden waste is desirable. The bins are covered with wiremesh covers to prevent pests from spreading garbage. The manure can be used seived or unseived.

The microbial culture for vermiculture and biosanitizer includes nitrogen fixing bacteria and species of *Azotobacter, Pseudomonas, Tricodermae*, *Verticillium*, *Metarizium* etc.

Biogas Generation Human excreta, animal droppings and plant and agricultural wastes can be processed in a biogas or *gobar* gas plant to produce fuel gas and rich manure. The plant consists of a circular tank shaped like a well. The tank is divided into two sections by a partition wall. It is covered on top by a cylindrical dome for the collection of gas.

Excreta or night soil from the water closet and other diluted organic wastes are directly fed into the round digestion tank through an inlet pipe. The gas produced by anaerobic digestion is collected in the cylindrical dome and is conveyed by a pipe to the kitchen. The digested effluent sludge comes out through the outlet pipe.

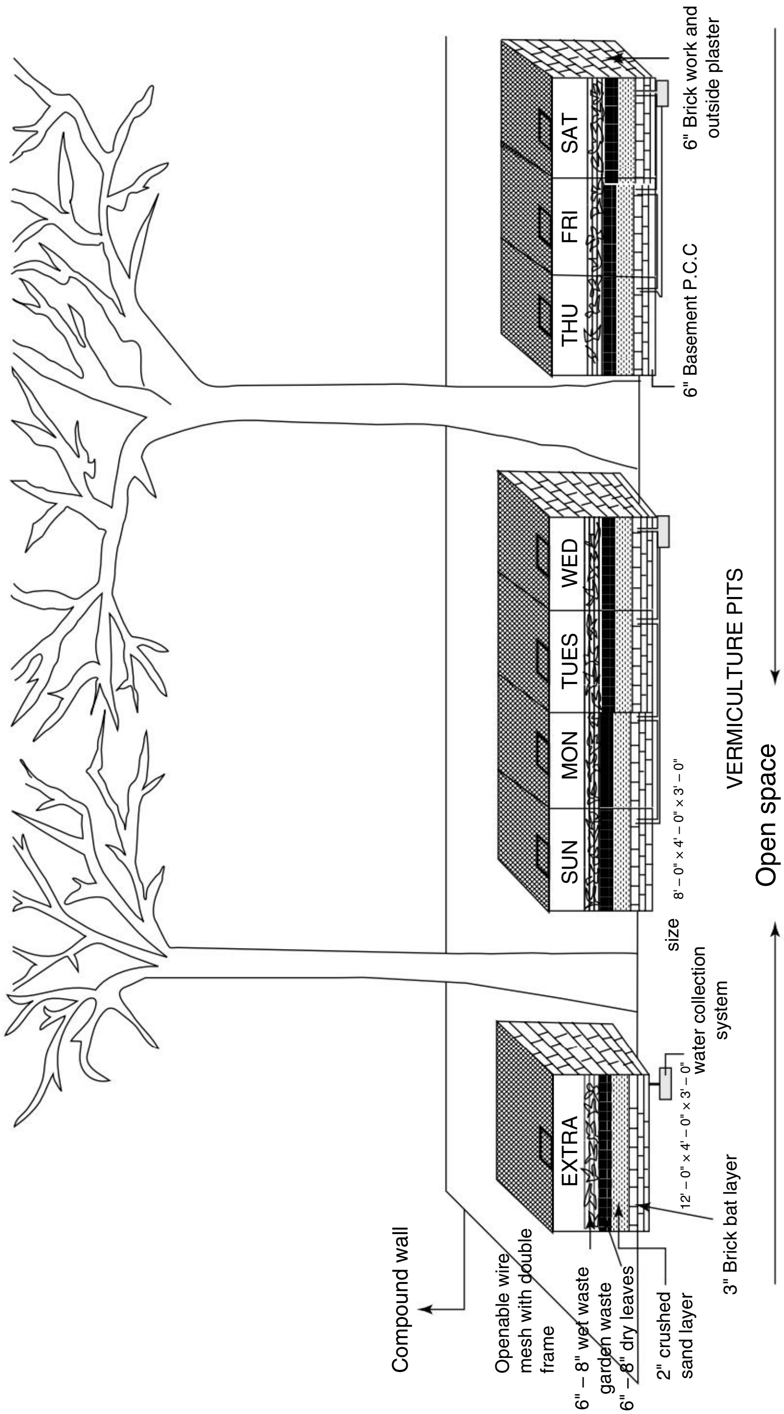


Fig 13.6 *A biosanitizer plant in operation at MSIHMCT, Pune*

The two main products formed by anaerobic digestion are

1. fuel gas, which is approximately 55 per cent methane and 45 per cent carbon dioxide
2. manure, which is rich in nitrogen and humus.

The gas produced can be used for cooking, lighting and running engines. Many companies are working towards large-scale production of biogas and manure from refuse collected by municipal corporations.

Recycling Recycling is the reprocessing of waste products so that they can be re-used.

Recycling food waste One way of utilising the energy from waste food is by using it as feed for pigs and poultry. It should be collected separately, taking care not to mix other refuse like cans, broken glass, etc. Waste food may be used for preparation of poultry feed after it is boiled well, shredded, dried and enriched with minerals. Destruction of all pathogens should be ascertained, otherwise they may find their way into the flesh of animals and ultimately reach the food consumed by humans.

Recycling non-biodegradable waste All kinds of glass, plastic, polythene, paper and metal can be recycled. Each of these items should be collected in separate containers or bags and sent for recycling. This will drastically reduce the volume of garbage to be disposed off daily and indirectly reduce pollution.

The use of recycled plastics is, however, not permitted in the food industry.

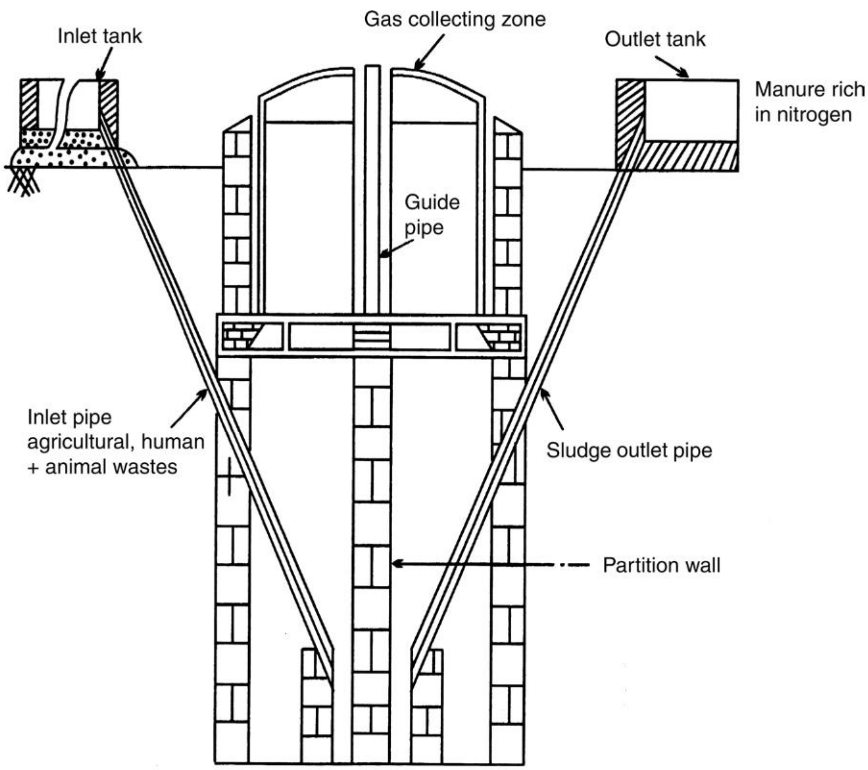


Fig. 13.7 *Biogas plant*

LIQUID WASTES OR SEWAGE

Liquid wastes or sewage includes wastewater from sinks and drains from the kitchen, dishwashing area, laundry, bathrooms, toilets and other drains from the building and yard which is normally carried away by underground sewers.

It contains human excreta, chemicals like detergents, pesticides and oil and clean up wastewater rich in nutrients from animal and vegetable foods. It is one of the most dangerous sources of human pathogens and should not come in contact with food, water, utensils, equipment or any other food contact surface.

Sewage must be kept separate from other wastes because of the possible presence of human intestinal pathogens and the importance of guaranteeing their destruction. Disposal of sewage in a sanitary manner thus forms a pre-requisite for good food sanitation.

As far as possible, sewage should be disposed of in a public sewerage system or in a manner approved by the health authority. Care should be taken to prevent contamination of the ground and water supply and to keep all pests away. The temporary food service establishment operator needs to take special care.

In catering establishments located in towns and cities, sewage is removed through a system of underground sewers and drains called the water carriage system. These sewers take the sewage to a far off place away from the city. Before it is disposed of, it is treated in sewage treatment disposal farms or modern sewage treatment plants.

If the water carriage system is not available, sewage is treated in specially constructed septic tanks. Sewage should be treated before it is disposed of to reduce the possibilities of pollution and contamination.

Kitchen and wash up area wastewater should not be allowed to stagnate, if sewers or drains are not available. This water could be filtered and drained into the subsoil through a simple soakpit.

Plumbing

Proper plumbing in a sanitary manner is essential to good food sanitation as it prevents sewage contamination of food in preparation and storage areas.

Problems commonly encountered with faulty plumbing are:

1. leak in sewer pipes
2. cross-connections with potable water pipes
3. back flow of raw sewage
4. blockages or choked pipes

Plumbing is necessary to safely carry sewage and liquid wastes from the catering establishment to the sewage disposal system and prevent any problems leading to contamination of food and water.

GASEOUS WASTES

Gaseous wastes include strong fumes originating from food being cooked and smoke from the kitchen, especially when wood or coal is used as cooking fuel. Gaseous wastes are a problem in the *tandoor* and barbeque sections of the Indian kitchen. These have been dealt with separately in Chapter 8 under ventilation and Chapter 14 under the topic of air pollution.

SUMMARY

Cleanliness and sanitation in catering establishments include adequate treatment and safe disposal of all wastes arising from the kitchen, dining areas, wash up area, sanitary conveniences, etc. without endangering human life or polluting the environment. Wastes are classified as solid, liquid and gaseous wastes. All wastes should be collected and disposed of separately without creating any nuisance or damaging plant and animal life.

Garbage and refuse should be removed from the premises promptly. The wastes should be stored in proper containers till they are disposed of. Kitchen waste can be fruitfully used in vermiculture technology or for feeding pigs and poultry. Biogas can be generated with the combined use of kitchen waste and sludge. The residue left after gas production is used as manure.

Liquid wastes are usually disposed off through underground sewers. Sewage includes wastewater from all sinks and drains as well as water closets. It needs adequate treatment before it is disposed of as it contains human pathogens.

Gaseous wastes include strong fumes and smoke from the kitchen, which escape into the atmosphere.

It is the responsibility of all employees to see that garbage is collected, stored and disposed of properly.

KEY TERMS

Bio degradable Wastes organic wastes which can be completely broken down and returned to nature by aerobic or anaerobic decomposition by microbes.

Biosanitiser Method of conversion of garbage and garden waste into rich organic manure by action of species of microbes including nitrogen fixing bacteria.

Composting Method of disposal of refuse and sludge in which waste is decomposed by microorganisms to form a humus like material called compost which is an excellent fertiliser and nitrogen and phosphorous from the animal and plant wastes are returned to the soil.

Garbage Also called swill, is the waste resulting from preparation, cooking and consumption of food which needs to be disposed off correctly.

Gaseous wastes From the kitchen include strong fumes food being cooked, and smoke and pollutants from fuel which need to be removed from the kitchen and ideally treated before releasing them into the air.

Incineration Excellent method of disposal for dry garbage, soiled cotton and outdated pesticides and converting it into harmless waste by burning in an incinerator.

Mechanical disposers Reduce the volume of garbage by either compacting dry bulky waste or crushing soft biodegradable waste.

Non-biodegradable Inorganic or synthetic wastes which accumulate in nature if they are not suitably disposed off as they cannot be broken down by microbes.

Refuse The term means any waste material both garbage as well as non-food waste from the kitchen and service areas like cans, bottles, polyethene bags, paper plates etc.

Sewage Liquid waste arising from kitchens, dishwashing, laundry, bathrooms, toilets and all other drains which is carried away by underground sewers and should be treated before disposal as it contains harmful human pathogens as well as detergents, pesticide etc.

Social waste Major waste in the form of garbage and refuse which needs to be sorted, collected, stored and disposed off efficiently, includes both biodegradable and non biodegradable wastes.

Vermiculture An excellent form of disposal of biodegradable wastes by earthworms who feed on garbage. Bacteria present in the gut of earthworms decompose organic matter and excrete it as vermicastings or manure which is an enriched biofertiliser and restores fertility to the soil.

REVIEW QUESTIONS

1. Fill in the blanks with suitable words.
   (a) Proper plumbing prevents __________ contamination of food in the catering industry.
   (b) The food waste disposer can finely grind and washdown almost all food waste except __________ and _________.
   (c) Solid wastes should be sorted into __________ and __________ and then stored separately.
   (d) Ideally, sewage should be disposed of in a public __________ system.
   (e) __________ wastes are often compacted before disposal.
   (f) Agricultural wastes can be used as __________ or __________ after appropriate treatment.
   (g) __________ wastes are the most important and dangerous source of human pathogens.
   (h) The energy from waste food can be utilised for producing more food by using it as __________ __________.
2. State whether True or False. If false, correct the statement.
   (a) Bins need not be cleaned each time they are emptied if they are lined with a plastic bag.
   (b) Pulpers and compacters are used to grind food waste and reduce it to ash.
   (c) If improperly disposed, garbage can pollute our water supply and environment.
   (d) When wood or coal is the cooking fuel, there are more gaseous wastes.
   (e) All types of wastes should be collected together and then disposed of.
   (f) Food waste disposers are the most modern and hygienic method of waste disposal.
   (g) The management should ensure that all wastes are properly disposed.
   (h) After sewage is treated, the concentration of solids and organic matter in it increases.
3. Select the most appropriate answer in the following.
   (a) Which of the following need not be disposed of immediately
      (i) emptycans
      (ii) animal carcass
      (iii) plate waste
      (iv) polythene bags
         I. (ii) and (iii) only
         II. (iv) and (i) only
         III. (iii) and (iv) only
         IV. (i) and (ii) only
   (b) Garbage from the kitchen should be
      (i) properly collected and stored
      (ii) sanitarily disposed
      (iii) stored overnight in the kitchen
      (iv) emptied once a week only
         I. (i) and (ii)
         II. (ii) and (iii)
         III. (iii) and (iv)
         IV. (i) and (iv)
   (c) Garbage bins should be placed
      (i) on a platform 10–20 cm (4–8 inches) above the ground
      (ii) in the yard on the ground directly
      (iii) mounted on a wall
      (iv) on a platform at least 36 cm (14 inches) above ground
   (d) Biogas is generated from
      (i) animal droppings and agricultural waste
      (ii) human excreta
      (iii) cans, broken glass and other litter
      (iv) polythene bags and cartons
         I. (i) and (ii)
         II. (ii) and (iii)

III. (iii) and (iv)
IV. (i) and (iv)

(e) If waste matter is improperly disposed it can
 (i) damage plant and animal life
 (ii) endanger human life
 (iii) pollute the environment
 (iv) all of the above

(f) Liquid wastes are harmful because they contain
 (i) human pathogens
 (ii) harmful chemicals
 (iii) high concentration of nutrients
 (iv) all of the above
 (v) none of the above

4. Match the method of waste disposal in Column *A* with a suitable characteristic form Column *B*

A	*B*
1. Dumping	(a) used for small volume of waste
2. Composting	(b) prevents soft, wet, garbage from decaying
3. Incineration	(c) reclaiming low lying land
4. Compactors	(d) combined disposal of refuse and sludge
5. Pulpers	(e) conserves humus and enriches the soil
6. Biogas	(f) most hygienic method except for wet garbage
7. Vermiculture	(g) produces methane and manure
8. Burial	(h) useful for dry bulky waste

5. Arrange the following in the order of swiftness of disposal by reducing waste to an innocuous mass
 (i) controlled dumping
 (ii) incineration
 (iii) vermiculture
 (iv) biogas
 (v) pulpers
 (vi) biosanitisers
6. Briefly outline the various ways in which garbage can be disposed off.
7. In which method of garbage disposal is the organic nitrogen from soil converted to inorganic nitrogen and returned to the air?
8. What will happen if untreated sewage is discharged into a lake?
9. Why should garbage bins be kept dry?
10. How should sewage be treated and where should it be disposed?
11. How and where should garbage be stored?
12. Which type of refuse will be produced from the service area?
13. Why is proper waste disposal necessary?
14. Give two examples for each type of waste arising from the food industry and suggest methods for its safe disposal.
15. What characteristics are desirable for a garbage bin?

14

- **Air pollution**
- **Indoor air**
- **Water pollution**
- **Pollution by pesticide residues**
- **Soil pollution**
- **Solid waste pollution**
- **E-waste or electronic waste**
- **Pollution by radiation**
- **Noise pollution**
- **Measures to check pollution**

Environmental Pollution

INTRODUCTION

Environmental pollution is a term that refers to the different ways by which people pollute their surroundings. It is one of the most serious problems facing the world today because the air, water, food and soil which is being polluted, is necessary for the survival of living things.

Rapid advances in science and technology have made a great many conveniences available to us. These conveniences produce a large amount of waste and scant attention is paid to the disposal of this waste. What is really necessary is to find ways and means to reduce the amount of pollution in our surroundings without giving up necessary conveniences.

Improved environmental sanitation is necessary to combat the majority of health problems in India which arise from contaminated drinking water and insanitary conditions. It has been recognised that improvement in sanitary conditions would work out cheaper than any other health measures to overcome water-borne diseases which account for 80 per cent of illnesses in India.

AIR POLLUTION

Air gets polluted due to respiration, combustion, dust, microorganisms, decomposing organic matter and fumes from food being cooked. Polluted air is the cause of various diseases of the respiratory tract. Long periods of heavy air pollution in cities has increased the illness and death rate significantly. Most materials get soiled and wear out faster in polluted air. Metals like silver and brass get tarnished quickly on long exposure to tainted air.

Some of the major causes of air pollution are

1. *Faulty ventilation:* air becomes warm and stuffy and may give rise to drowsiness, headache, nausea and vomiting, thereby reducing work efficiency drastically. Microorganisms from the respiratory tract get dispersed in droplets expelled during coughing and sneezing or talking loudly and can spread the infection further.
2. *Imperfect fuel combustion:* imperfect combustion of domestic fuel produces carbon monoxide along with carbon dioxide, fumes and smoke. A curtain of smog often hangs over big cities. It irritates the eyes, throat and chest. Smog is composed of smoke, fog and other substances like oxides of nitrogen. Burning wood, coal or oil produces very fine particles of carbon, silica and iron oxide called particulates. *Tandoors* and barbeques produce a large amount of particulates.
3. *Decomposing organic matter:* decomposing organic in sewers, drains and garbage bins matter putrefies and produces foul smelling poisonous gases like hydrogen sulphide (H_2S), ammonia (NH_3), marsh gas, etc. Microorganisms flourish and food spoils faster in such polluted air.
4. *Dust:* dust particles, either suspended in the air or settled on objects, contain pollen grains, spores, cotton fibres, particles of hair, scales of epithelium and bacteria. Internal dust is more harmful as it contains a larger number of microorganisms, especially the dust in public places. Dust causes allergies such as hay fever, rhinitis, etc.
5. *Insecticide and pesticide:* residues from aerosol sprays pollute the air.
6. *Chlorofluorocarbons* (CFCs): these are chemicals which are widely used as refrigerants and in insulation and packaging. They affect humankind by thinning the ozone layer which protects animals and plants from harmful ultraviolet rays.

INDOOR AIR

The increase in reports and evidence of symptoms of specific diseases seen in people working in airconditioned and mechanically ventilated buildings have made health professionals realise the fact that not only does the outdoor environment need to be preserved but the indoor environment is also a major cause of concern. The number of chemically hypersensitive people is on the rise.

Studies have proved that the level of contaminants in indoor air is several times higher than outdoor air and as people spend 85% to 90% of their time indoors, they suffer the consequences of ‘Sick Building Syndrome’. 'Sick Building Syndrome’ (SBS) is a term that describes the presence of acute non-specific symptoms in the majority of people working in buildings with an adverse environment.

Symptoms

Irritation of the eyes, inability to concentrate, blocked nose and throat, general malaise, headache, dizziness, lethargy, fatigue, nausea, irritation, wheezing, sinus congestion, dry skin and skin rash are some of the symptoms commonly observed in people working in rooms with poor Indoor Air Quality (IAQ). Most of the pollutants are airborne and symptoms are generally respiratory in nature.

Reasons for SBS SBS in buildings may be due to a variety of causes like

1. Inadequate fresh air.
2. Poor circulation of air.
3. Badly placed vents.
4. Increased occupancy and activities beyond the carrying capacity.
5. Poorly maintained airconditioning system.
6. Improperly located outdoor vents that bring in contaminated air from restrooms, exhausts of other buildings in the vicinity or from automobiles.

Pollutants Inside Buildings

The air inside a building will contain all pollutants present in outside air like carbon monoxide, sulphur, nitrogen dioxide, pollen grains, pesticides and chemical compounds along with pollutants generated indoors by the occupants and their activities. Hazardous contaminants include environmental tobacco smoke, volatile organic compounds (VOCs) emanating from solvents, varnishes, paints, pesticides, formaldehyde, asbsestos, etc. Biological contaminants multiply in rooms with a high humidity and are often exhaled by humans. Bacteria are dispersed in toilets in small droplets as an aerosol. Indoor allergens include pollen, mould, hair, dust mites, insect body parts and chemical additives causing lung and skin diseases. Odour and dust cause significant discomfort affecting productivity, work efficiency and absenteeism.

Control Measures

Table 14.1 **Some Common Pollutants, their effect on health and Control Measures**

Sl. No	*Pollutant*	*Source*	*Health effect*	*Control measures*
1.	Environmental Tobacco Smoke (ETS)	Cigarette-Smoke Smoke exhaled by smoker	Leading cause of lung cancer, headache eye irritation, wheezing cough. Asthma and bronchitis in children.	Ban cigarette smoking
2.	Particulates (carbon, silica, iron oxide)	Tandoor and Barbeque section	Respiratory infections and cancer, eye irritation	Use of ventilator hoods and exhaust fans purify air from kitchen

Contd...

Table 14.1 (Contd)

Sl. No	*Pollutant*	*Source*	*Health effect*	*Control measures*
3.	Carbon Monoxide (CO)	Environmental smoke-improper combustion	Fatigue, chest pain in heart patients, impaired vision, headaches, dizziness, nausea and respiratory irritation.	Emission tests use incinerators
4.	Bacteria, Fungus, Mold, Mildew	Wet or moist walls, dusty ceilings carpets and furniture, poorly Maintained Airconditioners	Allergic reactions, infectious illnesses influenza measles and chicken pox, eye nose throat irritation etc.	Control RH Good Housekeeping proper maintenance ventilation
5.	Formaldehyde	Pressed wood products made by using adhesives, ETS, drapes other textiles and glues.	Eye, nose and throat irritation, wheezing, coughing, skin rash and severe allergic reactions	use low formaldehyde emitting materials
6.	Volatile Organic Compounds (VOCs)	Paints, paints strippers and other solvents, wood preservatives, carpets, varnishes and cleaning and disinfecting agents.	Eye, nose and throat irritation, headaches, loss of co-ordination, nausea, damage to central nervous system.	Proper storage and use of paints. Good ventilation
7.	Asbestos	Fire proofing material, floors and tiles.	The long term effects are chest and abdominal cancer and lung infections. Asbestos induced lung cancer.	Eliminate use of asbestos.

Source: Adapted from Clean & Hygiene

Air pollution can be minimised by the following measures

1. adequate ventilation in all buildings
2. use smokeless fuels, solar energy and smokeless *chullahs* wherever possible
3. efficient maintenance of equipment and controlled air draughts for complete combustion
4. automobile emissions should be checked and vehicles certified accordingly
5. treat toxic substances before discharging them into the atmosphere
6. create conditions for self-purification of air by planting trees
7. use of unleaded petrol
8. in some areas of the United States, clean air ordinances restrict the nature of exhausts being discharged into air from retail and other establishments. Exhaust air from cooking areas, which is thick with strong food odours, smoke and grease, may have to be purified before it is discharged into the air
9. use of ventilation hoods, chimneys and exhaust fans in all kitchens

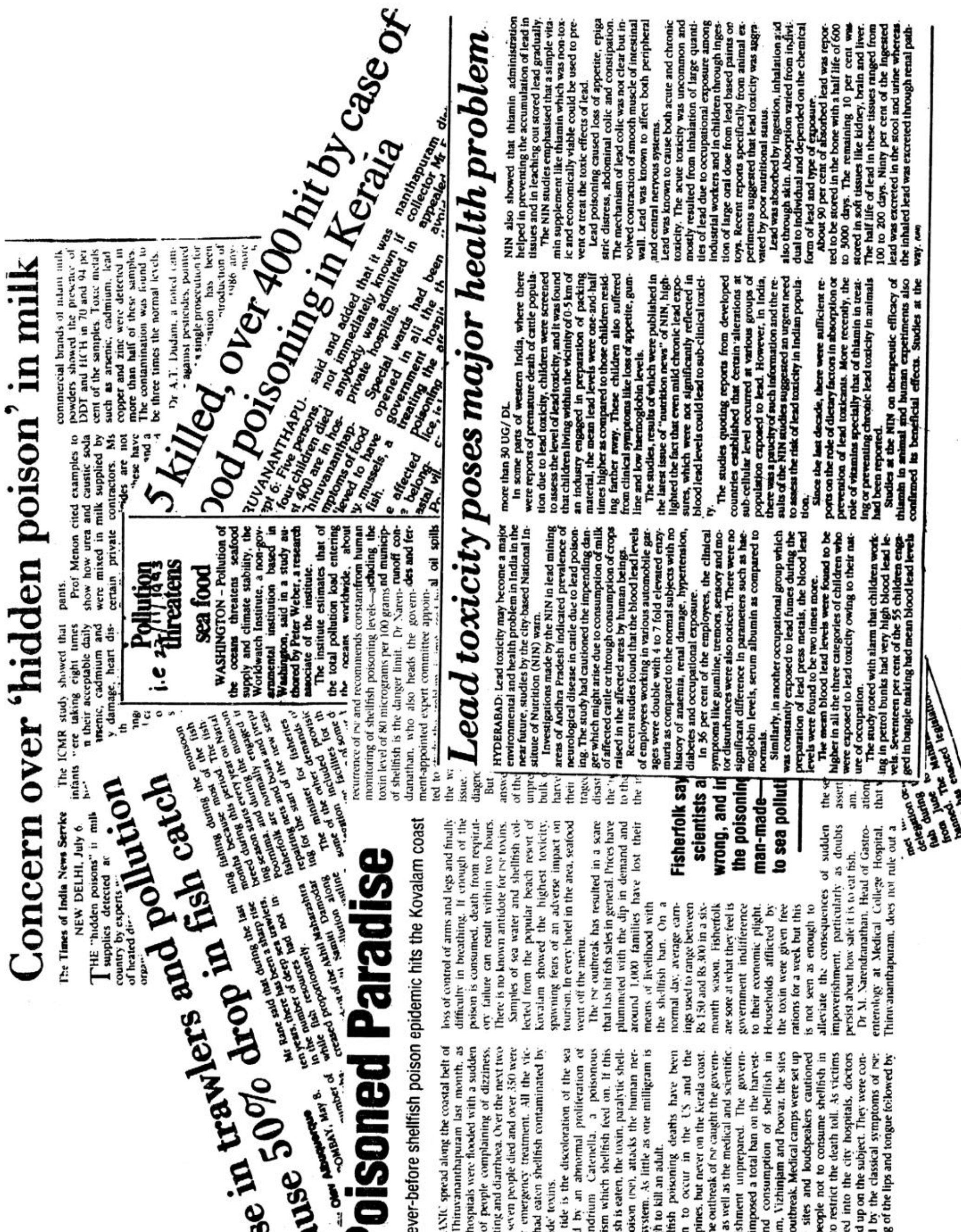


Fig. 14.1 *Newspaper reports on pollutants*

WATER POLLUTION

Water pollution reduces the amount of pure, clear, fresh water that is available for drinking and personal use and for such activities like fishing, swimming and water sports.

Like air, water pollution is also directly related to population growth, modernisation and insensitivity to the hazards of pollution. Day by day, larger volumes of wastes from industries and homes is dumped into water bodies. The water cycle, which was earlier maintained by the forces of nature, cannot deal with the new harmful products produced by industries which are non-biodegradable. In fact, these products are a threat to marine life and to humans (Fig. 14.2).

Humankind is directly affected if such water is used for drinking or personal use. If food from contaminated waters or food grown using such water is consumed, toxins and pathogens are transferred to humans.

Major Cause of Water Pollution

1. *Wastes from the food industry:* these wastes contain a variety of organic compounds which may be simple and easy to oxidise or complex and difficult to decompose. Concentrated organic food wastes use up oxygen in water and permit anaerobic microorganisms to flourish. These microorganisms putrefy and ferment the wastes, thereby making water unfit for use. See Chapter on sewage and contamination of water supply.
2. *Excessive use of fertilisers:* if excessive amounts of low cost chemical fertilisers are used, the surplus drains into ponds, lakes and rivers. These fertilisers stimulate the growth of algae, ultimately making water cloudy, malodorous and unfit for consumption.
3. *Sewage*: this is the most serious water pollutant as far as public health is concerned. Sewage comprises the wastewater collected from residential and industrial areas as well as the rain water which drains away.

   Wastewater from the kitchens, bathrooms, toilets and other drains is collected by underground sewers and disposed off into the sea or river with or without treatment. Wastes from the body contain a large number of microorganisms which may be harmless or pathogenic. If untreated sewage pollutes a source of drinking water, it can lead to epidemics of gastro-intestinal diseases.
4. *Detergents:* they are a boon to dishwashers and housekeeping staff but if improperly disposed, they can pollute the water supply. Detergent foams pile up as they are non-bio degradable and suds may be seen in drinking water.
5. *Chemical pollutants:* waste products from industries are discharged into a body of water causing harm to aquatic life and to the environment. These toxic substances find their way into the human body directly through drinking water or indirectly through food chains.
6. *Oil*: this is a common ocean pollutant. Oil forms a thick sticky layer over water because of which fish, birds, seals and walruses die. It ruins beaches and coastal water making them unfit for water sports.
7. *Dissolved gases:* dissolved carbon dioxide and hydrogen sulphide gas make water acidic and cause symptoms of diarrhoea.

8. *Solid refuse and kitchen waste:* decaying vegetable and animal matter is dumped into water. Biodegradable organic matter is broken down by microorganisms into harmless wastes, but non-biodegradable materials remain.
9. *Festive pollutant* - Tonnes of plastic, wood and idols made of plaster of paris are immersed into rivers after festivals.

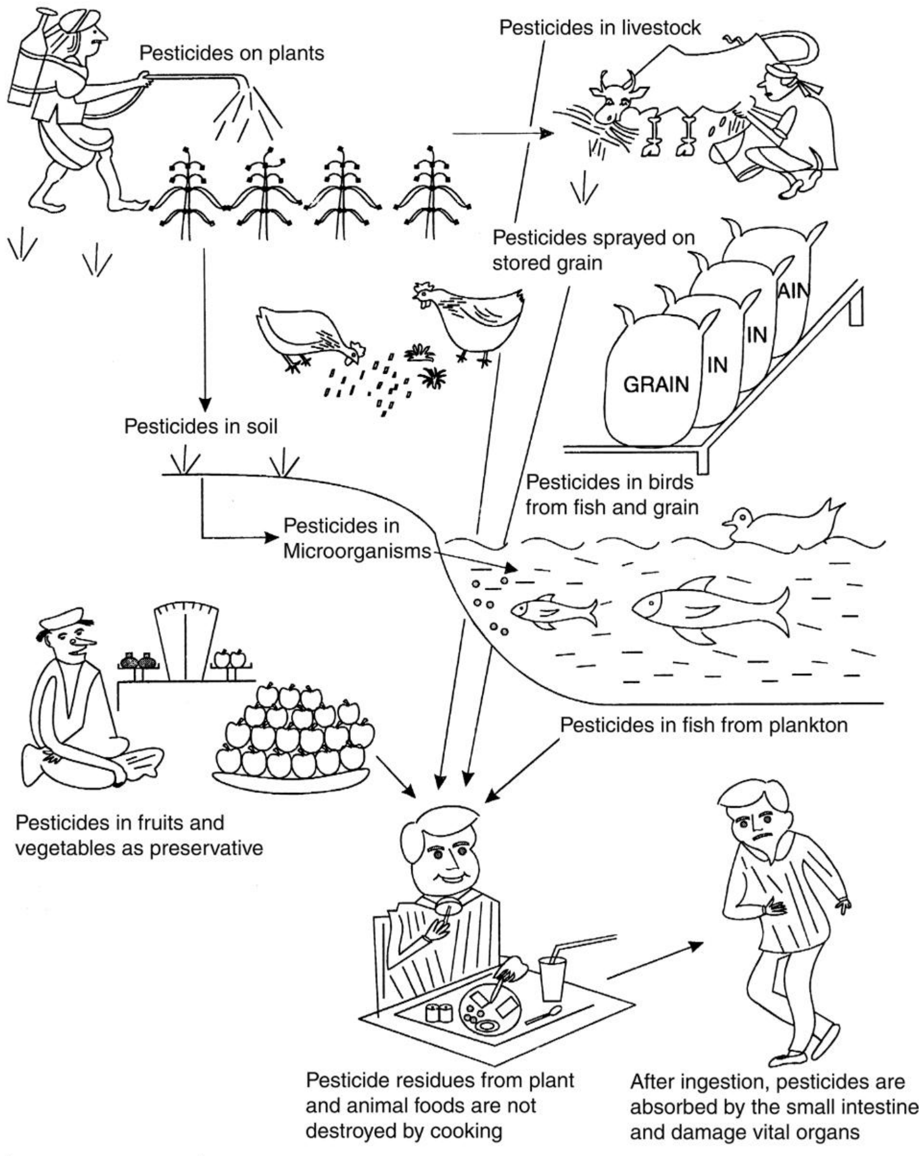


Fig. 14.2 *The toxic food chain*

Measures to Reduce Water Pollution

1. *Food industry wastes and industrial effluents*: should first be treated to reduce the level of oxidisable material and then should be greatly diluted before emptying it into a source of water.
2. *Wastewater management:* wastewater from kitchens and bathrooms should be drained through closed pipes or soakpits and should not be allowed to accumulate or contaminate a source of drinking water. Sewers should be well maintained and sewage should be adequately treated before it is disposed off.
3. *Use of newer technologies:* proper disposal of solid wastes through biogas plants, composting, vermiculture, etc. should be encouraged.
4. *Fertilisers:* wherever feasible use organic fertilisers. Avoid using excessive amounts of inorganic fertilisers.
5. *Substitute lead used in water pipes* with galvanised iron.
6. Popularise production and *use of biodegradable* or environment-friendly products.
7. *Wells* should be dug deep, in clean surroundings and kept covered. Water should be drawn by a handpump or a bucket attached to a nylon rope. The bucket should be kept separate for this purpose. Water from toilets, baths, utensil washing, etc. should not drain or seep into the well. Clean and disinfect well water regularly. For *tube-wells* use galvanised iron pipes fitted with a strainer and dig deep through the first impervious layer.
8. *Remove weeds and algae* from tanks and ponds periodically and add copper sulphate as a disinfectant. Fence tanks and ponds to keep cattle away from the water source.

POLLUTION BY PESTICIDE RESIDUES

Pesticides are chemicals used to control or eliminate pests like insects, rodents, bacteria, fungi and viruses. Many insects transmit serious diseases, others destroy food or cause heavy damage to buildings and interiors.

Pesticides have been largely responsible for increased yields and better quality of cereals, pulses, fruits and vegetables by keeping insects and other pests away. However Pesticides are present everywhere and in our food—milk, meat, fruits, vegetables, and even in bottled water and beverages.

More than 30 pesticides banned in several countries all over the world are still manufactured and used in India.

Some of the pesticides still manufactured and used in India are:-

- Malathion
- Chlorpyrifos
- Lindane
- Carbaryl
- Alachlor
- Dicofol
- Endosulfan
- Methyl parathion
- Monocrotophos
- Paraquat dichloride
- Phorate

- Sodium cyanide
- Zinc phosphide

Major Cause of Pesticide Pollution

Pesticides sprayed on fields and farms may remain on plants and grains, can get mixed with soil, contaminate grass and fodder and are leached into nearby water. They find their way into the human body through the food chain.

Some pesticides have a persistent or long-lasting effect and remain in the environment even after the pest has been destroyed. The effective deposit leaves a residue after metabolic degradation, weathering or because of other reactions.

Pesticide residues are classified into two categories: non-systemic and systemic.

Non-systemic residues remain on the surface of foods and are removed when food is washed, peeled or dehusked. Various methods of processing like milling, cooking, canning and refining of oil, further reduces these residues.

Systemic pesticide residues and their toxic metabolites reach humans through food and water.

The pesticide residue builds up in the body of animals through the food chain. Pesticide residues have been found in fish, livestock, milk and plants. An interesting example is Endosulfan is an organochlorine insecticide that acts as a contact poison and is used as an insecticide on crops such as cereals, oilseeds, fruit, coffee, potato and vegetables. It is highly toxic and belongs to the group of persistent organic pollutants(POP's).

It is banned in 56 countries because of its high toxicity and environmental contamination. It is known to be an endocrine disruptor and is linked to breast cancer, birth defects and Parkinsons disease.

Some pests, like mosquitoes and rats, have developed increasing resistance to usual pesticides. The integrated pest control system is a recently developed method to control pests.

Since most single pest control methods have not been successful, this method combines the use of chemical pesticides with other effective techniques for example biological control. Its main aim is to use economical and environment friendly techniques to control pests. At present it is being used successfully to control crop pests.

Harmful effects of pesticides are often due to their abuse or ignorance about their use. In order to reduce the harmful effects of pesticide residues, the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO) have formulated safe limits for all pesticides. The government of India has banned the use of a number of pesticides. The use of DDT in agriculture and BHC (benzene hexachloride) on vegetables, fruits, oilseed crops and in preservation of grains has already been banned. The pesticides classified as highly hazardous which are banned worldwide, need to be banned in India as well.

Table 14.2 **Pesticide-residue in some fruits and vegetables**

SI. No	*Fruit/Vegetable*	*Pesticides detected in % of samples*	*Maximum no. of pesticides found on a single sample*
1.	Apples	93.6%	9
2.	Strawberries	81.5%	11

Contd...

Table 14.2 (Contd)

Sl. No	Fruit/Vegetable	Pesticides detected in % of samples	Maximum no. of pesticides found on a single sample
3.	Lettuce	68.2%	9
4.	Grapes	84.2%	8
5.	Spinach	70.0%	6
6.	Potatoes	81.0%	4
7.	Raspberries	47.9%	6
8.	Oranges	85.1%	4
9.	Cauliflower	84.6%	5
10.	Mushrooms	60.2%	5
11.	Tomatoes	46.9%	5
12.	Papaya	23.5%	4
13.	Cabbage	17.9%	3
14.	Bananas	41.7%	2
15.	Peas, frozen	22.9%	2

Source: Adapted from Clean & Hygiene

Measures to Control Pesticide Pollution

1. Pesticides should be used with utmost care and only in the necessary amounts.
2. They should be stored in properly labelled containers away from food production and service areas.
3. Harmful insecticides should be banned and less harmful ones should be introduced.
4. Biological control of pests by using natural enemies of pests, should be encouraged.
5. Pesticides should be used within safe limits laid down by UN agencies like FAO and WHO.

SOIL POLLUTION

Soil is an important natural resource. Human beings depend on it directly or indirectly for their food.

In nature, plant and animal wastes are broken down by bacteria and fungi, which are found in the soil, into simple inorganic forms which can be utilised by plants. By this process, nutrients are returned to the soil.

Soil pollution results from

1. insanitary habits
2. excessive use of fertilisers and pesticides

3. incorrect disposal of solid and liquid wastes like chemicals and heavy metals
4. radioactive fallout

All these factors damage the thin layer of fertile soil which covers the land surface on which food is grown.

Soil pollution can be prevented by

1. practising vermiculture
2. use of biogas plants
3. composting biodegradable waste
4. using required amounts of fertilisers and pesticides only
5. sanitary disposal of refuse

Prevention of soil pollution has been explained in Chapter 15 on Disposal of Waste and under pesticide residue pollution in this chapter.

SOLID WASTE POLLUTION

Solid wastes are the most visible pollutants which litter roadsides and surroundings and are seen floating in rivers and streams. Unsightly dumps are seen in and around heavily populated urban areas.

Solid wastes include rubble from demolished buildings, garbage and litter like used cans, broken bottles, polythene bags, packaging material, metal scraps, tyres and tubes, rags, rusty equipment, broken furniture, old automobiles, etc. For disposal of such wastes and health hazards refer to Chapter 15 on Disposal of Waste.

Solid Waste should be segregated into

1. Biodegradable
2. Non-biodegradable
   (a) Recyclable
   (b) Disposable

Discarded plastics have been successfully converted into leather look-alike bags.

Solid wastes should ideally be sorted at the source, collected in separate bags and sent for recycling or composting. This will help in saving valuable resources. In India, ragpickers collect recyclable waste from garbage dumps for their livelihood.

Disposal of solid waste can be a revenue earner and proper disposal will ensure that the water supply, soil and atmosphere is not polluted from the methane fumes that emanate from the mounds of rotting garbage.

E-WASTE OR ELECTRONIC WASTE

E-waste has become a serious cause of concern that needs to be tackled.

Electronic waste comprises unused and defunct computers, keyboards, television sets, DVD's and CD's.

These electronic systems contain toxic metals like lead, mercury, arsenic, etc., which are harmful to health and can contaminate the environment if they are not disposed or recycled correctly.

Unauthorised scrap dealers often extract valuable and re-usable metals from electronic items by melting or burning the waste and discard the rest into the environment.

Discarded e-waste is either disposed off in a landfill site or it may be recycled. Products that cannot be re-used or refurbished are either dismantled or shredded. To aid the disposal of e-waste, recycling plants are being set up in India. Environmental conscious companies have offered to collect this e-waste and recycle it and ensure that the toxic elements in the e-waste do not pollute the environment. This will facilitate recovery of valuable metals, recycling plastic and glass thereby reducing degradation of the environment.

POLLUTION BY RADIATION

Radioactive Pollution or Nuclear Radiation is a potential health hazard of modern times. Radioactive substances emit extremely dangerous invisible radiation which can bring about biological and chemical changes in body cells.

Nuclear radiation comes from testing of nuclear weapons and from nuclear power plants.

Electromagnetic radiation is produced by lasers, microwave ovens, computers, television sets and X-ray machines. All these produce small amounts of electromagnetic radiation. Their effect on human health in small doses is being studied by scientists.

NOISE POLLUTION

With rapid urbanisation and technological developments, people living in or near cities are often exposed to loud noises. The loud screeching, grating or vibrating noise is created by various machines and means of transport. Blaring music, announcements, television broadcasts and fire crackers can disturb work and sleep.

Machines and appliances like air conditioners, vacuum cleaners, etc. also produce a lot of noise.

Constant noise like the dripping of a tap, even if not very loud, is annoying and one can sense the relief when it stops. Continuous moderately loud sound can also cause headache, fatigue, nausea and tension. Noise pollution can be extremely troublesome and can damage one's hearing or even lead to deafness.

Noise can also cause psychological disorders due to a constant strain on the nervous system. It may also be responsible for the development of ulcers and high blood pressure.

Prevention of Noise Pollution

To reduce these unpleasant, distracting and irritating sounds, acoustic engineers have developed many devices, some of which have been listed below:

1. use of sound absorbing material like acoustical tiles and carpets
2. insulation against sound in buildings by constructing thick heavy walls and well sealed doors
3. keep machines and appliances in good repair; regular maintenance and servicing of all machines
4. ban loud blaring noise in residential areas
5. proper planning of cities with respect to railways, aerodromes, industrial areas and residential areas.

MEASURES TO CHECK POLLUTION

1. Efforts should be made towards minimising production of harmful wastes.
2. Appropriate waste management practices should be followed and newer and safer methods of disposing waste should be developed, such as
   (a) convert polluting wastes into harmless products which are environmentally acceptable
   (b) recycle the wastes in the same process
   (c) use the waste as the resource or raw material for another process.
3. The raw material used for combustion should be changed. For example, triethyl lead has been replaced in gasoline as lead was the major pollutant in automobile exhausts.
4. Equipment should be designed to trap particulates and prevent their release into the atmosphere, for example, through use of filters in equipment.
5. Effluent from factories should be treated before it is released.
6. Control on the use of pesticides, fertilisers and radioactive materials should be practised.
7. While planning cities and industrial areas, the environment should be preserved, trees should be planted, parks and gardens should be included in the plan and congestion should be avoided.
8. Awareness should be created among citizens about environment-related health problems arising because of rapid and unplanned development and population growth. Collective action on their part can greatly help in prevention and control of pollution.
9. The Garbage (control) Amendment Bill 2008. Under this bill a penality of Rs 500/- to Rs 5000/- is imposed and imprisonment up to 15 days for offenders.
10. Ban on plastic bags less than 20 × 30 cm in size and 40 microns in thickness.

SUMMARY

Environmental sanitation deals with measures which one can follow to preserve and protect the environment and ultimately the very existence of humankind on earth.

Pollution is the accumulation of some unused material in an environment where it is not naturally found. When such substances or wastes accumulate in large quantities, they become harmful pollutants and change the environment by altering its chemical and biological make up. Pollution is a result of rapid urbanisation and technological development. The problem is more in highly developed countries, where industries belch out thick toxic fumes and the effluent from factories destroys aquatic life. Poorly ventilated kitchens and other public areas affects work efficiency and health. Exhausts from vehicles pollute the air. Water is polluted by wastes from the food industry, sewage, detergents and other chemicals which are discharged into it. Pesticide residues pollute the water source and find their way into the human body and may have a persistent or long lasting effect as the residue builds up in the body. Soil gets polluted by insanitary habits, incorrect disposal of garbage and faulty agricultural practices. In turn, the pollutants reach the food we consume. Different types of radiation can be harmful to man through the foods he eats. Noise pollution from poorly maintained equipment, vehicles, industries and music can be very annoying and can affect one's health.

Environmental sanitation can be brought about by creating awareness among all citizens and taking some collective action.

KEY TERMS

E-waste Electronic waste arising from defunct computers, television sets, CD's, DVD's etc which contain toxic metals and can contaminate the environment.

Indoor Air Quality (IAQ) The quality of air in closed spaces, specially airconditioned and mechanically ventilated buildings, and its effect on health and work efficiency.

Pollution Accumulation of some unused material in an environment where it is not naturally found.

Sick Building Syndrome (SBS) It is a term that describes the presence of acute non-specific symptoms in the majority of people working in a building with an adverse environment.

Volatile Organic Compounds (VOC) A group of hazardous chemicals which emanate from solvents, varnishes, paints, LPG stoves, pesticides, air freshners etc.

REVIEW QUESTIONS

1. Select the most appropriate answers in the following.
   (a) Air pollution in industrial areas could be reduced by:
      (i) shutting down factories
      (ii) having less fuel burning devices
      (iii) growing more trees and providing 'green belts' between factories and residential areas
      (iv) have people use masks to filter the air
   (b) Wastewater from household kitchens and bathrooms should be
      (i) drained through closed pipes or soak pits before it is let off into a water source.
      (ii) allowed to drain into a nearby river or lake as it is not a harmful pollutant.
      (iii) allowed to collect in open spaces to be used by cattle later.
      (iv) drained into vegetable gardens to irrigate and fertilise plants.
   (c) Safe limits of pesticide residue as laid down by the FAO/WHO help
      (i) in applying less harmful pesticides to crops and stored grains
      (ii) in reducing toxicity resulting from pesticide residue build-up in the human body
      (iii) to ascertain the type of pesticides which are safe for human consumption
      (iv) in increasing crop yields
   (d) Excessive use of fertilisers and pesticides pollutes the soil by:
      (i) destroying nutrients in the soil
      (ii) inhibiting growth of plants
      (iii) destroying natural scavengers in the soil like bacteria and fungi
      (iv) destroying pests
   (e) Solid wastes include
      (i) Radioactive elements and pesticides
      (ii) Soap suds, dyes and oil
      (iii) Pollen, dust and particulates
      (iv) Polythene bags, used cans, rags
   (f) Noise produced by machines and appliances could be scaled down by
      (i) reducing the number of machines
      (ii) keeping them far apart
      (iii) resorting to manual labour
      (iv) regular maintenance and servicing

(g) Select the group most affected by oil as a pollutant
  (i) fish, marine birds, seals and walruses
  (ii) earthworms, butterflies and moths
  (iii) cockroaches, rats, mice and flies
  (iv) sparrows, crows, pigeons and bulbuls

2. State whether True or False.
  (a) We cannot reduce environmental pollution without giving up our necessary conveniences
  (b) Indoor pollutants may prove more harmful than outdoor pollutants as they are concentrated in a small area
  (c) Increase in CO_2 percentage in work areas improves work efficiency of employees
  (d) Good ventilation helps reduce the risk of contacting respiratory illnesses
  (e) Using recycled paper as packaging material is preferred to non-biodegradable thermocol or polythene
  (f) Pesticide residue build-up is reduced in the body of animals through the food chain
  (g) Judicious crop rotation helps control some insect pests and avoids unnecessary use of pesticides
  (h) Creating general awareness among the public, towards preserving the environment is the most significant step towards pollution control

3. Fill in the blanks with appropriate answers.
  (a) Majority of health problems in India occur due to contamination of __________, __________ and __________.
  (b) Improved environmental sanitation is necessary for a better __________ of life for humankind.
  (c) Ultraviolet light of sunlight has a __________ effect on air around us.
  (d) Silver and brass get __________ on exposure to tainted air.
  (e) __________ present in green leaves of plants help in self purification of air.
  (f) Decomposing organic matter produces foul smelling gases such as __________ and _______.
  (g) __________ and __________ in air are known to cause allergies in humans.
  (h) CFCs used in refrigerants, insulation and packaging material result in thinning of the __________ which acts as a protective shield against harmful __________, __________.
  (i) Use of __________ petrol reduces the carcinogenic risk to humans.
  (j) __________ is a cheap and pollutant free source of energy.
  (k) Normal weather conditions help in __________ the concentration of pollutants.
  (l) Smoke from *tandoors* and barbeques release a large amount of __________ into air.
  (m) Ventilation in kitchens can be improved by using __________, __________ and __________.
  (n) Gases such as __________ and __________ combine with moisture in air to give acid rain.
  (o) Water pollution reduces the amount of water available at resorts for activities such as __________, __________ and __________.
  (p) Detergents pollute water as the foaming agents are __________.
  (q) Industrial effluents should be treated to reduce the level of __________ and greatly __________ before emptying into a water-source.
  (r) Lead poisoning from drinking water can be minimised by using __________ in water pipes.

(s) __________ is the most visible pollutant of heavily populated urban areas.
(t) Exposure to noise pollution over a prolonged period of time could lead to loss of __________ in people.

4. What is environmental pollution?
5. Give six ways by which air could get polluted.
6. Give two harmful effects of polluted air on human health and the environment.
7. What products result from imperfect combustion, how do they affect people?
8. In which two ways can exhaust from automobiles be treated to minimise air pollution?
9. How does excessive use of fertilisers pollute water and make it unfit for use?
10. In what way does oil as a pollutant harmfully affect the environment?
11. How does toxicity due to lead present in potable water occur?
12. How can pollution of water in ponds and tanks be minimised?
13. Name three ways by which pesticides pollute the environment?
14. Name the two categories of pesticide residues.
15. Enumerate methods of preventing soil pollution.
16. Which types of radiation are known to be harmful to man?
17. Enumerate five different areas in which people could most likely be affected by noise pollution.
18. Name three safe methods of disposing off wastes.
19. List three ways by which soil pollution occurs.
20. Explain the following terms:
    (a) e-waste
    (b) VOC's
    (c) SBS

Part IV

PERSONAL HYGIENE AND SAFETY

15

- **Necessity for personal hygiene**
- **Health of staff**
- **Personal appearance**
- **Sanitary practices**
- **Habits**
- **Protective clothing**
- **Importance of rest, recreation and exercise**

Personal Hygiene

INTRODUCTION

Microorganisms live in and on the human body and those that cause food-borne illnesses are present on the skin, in the nose and throat or in the gastro-intestinal tract. A chain of events links the human carrier of food poisoning bacteria to the food, either directly or indirectly. Once transmitted, the organisms may multiply in the food before it reaches the victim.

The strongest link in this chain of infection is humans. People are the greatest threat to the safety of food. This is because people are involved in food preparation at each and every stage it passes through. They carry microorganisms on their body even if they are not carriers or diseased.

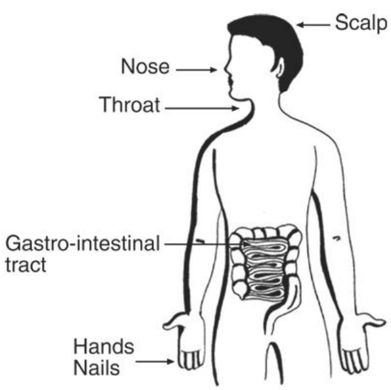


Fig. 15.1 *Food handlers harbour microorganisms in and on their body*

Only careful personal hygiene practices can prevent contamination of food and a conscious effort should be made by all food handlers to break this chain of infection. Good personal hygiene and good food service sanitation go hand in hand.

NECESSITY FOR PERSONAL HYGIENE

Personal hygiene is necessary for everybody but more so for food handlers because the health and well-being of hundreds of people is in their hands. A careless food handler could be responsible for the spread of an epidemic. It is the duty of every caterer to ensure that personal hygiene is a habit for all food handlers. The caterer is legally responsible for the wholesomeness of food supplied. It is also the moral obligation of every caterer to ensure that food is prepared and served hygienically. Sanitation codes call for a high degree of personal cleanliness for all employees in food establishments. An employee suffering from a disease that can be communicated by food or one who is a carrier of food-borne disease, is not permitted to work till he is medically certified.

Workers can spread infection knowingly by working when they are ill and infect other workers and consumers directly or indirectly. Sometimes, healthy workers spread disease by cross-contamination. They carry microorganisms from an infected area to one that previously had no harmful microorganisms.

In some instances, the infected person does not show any visible signs or symptoms of the disease. Such persons are called carriers and they unknowingly spread disease producing organisms which they carry in their bodies. They are the most dangerous of all food handlers as it is very difficult to trace the source of infection in such cases.

Hence, it can be realised that food poisoning does not just happen, it is always caused and the cause is carelessness on the part of the human being. It is estimated that 50 per cent of all food handlers carry microorganisms that can be transmitted to food. For these reasons, personal hygiene is very necessary and should be practised by every food handler.

HEALTH OF STAFF

A sick worker is not only a source of infection, but, being unwell, is likely to take less care in handling food.

All staff employed in food preparation and service areas should be in a state of good health. Working in a catering establishment means working long hours. The work may involve heavy physical exertion and mental tension and meal timings may be irregular. Workers may have to lift heavy loads, work in hot steamy kitchens and constantly be on their feet during working hours. They need to be active and alert. For this, both the body and the mind must be in the best possible health.

Good health is not only the absence of disease. It does not depend on the person's height and weight but means that both the body and mind are in excellent condition, free from illness or tension. It also means that a person is physically fit and mentally alert, capable of taking on spot decisions and handling crisis situations. He or she should be able to carry out routine work without any signs of undue fatigue and still have ample reserve energy for recreation or to meet an emergency if required.

To achieve all this it is necessary for the employer to ensure good health and safe working conditions for all employees by observing the following:

1. It is compulsory to have a detailed medical checkup at the time of recruitment. Recent history of any illness should be known before employing a worker. All food service workers should be free from any infection that is likely to be transmitted.
2. Medical check–ups every six months and a check–up following a severe illness, especially one related to the gastro-intestinal tract, should be done. The cost for this should be borne by the employer.
3. Periodic deworming (six monthly) and necessary inoculation (typhoid, tetanus, etc.) should be ensured.
4. All illnesses should be reported to the management and ill workers should be kept away from food during that period.
5. Personal cleanliness of employees in terms of general appearance, uniforms, hands and fingernails, should be checked discreetly.
6. Sanitary accommodation, i.e. water closets (W.C.'s) and urinals for males and WCs for females with sanitary bins should be provided. Restrooms and lockers used by employees should be inspected for cleanliness.
7. A nutritious and wholesome meal should be provided while on duty in a separate room designed for this purpose.
8. The work area should be planned in such a way that accidents like falls, cuts and burns are prevented from occurring while at work. The workers should also be trained in proper methods of work.
9. Work hours should be 48 hours a week. This may be in shifts.
10. A weekly off is compulsory.

The employer should realise the importance of good health and help the employee in maintaining it. Good health and the right attitude towards work increases work efficiency and productivity and this, in turn, increases the profits of the establishment.

PERSONAL APPEARANCE

A good personal appearance helps both the employee and the organisation. It increases one's self confidence. It helps in promoting business by improving performance at work. It reflects on the standards set by the organisation and customers know what to expect.

It inspires customer confidence, makes them feel important and helps in attracting more customers. Good health and good personal appearance can be achieved by maintaining personal cleanliness both at home and at work.

SANITARY PRACTICES

Bathing

Workers must bathe daily as body odour is offensive and skin is the main breeding ground for bacteria. Use of good soap is important to wash away sweat and dirt, to emulsify secretions of the sebacious glands and to make cleaning of skin easy. A good deodorant should be used after a bath and undergarments should be changed everyday.

Hair

Hair can be a breeding ground for bacteria found on the skin. Unclean hair causes dandruff and lice, and makes the scalp itch.

Running hands through hair or scratching the scalp is a common habit because of which *Staphylococci* present on the scalp may spread and hair may fall into food. The presence of hair in food is obnoxious and can be avoided if food handlers wear caps, scarves or use nets. These would discourage the employees from touching their scalp and contaminating food.

Fig. 15.2 *Do not touch or scratch your head while cooking*

Fig. 15.3 *A head cover prevents hair failing into food*

A head covering helps to keep hair out of food, prevents contamination by *Staphylococci*, keeps hair free from kitchen grease and prevents long hair from getting entangled in machinery.

Hair should be neatly tied if long. Hair length for men should be up to mid-ears. Hair should be shampooed regularly. Moustaches and beards should be clean and trimmed. Men without moustaches or beards should be clean shaven. Kitchen staff are not permitted to grow beards.

Eyes

Eyes must be kept clean and washed frequently. Rubbing of eyes should be avoided. An employee suffering from sore eyes should not be allowed to work.

Teeth and Mouth

Teeth should be brushed regularly and thoroughly cleaned with a moderately hard brush. This should be done twice a day, i.e., first thing in the morning and last thing before retiring. Food particles get lodged in the teeth and cause decay. Deposition of tartar requires attention or teeth may loosen at the root. Toothbrushes must be kept clean and should be changed frequently. The tongue tends to get coated and can be cleaned with a tongue cleaner. The mouth should be rinsed well and gargling is a must after every meal. These habits ensure good dental health, prevent painful cavities and bad breath.

Hands

Our hands are possibly the most unsafe serving equipment in the chain of infection in the entire food service operation. Bacteria flourish on the skin because of the ideal temperature conditions. Skin secretions provide food for growth and microbes get lodged in pores, crevices and possibly cracks on the skin. The presence of *Staphylococcis* on the skin is dangerous for the food industry.

In addition to the normal flora on the skin, inadequate hand washing could cause accumulation of microorganisms usually found in the bowels or those which could have been picked up from raw contaminated foods.

Because our hands are in direct contact with food all the time, cross-contamination can occur and bacteria can be transferred to high risk foods. To prevent this hands should be washed

(a) before beginning work and after a break
(b) before handling foods
(c) after eating or smoking a cigarette
(d) after using the toilet
(e) after touching infected or unsanitary areas of the body or combing hair
(f) after using a handkerchief, sneezing or coughing into the hands
(g) after handling raw foods, especially meat, fish and poultry
(h) after scullery or any cleaning operation
(i) after handling waste food or refuse
(j) whenever they are dirty
(k) every hour while working in the kitchen

Hands should be washed with plenty of soap and water and preferably rinsed in running water. If soap tablets are used, they should be kept dry. Liquid soap is more hygienic and economical to use. Washing hands with antiseptic soap and water reduces the load of coliform organisms and *Staphylococci* from the skin. But some *Staphylococci* still remain and this is the reason why foods which favour growth and which may not be heated before service, should not be touched by the fingers.

Hand washing should be done properly or it will not be effective.

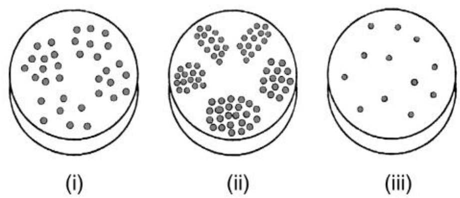


Fig. 15.4 *Bacterial colonies from fingers from*
(i) Unwashed hands
(ii) After handling raw fish
(iii) Washed hands

Fig. 15.5 *A hot air dryer, paper towels or a roller towel are hygienic ways of drying hands*

Hands must be dried thoroughly by using a roller towel, a hot air dryer or disposable paper towels. Frequent hand washing with soap and hot water can make the skin crack causing roughness. This can be prevented by wearing gloves or using a cream to keep them soft. Gloves are helpful as long as they are unbroken and cleaned well. The use of gloves is recommended while working with foods like sandwiches, cold cuts, pastries and salads. Plastic gloves must be changed frequently.

Cuts, burns and raw surfaces can harbour staphylococci. These should be covered with a waterproof dressing. If the wound is infected, inflamed or pus is formed, the person should not be allowed to handle food. Even the smallest cut can harbour a large number of bacteria.

Food should be touched with bare hands only if absolutely necessary. Fingers must not be dipped into food to taste it. The use of tongs or spoons for handling or tasting food should be encouraged.

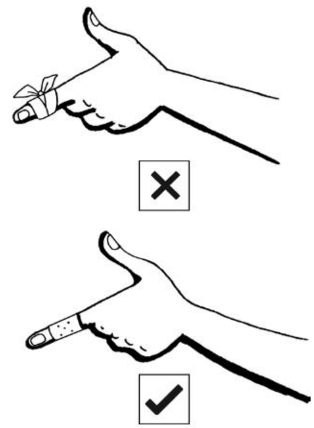


Fig. 15.6 *All injuries should be covered with a waterproof dressing*

Fingernails

Fingernails are a frequent source of contamination or cross-contamination. They should be trimmed and kept clean. Long nails with ragged edges tend to harbour more germs. Nail polish should be avoided in production areas as it may mask accumulated dirt or it could chip and enter the food (some nail polishes are toxic). It has been observed that if nails are varnished, food handlers do not like using nail brushes or trimming their nails. Hence use of nail polishes should be discouraged.

Jewellery

Any jewellery which comes into contact with food should not be worn. Finger rings can accumulate dirt, like dough accumulating in a ring while kneading, which could later enter the food. There is also a danger of stones or small parts of rings, earrings and necklaces falling into food. Bangles and bracelets get heated soon and come in the way of work. Wrist watches should not be worn in the kitchen. They can fall off, wrist watch faces can break and glass can accidently get into food. Also, the skin underneath remains moist and may harbour bacteria.

Feet and Footwear

As most of the jobs in catering establishments have to be performed standing, the feet of employees are subjected to extra stress and strain. So extra attention should be given to the feet. Feet should be washed and kept clean, especially between the toes. Socks should always be worn with shoes to keep away dirt and absorb perspiration. They should be washed daily. Shoes should be sturdy, clean, well polished and form a part of the uniform. They should be comfortable and well fitting with a low heel. Shoes are necessary for protection of the feet against falling objects and spills.

HABITS

Good habits play an important role in maintaining good health. Once formed, they are difficult to break. Good habits grow by practice. Since man is a slave of his habits, care should be taken to form good habits and avoid bad ones, particularly the common ones listed below.

1. Smoking while preparing food can lead to contamination of the food and hence, is prohibited. Smokers may touch their lips or saliva could get transferred onto their fingers and could contaminate food. Smokers are also prone to cough which could contaminate food by droplet infection.
2. Unguarded coughs and sneezes can disperse a number of bacteria in droplets of moisture from the nose, mouth and throat. This can contaminate food directly or indirectly.
3. Nose picking or fingering the nose may leave *Staphylococci* or other harmful bacteria on the fingers and should be avoided.
4. Avoid handling or shaking a dirty handkerchief near food. Paper or disposable handkerchiefs are a more hygienic substitute for cloth ones.

Fig. 15.7 *Do not touch your nose*

Fig. 15.8 *Do not sneeze or cough onto food*

Fig. 15.9 *Do not touch your nose while handling food*

Fig. 15.10 *Use a disposable tissue to blow your nose and wash hands thereafter*

5. Avoid using a dish cloth to wipe perspiration or wipe hands after using the water closet (W.C.).
6. Avoid washing hands in sinks used for food preparation.
7. Avoid picking up bread, bread rolls, butter pats or icecubes with bare hands. Use disposable gloves and tongs.
8. Do not touch food contact surfaces of crockery and cutlery.
9. Tasting food with fingers or with the same spoon repeatedly should be avoided.
10. Chewing gum or taking snuff should not be allowed in food preparation and service areas.
11. Leaving food uncovered for a long time should be avoided.
12. Blowing on paper or plastic bags to open them and on milk to keep cream from being poured, should be avoided.

Fig. 15.11 *Blowing on milk to remove cream is a wrong practice*

PROTECTIVE CLOTHING

All employees working in food establishments must wear a clean and appropriate uniform while on duty. The uniform should be such that (a) it protects the worker from external heat, grease and vapours from the work environment, (b) saves wear and tear of clothes of the employee, (c) protects the food from any bacteria present on the workers clothes. For this, it should be large enough to ensure that food will not come into contact with any clothes worn underneath.

The choice of uniform will vary for different areas of work. It should be so designed that it helps the worker in his work and increases his efficiency. It should be light, comfortable, durable and should be made from absorbent material. It should be easy to wash and must be laundered and changed daily. White or light colours are selected as stains show up readily on them and they need to be changed frequently.

Kitchen Uniforms

The chef's uniform is white in colour, made of heavy duty cotton and includes

1. a double breasted chef coat with full sleeves
2. a large white apron tied around the waist
3. a scarf around the neck
4. a chef cap
5. black and white checked trousers
6. shoes and socks

The double breasted chef coat with long sleeves and the apron protects the body and the arms from hot splashes. The chef cap is perforated on top to allow circulation of air to the head. The cap prevents loose hair and dandruff from falling on food and absorbs perspiration from the forehead.

Dishwashers and butchers need waterproof aprons made of rubber sheeting or canvas. Cleaners are not given white uniforms as they are difficult to maintain. Blue or *khaki* are suitable colours for them.

Service Uniforms

In the food service area, the colour of the uniform should blend with the colour scheme of the restaurant. Pastel shades suit most Indian complexions and the decor of the place better than bright gaudy colours. Waiters should wear washable jackets and waitresses should wear light coloured wash and wear dresses or both could wear the traditional black and white service uniform with a tie or bow. Synthetic blends of fabric are easier to maintain than cotton and are permitted in the service area.

Uniforms must be worn properly and should be in a good state of repair. They must be provided by the employers, who also make arrangements for their storage and washing. The employer should provide a suitable cloakroom with a full length mirror. Uniforms should only be worn while on duty. Each employee should have a locker to keep his or her uniform, personal clothes and belongings. The locker should have hangers for hanging clothes and uniforms. Clothes should be changed in the cloakroom only. There should be a sufficient number of uniforms always available. Only then can the employer question the employee about not being in proper uniform. Uniform pockets should not be stuffed with personal belongings like combs, wallets or other personal articles which may carry microorganisms.

Soiled clothing could harbour disease producing organisms and also appear unappealing to the customers. Bacteria can grow in food stains and perspiration stains.

A well dressed, neat and clean staff creates a good impression on customers. Clean protective clothing helps in boosting the staff morale by making them interested in their personal appearance and in hygiene.

IMPORTANCE OF REST, EXERCISE AND RECREATION

There should be a balance between the amount of work done and the rest, relaxation and sleep obtained. Rest and relaxation help in reviving the individual, lessens psychological and physical fatigue and motivates him or her to work. Fatigue reduces the capacity of an individual to work. The long work hours, split duty and night duty requires that workers get adequate amount of rest, relaxation and sleep to keep them active and alert at work.

The amount of sleep required by an individual varies from four to nine hours. On an average, a person needs six to seven hours of undisturbed sleep to feel refreshed when he awakens. Lack of sleep increases tension and makes a person irritable and aggressive.

For the human body to function properly and remain in good health it must not only be rested but exercised regularly as well. The amount of exercise required depends on the nature of the job done. An active waiter or cleaner needs lesser exercise than a desk manager who spends long hours in his office.

Exercising regularly in fresh air is necessary for people working under pressure, rush, heat and odd working hours. Exercise helps to (a) promote good health by improving circulation and respiration, (b) maintains muscle tone and promotes digestion, (c) keeps skin clean and (d) maintains efficiency of the nervous system.

It keeps the individual fit and healthy with no extra fat. Exercise could be in the form of walking, jogging, cycling, swimming or Yoga.

Some form of recreation is necessary in a person's leisure time. Recreation is necessary for a healthy mind. The choice of recreation varies from individual to individual. What may be work for one person, may be recreation for another. Recreation helps in breaking the monotony, frustration or dislike for one's job. It helps in refreshing the mind, just like exercise refreshes the body.

Adequate rest, exercise and recreation are essential for both physical and psychological fitness.

SUMMARY

Food handlers harbour disease producing organisms on the skin, in the nose and throat and in the gastro-intestinal tract. This makes personal hygiene very important in preventing bacteria from reaching food. It is the responsibility of the management to ensure that all employees follow strict hygienic practices and personal cleanliness while on duty. The food handlers are the greatest threat to the safety of food and conscious effort on their part could prevent the spread of disease.

The employer should check that all employees have a clean and tidy personal appearance and follow sanitary practices while handling food. All employees should observe healthy habits. They should be particular about their appearance and should be in clean and comfortable uniform while on duty. Adequate restrooms and locker facilities should be provided by the employer. The importance of rest, recreation and exercise and its relationship to work efficiency should be understood. Regular medical checkups, a clean and comfortable work environment and well balanced meals while on duty will help in increasing performance at work.

KEY TERMS

Foodservice Employees Any individual who in the course of his or her normal duties handles food, food equipment or sells or serves food.

Health Check-up A periodic physical examination along with investigations like ECG, X-rays, bio-chemical examination of blood, urine, stool etc. which enables the person to detect disease at an early stage sometimes even before symptoms become manifest.

Personal Hygiene Need Food handlers serve as the host or carrier of disease organisms present in and on their body hence cleanliness, health and good habits or good personal hygiene is necessary to prevent spread of disease through food.

Personal Hygiene Personal cleanliness, maintenance of health and good habits to prevent spread of disease through disease causing organisms present in and on the body of food handlers through food.

Protective Clothing Aprons, overalls or uniforms worn by foodservice employees which help protect food from contamination and employees from heat, grease and rapours from the work environment. It should be comfortable, durable, absorbent and easy to wash.

Recreation Activity undertaken during leisure, either indoor/outdoor, active/passive, home-based/away from home to keep the mind healthy.

Refreshment of body or mind after work by any form of play, amusement, sports, hobbies for relaxation.

Rest Natural repose or relief from daily activity which is obtained by sleep or desisting from activity or exertion for physical and mental peace.

Sanitation Codes It is a compilation of all the regulations governing the foodservice industry.

It is written in simple language to help the foodservice operator meet his/her obligation to protect the health of the consumer. It outlines all essential sanitation requirements.

REVIEW QUESTIONS

1. Select the most appropriate answer in the following.
   (a) When you cough or sneeze in the kitchen
      (i) use your apron to cover your mouth
      (ii) use any handy cloth and wash your hands later
      (iii) do nothing, may be no one has noticed.
      (iv) use disposable tissues and wash hands before working
   (b) Wounds like cuts, burns, etc. should be covered with
      (i) waterproof dressing
      (ii) antiseptic ointment
      (iii) elastoplast
      (iv) cotton and bandage
   (c) Food handlers should keep their fingernails
      (i) short, manicured and unvarnished
      (ii) smooth, well shaped and unvarnished
      (iii) long and unvarnished
      (iv) short and varnished
   (d) Smoking is not permitted in food preparation areas mainly because
      (i) it is injurious to health
      (ii) cigarettes are expensive
      (iii) saliva may contaminate fingers
      (iv) teeth get discoloured and decayed
   (e) To taste food always use
      (i) your fingers to save time
      (ii) a spatula
      (iii) a wooden spoon
      (iv) a separate teaspoon
   (f) While working in the kitchen hair should be covered with
      (i) a scarf
      (ii) a hairnet
      (iii) a paper cap
      (iv) any of the above
   (g) Which of the following illnesses should be reported immediately to the supervisor
      (i) vomiting and diarrhoea
      (ii) throat infection
      (iii) skin infection
      (iv) all of the above
   (h) Hair is kept covered mainly because
      (i) a food handler looks smarter
      (ii) headcovers help in keeping hair clean
      (iii) dandruff and hair may fall into food
      (iv) it is a part of the uniform
   (i) If you cut your finger while chopping food you should
      (i) apply turmeric from the masala box
      (ii) tear a strip from the dishcloth and tie the wound
      (iii) clean and cover wound with a waterproof dressing
      (iv) wash the cut and continue work as you have no leave left
2. State whether True or False. If false correct the statement.
   (a) Hands are sterile after they are washed.
   (b) Persons with septic wounds can work in the kitchen as long as the wound is dressed.
   (c) When a person is suffering from a cold it is desirable to use paper tissues instead of handkerchiefs.
   (d) Human secretions and excreta are sources of harmful bacteria.
   (e) Bangles and intricate rings should not be worn while preparing food.
   (f) Undergarments are not visible and do not come in contact with food so they need not be changed daily.
   (g) Uniforms for kitchen staff should be

dark in colour so that they look clean for a longer time.

(h) Regular exercise, rest and recreation are prerequisites for good health.

3. List the ways in which personal hygiene can help in breaking the chain of infection.
4. How does a good personal appearance help both the employee and the establishment?
5. As a food handler what should you do when you fall ill?
6. Which points should be kept in mind while selecting uniforms for (a) kitchen staff, (b) dishwashing staff, (c) service staff.
7. Why are our hands called the most dangerous serving tools?
8. Why should you cover your nose and mouth when you sneeze?
9. List four essential habits which should be observed for being healthy and physically fit.
10. Why is smoking, chewing paan and tobacco not permitted in food preparation areas?
11. When is handwashing essential? How should hands be washed and dried?
12. Why is a medical checkup necessary for food handlers?
13. Why is a weekly holiday necessary for all employees?

16

- Sanitation training and education; Advantages of the training programme
- Who should be trained
- What a training programme should include
- Steps in planning and implementing a training programme
- Employment practice
- Accidents and their effect
- How accidents take place
- Types of accidents
- Safety instructions to kitchen staff

Safety at the Work Place

INTRODUCTION

Management has an important role to play in maintaining high standards of sanitation and a safe work environment in their establishment. They should be convinced of the importance of food sanitation and should be interested in ensuring that all employees practise safe food handling. This requires special efforts on part of the management and time taken out from the routine hectic schedules.

Food service establishments should be safe to work in. A safe and clean establishment increases productivity and profits. Not only should customers be protected from food-borne illnesses, but, in the interest of both customer and employees, premises should be safe and it is the foremost duty of the management to ensure safety at the work place.

Prevention of accidents and sanitation are closely related in the sense that accidents may result in food contamination. The food service manager should realise that accidentsdo not just happen, they are caused. They can very often be prevented from happening by practicing proper work habits.

SANITATION TRAINING AND EDUCATION

In the industry today, special attention needs to be focussed on training all employees, directly or indirectly concerned with food, in safe food practices. In most instances, it has been observed that the managers are busy with other matters like running the food service establishment and proprietors may not be inclined to spend time and money on training employees.

This training is, however, necessary for the following reasons:

1. The incidence of food-borne illnesses is on the rise.
2. It is the legal responsibility of the management to serve clean wholesome food.
3. Most of the employees have no formal training either before or at the time of recruitment and have picked up the job from an older worker to whom they have been assigned.
4. In this industry, the labour turnover rate as well as job change rate is very high.
5. Very few establishments have an inbuilt, well structured sanitation programme.
6. Professionally trained food service personnel are not available or do not have the time.

Training workers in safe food practices will cost the management both time and money as workers and trainers will stay away from work for sometime; learning resources like films, slides, posters and handouts have to be procured and a professional trainer may also be needed. However, in the long run, this training is beneficial as it helps cut down on

1. losses incurred due to visibly spoiled food
2. loss of reputation on account of
   (a) outbreak of food borne illness
   (b) presence of hair, insect droppings or body parts or any other filth in food served
   (c) unhygienic service of food
   (d) dirty toilets
3. financial loss if licence is suspended

Employees Need this Training

Most workers belong to the lower socio-economic group and may have studied till primary school only. They may have language problems and difficulties in reading and writing. They usually have no formal training and for them chances of promotion are bleak. Because of this background, they do not understand the importance of sanitation.

Because of low chances of promotion, low pay scales, inconvenient long work hours, working break shift or on holidays and the temporary nature of some jobs, the employee turnover is high. There is a frequent need to train new employees about their job. Training in sanitation should thus go on side by side and should begin as soon as an employee joins duty.

An ideal situation would be one where it is mandatory for every food handler to complete a course in sanitary food handling. This programme should be a continuous one. But this may not always be feasible as some proprietors may object because of high training expenses as well as high employee turnover. In such cases, to begin with, all managers should be trained and they inturn would train workers. This would cut down on training expenses but would put pressure on the already over-burdened managers.

Advantages of the Training Programme

For the Employer

1. labour turnover will be reduced
2. employees will need lesser supervision
3. increased food production
4. need for skilled employees will be partly fulfilled
5. working conditions will improve
6. reduction in cases of food-borne illness

For the Employee

1. chances of advancement in position
2. greater sense of security
3. job satisfaction

WHO SHOULD BE TRAINED

For a food sanitation training programme to be successful, all employees should be involved right from the top management down to the person doing the most menial job.

Every person should understand the importance of his or her role in the overall sanitation programme and how a simple act of carelessness on the part of one employee can affect the health of a large number of people or wipe out the efforts of other employees. For example, if cleaned, sanitised and properly stored glassware is mishandled by the service personnel, the efforts of the dishwashing team would be all in vain.

The basic principles underlying food sanitation should be made clear to all employees. Only when a person understands the importance of following certain guidelines for completing a job, will the task become interesting. It will also make the employee feel responsible for the job.

Once the management has decided upon employees training, careful thought and consideration is required to carry it out. If the task of training a new employee is given to an experienced but untrained older employee, there are chances that the new employee will pick up all work habits both good and bad from his senior. Sanitation training needs much more. Just imparting training is not enough, it needs to be implemented continuously. Such training programmes need to be conducted all round the year, both for new and experienced employees.

WHAT A TRAINING PROGRAMME SHOULD INCLUDE

The training programme should include personal, food and environmental hygiene. Instructions and training material should be specifically related to the catering industry. To make it interesting, posters on hygiene should be displayed in prominent places and principles of sanitation should be distributed free of cost to all employees.

For a training programme to be really effective, it must be carefully planned, well executed, continually monitored and evaluated.

STEPS IN PLANNING AND IMPLEMENTING A TRAINING PROGRAMME

The training programme should be planned after

1. listing the objectives of the programme
2. preparing the content
3. identifying the group
4. selecting the trainer
5. preparing or procuring training material
6. planning the training schedule
7. conducting the training
8. motivating the trainees
9. evaluating the programme through written tests and actual performance

The manager should maintain a separate file for every employee and regularly record performance, appearance, absenteeism, etc. Good records should be recognised and appreciated. If such systems are followed, it will encourage employees to practice good work habits.

EMPLOYMENT PRACTICE

For any employment, a certificate indicating state of general health, past medical history and sometimes, result of medical examination is required by the management prior to appoinment. Employees handling food or working in the kitchen or dishwashing area need to furnish additional information.

The information on past illness should be filled in by the health authority and the questionnaire should be signed by the employee. Apart from the other information required, the questionnaire should record past history of typhoid, paratyphoid, dysentery, diarrhoea and tuberculosis. Any attack of diarrhoea and/or vomiting lasting more than two days should be recorded. Information regarding boils, skin rash or discharge from eyes or nose, etc. is to be noted. Place and date of visit abroad should also be noted.

The employee should be given to understand that this information is needed not only to safeguard the customer but also to check whether the employee needs any special treatment for his or her own protection. It should also be explained that rejection on medical grounds is quite uncommon. After they are recruited, they will be medically examined every six months.

Healthy, trained employees are more likely to carry out safe work practices and prevent untoward accidents at the work place, provided the work place is well planned and safe to work.

An accident is an unintended event which results in injury, loss or damage. It may or may not result from human error.

ACCIDENTS AND THEIR EFFECT

Accidents have a direct or indirect effect on individuals and the establishment.

Direct effect of accidents

1. *Injury:* Accidents result in injury which can cause much pain and absenteeism from work. Unattended wounds may become a source of infection. For the uninjured workers and customers it creates tension and anxiety.

2. *Expenditure:* Accidents are expensive. Workers must be covered by medical insurance through Employees State Insurance Scheme (ESIS) and disability compensation is required for employees injured on the job.

   Frequent accidents will result in additional expenditure to the management.

Indirect effect of accidents

1. *Damaged or broken material*
2. *Reduced efficiency:* if area is accident-prone, workers try to avoid accidents and work slowly; other staff will be engaged in attending to the injured, cleaning up the mess, doctors visits and investigations
3. *Work schedule and routine is upset:* work is completed in a hurry and hygienic aspect tends to get overlooked in an attempt to just complete the job
4. *Injured workers may have to stay away from work* and need to be replaced, resulting in training of new employees or being under-staffed
5. *Accidents lower morale:* frequent accidents indicate that management is not concerned about the customers and employees welfare
6. *Accidents spoil reputation*
7. *Accidents can result in fines or imprisonment:* under the Occupational Safety and Health Act, the food service operator may face legal action

HOW ACCIDENTS TAKE PLACE

The Human Factor (The Careless, Negligent and Slack Food Handler)

In a vast majority of cases, it has been noticed that people are responsible for most of the accidents as they are the ones who create unsafe conditions. They ignore wiring where insulation has worn off, leave cupboard doors and drawers open, block passages with equipment, are not particular about protective clothing, leave spills on the floor unmopped, and do not remove accumulated grease on filters.

They may be careless, for example,

1. pick up broken glass with bare hands
2. ignore operating instructions on equipment
3. lift very heavy loads alone
4. do not use safety devices on grinders and slicers

They may be inattentive, for example,

1. bump into other people
2. drop heavy items or spill hot liquids on their own feet
3. close doors and drawers on their own fingers and squash them
4. rush with arms full and minds elsewhere on wet greasy floors

The Unsafe Work Place

The layout may be badly planned or conditions in the kitchen may be conducive to unnecessary accidents. The unsafe work place may also be created by negligence on part of the employees.

Unsafe surroundings are created by the following:

1. steep, narrow, dark stairways
2. unnecessary steps
3. clogged floor drains
4. narrow aisles caused by furniture or equipment wrongly arranged in heavy traffic areas
5. ladders too short to reach uppermost shelves so boxes are used instead
6. unprotected meat slicer blades
7. doors opening into corridors
8. knives left lying around
9. handles of pots and pans protruding outwards

TYPES OF ACCIDENTS

Accidents occuring in food service establishments are classified into the following categories:

1. cuts and lacerations
2. burns and scalds
3. falls and collisions
4. fires
5. electrical shock
6. back strain

Cuts and Lacerations

Cuts and lacerations are skin breaks caused by (a) careless handling of knives, food slicers, choppers, mixers, broken glass, etc. by untrained employees during the rush hour, (b) by sharp edges of badly designed equipment, and (c) by following incorrect practices such as catching knives as they fall, leaving them in the dishwater in sinks or washing them in the dishwashing machine or using blunt knives which need a lot of pressure to cut with.

Burns and Scalds

Burns and scalds are the second most common accidents in the kitchen. They results in injury of varying degrees of severity. They are caused by contact with (a) hot surfaces of grills, ovens, griddles, burners, etc., (b) hot water or steam from boilers and steamers, (c) spillage or splashes from hot food or drink, (d) hot fat from frying pans, woks, deep fat fryers, and (e) by using defective equipment like loose handles on utensils, faulty tongs, etc.

Falls and Collisions

Workers are generally in a hurry during peak hours of business, carrying things to and fro and items which can obstruct vision.

Workers may (a) slip and fall on floors made of slippery material—floors can be made slippery because of grease, fruit and vegetable peels and water on the floor—or workers footwear may have slippery soles, (b) fall from a height while trying to reach for things—they may climb on unsafe boxes, chairs, shelves and rickety ladders, (c) collide with other people, equipment, furniture, etc., damaging it as well as hurting themselves or (d) trip and fall if shoe gets stuck in torn carpets or matting, fall over a loose tile or hole in the floor, miss an unseen step, trip over trailing power cables.

Objects (a) stacked at a height or stored on a rickety shelf in a dangerous position on the shelf may land on someone's head, (b) objects precariously placed can be dropped by clumsy people, or (c) objects placed in passageways may make people trip and fall.

Falls and collisions result in bruises, bumps, sprains or fractures.

Fires

Maximum number of fires are reported from the food industry. They damage buildings, equipment and provisions and result in death or injury to people. Of all the fires occurring one-third are of electrical origin caused by faulty wiring, operation and placement of equipment, overloaded circuits, old worn-out wiring, overheating and burning of motors due to insufficient ventilation.

Hot fat in deep fat-fryers reaches its flash point and bursts into flames. Grease accumulated in filter traps on walls catches fire very fast.

Burning cigarette butts discarded carelessly in trash or near inflammable material may smoulder unnoticed for hours before bursting into flames.

A leak in the gas pipeline or cylinder can cause serious fires.

The severity of a fire is increased by

1. inadequate fire protection equipment like extinguishers, blankets, alarms
2. outdated fire extinguishers
3. employees not trained in their use
4. poor housekeeping practices
5. overcrowding
6. exits not clearly marked

A large number of electrical gadgets are used nowadays. If these are not handled carefully they can seriously shock unwary users.

Electrical appliances pose a hazard, if

1. they are poorly maintained, wires are exposed, plugs are missing, etc.
2. improperly earthed
3. placed in damp or wet areas near the sink, on the drainboard or handled with wet hands
4. operator stands in a pool of water or without footwear

Table 16.1 Useful Safety Devices on Equipment

Name of Equipment	*Type of Safety Guard*
1. Robo coupe	Unless properly assembled and closed, the machinery (used for slicing vegetables) does not start operating. (Electrical equipment)
2. Buffalo chopper	Electrical equipment used for cutting meat. Unless the cover in properly fixed, the chopper does not work.

Contd...

Table 16.1 (Contd)

Name of Equipment	*Type of Safety Guard*
3. Combination oven	If there is gas leakage, then the alarm rings and the gas supply shuts completely.
4. Walk in freezer	In case an employee gets trapped in the walk-in freezer and it gets locked from outside, the employee has to press the alarm available inside the walk-in. This alarm will be heard in the maintenance department and the staff there, will on locating the source of the alarm immediately inform the concerned department/kitchen section to rescue the employee.
5. Electric circuit breakers (ECBs)	These are fitted in electrical equipments. In case there is power fluctuation or short circuit, the ECB melts thereby breaking the circuit.
6. Grinder	Wooden pusher to move or press food into the grinders so that fingers are safe.
7. Coconut scraper attached to grinder	Metal shield to cover the sharp serrated blades when the grinder is on and scraper is not in use.

Lifting heavy, awkward items alone or in a faulty position can injure the muscles of the back and the spinal cord.

A vast majority of all accidents in food service establishments can be avoided by practising good habits and keen foresight on the part of all employees.

The food service manager should plan out work to be done to reduce haste. A well-planned layout eliminates physical hazards. The entrance and exit should be clearly marked and doors should be kept shut. The management should ensure that fire extinguishers are provided in all areas where fires can occur and a well stocked first aid box is available in an accessible area. At least some employees should be trained in giving first aid.

Workers should be trained in good safety habits and constant supervision should be provided to ensure safe working conditions and to eliminate faulty practices. Safe working and good work habits go hand in hand.

Safe working habits

1. Keep all surfaces clean and dry.
2. Mop up spills immediately.
3. Use protective clothing.
4. Follow operational instructions on equipment.
5. Keep appliances in good condition.
6. Check for earthing, cover glass bulbs with shields.
7. Avoid shortcuts to save time.
8. Work in well lit, well ventilated rooms.
9. Keep drawers and cupboards shut.
10. Report illness immediately.
11. Clean, treat and dress wounds with protective waterproof dressing.
12. Practice personal hygiene.

SAFETY INSTRUCTIONS TO KITCHEN STAFF

To prevent accidents from happening, the following precautions should be taken

1. *Cuts and lacerations*
   (a) While carrying a knife, hold the point down and keep the sharp edge away from the body.
   (b) When cutting, use a chopping board, hold material correctly and cut away from the body.
   (c) Sharpen knives when they become blunt. Blunt knives are more dangerous as material slips away while cutting or more pressure needs to be used.
   (d) Do not catch a falling knife, move away, let it fall and then pick it up.
   (e) Knives should not be washed in the dishwasher or left soaking in detergent solution in the dishwashing sink.
   (f) While chopping meat do not rest your left/free hand on the meat block but place hand behind the knife.
   (g) Do not cut frozen meat; the knife blade may slip.
   (h) Concentrate on your work and follow instructions while operating appliances.
   (i) Handle broken glassware with care.
   (j) Open tin cans with a cutter only, to prevent jagged edges. Do not open bottle caps by putting it in the mouth,
   (k) Use proper shears for opening wired cases and not teeth or hands.
   (l) Use safety guards. If coconut scraper attached to wet masala grinder is not in use, keep it covered.
   (m) Smoothen out and seal all sharp edges or rough corners on equipment.
   (n) Keep fingers out of mincing machine when in use.
2. *Burns and scalds*
   (a) Store highly inflammable material carefully.
   (b) Place equipment on a non-combustible base.
   (c) Do not bend over open flames.
   (d) Use protective clothing made of cotton or fire resistant material.
   (e) Use padded gloves or dry dusters to pick up hot items as wet or damp cloths transmit heat faster and cause burns.
   (f) Do not put frozen, wet items in the deep fat fryer.
   (g) Keep level of fat in deep fat fryer not more than two-thirds full.
   (h) Check taps of all urns and boilers.
   (i) Train all employees on use of fire extinguishers, through fire drills.
   (j) Ensure that steam condensor pipes are kept free to prevent hot steam build-up in equipment.
3. *Falls and collisions*
   (a) Provide adequate lighting.
   (b) Keep floors clean, dry and grease-free.
   (c) Mop up spills at once.
   (d) When mopping or polishing floors, put up sign boards.
   (e) On wet floors, use duckboards or non-skid mats.
   (f) Floors, flooring and stairs should be well maintained. Torn carpets, loose tiles, broken floors, loose steps, loose electrical wires, or any other obstruction should be attended to at once.

(g) Matting and carpeting should be well laid.
(h) Use a stepladder which is tall enough to reach for material kept at a height.
(i) Arrange all material to be stored at a height, safely on a sturdy shelf.
(j) Keep traffic lines clean, dry and free from obstruction.
(k) While carrying large items, do not let it block your view.
(l) Have self closing doors with transparent glass at eye level.
(m) Take care of your head and prevent bad bumps while bending down and getting up again.

4. *Shock*
(a) Place electrical appliances in a safe place.
(b) Check earthing of all equipment.
(c) Ensure proper wiring and installation. Change old, frayed wiring.
(d) Use all safety devices provided.
(e) Do not change blades of the mixer without switching off electricity.
(f) Do not clean electrical appliances unless plug is removed from the socket.
(g) Do not misuse appliances, follow the instructions given.
(h) Allow skilled workers to operate complicated machinery.
(i) Long loose hair or flowing clothing can get caught in equipment.

It is thus quite obvious that accidents occur because of two main reasons: (a) unsafe conditions already existing in the surroundings which can be greatly minimised and (b) unsafe conditions created by the food handlers through ignorance, carelessness, negligence and faulty habits which can be corrected through continuous supervision and training.

SUMMARY

The management has a key role to play if high standards of sanitation have to be achieved. Once they are convinced of the importance of food sanitation, they will be able to motivate employees to practice safe food handling. As most employees do not have any formal training before recruitment and do not understand why so much emphasis is being laid on cleanliness and good work habits, it is the duty of the management to train all employees, directly or indirectly concerned with food, in safe food practices.

Even if the training costs the management in terms of time and money, it would be money well spent and both the management and employee will benefit from it. For a successful training programme, all employees should be involved and basic principles of sanitation should be highlighted. The management should keep a check on whether the training is being implemented. These programmes should be carefully planned, well executed, continuously monitored and evaluated.

The management is also responsible for employing people who are medically fit and getting them medically examined every six months.

An important aspect which the management is responsible for is provision of a safe work place. All accidents can be prevented by eliminating unsafe conditions which may be existing or by instilling good work habits in all employees. Accidents cause pain, loss or damage.

Common accidents in catering establishments include, cuts, bruises, sprains, burns, shock and fractures. Fires are one of the most serious hazards and need to be prevented. Adequate first aid measures and fire fighting equipment should be available and easily accessible. Training and continuous supervision can go a long way in making the food service establishment clean and safe for both employees and customers.

KEY TERMS

Accidents Accidents are unintended events which results in injury, loss or damage. They may or may not result from human error.

Safety The condition of being safe i.e. unlikely to cause injury, damage or harm and being free from danger.

Safety devices Any of certain devices like ECB's, alarm bells etc or built in features on equipment which prevent accidents from happening and protects both the operator from injury or harm and the equipment and surroundings from getting damaged.

Security Freedom from fear, anxiety and doubts concerning humans as well as protection against pilferages.

Training Programmes Specially designed sequence of activities, demonstrations, lectures, audio-visual shows used to impart knowledge to employees and to inculcate good habits and practices in an interesting and understandable manner.

REVIEW QUESTIONS

1. Select the most appropriate answer in the following
   (a) For a food sanitation training programme to be successful you should train
      (i) the managers only
      (ii) all employees from top management to workers
      (iii) kitchen, service and dishwashing staff
      (iv) all supervisors
   (b) While frying a large quantity of finger chips, the level of fat in the deep fat fryer should be
      (i) filled to the brim
      (ii) three-fourth full
      (iii) two-third full
      (iv) one-third full
   (c) Money spent on training in sanitary food practices is money well spent because
      (i) it reduces losses incurred because of noticeably spoilt food
      (ii) it is obligatory on part of management
      (iii) it prevents financial loss, suspension of licence and closure of establishment
      (iv) it preserves the reputation
         I. (i) and (iv) only
         II. (i), (iii) and (iv)
         III. (ii) only
         IV. (ii) and (iii) only
   (d) Which of the following is correct with respect to training material?
      (i) do not use as it increases training cost
      (ii) use to add interest and effectiveness
      (iii) oral instructions in the form of lectures is sufficient
      (iv) include audio visual aids, demonstrations and handouts
         I. (i) and (iii) only
         II. (ii) and (iv) only
         III. (iv) only
         IV. none of the above
   (e) Training programmes should be conducted
      (i) during probation period for new recruits only
      (ii) after confirmation for new employees
      (iii) once during service for all employees
      (iv) all year round for all employees
   (f) When frying wet food, they should be
      (i) dried and coated before frying
      (ii) immersed in very hot fat to dry them quickly
      (iii) immersed in warm fat to prevent splutering
      (iv) they should be cooked by some other method of cooking.

2. Choose the right steps to be taken in the event of suspected gas leakage in the kitchen
   (a) close doors and windows
   (b) ask people to leave the kitchen
   (c) strike a match near the cylinder to see if there is really any leak
   (d) call the fire brigade
   (e) call the gas agency
   (f) switch on all lights
   (g) turn-off the gas supply
   (h) use other burners where you do not suspect a leak
3. What type of accident can result if
   (a) you lift heated pots with a damp duster
   (b) equipment has sharp edges
   (c) you wash knives in a dishwashing machine
   (d) the carpeting is torn
   (e) you lift heavy items alone
   (f) you operate a mixer on a wet drainboard
   (g) the earthing is faulty
   (h) the fat in the frier is overheated
   (i) you carry large bulky containers which obstruct your vision
   (j) you allow grease to accumulate on filter traps
4. Fill in the blanks with appropriate words
   (a) __________ __________ should be located in all areas where fires can occur.
   (b) To prevent accidents __________ working and __________ work habits are necessary.
   (c) While operating the wet masala grinder, always put a __________ __________ on the coconut scraper.
   (d) Training programmes should include both __________ and __________ hygiene.
   (e) Training workers in safe food practices will cost the management both __________ and __________.
5. State whether True or False.
   (a) Accidents may result in food contamination.
   (b) Most of the accidents occurring in catering establishments can be avoided.
   (c) If the tin cutter cannot be found, open the tin with a sharp knife.
   (d) Water spilt on a kitchen floor need not be mopped up immediately as it will dry with the kitchen heat.
   (e) Training costs can be reduced by training the managers only and they in turn should spend their spare time in training workers.
   (f) Once all employees are trained, sanitation can be ensured.
6. Outline the safety procedures to be followed when using the following equipment
   (a) ovens
   (b) rice boiler
   (c) deep fat fryer
   (d) high pressure burners
   (e) wet grinder
   (f) idli steamer
7. (a) Identify the safety hazards in the kitchen.
   (b) What steps can you take to eliminate them?
8. Why is training in sanitation necessary for all food service operators?
9. Why is the rate of employee turnover in this industry high?
10. How can you motivate employees to practice good work habits?
11. What are the four basic requirements for a successful training programme?
12. (a) Describe the correct method of using a knife.
    (b) How should knives be stored after use?
13. What are the possible causes for a fire breaking out in a restaurant?
14. How can falls and collisions be prevented?
15. How should glasses be handled hygienically and safely?
16. Why is it essential to record information on past illnesses for food handlers?
17. Why are ventilated hoods necessary on some kitchen equipment?
18. How do accidents occur and why should they be prevented?
19. List the various types of accidents occurring in catering establishments.
20. Why is it necessary to thaw frozen meat before deboning it?

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Part V

REGULATORY AGENCIES

- Food Laws and Regulations
- Quality and Food Standards
- Recent Concerns

17

- Regulatory agencies
- Control of food quality
- The food safety and standards act, 2006
- The plastics manufacture, sale and usage rules, 1999
- The Atomic Energy (contol of irradiation of food) Rules 1996
- Adulteration
- Misbranding
- Local health authority

Food Laws and Regulations

INTRODUCTION

Food standards have been formulated in the interest of the public, to protect them from consuming improperly handled food and thereby prevent food-borne illnesses from spreading. There are several acts and regulations that are in force. In any given area, the local health authority ensures that these acts are followed.

Violation of these acts is against the law and any person who fails to comply with these codes may have to pay a heavy fine or undergo prosecution. The food operator has a lot to gain by cooperating with the regulatory agencies and conforming to the rules laid down by them.

REGULATORY AGENCIES

Regulatory and advisory controls administered by agencies of the government are:

The Central Committee for Food Standards is chaired by the Director-General Health Services. This committee advises the central and state government on all matters pertaining to the Prevention of Food Adulteration (PFA) Act, 1954 and Rules 1955.

The Director of Medical and Health Services or Chief Officer in charge of health administration in a state is the Food (Health) Authority. For example, in the state of Maharashtra, the Commissioner of Food and Drugs Administration is the Food (Health) Authority.

The central or state government appoints the Medical Officer Health who is in charge of health administration in the local area. This officer is the Local (Health) Authority or Local Authority for a municipal corporation, a cantonment or a notified area. Food inspectors and sanitary inspectors report to him or her.

There are four Central Food Laboratories in India located at Calcutta, Ghaziabad, Mysore and Pune.

These laboratories analyse samples of food sent by an authority. They conduct investigations for fixing standards for any article of food and work in collaboration with state laboratories.

Every state has a Public Health Laboratory. They have a three-tier system of functioning—there are state, regional and district level laboratories. The Deputy Director of Health Services is in charge of all laboratories in the state.

Functions of Public Health Laboratories in the State of Maharashtra

1. Chemical and microbiological analysis of food
   - Samples received under prevention of Food Adulteration Act 1954.
   - Suspected/leftover food, water and related samples to detect causative agent in food poisoning outbreak investigation.
   - Food served to VIP and VVIP.
   - Other government and private food samples.
2. Water quality monitoring
   - Chemical and bacteriological examination of water samples.
   - Examination of bleaching powder (TCL) and dose determination, liquid chlorine, tablets, water disinfectants.
   - Alum examination, alum dose determination.
   - Fluoride estimation in water samples.
3. Water, industrial waste/effluents examination under Maharashtra Prevention of Water Pollution & Control Act 1974.
4. Examination of iodised salt and urine Samples under National Iodine Deficiency Disorder Control Programme.
5. Stool/rectal swabs/vomit samples examination for bacteriological culture for cholera and other agents of diarrhoea, dysentery, gastroenteritis, blood samples for enteric fever cultures, food poisoning agents and drug sensitivity test.
6. Antimicrobial susceptibility testing.

7. Training and health education
   - In service and interstate training to the technical staff.
   - International training to the WHO fellows.
   - Training to the medical DPH candidates, medical students, college students, catering diploma students, nursing staff, sanitary and food inspectors.
   - Inter–state training for members of consumer forum.

The regulatory and advisory agencies have the objectives of ensuring wholesomeness of food and maintaining sanitary conditions.

Standards are set by qualified sanitarians and health officials and they are voted into law by elected representatives. They cover anything having to do with food operations like food; personnel; equipment and utensils (material used, construction, design, cleanability, storage, etc.); facilities, construction and design; adulteration; and misbranding. Compliance is necessary.

CONTROL OF FOOD QUALITY

Food Standards

To protect people from health hazards because of adulteration, it is necessary to impose control and check over the quality of food available to consumers. Standards are yardsticks established by an authority for measuring quantity, weight or quality. This system ensures that each food stuff is what it purports to be or what its label claims it to be and assures uniformity. National official standards are set to safeguard the consumers health and ensure fair food trade practices. In 1963, the FAO and WHO established a commission for setting up international food standards.

The Codex Alimentarius The Codex Alimentarius (meaning food code or food book in Latin) is a collection of internationally recognised standards, guidelines and recommendations pertaining to food and its safety.

The Codex Alimentarius commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The main purposes of this programme are protecting health of the consumers and ensuring fair trade practices in the food trade and promoting coordination of all food standards work undertaken by international governmental and non-governmental organisations.

The Codex Alimentarius officially covers all foods, whether processed, semiprocessed or raw. Specific standards have been worked out for foods that are marketed directly to the consumer such as

- *Meat* products (fresh, frozen, processed meats and *poultry*)
- Fish and fishery products (marine, fresh water and *aquaculture*)
- *Milk* and milk products (all fresh, processed and frozen items)
- Foods for special *dietary* uses (including *infant formulae* and *baby foods*)
- Fresh and processed *vegetables*, *fruits*, and *fruit juices*
- *Cereals* and derived products, dried legumes
- Fats, oils and derived products such as *margarine*
- Miscellaneous food products (*chocolate, sugar, honey, mineral water*)

In addition to standards for specific foods, the Codex Alimentarius contains general standards covering matters such as *food labelling*, food *hygiene*, *food additives* and *pesticide* residues, and procedures for assessing the safety of foods derived from modern *biotechnology* for example, genetically modified foods. It also contains guidelines for the management of governmental *import* and *export* inspection and *certification* systems for foods. See Fig. 17.1.

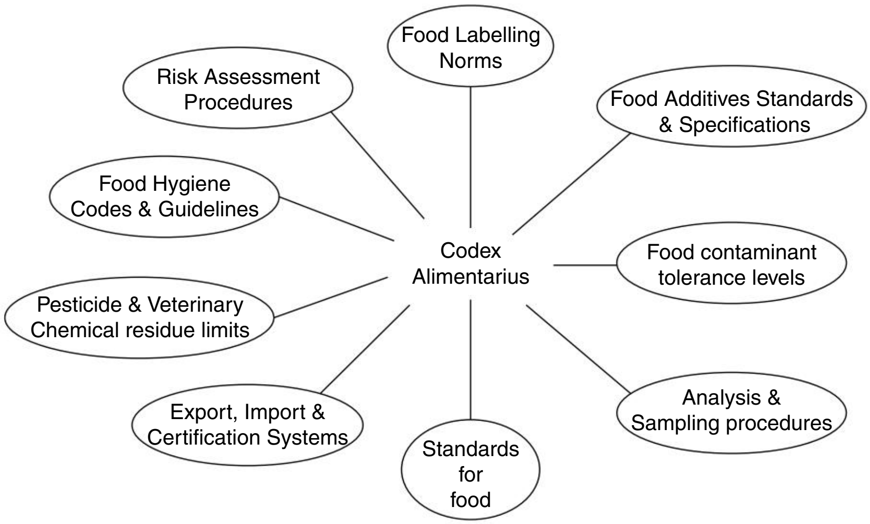

Fig. 17.1 *Codex Alimentarius covers all foods as well as general standards for protecting the health of consumers*

The Codex Alimentarius is published in five languages namely *Arabic, Chinese, English, French* and *Spanish*.

Although it has been perceived as a mandatory standard for food safety, it is a voluntary reference standard for food and there is no obligation on countries to adopt Codex standards. However, Codex Alimentarius is recognised by the World Trade Organisation (WTO) as an international reference standard for resolving disputes concerning food safety and consumer protection.

Indian Standards

These are based on the international Codex Alimentarius with suitable modifications. They include (a) compulsory standards and (b) voluntary standards.

Compulsory Standards

Prevention of Food Adulteration Act 1954 (PFA) These standards prescribe the minimum requirements for all types and categories of food. Any food that does not conform to the minimum standards laid down by PFA rules is said to be adulterated.

Essential Commodities Act 1955 Under this act, there are a number of control orders. The main objectives of this act are to regulate the manufacture, commerce and distribution of essential commodities including food. The following orders are included under this act:

1. *The Fruit Products Order 1955 (FPO)*: the manufacture and distribution of all fruit and vegetable products, synthetic syrups, aerated beverages and vinegar is regulated under this order. It lays the limits for the presence of poisonous elements, permitted food colours, preservatives and additives. The order specifies the standards of sanitation and hygiene to be followed in factories. It gives directions regarding packing, marking and labelling of containers. It stipulates the standards for quality products. Under this order, it is mandatory for manufacturers of fruit and vegetable products to secure a valid licence from the Ministry of Food Processing Industries.
2. *Meat Products Control Order 1973*: this order controls the manufacture, quality and distribution of all raw and processed meat and meat products. The order is regulated by the Directorate of Marketing and Inspection and requires that the meat be obtained from healthy animals, slaughtered in a licensed slaughter house and is fit for human consumption.
3. *Milk and Milk Products Order 1992*: this order is applicable to large units handling more than 10,000 litres milk per day or milk products containing milk solids in excess of 500 tonnes per year. The production, sale, purchase and distribution of milk powder and milk products is covered under this.
4. *Solvent Extracted Oils, De-oiled Meal and Edible Flour Control Order 1967 and Vegetable Products Control Order 1976*: the manufacture and distribution of solvent extracted oils, de-oiled meals, edible flours and hydrogenated vegetable oils is controlled by this order. The order stipulates that any vegetable oil product, unless it conforms to the standards of quality and offers requirements for vanaspati or bakery shortening or margarine, shall not be manufactured, stocked or sold.

   A licence is granted by the Directorate of Vanaspati, Vegetable oils and fats under the Ministry of Civil Supplies Consumer Affairs and Public Distribution. The directorate also controls the market price of vanaspati.
5. *Standards on Weights and Measures (Packaged Commodities) Rules 1977*: under this rule, it is obligatory to declare the quantity of the packed commodity on the label.

The Edible Oils Packaging (Regulation) Order 1998 All edible vegetable oils and fats excluding margarine, vanaspati, bakery shortening and fat spreads are included in this Act. From the 15th day of December, 1998, no person shall sell or expose for sale, or distribute, or offer for sale, or despatch, or deliver to any person for the purpose of sale any edible oil that does not conform to the standards of quality as provided in the Prevention of Food Adulteration Act, 1954 and rules thereunder and that is not packed in a container, marked and labelled in the specified manner.

All edible oil packers need a certificate of registration. This certificate is issued only when sanitary requirements are fulfilled and the plant has qualified, experienced chemists and a laboratory for testing samples of edible oils.

The container in which the edible oil is packed should have the following particulars in English or Hindi in Devnagri Script.

1. Name/trade name
2. Name and address of packer
3. Name/description of contents
4. Net mass/volume of contents
5. Batch no., month and year of manufacture
6. Registration no.

The label should not contain any statement or claim that is false or misleading with respect to the quality or nutritive value of the edible oil.

Voluntary Standards

1. *Bureau of Indian Standards (BIS)*: The BIS has formulated Indian standards for processed foods with respect to raw material, hygiene, packaging and labelling. Manufacturers who comply with the standards laid down by BIS can obtain an Indian Standards Institute (ISI) mark. However, certain items like additives, food colours, vanaspati, milk powder, condensed milk and packaging containers need compulsory certification.
2. *Agricultural Produce (Grading and Marketing) Act 1937 (Agmark)*: Agmark provides standards for grading and marketing agricultural commodities. The consumer is assured of the quality as per standards laid down. The standards/grades are based on physical and chemical characteristics, intrinsic and acquired during processing or otherwise. Agricultural and allied commodities are graded 1, 2, 3 and 4 or special, good, fair and ordinary.

   Manufacturers who comply with the standards laid down by Directorate of Marketing and Inspection, put an Agmark label on their product. Complying with these standards is not compulsory.

THE FOOD SAFETY AND STANDARDS ACT, 2006

The Food Safety and Standards Act, 2006 is an integrated food law that consolidates all the laws relating to food.

The Food Safety and Standards Authority of India was established under this act to lay down scientific standards for articles of food. The main purpose of this Act was to ensure the availability of safe and wholesome food for human consumption. The act covers laws that regulate the manufacture, storage, distribution, sale and import of food. This was enacted by Parliament on 23rd August, 2006 in the 57th Year of the Republic of India.

Until this Act was formulated, there were multiple food laws and varied standards/act by different enforcement agencies that created confusion in the minds of the consumers, traders, manufacturers and investors. The permissible level of food additives, food colours, preservatives, pesticide residues, etc., varied from one law to another. The need to have one standard was strongly felt in place of the multiple laws and agencies, if the food processing industry were to develop well.

This Act was formulated after reviewing the Food laws of various developing and developed countries and other relevant international agreements. The present emphasis is on the following:

1. Use of food additives or processing aid.
2. Contaminants, naturally occurring toxic substances, heavy metals, etc.
3. Pesticides, veterinary drugs residues, antibiotic residues and micro-biological counts.
4. Genetically modified foods, organic foods, functional foods, proprietary foods.
5. Packaging and labelling of foods.
6. Restrictions on advertisements and prohibition as to unfair trade practices.

GENERAL PROVISIONS AS TO ARTICLES OF FOOD

Use of Food Additive or Processing Aid

No article of food shall contain any food additive or processing aid unless it is in accordance with the provisions of this Act and regulations made thereunder. In this context "processing aid" means any substance or material, not including apparatus or utensils, and not consumed as a food ingredient by itself, used in the processing of raw materials, foods or its ingredients to fulfil a certain technological purpose during treatment or processing and that may result in the non-intentional but unavoidable presence of residues or derivatives in the final product.

Contaminants, Naturally Occurring Toxic Substances, Heavy Metals, etc

No article of food shall contain any contaminant, naturally occurring toxic substances or toxins or hormone or heavy metals in excess of such quantities as may be specified by regulations.

Pesticides, Veterinary Drugs Residues, Antibiotic Residues and Microbiological Counts

1. No article of food shall contain insecticides or pesticides residues, veterinary drugs residues, antibiotic residues, solvent residues, pharmacological active substances and microbiological counts in excess of such tolerance limits as may be specified by regulations.
2. No insecticide shall be used directly on article of food except fumigants registered and approved under the Insecticides Act, 1968 (46 of 1968).

The term "pesticide residue" means any specified substance in food resulting from the use of a pesticide and includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products and impurities considered to be toxicological significance and also includes such residues coming into food from environment; while "residues of veterinary drugs" include the parent compounds or their metabolites or both in any edible portion of any animal product and include residues of associated impurities of the veterinary drug concerned.

Genetically Modified Foods, Organic Foods, Functional Foods, Proprietary Foods, etc.

Save as otherwise provided under this Act and regulations made thereunder, no person shall manufacture, distribute, sell or import any novel food, genetically modified articles of food, irradiated food, organic foods, foods for special dietary uses, functional foods, neutraceuticals, health supplements, proprietary foods and such other articles of food that the Central Government may notify in this behalf.

1. "Foods for special dietary uses or functional foods or nutraceuticals or health supplements" means:

   (a) Foods that are specially processed or formulated to satisfy particular dietary requirements that exist because of a particular physical or physiological condition or specific diseases and disorders and that are presented as such, wherein the composition of these foodstuffs must differ significantly from the composition of ordinary foods of comparable nature, if such ordinary foods exist and may contain one or more of the following ingredients, namely:

(i) plants or botanicals or their parts in the form of powder, concentrate or extract in water, ethyl alcohol or hydro alcoholic extract, single or in combination;

(ii) minerals or vitamins or proteins or metals or their compounds or amino acids (in amounts not exceeding the Recommended Daily Allowance for Indians) or enzymes (within permissible limits);

(iii) substances from animal origin;

(iv) a dietary substance for use by human beings to supplement the diet by increasing the total dietary intake;

(b) (i) a product that is labelled as a "Food for special dietary uses or functional foods or nutraceuticals or health supplements or similar such foods" that is not represented for use as a conventional food and whereby such products may be formulated in the form or powders, granules, tablets, capsules, liquids, jelly and other dosage forms but not parenterals, and are meant for oral administration;

(ii) such product does not include a drug as defined in clause (b) and ayurvedic, siddha and unani drugs as defined in clauses (a) and (h) of section 3 of the Drugs and Cosmetics Act, 1940 (23 of 1940) and rules made thereunder;

(iii) does not claim to cure or mitigate any specific disease, disorder or condition (except for certain health benefit or such promotion claims) as may be permitted by the regulations made under this Act;

(iv) does not include a narcotic drug or a psychotropic substance as defined in the Schedule of the Narcotic Drugs and Psychotropic Substances Act, 1985 (61 of 1985) and rules made thereunder and substances listed in Schedules E and EI of the Drugs and Cosmetics Rules, 1945;

2. "genetically engineered or modified food" means food and food ingredients composed of or containing genetically modified or engineered organisms obtained through modern biotechnology, or food and food ingredients produced from but not containing genetically modified or engineered organisms obtained through modern biotechnology;
3. "organic food" means food products that have been produced in accordance with specified organic production standards;
4. "proprietary and novel food" means an article of food for which standards have not been specified but is not unsafe:
   Provided that such food does not contain any of the foods and ingredients prohibited under this Act and the regulations made thereunder.

Packaging and Labelling of Foods

1. No person shall manufacture, distribute, sell or expose for sale or dispatch or deliver to any agent or broker for the purpose of sale, any packaged food products that are not marked and labelled in the manner as may be specified by regulations.

   Provided that the labels shall not contain any statement, claim, design or device that is false or misleading in any particular concerning the food products contained in the package or concerning the quantity or the nutritive value implying medicinal or therapeutic claims or in relation to the place of origin of the said food products.

2. Every food business operator shall ensure that the labelling and presentation of the food, including their shape, appearance or packaging, the packaging materials used, the manner in which they are arranged and the setting in which they are displayed, and the information which is made available about them through whatever medium, does not mislead consumers.

Restrictions on Advertisement and Prohibition as to Unfair Trade Practices

1. No advertisement shall be made of any food which is misleading or deceiving or contravenes the provisions of this Act, the rules and regulations made thereunder.
2. No person shall engage himself in any unfair trade practice for purpose of promoting the sale, supply, use and consumption of articles of food or adopt any unfair or deceptive practice including the practice of making any statement, whether orally or in writing or by visible representation which
   - (a) falsely represents that the foods are of a particular standard, quality, quantity or grade-composition;
   - (b) makes a false or misleading representation concerning the need for or the usefulness;
   - (c) gives to the public any guarantee of the efficacy that is not based on an adequate or scientific justification thereof.

PROVISIONS RELATING TO IMPORT

All Imports of Articles of Food will be Subject to this Act

1. No person shall import into India
   - (i) any unsafe or misbranded or sub-standard food or food containing extraneous matter;
   - (ii) any article of food for the import of which a licence is required under any Act or rules on regulations, except in accordance with the conditions of the licence; and
   - (iii) any article of food in contravention of any other provision of this Act or of any rule or regulation made thereunder or any other Act.
2. The Central Government shall, while prohibiting, restricting or otherwise regulating import of articles of food under the Foreign Trade (Development and Regulation) Act, 1992 (22 of 1992), follow the standards laid down by the Food Authority under the provisions of this Act and the rules and regulations made thereunder.

SPECIAL RESPONSIBILITIES FOR FOOD SAFETY

Responsibilities of the Food Business Operator

1. Every food business operator shall ensure that the articles of food satisfy the requirements of this Act and the rules and regulations made thereunder at all stages of production, processing, import, distribution and sale within the businesses under his control.

2. No food business operator shall himself or by any person on his behalf manufacture, store, sell or distribute any article of food
   (i) which is unsafe; or
   (ii) which is misbranded or sub-standard or contains extraneous matter; or
   (iii) for which a licence is required, except in accordance with the conditions of the licence; or
   (iv) which is for the time being prohibited by the Food Authority or the Central Government or the State Government in the interest of public health; or
   (v) in contravention of any other provision of this Act or of any rule or regulation made thereunder.
3. No food business operator shall employ any person who is suffering from infectious, contagious or loathsome disease.
4. No food business operator shall sell or offer for sale any article of food to any vendor unless he also gives a guarantee in writing in the form specified by regulations about the nature and quality of such article to the vendor:

   Provided that a bill, cash memo or invoice in respect of the sale of any article of food given by a food business operator to the vendor shall be deemed to be a guarantee under this section, even if a guarantee in the specified form is not included in the bill, cash memo or invoice.
5. Where any food that is unsafe is part of a batch, lot or consignment of food of the same class or description, it shall be presumed that all the food in that batch, lot or consignment is also unsafe, unless following a detailed assessment within a specified time, it is found that there is no evidence that the rest of the batch, lot or consignment is unsafe:

   Provided that any conformity of a food with specific provisions applicable to that food shall be without prejudice to the competent authorities taking appropriate measures to impose restrictions on that food being placed on the market or to require its withdrawal from the market for the reasons to be recorded in writing where such authorities suspect that, despite the conformity, the food is unsafe.

Liability of Manufacturers, Packers, Wholesalers, Distributors and Sellers

1. The manufacturer or packer of an article of food shall be liable for such article of food if it does not meet the requirements of this Act and the rules and regulations made thereunder.
2. The wholesaler or distributor shall be liable under this Act for any article of food which is—
   (a) supplied after the date of its expiry; or
   (b) stored or supplied in violation of the safety instructions of the manufacturer; or
   (c) unsafe or misbranded; or
   (d) unidentifiable of manufacturer from whom the articles of food have been received; or
   (e) stored or handled or kept in violation of the provisions of this Act, the rules and regulations made thereunder; or
   (f) received by him with knowledge of being unsafe.
3. The seller shall be liable under this Act for any article of food which is
   (a) sold after the date of its expiry; or
   (b) handled or kept in unhygienic conditions; or
   (c) misbranded; or
   (d) unidentifiable of the manufacturer or the distributors from whom such articles of food were received; or
   (e) received by him with knowledge of being unsafe.

Food Recall Procedures

1. If food business operator considers or has reasons to believe that a food that he has processed, manufactured or distributed is not in compliance with this Act, or the rules or regulations made thereunder, he shall immediately initiate procedures to withdraw the food in question from the market and consumers indicating reasons for its withdrawal and inform the competent authorities thereof.
2. A food business operator shall immediately inform the competent authorities and co-operate with them, if he considers or has reasons to believe that a food that he has placed on the market may be unsafe for the consumers.
3. The food business operator shall inform the competent authorities of the action taken to prevent risks to the consumer and shall not prevent or discourage any person from co-operating, in accordance with this Act, with the competent authorities, where this may prevent, reduce or eliminate a risk arising from a food.
4. Every food business operator shall follow such conditions and guidelines relating to food recall procedures as the Food Authority may specify by regulations.

ENFORCEMENT OF THE ACT

Authorities Responsible

The authorities responsible for the enforcement of this Act are the Food Authority and the State Food Safety Authorities. They are supposed to monitor and verify that the relevant requirements of law are fulfilled by food business operators at all stages of food business from the farm to the table.

The Central Government has, by notification, established a body to be known as the Food Safety and Standards Authority of India. While the head office of the Food Authority is at Delhi, additional offices may be established in other places in India, if required.

The Food Authority consists of a Chairperson and members, representing the ministries or departments of the Central Government dealing with Agriculture, Commerce, Consumer Affairs, Food Processing, Health, Legistative Affairs, and Small Scale Industries.

All other sectors like the food industry, farmers organisations, retailers organisations, consumer organisations, food technologists or scientists would be well-represented by appointing eminent members from these organisations.

FSSAI Central Advisory Committee

The FSSAI has constituted a 45-member Central Advisory Committee. The chairperson of the Central Advisory Committee is Mr VN Gaur, Chief Executive Officer of FSSAI. Thirty five government officials from the states holding the post of Commissioner of Food Safety have been appointed as members in the committee. The other members are the Director, Confederation of Indian Food Trade and Industry (CIFTI, food wing of FICCI) and representative of the All India Food Processors Association, ie., two persons from the processed food industry, two persons from the agriculture sector, two members from consumers organisations, two members from research bodies and food laboratories sector and the chairperson of the FSSAI Scientific Committee.

At present the Food Safety and Standards Authority of India (FSSAI) has engaged agencies for finalisation of the Food Safety and Quality Standards and Regulatory Guidelines for Food Safety and Standards Authority of India. The Director of FSSAI is Mr SS Chahal.

The agencies shall suggest and finalise the procedure to be followed for assist in notifying standards and guidelines in relation to articles of food meant for human consumption, procedure for making or amending regulations in view of urgency concerning food safety or public health, assist in notifying the regulations pertaining to limits of additives, contaminants, toxicants, heavy metals, etc., tolerance limits of pesticides, veterinary drugs residues, etc., assist in finalising the procedures for manner of marking and labelling of foods, assisting in notifying the conditions and guidelines relating to food recall procedures.

The agencies shall also assist in registration, making application for obtaining licence, the fee payable therefore and the circumstances under which such licence may be cancelled or forfeited, assist in finalising the procedures for getting the food analysed, details of fees, etc., assist in finalising the functions and procedures to be followed by food laboratories, sample analysis procedure to be followed, assist in issuing guidelines or directions for participation in Codex meetings and preparation of response to Codex matters, assist in finalising the duties of Food Safety Officer, Designated Officer and Commissioner of Food Safety.

Rules and Regulations proposed are in consonance with the spirit of the Act and keeping in view best practices followed at International level like EU Food Safety Authority, UK Food Safety Agency, Food and Drug Administration, USA, etc. During drafting of Rules and Regulations as per the provision of the Act, the agency should devise suitable mechanism for interface with industry and consumers. National Level Workshops may be organised and ensured that inputs gathered therein are duly incorporated in the draft.

The state government shall appoint the Commissioner of Food Safety for the State for Efficient implementation of Food Safety and Standards and other requirements laid down under this Act and the rules and regulations. The Commissioner of Food Safety will appoint designated officers, one for each district in a state to be in-charge of food safety administration. The designated officer shall not be below the rank of a sub-divisional officer. The commissioner shall also appoint food safety officers provided they have necessary prescribe qualifications. The Food Safety Officer may take a sample of any food or article or any substance that appears to him to be intended for sale. He is permitted to enter and inspect any place where food is manufactured, stored for sale, stored for manufacture or exposed, or where any adulterant is manufactured or kept. He is responsible for inspection of food business, drawing samples and sending them to Food Analysts for analysis. Analysis of food should be done only in laboratories and research institutions accredited by National Accreditation Board for Testing and Calibration Laboratories. Certified Food Analysts analyse food samples received in sealed sample containers sent by the Food Safety officer. If the quality or purity of the article, being primary food, has fallen below the specified standard or its constituents are present in quantities not within the specified limits of variability, in either case, solely due to natural causes and beyond the control of human agency, then such article shall not be deemed to be unsafe or sub-standard or food containing extraneous matter.

Penalties and Punishments

A person may render any article of food injurious to health by any one or more of the following operations

- adding any article or substance to the food;
- using any article or substance as an ingredient in the preparation of the food;

- abstracting any constituent from the food; or
- subjecting the food to any other process of treatment,

with the knowledge that it may be offered for sale or distributed for human consumption.

This is an offence and is liable to a penalty. The quantum of the penalty will depend on various factors. Any person who sells food that is not in compliance with the provisions of this Act shall be liable to a penalty not exceeding five lakh rupees.

A penalty is imposed for the following

- Food is not of the nature or substance or quality demanded.
- Food is substandard.
- Food is misbranded.
- Advertisements are misleading.
- Extraneous matter is present in food.
- Failure to comply with directions of Food Safety Officer.
- Unhygienic or unsanitary processing of food.
- Possessing adulterants.
- Any other contravention.

Apart from the above penalties, various punishments have been listed that include imprisonment for a term extending from three months to seven years or life imprisonment and also a fine ranging from one to ten lakh rupees.

Punishment is meted out for manufacture, sale storing, distributing or importing unsafe food that may or may not cause injury, serious injury or death; tampering with food, package, labelling of seized items; providing false or misleading information; obstructing or impersonating a Food Safety Officer; carrying out business without licence. If he subsequently commits offences for which he has been convicted earlier, he shall be liable to twice the punishment, fine on a daily basis and cancellation of licence.

The Food Safety and Standards Act, 2006 will extend all over India. It shall come into force on such date as the central government may notify in the Official Gazette.

The following Food Acts/Orders will be officially withdrawn/cancelled on commencement of the provisions of this Act.

1. The Prevention of Food Adulteration Act, 1954 (37 of 1954).
2. The Fruit Products Order, 1955.
3. The Meat Food Products Order, 1973.
4. The Vegetable Oil Products (Control) Order, 1947.
5. The Edible Oils Packaging (Regulation) Order, 1998.
6. The Solvent Extracted Oil, De oiled Meal, and Edible Flour (Control) Order, 1967.
7. The Milk and Milk Products Order, 1992.
8. Any other order issued under the Essential Commodities Act, 1955 (10 of 1955) relating to food.

THE PLASTICS MANUFACTURE, SALE AND USAGE RULES, 1999

In the interest of the public and the environment, the Government has imposed restrictions on the manufacture, sale, distribution and use of virgin and recycled plastic carry bags and recycled plastic containers. No person is allowed to manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags that are less than 8 × 12 inches (20 × 30 cms) in size and 20 microns in thickness.

Carry bags and containers made of recycled plastics should not be used for storing, carrying, dispensing or packaging of foodstuffs. Virgin plastic carry bags and containers should be in natural shade or white. Recycled plastic carry bags and containers that are used for purposes other than storing and packaging food stuffs may be coloured using certified pigments and colourants.

Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standards specification IS : 14534 : 1998 entitled 'The Guidelines for Recycling of Plastics'. Plastic manufacturers need to register their unit with the State Pollution Control Board Pollution Control Committee prior to commencement of production to ensure that liquid effluent and gaseous emissions from their unit do not pollute the water supply and air in the vicinity. The State Pollution Control Board issues a registration certificate valid for a period of three years. This certificate is issued only after receiving a valid consent from water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981. The solid wastes generated, mode of storage within the plant and provision made for disposal is also ascertained.

Table 17.1 **Technological conditions for irradiation**

Sl. No.	*Name of food*	*Purpose of Irradiation*	*Dose (KGy)*			*Specific Conditions*
			Minimum	*Maximum*	*Overall Average*	
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
1.	Onions	To inhibit sprouting	0.03 (30 Gy)	0.09 (90 Gy)	0.06 (60 Gy)	
2	Potatoes	To inhibit sprouting	0.06 (60 Gy)	0.15 (150 Gy)	0.10 (100 Gy)	
3.	Frozen sea-foods	To reduce the number of certain pathogenic microorganisms such as Salmonella in packaged frozen sea-foods	4	6	6	Irradiation should be carried out in a frozen state
4.	Spices	To control insect infestation to reduce microbial load and pathogenic microorganisms	6	14	10	Irradiation under pre-packed condition
5.	Rice	To control insect infestation	0.25	1.0	0.62	Irradiation under pre-packed condition
6.	Semolina (Sooji or Rawa), Wheat atta and Maida	To control insect infestation	0.25	1.0	0.62	Irradiation under pre-packed condition

Contd...

Table 17.1 (Contd)

Sl. No.	*Name of food*	*Purpose of Irradiation*	*Dose (KGy)*			*Specific Conditions*
			Minimum	*Maximum*	*Overall Average*	
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
7.	Mango	To improve shelf-life and for quarantine purposes	0.25	0.75	0.50	–
8.	Raisins, Figs, and Dried Dates	To control insect infestation	0.25	0.75	0.50	Irradiation under pre-packed condition
9.	Ginger, Garlic and Shallots (Small onions)	To inhibit sprouting	0.3	0.15	0.09	–
10.	Meat and Meat products including Chicken	To reduce number of spoilage microorganisms and certain pathogenic microorganisms and parasites	2.5	4.0	3.25	Irradiation under pre-packed condition and to be carried at 0–3°C

Source: Professionals—The PFA Act 1954, 2007, p. 535

THE ATOMIC ENERGY (CONTROL OF IRRADIATION OF FOOD) RULES 1996

Foodstuff is subjected to ionising radiation for its preservation, protection against parasites or improvement of its hygienic or technological quality. Irradiation of food should not be undertaken unless it is really necessary. A licence is required for operating an irradiation facility where food is subjected to radiation.

General Conditions for Irradiated Foods

General Conditions for the Process

Radiation source The following types of ionizing radiation may be used

(a) Gamma rays from the radionuclides 60 Co or 137 Cs;
(b) X-rays generated from machine sources operated at or below an energy level of 5 MeV;
(c) Electrons generated from machine sources operated at or below an energy level of 10 MeV.

Absorbed dose The overall average dose absorbed by a food subjected to radiation processing should not exceed 10 KGy.

Facility and control of the process Radiation treatment of foods shall be carried out in facilities licensed and registered for this purpose by the licensing authority.

Technological Requirements

Conditions for irradiation The irradiation of food is justified only when it fulfils a technological need.

Food quality and packaging requirements The doses applied shall be commensurate with technological and public health purposes to be achieved and shall be in accordance with good radiation processing practice. Foods to be irradiated and their packaging materials shall be of suitable quality, acceptable hygienic condition and appropriate for this purpose and shall be handled, before and after irradiation, according to good manufacturing practices taking into account the particular requirements of the technology of the process.

Labelling

For irradiated foods, whether prepacked or not, the relevant shipping documents shall give appropriate information to identify the registered facility that has irradiated the food, the date(s) of treatment and lot identification. Packed foods should have the irradiation logo clearly visible on the package.

Re-irradiation

Except for foods with low moisture content (cereals, pulses, dehydrated foods and other such commodities) irradiated for the purpose of controlling insect reinfestation, foods shall not be re-irradiated.

Food may be packed before treatment to prevent post-treatment recontamination. Standards set for packaging material should be strictly adhered to. A Radiological Safety Officer with requisite qualifications should be appointed to ensure that suitable safety measures and work practices are aimed at to minimise exposure of workers to radiation and carry out leakage tests to prevent radiation hazards. All records need to be maintained for inspection of the facility and a radiation warning symbol indicating irradiation is in progress needs to be displayed.

Unsafe Food

An article of food whose nature, substance or quality is so affected as to render it injurious to health: —

(i) by the article itself, or its package thereof, which is composed, whether wholly or in part, of poisonous or deleterious substances; or
(ii) by the article consisting, wholly or in part, of any filthy, putrid, rotten, decomposed or diseased animal substance or vegetable substance; or
(iii) by virtue of its unhygienic processing or the presence in that article of any harmful substance; or
(iv) by the substitution of any inferior or cheaper substance whether wholly or in part; or
(v) by addition of a substance directly or as an ingredient that is not permitted; or
(vi) by the abstraction, wholly or in part, of any of its constituents; or

(vii) by the article being so coloured, favoured or coated, powdered or polished, as to damage or conceal the article or to make it appear better or of greater value than it really is; or
(viii) by the presence of any colouring matter or preservatives other than that specified in respect thereof; or
(ix) by the article having been infected or infested with worms, weevils or insects; or
(x) by virtue of its being prepared, packed or kept under insanitary conditions; or
(xi) by virtue of its being misbranded or sub-standard or food containing extraneous matter; or
(xii) by virtue of containing pesticides and other contaminants in excess of quantities specified by regulations.

ADULTERATION

Adulteration of food consists of a large number of practices such as mixing other food or non-food items, substitution, extraction, concealing the quality, selling decomposed food, misbranding or giving false information on the labels and addition of poisonous or toxic substances to food.

Food adulteration has an economic significance and with increasing prices the unscrupulous traders indulge in adulteration to exploit people. Some forms of adulteration are injurious to health, for example, addition of argemone oil to mustard oil. The consumer looks for dealers who supply food at a lower rate, ignorant of the fact that the cheaper substitute may be adulterated. The consumer may be attracted by apparent improvements in colour, taste and aroma caused by using compounds which are banned by law. Consumption of adulterated food leads to ill health and food poisoning.

Definition: According to the Indian Prevention of Food Adulteration Act (PFA) 1954, a food is said to be adulterated if it has any ingredient which is injurious to health.

A food is said to be adulterated if

1. it contains any poisonous or deleterious substance which may render it injurious to health (unless naturally present in less than harmful level)
2. it bears or contains any added poisonous or added deleterious substance which is unsafe
3. it contains in whole or in part any filthy, putrid or decomposed substance, or if it is otherwise unfit for consumption
4. it has been prepared, packed or held under insanitary conditions
5. it is, in whole or in part, the product of a diseased animal or of an animal which has died otherwise than by slaughter
6. if its container is composed, in whole or in part, of any poisonous or deleterious substance which may render the contents injurious to health.

MISBRANDING

A food is misbranded if its labelling is false or misleading in any particular. A food is deemed to be misbranded if it contains a chemical preservative, which is not stated on the label. The Prevention of Food Adulteration Act, 1954 states that the term ‘chemical preservative’ means any chemical which, when added to food, tends to prevent or retard deterioration but does not include common salt, sugar, vinegar, spices or oils extracted from spices or substances added by wood smoke.

Table 17.2 Description of Food Samples Analysed at Public Health Laboratories in Maharashtra State during Year 2009

No	Month	Food and drug administration			Local bodies			Govt. bodies			Private bodies			Grand total		
		Receipt	Examined	Adulterated	Receipt	Examined	Adulterated	Receipt	Examined	Adulterated	Receipt	Examined	Adulterated	Receipt	Examined	Adulterated
1.	Jan.	1623	1668	137	332	385	21	865	1083	47	2609	2205	10	5429	5341	215
2.	Feb.	1879	1603	107	496	264	31	1192	1111	26	1999	2480	11	5566	5458	173
3.	March	2005	1731	186	523	412	34	1205	1121	26	2877	2941	22	6610	6205	268
4.	April	3799	1882	215	434	375	43	601	883	29	1539	1770	21	3799	4910	308
5.	May	944	1519	181	348	608	43	949	929	36	1404	1619	3	3645	4675	263
6.	June	1095	986	139	266	416	43	387	707	60	1628	1808	9	3415	3917	212
7.	July	1437	1410	176	542	473	48	535	767	25	3235	2945	7	5749	5595	256
8.	Aug.	1360	1320	130	267	358	63	792	567	21	2335	2791	15	4754	5036	229
9.	Sept.	1698	1337	176	385	330	57	3305	1073	132	1425	1442	29	6813	4182	394
10.	Oct.	1537	1453	145	383	999	31	1475	2016	174	1715	1148	7	5110	4916	357
11.	Nov.	1465	1472	211	275	358	44	1177	2025	232	2091	1577	178	4466	5432	427
12.	Dec.	1405	1557	189	345	352	64	995	931	81	1397	1877	26	4142	4717	360
	Total	20247	17938	1992	4596	5330	522	13478	13213	889	24254	24603	338	59498	60384	3462

An article of food is said to be misbranded

(A) if it is purported, or is represented to be, or is being—
  (i) offered or promoted for sale with false, misleading or deceptive claims either:
    (a) upon the label of the package, or
    (b) through advertisement, or
  (ii) sold by a name that belongs to another article of food; or
  (iii) offered or promoted for sale under the name of a fictitious individual or company as the manufacturer or producer of the article as borne on the package containing the article or the label on such package; or

(B) if the article is sold in packages that have been sealed or prepared by or at the instance of the manufacturer or producer bearing his name and address but—
  (i) the article is an imitation of, or is a substitute for, or resembles in a manner likely to deceive, another article of food under the name of which it is sold, and is not plainly and conspicuously labelled so as to indicate its true character; or
  (ii) the package containing the article or the label on the package bears any statement, design or device regarding the ingredients or the substances contained therein, which is false or misleading in any material particular, or if the package is otherwise deceptive with respect to its contents; or
  (iii) the article is offered for sale as the product of any place or country which is false; or

(C) if the article contained in the package—
  (i) contains any artificial flavouring, colouring or chemical preservative and the package is without a declaratory label stating that fact or is not labelled in accordance with the requirements of this Act or regulations made thereunder or is in contravention thereof; or
  (ii) is offered for sale for special dietary uses, unless its label bears such information as may be specified by regulation, concerning its vitamins, minerals or other dietary properties in order sufficiently to inform its purchaser as to its value for such use; or
  (iii) is not conspicuously or correctly stated on the outside thereof within the limits of variability laid down under this Act.

Table 17.3 Some Simple Tests for Detecting Common Adulterants in Food

S.No.	*Food stuff*	*Adulterant*	*Test*
1.	Asafoetida	Scented and coloured resin or gum	Pure asafoetida dissolves in water to form a milky white solution
2.	*Bajra*	Grains infested with ergot fungus	Infested grains will have an off taste and will float on water
3.	Betelnut powder (*supari*)	Saw dust and artificial colour	Saw dust will float in water and added colour will dissolve in water
4.	Bura sugar	Washing soda	Gives effervescence with hydrochloric acid if washing soda is present; if dissolved in water, soda will turn red litmus blue

Contd...

Table 17.3 (Contd)

S.No.	Food stuff	Adulterant	Test
5.	Cardamom	Essential oil is removed and pods are coated with talcum powder	Talcum can be rubbed off the pods; on tasting, if there is hardly any aromatic flavour, it indicates removal of essential oil
6.	Chilli powder	Saw dust and artificial colour	Saw dust will float in water and added colour will dissolve in water
7.	Cinnamon	Cassia bark	Thick bark with less aroma than pure cinnamon, which is thin, shows adulteration
8.	Cloves	Volatile oil may be removed	If oil is removed, cloves appear shrunken in appearance
9.	Coconut oil	Any other oil	Refrigerate oil in a bottle. Pure coconut oil solidifies leaving the adulterant as a separate layer
10.	Coffee	Chicory	Shake a small sample in cold water, coffee will float while chicory will sink and stain the water brownish
11.	Coriander powder	Powdered horse dung	When powder is soaked in water, horse dung will float
12.	Cumin seeds	Grass seeds coloured with charcoal dust	If rubbed in hands, finger will turn black
13.	Edible oil	Argemone	A reddish brown precipitate is formed when oil and hydrochloric acid are gently mixed with ferric chloride solution if argemone is present
14.	Ghee (pure)	Vanaspati	Dissolve a large pinch of cane sugar in 10 ml concentrated hydrochloric acid. Add 10 ml of melted ghee and shake thoroughly for two minutes. Allow it to stand for 10 minutes. If vanaspati is present, aqueous layer will turn red
15.	Groundnut oil	Cotton seed oil	Mix 2.5 ml of oil/fat with 2.5 ml Halphens reagent. Lightly screw cap and heat in boiling water for 30 minutes. The test is positive if a rose colour is obtained

Contd...

Table 17.3 (Contd)

S.No.	Food stuff	Adulterant	Test
16.	Mawa	Starch	Add tincture of iodine, development of blue colour indicates presence of starch
17.	Milk	Water	Lactometer reading should not ordinarily be less than 1.026
		Starch	Add tincture of iodine, development of blue colour indicates presence of starch
18.	Mustard seeds	Argemone seeds	Visual examination, small black seeds resembling mustard but not uniformly smooth or round are visible under a magnifying glass
19.	Peppercorns	Dried papaya seeds	Visual examination
20.	Pulses (whole)	Insects, larvae	Grains float on water and unpleasant odour and taste is seen
21.	Pulses (split and dehusked)	Kesari dal and metanil yellow	Visual examination reveals wedge shaped dal and, on addition of concentrated hydrochloric acid, yellow dal turns magenta red
22.	Saffron	Dried, coloured and scented maize fibres	Genuine saffron is tough. Maize fibres break easily and dissolve in water giving instant aroma of saffron
23.	Sago	Sand and talcum	Gritty feel in mouth; pure sago swells on burning leaving very little ash
24.	Semolina	Iron filings	Pass magnet through semolina. Iron filings will cling to it
25.	Sugar	Chalk powder	Dissolve sugar in a glass of water, chalk will settle down at the bottom
26.	Tea dust	Used tea leaves which have been dried, powdered and coloured	Sprinkle dust on wet white filter paper. Spots of yellow, pink and red appearing on paper indicate artificial colouring
27.	Turmeric powder	Metanil yellow colouring	If metanil yellow is present, a magenta colour develops when conc. HCl is added to a solution of turmeric powder
28.	Varaq (Silver foil)	Aluminium foil	On igniting, genuine silver burns leaving a shining white ball while aluminium is reduced to dark grey black ash. Silver foil is delicate and crumbles, while aluminium is thicker and breaks into shreds

Prevention of Food Adulteration

1. Purchase food from authorised dealers only. Children should be discouraged from purchasing sweets, kulfis and ice creams from hawkers as they are likely to contain harmful colours and artificial sweeteners.
2. Before purchasing processed food items like masala powders, canned foods, bottled preserves, etc., check the "Best Before" date and Agmark/ISI mark/FPO licence.
3. Always ask for a cash or credit memo for all purchases. It helps the consumer in filing a complaint if necessary.
4. Destroy labels on empty tins, cartons and bottles before selling them to scrap dealers as they are likely to be misused for repacking spurious and adulterated food stuffs.
5. Keep drugs, preservatives and detergents away from food stuffs to prevent accidental adulteration.
6. Always purchase food articles in sealed, intact packages.
7. Insist on Agmark, ISI mark or FPO licence.

LOCAL HEALTH AUTHORITY

The legislation that most directly affects the food handler working in a catering establishment is the Prevention of Food Adulteration Act, 1954 and Rules, 1955. This legislation is enforced by the local health authorities in their respective area through Sanitary Inspectors and Food Inspectors. Apart from enforcing legislations, these inspectors/officers are available to give advice and guidance on any matter pertaining to food hygiene.

Application for a Licence

Before starting any food business, the food service operator should apply for a licence in the prescribed form to the licensing authority and pay a fee for the licence. According to the PFA Act, 1954, no person is allowed to manufacture, sell, stock, distribute or exhibit for sale any food article without a valid licence. This licence is issued by the local health authority after necessary inspection of the premises.

The Sanitary Inspector visits the premises and checks the following points:

1. whether the premises conform to the municipal corporation norms. If the structure is an authorised one, a permanent licence may be issued. If the building or structure is unauthorised, a temporary licence is issued for 11 months.
2. sanitation of the site
   (a) whether surroundings are clean and free from any pollutants
   (b) drainage facilities and waste disposal facilities available
   (c) potable water supply
   (d) ventilation and lighting in the kitchen
   (e) a bin for temporary disposal of garbage

Once the licence is issued, it should be renewed every two years. A licence once issued, may be suspended or cancelled if the licence holder does not comply with the regulatory requirements or if the food service operation constitutes a major health hazard.

ATTRACTIVE COLOURS DANGEROUS TOXINS

We all have a weakness for bright colours, and in food, we associate them with freshness and purity. But we ... wrong as sellers often ... tendency in us ... but toxi...

It is regrettable that in today's so-called enlightened age, the use of chemical additives, such as artificial colours, flavours, preservatives etc is becoming more of a rule than an exception.

And this is happening despite the fact that these additives not only cause digestive problems by negatively affecting the working of the digestive enzymes and ... also ca...

70% of edible oil in state is adulterated: FDA

The Times of India News Service

MUMBAI: As much as 70 per cent of high-value edible oils like groundnut and coconut are adulterated in Maharashtra, according to food and drugs administration (FDA) commissioner Anilkumar Lakhina. Rs 1,000-crore worth of edible oil is produced and marketed annually in the state.

He was addressing a ... raised here recently ... Merchants Chamber ...

Also, regular inspection of stocks in drug stores by FDA officials has shown that "every ninth capsule or pill sold is substandard," he said.

Of the 4,500 drug manufacturers in Maharashtra, 66 companies produce as much as 70 per cent of the drugs. There are more than 40,000 drugs and formulations in the market. "My experience shows that multinational companies are no torch-bearers of quality," he added.

... spends not even 0.0001 per cent on their quality management," he lamented.

Maharashtra is better off than other states in terms of infrastructure and enforcement machinery, he said. However, the FDA in the state should be in tune with regulatory authorities of the developed world. The pharmaceutical industry in Maharashtra supplies 60 per cent of the nation's drugs and most of the imports of life-saving pharma products and medical devices are routed through Mumbai port. "Yet it is not possible for us to state confidently that the majority of food items available here are unadulterated or the drugs and medical devices are safe and effective. There is need ... tremendous effort to measure ... expectations."

He said there is a silver lining since there is a proposal to get World Bank funding on a grant basis for creating larger contingents of trained manpower and laboratories. The FDA, Maharashtra may restructure itself on the lines of the USFDA.

Mr Lakhina confessed that the FDA does not succeed in prosecutions in a majority of the cases. "All violations under the Drugs and Cosmetics Act are cognisable and they are regarded as crimes against society. Yet, the conviction rate is not even one per cent. The minimum time lag between the date of launching a case in courts and securing a decision is six years." The commissioner said 167 drug inspectors and 247 food inspectors spend 40 per cent of their time in commuting between their office and the courts, counselling police prosecutors and preparing briefs. "The defenders of delinquents fight to the last drop of their blood. The cost of bringing the offenders to book is enormous, but ineffective," he regretted.

... admitted that there is a ... flaw in the FDA being a two-track hierarchy of food and drug inspectors ... running parallel ... need to merge them.

Thane food poisoning: 6 held, shops sealed

EXPRESS NEWS SERVICE
THANE, AUG 29

THE Thane police today arrested six persons in connection with the food poisoning case which left at least 15 children ill after they consumed *pedas* on the occasion of Naral Poornima on Wednesday.

Police gave the names of the arrested as Dalaram Chowdhari of the Mamta Sweet Mart, Mohanlal Oza of the Prashant Sweet Mart, Vijay Gupta of the Omprakash sweetmart and Maniklal Vyas of the Laxmi Sweet Mart.

Police said that eight children are still in the hospital and are stated to be out of danger.

The trouble started after residents of the Ambikanagar and Loius Wadi in Wagle Estate consumed *pedas* on Wednesday. Soon, the children started complaining of loose motions, vomiting, nausea, suffocation and giddiness and were rushed to the Childrens Hospital at Naupada.

Of the thirteen admitted to the hospital, five ... charged the ...

One o... correspo... panic all ov... the food poi... area - "The ... food poisonin... district which ... lives, it seems, ... their minds," he sa...

On August 15, m... hundred school chi... Bhiwandi and Mumb... after consuming *pedas* at I... pendence Day functions.

The children were treate... the Thane civil, Bhiwandi ... and Kalwa civic hospitals. O... ers of a sweets' shop were ... rested in this connection an... manded to police custody.

The State Government ... taken a serious view of the ... ter and Chief Minister Man... Joshi and Health Mini... Daulatrao Aher had rushe... Thane to take stock of the si... tion. Joshi had ordered the ... trict officials to take strin... action against those fc... guilty.

Hotel's catering house sealed

RAJKOT: The Health Department of the Municipal Corporation has sealed the catering house of a hotel that supplied food including sweets for a dinner party here on Sunday night, leading to hospitalisation of 200 persons for suspected food poisoning. The squ... of the Health Department seized stale food and rotten veg... weighing over 200 kgs. from the hotel premises. The Hea... officials found that cleanliness was not being m... of the hotel. All the affected, who ate ... sweet dish at the party on ... it was officially stated. (PTI)

80 TN kids take ill after eating sweets

The Times of India News Service

CHENNAI: Over 80 children and 10 adults in Salem took ill after consuming date-expired chocolates discarded by a shopkeeper. The victims, including three men and seven women, were admitted to hospital on Thursday.

The hospital authorities said those admitted were recovering and would be discharged by Friday. Six of the victims, who had apparently taken about 20 chocolates each, were put on drips, said the medical officer.

A report from Salem said a local shopkeeper had discarded in a garbage dump some 70 cartons of chocolates. The were picked up and consumed by passing children.

The shopkeeper has been arrested for negligence. The discarded chocolates, with the 1989 expiry date, was manufactured by a Goa-based company, said the police

Fig. 17.2 *Why sanitation regulations and standards are necessary*

Conditions for Licence

1. The premises should be free from sanitary defects.
2. No employee should suffer from a contagious or infectious disease.
3. The manufacturers should maintain a record of food articles received, sold or dispatched.
4. A notice in English or Hindi should clearly state the kind of products being sold.
5. Hawkers should wear a metallic badge with licence number, name and nature of article for sale.
6. A licencee shall manufacture or sell pure products only. If any substance is mixed, it should be mentioned on the label.
7. Shopkeepers and proprietors of hotels and restaurants selling sweet or savoury snacks, should clearly mention the cooking media (ghee, edible oil, hydrogenated vegetable fat or any other fat) used in preparing sweetmeats and savouries. This information should be clearly displayed on a noticeboard in the premises.
8. Food should not be served or covered with printed paper, waste paper or newspaper.
9. An application for renewal of licence should be made at least 30 days before expiry of existing licence.
10. Food articles which are not meant for human consumption should not be stored or sold on the same premises as edible food items.
11. No person shall manufacture, store or sell any article of food in any premises not effectively separated from any toilet, urinal, drain or garbage dump.

Food Inspectors

They are appointed by the government and report to the local health authority, i.e., the medical officer of health.

Powers of food inspectors

1. to collect samples of any food article and send it to the laboratory for analysis
2. to inspect any food premises
3. to prohibit the sale of any article of food in the interest of the public, having taken prior permission from the authorities.

Duties of food inspectors

1. to inspect licensed establishments and check that conditions of licence are being observed
2. to collect and send suspect food samples for analysis
3. to investigate complaints
4. to stop any vehicle carrying food or detain imported food packages which may contain prohibited items of food
5. to record all inspections and submit a report to medical officer of health

Each food inspector should collect and send at least ten food samples per month for analysis to the laboratory.

If the result is unfavourable, the punishment includes imprisonment for a term of six months to three years and a fine of not less than rupees one thousand.

All cases of food poisoning should be reported to the nearest authority, i.e. the municipal corporation or the police. Suspected food samples are sent to the public health laboratory for analysis. If food samples are not available, then a sample of vomit or a rectal swab may be sent for analysis.

Medical Examination

All workers who handle food and food contact surfaces should be medically examined in corporation hospitals every six months. The establishment should maintain a record of six monthly medical reports for each employee and submit the same to the food inspector, when asked for.

Food Inspection Report

Food inspectors should make surprise visits to catering establishments and check whether the following points are being followed according to the standards laid down in the Municipal Health Laws:

1. quality of food used
2. potability of water and ice and its storage
3. food handling practices
4. food storage, preparation and holding area; temperature control
5. dishwashing and storage area
6. drains and sinks and sewage disposal
7. flooring, ceilings, walls and their maintenance; ventilation and lighting
8. personal hygiene of food handlers and servers
9. protective clothing
10. dining rooms and service areas
11. garbage bins and garbage disposal
12. various storage areas (separate for different activities)
13. presence of pests and precautions taken
14. staff room for employees, adequate sanitary accommodation for employees and customers
15. utensils, equipment maintenance and installation

The food inspector should maintain a record of all inspections made and action taken, to the medical officer of health. If it is observed that conditions mentioned in the licence are not being followed, the local health authority serves a notice to the establishment demanding that the lapses should be rectified within a stipulated period and checks whether corrections have been made.

Apart from this, the local health authority holds exhibitions for food handlers with the help of the public health laboratory, to educate members of the industry. They also help food handlers to avoid misleading the public by false or misleading labelling and advertising. They check water supply and pollution and report such cases also.

Table 17.4 Samples Examined in the Public Health Labs in the State from 2004–05 to 2009–10 (up to Dec. 2009)

S. No.	Type of Samples	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10 (upto Dec. 09)
1.	**Water Quality Monitoring**						
	Water samples tested at PH labs	566750	436144	384203	436485	380813	378964
	Water samples tested at mini labs	277756	377245	381702	412717	386262	411948
2.	**Rectal Swabs Examined**	6480	6699	3149	4992	2917	3318
	Stool samples Positive for *V. Cholerae* O-1	650	761	282	783	189	396
	Stool samples Positive for *V. Cholerae* O-139	Nil	Nil	Nil	Nil	Nil	Nil
	Stool samples Positive for *V. Cholerae* non O1	7	10	6	10	18	17
	Salmonella and other *Vibrio*	5	10	1	13	10	2
3.	**Food Sample Examination (Microbiological)**	1717	1567	1531	1060	2392	1830
4.	**Blood Sample for *S. typhi***	172	340	447	380	156	95
5.	**Chemical Water Sample Examination**						
	Chemical potability	6784	7364	8438	9236	17839	19582
	Sewage (M.P.C.B)	2	4	18	72	11	11
	Sewage and other samples	377	417	364	395	1072	1141
	Bleaching powder samples	50628	62458	51825	56484	94862	104511
	Alum samples	780	840	856	840	1450	1560
	Water samples for fluoride	803	2783	483	1888	2370	2391
	Other	96	529	3142	367	770	827
6.	**Food Sample Examination**						
	Total samples examined	41855	36698	39115	50767	54431	38663
7.	**Urine Samples under IDD Programme**	1697	1267	1380	2955	2226	832
8.	**Iodised Salt Samples**	7319	5799	4021	18393	19223	14421

Municipal Health Laws

Rules Regarding Grading of Hotels and Restaurants Grading shall be done totally on the basis of 100 points. Out of 100 points, 75 points shall be given for matters specified in Schedule C. The remaining 20 points are for aspects specified in Schedule A and 5 points for facilities as per Schedule B given in the following pages.

If the licencee does not observe the rules and conditions specified in the licence, he or she shall be refused licence. If the licencee observes the rules and conditions as per schedule A, B, C, he or she may be given points for them. If the licencee does not observe special and important rules, he or she may be given minus points, as observance of these rules are legally binding on the licencee.

Grading

Points	*Grading*
35–50	C
51–80	B
81–100	A

If any hotel/restaurant does not qualify for any of the above grades then the concerned licencee is liable for prosecution, or the concerned licence may be suspended or cancelled or the concerned hotel shall be permanently graded C.

Schedule A Grading chart for maintaining general cleanliness at hotels and eating places:

		Points
1.	a place providing for cleaning with detergent or soap and disinfecting and air drying of cooking vessels, cups, saucers, etc.	3
2.	a place providing for washing with soap and water and disinfecting of hands and feet of employees	3
3.	physical cleanliness (daily baths, care of hair and nails, clean uniform, etc.) of employees	3
4.	an independent rest-room for employees and a locker arrangement for their clothes, etc.	3
5.	an arrangement to keep off flies from the place of storage of food stuff and the kitchen	3
6.	cleaning with disinfectant of floor and walls (up to height of 1.8 m (6 feet))	1
7.	a separate place for service of eatables and regular cleaning of tables	1
8.	a place with a location to transfer garbage from the area of activity, at least thrice a day	1
9.	a wash place with soap and clean towels for customers	1
10.	hygienic cleaning of trays used for service of eatables	1

Schedule B Grading chart for maintaining a special arrangement to augment natural light and ventilation:

		Points
1.	arrangement to maintain a reasonable temperature or artificial ventilation	2
2.	a coat of oil paint on all walls at the work place	1
3.	chimney or an exhaust to reduce suffocation due to smoke where coal or coke is used. Where coal is not used as fuel, one additional point each for 1 and 2 be granted	2

Schedule C General rules:

		Points
1.	The licence must be displayed at an easily visible location	1
2.	eatables and beverages must be prepared at a completely separate location	3
3.	a wash place of necessary measurement must be built at the work place and be connected with a municipal water supply with a meter; drainage from the wash place must be appropriately connected to the municipal drainage system	2
4.	The floors must be tiled or impervious to disallow seepage; this floor must be washed once a day	10
5.	vessels, cups and saucers, glass and other equipment must be thoroughly clean before and after use	10
6.	employees' clothing must be kept clean, people suffering from contagious or skin diseases must not be employed; employees must be provided with towels and soaps; they must not serve or handle items on sale without cleaning their hands	10
7.	garbage must be collected in containers coated with tar, inside and outside; such garbage must be emptied at least twice a day at a municipal garbage bin and cleaned	2
8.	walls and ceilings must be white washed twice a year (i.e., first week of April and October); if walls are oil painted or varnished, they must be cleaned suitably	10
9.	eatables must be stored in glass cases that keep flies and dust away; eatables must be prepared only in the kitchen	10
10.	drinking water must be stored in a clean vessel which is placed at least 38 cm above the floor and should have tight fitting lids with a tap	10
11.	the licenced premises must not in any way be connected with a lavatory or open drainage; the licenced premises must not be used as boarding	5
12.	general cleanliness must be maintained	2

	Points
Schedule A	20
Schedule B	05
Schedule C	75
Total	100

Grading should be done every two to three years.

Format for Obtaining a Licence

Muncipal Corporation
Food Licensing Section
Application/Renewal

Form No. ______
Price Re 1.00
Salestax 0.10
Total 1.10

FORM A
(According to Rule No. 5)

(An application for manufacturing eatables for selling, stocking, distributing on a commercial basis under the PFA Act 1955, Rule No 50.)

To,

The Food Licensing Authority

1. I (Full Name of licencee)______________________________
   Age (years)__________ Female/Male ______________________
   Address ______________________
   ____
2. Address of business place ______________________
   ____
3. Type of business and name of establishment ______________________
   ____
   (Preparation/storage/sale/distribution)
4. Is the building an authorised construction or any other ______________
   ____
5. Total area of business premises ______________________
   ____
6. What is the annual rate of turnover ______________________
   ____
7. In my absence Mr/Ms ______________________
   Complete address ______________________
   Age__________ M/F will look after this work.
8. Do the business premises belong to you (if not, attach letter from owner giving permission to start business) ______________________
   ____

9. As per PFA Act (Maharashtra Amendment Act, 1962), the licencee fee of Rs ______ is being paid.
10. Names ______
    Addresses and ______
    Age of partners if any ______

I hereby certify that I am fully aware of the rules and regulations of the Prevention of Food Adulteration Act 1954 and the information given in the above form for obtaining a licence in the corporation limits, to the best of my knowledge, is true and correct.

Date   Signature

Following documents are to be attached:

1. a copy of completion certificate of building.
2. if place is rented, receipt of rent paid/owners permission to start business.
3. proof of ownership of building.
4. for handcart business: two photographs and copy of licence/permission from anti-encroachment division.
5. for medical stores: permission from Joint Commission Food and Drug Administration.
6. if construction is unauthorised an agreement on Rs 10 stamp paper.
7. photocopy of partnership deed if business is in partnership.
8. no objection certificate from corporation.

SUMMARY

The function of the regulatory agencies is to ensure the wholesomeness of food and maintenance of sanitary conditions during its preparation, service, transportation or storage. These agencies work in the interest of the public and prevent the spread of food-borne illnesses.

The regulatory and advisory agencies of the government recommend standards and administer controls that directly or indirectly affect all food operators. The latest food law is the food safety and standards Act 2006 which is an integrated food law which consolidates all the laws relating to food. It has been formulated after reviewing the International laws and agreements. The medical officer health is the food authority or local authority for municipal corporations. He or she is assisted by food inspectors and sanitary inspectors. Food samples collected from various establishments by food inspectors are analysed in the state public health laboratories to check whether they conform to the set standards.

To control food quality, and to prevent adulteration and misbranding of food, various standards have been laid down for different food commodities. The legislation that most directly affects the food handler is the PFA Act, 1954 and Rules 1955, which have been modified and updated from time to time. All food service operators require a permit or licence to manufacture, stock, sell or distribute food. This licence is issued by the local health authority. Hotels and restaurants are graded on the basis of rules formulated by the municipal corporation called the Municipal Health Laws. Licences may be suspended or cancelled if rules and conditions specified in the licence are not observed.

KEY TERMS

Adulterant Any material that is used for making the food unsafe or sub-standard, misbranded or containing extraneous matter.

Consumer Persons and families purchasing and receiving food in order to meet their personal needs.

Contaminant Any substance, whether or not added to food, but that is present in such food as a result of the production (including operations carried out in crop husbandry, animal husbandry or veterinary medicine), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination and does not include insect fragments, rodent hairs and other extraneous matter.

Extraneous Matter Any matter contained in an article of food that may be carried from the raw materials, packaging materials or process systems used for its manufacture or which is added to it, but such matter does not render such article of food unsafe.

Food Any substance, whether processed, partially processed or unprocessed, which is intended for human consumption and includes primary food genetically modified or engineered food or food containing such ingredients, infant food, packaged drinking water, alcoholic drink, chewing gum and any substance, including water used into the food during its manufacture, preparation or treatment but does not include any animal feed, live animals unless they are prepared or processed for placing on the market for human consumption, plants prior to harvesting, drugs and medicinal products, cosmetics, narcotic or psychotropic substances.

Food Additive Any substance not normally consumed as a food by itself or used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may be reasonably expected to result (directly or indirectly), in it or its by-products becoming a component of or otherwise affecting the characteristics of such food but does not include "contaminants" or substances added to food for maintaining or improving nutritional qualities.

Food Authority The Food Safety and Standards Authority of India established under Section 4.

Food Business Operator In relation to food business means a person by whom the business is carried on or owned and is responsible for ensuring the compliance of this Act, rules and regulations made thereunder.

Food Code A method code published by the US food and Drug Administration in 1993 to ensure a uniform system of regulations that are consistent with federal food laws to ensure a safe supply.

Food Laboratory Any food laboratory or institute established by the Central or a State Government or any other agency and accredited by National Accreditation Board for Testing and Calibration Laboratories or an equivalent accreditation agency and recognised by the Food Authority under Section 43.

Food Safety Assurance that food is acceptable for human consumption according to its intended use.

Food Safety Audit A systematic and functionally independent examination of food safety measures adopted by manufacturing units to determine whether such measures and related results meet with objectives of food safety and the claims made in that behalf.

Food Safety Management System The adoption of Good Manufacturing Practices, Good Hygienic Practices, Hazard Analysis and Critical Control Point and such other practices as may be specified by regulation, for the food business.

Hazard A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Ingredient Any substance, including a food additive used in the manufacture or preparation of food and present in the final product, possibly in a modified form.

Label Any tag, brand, mark, pictorial or other descriptive matter, written, printed stencilled, marked, embossed, graphic, perforated, stamped or impressed on or attached to container, cover, lid or crown of any food package and includes a product insert.

Misbranding False or misleading labelling in respect of any particular on the lable/ container.

Package A pre-packed box, bottle, casket, tin, barrel, case, pouch, receptacle, sack, bag, wrapper or such other things in which an article of food is packed.

Premises Include any shop, stall, hotel, restaurant, airline services and food canteens, place or vehicle or vessel where any article of food is sold or manufactured or stored for sale.

Risk In relation to any article of food, means the probability of an adverse effect on the health of consumers of such food and the severity of that effect, consequential to a food hazard.

Standard In relation to any article of food, means the standards notified by the Food Authority.

Standard Purchase Specification Written guidelines that clearly define the quality, quantity and specific characteristics of the products to be purchased.

Substance Includes any natural or artificial substance or other matter, whether it is in a solid state or in liquid form or in the form of gas or vapour.

Sub-standard An article of food shall be deemed to be sub-standard if it does not meet the specified standards but not so as to render the article of food unsafe.

Unsafe Food A food article whose nature, substance or quality is so affected as to vender it injurious to health in any way.

REVIEW QUESTIONS

1. State whether True or False.
   (a) The food operator is liable to lose business if he complies with the health authorities
   (b) Public health laboratories are present in every state
   (c) Cheaper substitutes of food items may be adulterated
   (d) The PFA act does not cover the selling of deceased animals or animals which have died without slaughtering
   (e) Obtaining a cash/credit memo does not help in checking adulteration
2. Fill in the blanks with appropriate answers.
   (a) The local health authority for a municipal corporation or a cantonment or a notified area is the ___________ ___________ ___________.

(b) A food item is misbranded if its labelling is __________ or __________ in any particular.

(c) Before purchasing processed food one should check the__________ __________ besides the required stamp of the regulatory authority.

(d) __________ and __________ are responsible for enforcing the PFA act and rules.

(e) It is mandatory that a food service operator should apply for a valid __________ from the local health authority.

(f) All food handlers are required to undergo a medical examination in a corporation hospital every __________ months.

3. What functions do the Central Food Laboratories perform?
4. List five functions performed by the Public Health Laboratories?
5. What are the two main objectives of the regulatory and advisory agencies?
6. Define adulteration as laid down by the PFA act?
7. List the precautionary steps which one could take to avoid purchase of adulterated food.
8. What specifications are required by a catering facility in order to obtain a valid licence?
9. Name the six national official standards that have been formulated to safe guard the consumers health and to ensure fair food trade practices.
10. Match the food articles in Column *A* with the likely adulterants in Column *B*

	A	*B*
1.	Milk	(a) cheaper oils
2.	Chilli powder	(b) dried and coloured leaves and dust
3.	Ice cream	(c) cassia bark
4.	Coffee	(d) vanaspati
5.	Tea	(e) water
6.	Saffron	(f) blotting paper
7.	Turmeric powder	(g) scented and coloured hair of maize
8.	Cinnamon	(h) coal-tar dyes like metanil yellow
9.	Butter and ghee	(i) powdered tamarind seeds
10.	Edible oils	(j) coloured saw dust

11. Define the term unsafe food. Under which situations is a food considered unsafe.
12. Explain why the Food Safety and Standards Act 2006 is necessary.
13. Which law covers irradiated foods and why is this law necessary.

18

- Quality
- Hazard analysis and critical control point (HACCP)
- Application stages of HACCP
- HACCP benefits
- Sanitation Risk Management (SRM)
- Standards
- ISO 9000 Quality Management System
- ISO 14000 Environmental Management Systems
- ISO 22000 Food Safety Management System

Quality and Food Standards

INTRODUCTION

All food establishments are aware that quality of their products and services is vital if they have to survive in the competitive market. Initially the term quality was used for the product and this was evaluated by quality control inspectors. The meaning of quality has broadened to include much more than ensuring the quality of the finished product. Today the term quality includes every aspect of production and service right from the source of procurement of the raw material up to customer satisfaction. The customer today wants to be assured that the product/service he/she is purchasing is safe, i.e., has been processed and handled safely and will not be detrimental to health.

Quality is not just the responsibility of a single individual in the organisation. Everyone involved directly or indirectly in the production process or in food service is responsible for the quality of the product/service offered. If quality has to be achieved, it is necessary to have a system that ensures that all procedures that have been designed and planned are being followed. Some catering establishments design their own checklists and systems based on International Standards, for example, five star chain hotels.

When catering establishments adapt an international standard like HACCP and ISO 22000 they can help the organisation to improve the quality of the food manufactured and served by that organisation. These standards help quality conscious organisations run profitably while at the same time enhancing customer satisfaction, assure the customer that what is delivered is 100% safe, get repeat customers, attract and retain a satisfied work force and develop a quality conscious organisation.

QUALITY

Quality is a phenomenon that has widely been accepted and recognised in the past three decades. It has many definitions and many new ideas about Quality Improvement have been propogated by management experts.

Quality is measured and maintained by following certain systems, procedures and processes that are pertinent to that organisation and the culture of that organisation and the field which is being followed in that organisation.

Quality is sustained by many standards of Quality that are designed by the International Organisation for Standards (ISO). These agencies give certifications that ensure that systems and procedures are in line with the model systems and procedures.

Quality can be maintained by auditing the systems, procedures and processes by an external agency by auditors from time to time.

The term quality in the services sector is expressed in terms of "Customer Satisfaction" and "Customer Delight". The service's product has special characteristics as it is intangible in nature as compared to the manufactured product that is tangible. In the hospitality sector the product is both tangible and intangible and assurance of high quality is the key to success and sustainability of any business. Quality is defined in many ways. The conventional definition of quality usually describes a quality product as one that looks good, works well and is reliable, etc. The strategic meaning of the word "quality" is concerned with meeting customers' requirements. When a product surpasses our expectations, we consider that as a quality product. To have a quality product, every organisation needs to follow a set of standards and identify and control the factors that govern the standards.

Quality can be achieved through continuous process improvement (CPI) that is a never ending effort to discover and eliminate the main causes of problems in an organisation. It is simply a way of looking at how we can do our work better.

Quality conscious catering establishments want to assure their customers that the highest standards of hygiene are being followed while preparing and serving food. They concentrate mainly upon adhering to food safety standards, the method or process employed for preparation and service of the product. All food establishments need a food hygiene certification.

Total Quality Management (TQM) — This is a systematic approach to improving the effectiveness and profitability of business. The entire organisation is involved in this approach to ensure customer satisfaction. The focus of TQM is on the needs of the customer and on the objectives of the organisation. The process consists of the following major steps:

- Determine customers' requirements;
- develop facilities and services that will meet those requirements;
- establish standards;
- conform to the set standards;
- monitor customer satisfaction.

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP)

The provision of safe food to the customer is the responsibility of the management. In order to ensure that food served is safe, it is necessary to establish a food safety control system. The HACCP approach is one management technique that may be useful to caterers. It is mainly used to guarantee microbiological safety of foods.

HACCP is the acronym for "Hazard analysis and critical control point".

It is a system of food safety control, based on the prevention of food safety problems and is accepted by international authorities as the most effective means of controlling food-borne diseases. HACCP is derived from the "failure mode and effectiveness analysis", an engineering system that looks at a product and all its components and manufacturing stages and asks what can go wrong within the total system before deploying effective control mechanisms.

The HACCP system applied to food safety was originally developed in the 1960' s jointly by the Pillsbury Company, the United States Army laboratories at Natick and the National Aeronautics and Space Administration in their development for food for the astronauts of the American Space Programme.

It was necessary to design food production processes to eliminate pathogens and toxins from the food. As this could not be achieved by finished product testing alone, the "HACCP" concept was born, ensuring a concept of food safety, "*from the farm to the plate*".

In 1971, the Pillsbury Company presented HACCP to the first American National Conference for food production. Since then, the concept has been evolving in the food industry.

Much of the effectiveness of HACCP is achieved through the use of multi–disciplinary team of experts. The team has members from relevant areas, e.g., microbiology, chemistry, production, quality assurance, food technology and food engineering. The HACCP approach involves the identification and analysis of hazards associated with the stages of all food production all through the process of manufacturing, i.e., raw material procuring to the consumption of the finished product.

HACCP is a system of food safety control that is accepted internationally. It is the most effective way of controlling food-borne diseases.

Since it is based on the prevention of food safety problems, it looks at a product, e.g., chicken dishes and all ingredients and steps in manufacturing and asks what can go wrong within the total system.

The HACCP approach involves the identification and analysis of hazards associated with the stages of all food production, all through the process of manufacturing that is from the farm to the table.

Three types of Hazards are considered to affect food safety:

1. Physical hazards
2. Chemical hazards
3. Biological hazards

By following HACCP it is possible to eliminate pathogens and toxins from food. Only checking the finished product is not enough as pathogens and toxins may be present when raw material is procured, e.g., bacteria may multiply and produce toxins before the food is purchased. Heating food may destroy the bacteria and kill them but the toxin still remains in food. Mushrooms purchased from an unauthorised source may be poisonous. Hence, source of food and licences are also important.

Hazard analysis is the identification of all ingredients, stages in process, environmental features and human factors that can lead to hazards for the consumer. The risks and likelihood of them occurring is estimated.

Critical control points (CCPs) are the points at which control is essential to guarantee that potential hazards do not become actual hazards. A CCP is a location, a practice, a procedure or a process which, if not controlled, could result in an unacceptable safety risk. The term CCP draws attention to the fact that not all hazards are necessarily critical to the safety of the end product.

Examples of CCPs

1. Inspection of goods on delivery and before use include temperature checks where applicable;
2. separate storage and handling of ingredients and the finished product;
3. correct temperature ranges for refrigerated and frozen goods;
4. cleaning procedures for equipment and utensils;
5. cross-contamination with other menu items in process;
6. personal hygiene and health standards.

A hazard relates to safety not quality.

A microbiological hazard could render food unsafe for consumption. The nature of the pathogen should be clearly identified, i.e., the specific organism, the form in which it could be present, i.e., is it in the vegetative state or a resistant form such as spores and cysts? Is the pathogen capable of forming toxins, is it heat resistant, can it grow at refrigeration temperatures, is it anaerobic and does pH of the food have an effect on it?

Microbiological Hazards

Hazard type	*Source*	*Example*
Parasites/protozoa	Water, meat	*Crytoporidium, Giardia*
Viruses	Shellfish food handlers	SRSV, Hepatitis
Algae	Shellfish, water	Paralytic shellfish poisoning
Fungi	Crops, nuts, dried ingredients	Mycotoxins

Chemical Hazards

Raw materials	*Process contaminants*	*Packaging contaminants*
Pesticides	Cleaning agents	Ink/adhesives
Heavy metals	Refrigerants	Metals
Antibiotics	Pest control	Plasticisers with additives
Hormone residue	Chemicals, Fumes	

Physical Hazards

Items that are hard and may cause dental damage. Items that are sharp and may cause injury.

Preventative measures are used to control identified hazards.

Examples of preventative measures—factors capable of being controlled are as follows

1. A step in the process — sieving, cooking
2. Use of approved suppliers
3. Controlled storage
4. Time management
5. Segregation
6. Application of effective cleaning schedules e.g., sorting and washing with chlorine before storage.
7. Effective pest control.

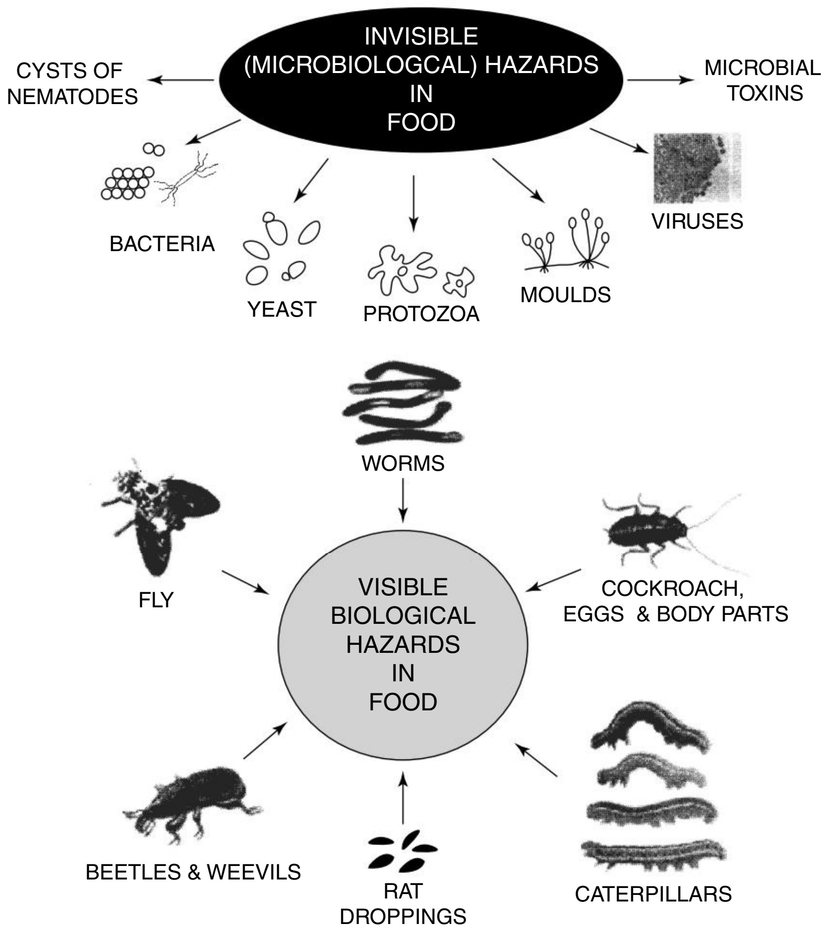

Fig. 18.1 *Microbiological and biological hazards which may be present in our food*

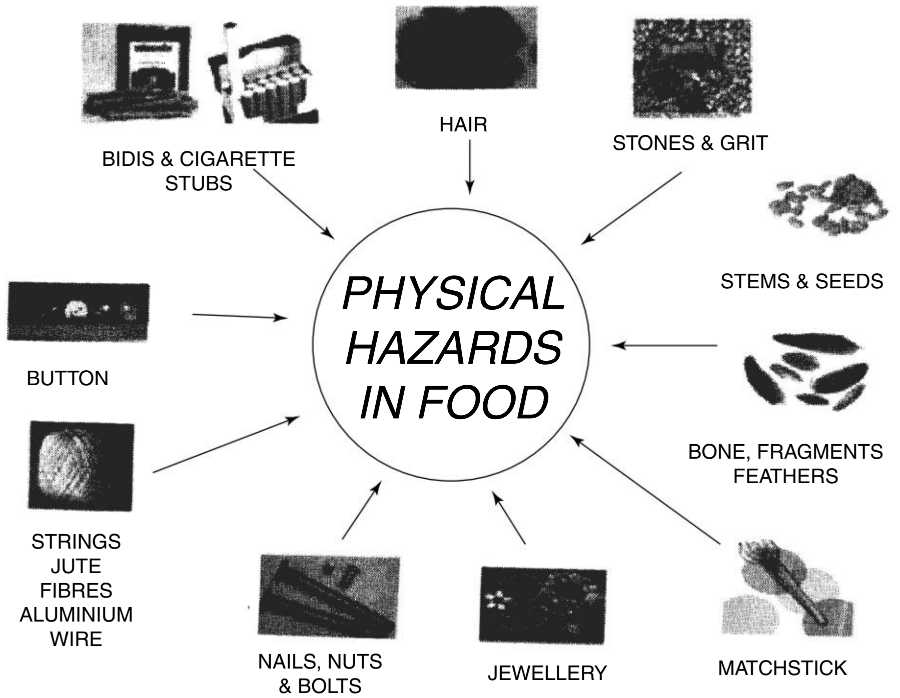

Fig. 18.2 *Physical hazards which may be found in food*

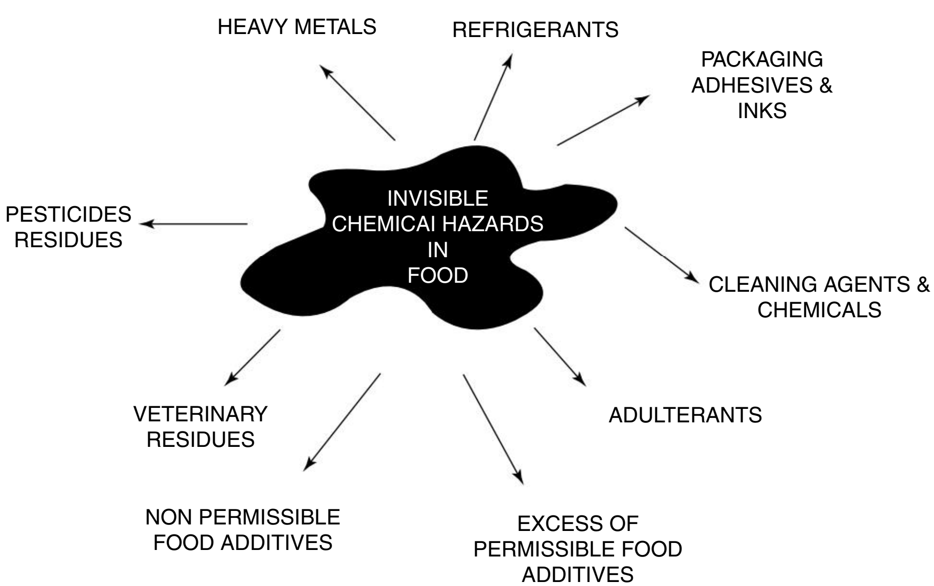

Fig. 18.3 *Invisible chemical hazards which may be found in food*

There are seven steps to be followed in the HACCP process. They are

1. Conduct a hazard analysis. Prepare a flow diagram of steps in the process, list significant hazards and specify the control measures.
2. Identify CCPs (critical control points) in the food process, e.g., temperature check for chicken.
3. Define critical limits for each identified CCP. See Fig. 18.5.
4. Establish CCP monitoring requirement (e.g. maintain records of date, time and temperature measured). Establish procedures to monitor CCPs.
5. Establish corrective action in case of default, i.e. if a critical limit has been exceeded.
6. Establish corrective record keeping procedures that document the HACCP system.
7. Establish procedures to verify that the HACCP system is working correctly.

STEPS IN HACCP

Conduct a Hazard Analysis

The hazard analysis process identifies significant hazards, estimates the likelihood of occurrence and their severity if they do occur, and develops preventive measures for a process or product to ensure or improve food safety. HACCP focuses on high risk hazards that are likely to happen. It includes an analysis of ingredients and pinpoints sensitive ingredients used, such as raw egg white in souffle, which can create a microbiological hazard in food. To begin with, a flow diagram depicting the different steps in the process needs to be prepared. The significant hazards at each step need to be listed and the preventive measures to control the hazard should be highlighted by the management and staff members. See Table 18.1 and Fig. 18.4.

Each hazard should be assessed in terms of the likelihood of occurrences and the severity, i.e. what is the level of risk. The risk is estimated taking into consideration the epidemiological data, technical information and the past experience of the team. Significant hazards are highlighted in this step. See Tables 18.2 and 18.3.

In the hazard analysis process, the management must ask and answer a series of questions for each control point in the flow diagram. The answers give us the preventive measures that may be taken to control hazards. For example, while reheating food it is necessary to ensure that internal temperature of food reaches 70°C. This is a physical preventive measure to destroy pathogenic organisms that may have survived the cooking process and multiplied in food while the food was being held.

Identify the CCPs—in the Food Process

We have read that CCPs are the points at which control is essential to ensure that potential hazards do not become actual hazards. The CCP is thus a step or procedure at which control can be applied and that can help to prevent a food safety hazard by eliminating it or reducing it to acceptable levels. Some examples of CCPs are cooking, chilling, sanitary procedures, prevention of cross – contamination and certain aspects of personal and environmental hygiene. A food

Table 18.1 Sample HACCP Information Work Sheet for Pineapple Gateaux

HACCP Information Work Sheet	
HACCP team	(*Team member's names*)
Scope of HACCP plan	Preparation of pineapple gateaux
Product Description and Intended Use	
1. Product name	Pineapple Gateaux
2. Method of preservation	Refrigeration
3. Composition (ingredients used)	Refined flour, eggs, sugar, gel, cream, cherries Pineapple essence
4. Important product characteristics	Cake should be light, spongy, no egg smell, cream well whipped
5. Packaging – primary and secondary	Aluminium foil covered cardboard for base, cake box (environment friendly)
6. Storage conditions	Refigerated below 4°C
7. Who will consume	All age groups
8. Special distribution control	Refrigerated vans
9. Shelflife	24 hrs
10. Where it is to be sold	Retail outlets with cold display cabinets
11. Sensitive consumer	Diabetic individuals Individuals allergic to egg
12. Labelling instructions	Consume within 24 hrs. Keep product refrigerated. Contains non-vegetarian's ingredients
13. Intended use	Consumption

process may have many control points, but only a few may be critical control points. CCPs are not necessarily the same for all food processes and may differ with the location and layout of the establishment, the equipment used, ingredients, practices and procedures followed. See Fig. 18.5 and Table 18.4.

CCPs are identified by the help of a CCP decision tree in which a series of questions are asked at each step in the food process that has an identified hazard. These questions help in identifying the CCPs. See Table 18.6.

Process Flow Chart	
Name of product	*Pineapple gateaux*

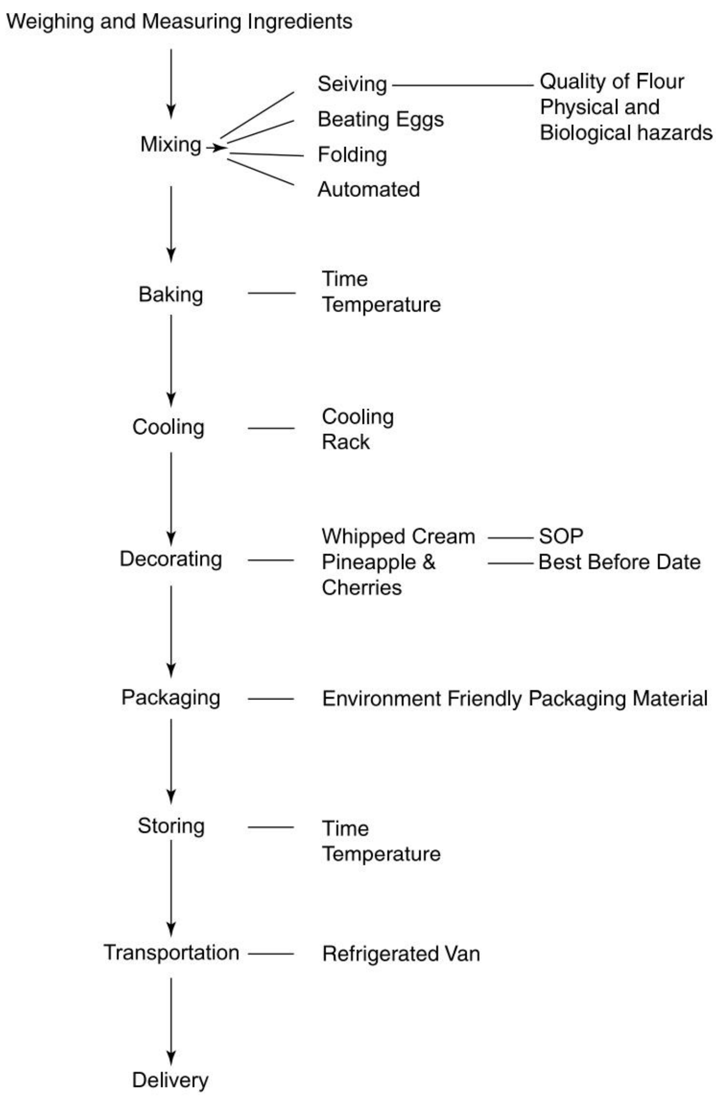

Fig. 18.4 *A flow diagram depicting different steps in the process*

Table 18.2 **Risk and Severity Analysis Chart to Identily Significant Hazards**

SEVERITY / RISK	Critical	Serious	Major	Minor
High				
Medium				
Low				

Significant   Non-Significant

Note: Each likely hazard should be assessed in terms of chances of occurence and severity, and significant hazards selected. (Record to be Prepared and Maintained)

Table 18.3 Hazard Analysis Work Sheet for Identifying Significant Hazards at Each Step in the Process

HACCP-Hazard Analysis Worksheet

Step No.	*Process details*	*Potential hazards*	*Cause*	*Risk and Severity Analysis*			*Preventive / Control measure*	*Is this hazard significant*
		Microbiological, chemical, physical, quality		*Risk*	*Severity*	*Overall*		

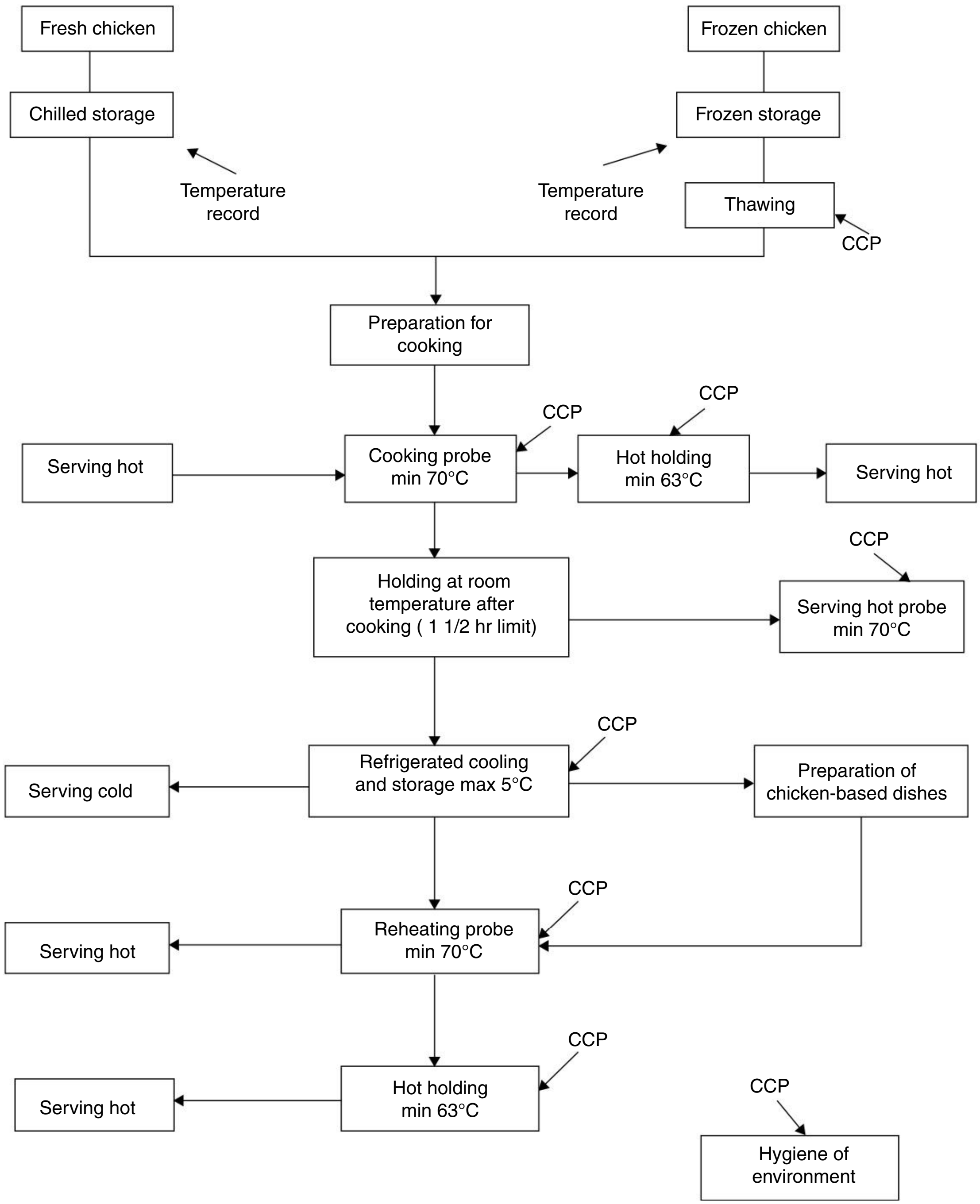

Fig. 18.5 *Specimen flow diagram indicating CCPs for chicken purchased from reliable suppliers according to specifications*

Table 18.4 CCP Determination Sheet

Process step	*Significant hazard*	*Q1. Could a control measure(s) be used by the operator at any process step? * If No = not a CCP + identification on how this hazard will be controlled before and after the process + proceed to next identified hazard * If Yes = description + next*	*Q2. Is it likely that contamination with the identified hazard could occur in excess of the acceptable level or could increase to an unacceptable level?* If No = not CCP+ proceed to the next identified hazard* If Yes = next question*	*Q3. Is this process specifically designed to eliminate/ reduce the likely occurrence of the identified hazard to an acceptable level?* If No = next question* If Yes = CCP+ go to last column*	*Q4. Will a subsequent step eliminate the identified hazard or reduce its likely occurrence to an acceptable level?* If No = CCP + go to last column* If Yes = not a CCP + identify subsequent step* proceed to next identified hazard*	*CCP number *Proceed to next identified hazard*

Define Critical Limits for the Control Measures Associated with Each Identified CCP

A critical limit is a boundary of safety. Some control measures have upper and lower critical limits. The temperature danger zone is 5°C to 63°C and potentially hazardous food should not be held within this range of temperature for more than 4 hours. See Table 18.5. Both upper and lower temperature limits must be observed, along with the time limit. Apart from time and temperature there are other critical limits.

Critical limits vary with each food and include factors such as humidity, water activity a_w, pH, preservatives, osmotic pressure, available chlorine, size of food item, thickness, etc. The critical limit for cooking mutton cutlets would be as follows

Thickness of cutlet — 2.5 cm
Internal temperature — 68°C for at least
Time — 15 secs
Temperature of broiler — 207°C

Table 18.5 Critical Limits for Control Measures

CCP	*Target limit*	*Critical limit*
Storing chilled products	5ºC	>8C
Storing frozen items	−18ºC	<−18ºC
Cooking processes		
Egg	70ºC	<70ºC
Veg, meat, seafood, cereal	63ºC	<63ºC
Dairy	72ºC	<72ºC
Poultry	74ºC	<74ºC
Cooling process		60 to 10ºC Not more than 4 hour
Reheating	75ºC	<75ºC
Receiving chilled product	5ºC	> 8ºC
Receiving frozen product	−18ºC	<−18ºC
Vegetable and fruit and equipment Disinfection		100−200 ppm
Rinsing temperature	82ºC	<82ºC

Table 18.6 Chicken Mayonnaise Sandwiches – A CCP Decision Tree for Cold Food Served Cold Example

Decision tree						
Process step or raw material	Significant hazard	Could a control measure be used at any process step	Is it likely that contamination with the identified hazard could occur in excess of the acceptable level or could increase to an unacceptable level?	Is the process specially designed to eliminate / reduce the likely occurrence of the identified hazard to an acceptable level?	Will a subsequent step eliminate the identified hazard or reduce its likely occurrence to an acceptable level?	CCP number
		If No = Not a CCP+ identification on how the hazard will be controlled before and after the process + proceed to next question	If no = Not CCP + proceed to the next identified hazard	If no = Next question	If no = CCP	
		If yes = description + next question	If yes = Next question	If yes = CCP	If yes = not a CCP + identify step + proceed to next identified hazard	
Storage	B — Microbial growth	Yes, Store at 5°C or cooler (maximum 8°C)	Yes	Yes		CCP-1

Contd ...

Table 18.6 (Contd)

Decision tree						
Processing	C-Detergent residue	Yes, Use clean equipments	No			
	B-Microbial growth	Yes, Use disinfected equipments, disinfected raw material	No			
Storage	B-Microbial growth	Yes, Store at 5°C or cooler (maximum 8°C)	Yes	Yes		CCP-2
Portioning	C-Detergent residue	Yes, Use clean equipments	No			
	B-Microbial growth	Yes, Use disinfected equipments	No			
Service	C-Detergent residue P-Physical	Yes, Use clean equipments	No			

Establish Procedures to Monitor CCPs

To ascertain whether a CCP is under control, it is necessary to monitor the processes. Monitoring is done by conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control. Monitoring procedures establish an accurate record for future verification. Records of date, time, temperature measured, etc., help in identifying any trend indicating loss of control and corrective action taken to bring the process back into control before a deviation occurs. Monitoring indicates when deviations have occurred, if corrective action is necessary and provide written documentation that is useful in verification of the HACCP plan.

Monitoring should ideally be a continuous process and if continuous monitoring is not possible, sampling systems or statistically designed data collection should be used. Staff must be trained for accurately monitoring each CCP and instruments used for measuring critical limits must be carefully calibrated. Calibration records must be documented. For example, the probe thermometer used for checking internal temperatures of food should be calibrated by immersing it in ice and setting the temperature with the help of a screw provided at the base of the thermometer. All records maintained as part of the HACCP documentation plan should have the signature and date of the staff doing the monitoring.

Establish Corrective Action in case of Default when Monitoring Shows that a Critical Limit has been Exceeded

Corrective action is necessary when a deviation occurs and critical limits are exceeded. Corrective action taken needs to be documented. Each CCP should have specific corrective action plans that correct the cause of the deviation and ensure that the CCP is under control. Corrective action procedures should be well documented in the HACCP plan and more frequent monitoring may be temporarily required to ensure that the deviation has been brought under control. See Table 18.7.

Establish Effective Record Keeping Procedures that Document the HACCP System

The management of the food establishment is responsible for the preparation and maintenance of the written HACCP plan. The implementation strategy has to be worked out. If the system has to work, records need to be maintained. The number of records depends on the size and complexity of the food establishments. The approved HACCP plan and all records should be filed and available at the food establishment. Documentation and up-to-date records are vital. Documents to be included are:

1. A list of HACCP team members and their responsibilities.
2. Product description and use.
3. Process flow diagram indicating CCPs.
4. Hazards associated with each CCP, preventive measures and critical limits.
5. Monitoring systems and corrective action plans in case of deviations from critical limits.
6. Record keeping procedures and verification procedures.

Kitchen Hygiene Checklist - Five Star Deluxe Hotel

Checklist		**Month**																															
Frequency Daily																																	
Prepared by Chef on Duty																																	
Sr. No.	***Check points***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***21***	***22***	***23***	***24***	***25***	***26***	***27***	***28***	***29***	***30***	***31***	***Observations if any***
1	General cleanliness																																
2	No visible sign of Pests																																
3	Personal Hygiene																																
	a. Uniforms - clean, changed daily																																
	b. Hair/beard covered properly																																
	c. Short nails,/no open wounds/no varnish/ restricted jewellery/no wrist watch																																
	d. Hands washed every 1 hour																																
	e. First Aid Box with adequate supplies																																
4	Environment Hygiene																																
	Dustbins with covers																																
	No paint peels in any area																																
	Walls and ceiling clean and free from grease																																
	No broken equipment in the kitchen																																
	Weekly cleaning schedule and daily cleaning schedule followed																																
5	Equipment Hygiene																																

Contd ...

(Contd)

Sr. No.	Check points	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Observations if any
	(Clean, disinfect before and after use with 200 ppm chlorine)																																
	a. Cutting board soaked in 200 ppm of chlorine																																
	b. Table tops cleaned with sanitizer																																
	c. Correct Table wipers are being used																																
	d. Knives disinfected																																
6	Processing																																
	a. Table tops cleaned with sanitizer																																
	b. Cross contamination avoided while processing raw, cooked food																																
	c. Gloves used for handling all finished and semi finished products																																
	d. Canned product after opening immediately transferred into trays or plastic boxes																																
	e. Perishable items stored in walk in when not in use																																
	f. All food items tagged																																
	g. Cutting board code followed																																
	h. Dairy products stored separately																																
	Signature																																
	Verified By	Record Number																5*Hotel/haccp/rec/ /Checklist															
	Authorized: (Executive Chef)	Date of Issue																MM/DD/YYYY															

Table 18.7 HACCP Plan

Step. No.	*Hazard/Cause*	*Preventive/Control measure*	*Critical limit*	*Monitoring*	*Corrective action*	*Records*
				What: How: Where: When: Who:	Immediate: product- process- Who: Longer: Who:	
				What: How: Where: When: Who:	Immediate: Who: Longer: Review supplier Who:	
				What: How: Where: When: Who:	Immediate: Who: Longer: Review supplier Who:	

Some Examples of Records to be Documented by Different Departments

Department	*Document*
Purchase	• Supplier audit report • Supplier evaluation report
Receiving/Stores	• Received food temperature record • Supplier vehicle temperature record • Storage time records for limited shelflife ingredients
Processing/Kitchen	• Records from all monitored CCPs like (Food temperature report) • Records verifying the continued adequacy of food processing procedures
Housekeeping	• Pest control record
Personnel/HR	• Staff member training records of staff responsible for implementation of HACCP plan
Engineering	• Equipment history record • Water chlorination record

An audit is a systematic evaluation of the systems, procedures and processes, to arrive at a result that is compared with a predetermined standard. The difference is known as a variance, which is studied in order to bridge the gap between the standard expected and the result achieved.

Audits are carried out by auditors who are internal and external. Internal audits ensure continuity of processes whereas external audits ensure that the process is followed as expected and is capable of delivering results. The lead auditor supervises the auditors during an audit. See Table 18.8.

Establish Procedures to Verify that the HACCP System is Working Correctly

The first stage to the verification process involves technical validation. It is necessary to confirm that critical limits at CCPs are satisfactory. This stage is complex and may require outside expertise. The second stage of verification ensures that the HACCP plan is working efficiently. The plan is frequently reviewed and all records including corrective action taken in case of deviations is checked. The third stage includes periodic revalidation by the HACCP team or internal audit. While the fourth stage is verification by the regulatory body or external audit.

Use of HACCP in Catering

The most important aspects to be considered are:

1. Handling and storage procedures from delivery to service of the menu items;
2. holding times and temperature;
3. cooling times;
4. personnel training.

Table 18.8 Internal Audit Checklist

Process / Dept / Area______ Date ______

Step No.	Deptt/Function	Activity	Look at (e.g. product, doc, record, eqpt. etc.)	Look for (e.g. objective information)	Sample size	Time	Remarks

HACCP has links with many other management systems and many of these elements like GMP, GAP, GHP are pre-requisites for HACCP implementation.

Table 18.9

1.	Conduct Hazard Analysis.
2.	Detect the Critical Control Points.
3.	Establish Critical Limits.
4.	Establish a system to monitor control of the CCP.
5.	Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
6.	Establish documentation concerning all procedures and records appropriate to these principles and their application.
7.	Establish procedures for verification to confirm that the HACCP system is working effectively.

APPLICATION STAGES OF HACCP

Define the terms of reference
↓
Assemble and train the HACCP Team
↓
Describe the products/processes
↓
Identify intended use
↓
Construct Flow Diagram
↓
On-site verification of Flow Diagram
↓
List all potential hazards
Conduct a hazard analysis
Determine control measures
↓
Determine CCPs
↓
Establish critical limit for each CCP
↓
Establish a monitoring system for each CCP
↓
Establish corrective action for deviations that may occur
↓
Establish verification procedures
↓
Establish record keeping and documentation
↓
Review the HACCP plan

Fig. 18.6 *Application stages of HACCP*

HACCP BENEFITS

- Enhances food safety and reduces risk of food borne diseases;
- Provide greater confidence to customers;
- Reduction in production costs through reduced wastage;
- Facilities compliance with statutory requirements;
- Current and potential hazards can be identified and removed or minimised.

SANITATION RISK MANAGEMENT (SRM)

Serving safe food to the public is the moral responsibility of the management and staff of food establishments. The operation of a food establishment is an inherently risky business because of the highly perishable nature of food and the ubiquitous nature of microorganisms causing food poisoning and food spoilage. Sanitation hazards are amongst the most critical risks that food service managers need to control if their business is to run. Media reports on food poisoning cases have led to the closure of restaurants, damages in terms of lawsuits and loss of business and reputation. These risks can be managed by following a *Sanitation Risk Management* (SRM) programme. This programme focuses on managing risks involved at each of the ten basic steps in any catering operation.

Each catering operation involves the following ten basic operating activities

1. Menu planning
2. Purchasing
3. Receiving
4. Storing
5. Issuing
6. Preparing
7. Cooking
8. Holding
9. Serving
10. Cleaning up and maintenance

The risks involved at each of these stages are identified and procedures for minimising the risks are put into effect. These ten steps are also referred to as the control poins. If the risks at each of these control points are reduced, managers can effectively cut down the overall risks involved in any food operation, resulting in satisfaction of both internal and external customer.

Control point	*Significance*
1. Menu planning	All other control points depend on the menu. Hence, all control points should be understood before deciding on the menu to be served.
2. Purchasing	Important for quality of final product. Can minimise investment in inventory, control costs, maximise profits and reduce risks.
3. Receiving	Quality, quantity and price needs to be checked and goods received should be stored immediately in correct storage area.

Contd...

(Contd)

Control point	*Significance*
4. Storing	Food should be protected from contamination, spoilage and pilferage to minimise costs and risks, and maximise profits. Storage conditions, temperature and best before dates to be checked.
5. Issuing	Issuing procedures, authorisation and sanitation procedures are vital to minimise risks and protect profits.
6. Preparing	The first step in production activity involves many stages like picking, cleaning, trimming, thawing etc., which are vital. Food is exposed to sanitation hazards at this stage that need stringent control.
7. Cooking	Application of heat that results in changes in colour, texture, taste, appearance, digestibility and nutritive value, which needs careful monitoring and control. Sanitation hazards are high at this stage.
8. Holding	This is a critical control stage as menu items are often held hot or cold during food service. Many products are prepared well in advance and holding temperatures need careful monitoring to maintain quality and minimise microbial hazards.
9. Serving	Menu items should be served quickly and efficiently by following service procedures to minimise touching food and mouth contact surfaces, and protecting the safety and quality of food.
10. Cleaning and maintenance	One of the most important control points needed at every stage in the operation. Cleaning should be followed by sanitising. All areas, equipment, uniforms, etc., should be well maintained.

All the above ten control points need to be covered in an SRM programme and specific standards and standard operating procedures need to be formulated, which may vary from one establishment to another. The SRM programme is an HACCP based approach that focuses on the basic ten control points common to most food establishments. It is a systematic approach to managing risks. A manager has four resources to control namely:

- People
- Inventory
- Equipment and
- Facilities

These four resources need to be evaluated in relation to each of the ten control points and standards and procedures need to be formulated, keeping resources in mind for optimum utilisation of resources.

People should be trained in proper sanitation practices. Inventory in terms of food, beverage, etc., needs control because it is the vital link in a food establishment operation's cost and quality control system. These vital assets need to be protected from contamination, spoilage, waste and pilferage.

Equipment selection, placement, cleaning and maintenance as well as the location, layout and design of the facility needs huge investments and their selection has a major impact on whether the SRM programme will be successful or not.

All staff members ranging from the owners, CEOs, top management, middle level managers and staff are responsible for the SRM programme along with the regulatory bodies and should be genuinely committed.

While the SRM programme focuses on reducing overall risks by indentifying the risks associated with each of the ten stages in a food service operation, the HACCP approach seeks to eliminate safety risks in food processing by identifying the specific hazard either chemical, biological or physical at each important point or critical control point in a food production system. The SRM programme is an HACCP based system that goes beyond the issues of food safety and includes not only safety but also quality and cost control concerns. But the very core of the SRM is HACCP and reduction of risks.

The HACCP system is prevention based and is designed to prevent potential food safety problems and is based on seven principles (see Table 18.9).

Advantages of the SRM Programme

A formal SRM programme not costs only money but it also ensures immediate returns in terms of

- Guest satisfaction.
- Protecting health and reducing absenteeism.
- Reducing liabilities on account of injury, accidents and death.
- Reducing cost of cleaning agents and increasing effectiveness.
- Increasing life of equipment and facilities through proper operating procedures and standards.
- Simplifying supervision through standardised checklists.
- Minimising waste and simplying work methods by following written cleaning procedures.
- Reducing operational risks, closures, legal cases, etc., and providing acceptable returns on investments.
- Ensures a continuous effort towards better sanitation.

STANDARDS

Standards are essential in most aspects of our life. They ensure that products and services have desirable characteristics such as quality, safety, reliability, efficiency, eco-friendly, etc., and are available at an economical cost. We often take these desirable characteristics for granted, but when standards are absent and products and services are of inferior quality, are unsafe, unreliable or incompatible with the equipment we already have, we are concerned.

When products, systems, machinery and equipment work efficiently and safely, it is often because they meet standards. The organisation responsible for many thousands of the standards that benefit the world is the International Organisation for Standardisation or ISO.

ISO-International Organisation for Standardisation

ISO derived from the Greek word 'Isos' meaning "equal" is the acronym for "International Organisation for Standardisation" worldwide (the isotherm lines of a weather map show equal temperatures). Organisations certified under an ISO 9000 standard are assured to have quality equal to their *peer* organisations. The IOS adopted the ISO prefix while naming the standards. ISO is an internationally approved quality standard accepted by almost all countries around the world. They provide a series of guidelines to companies on what is required of a quality system. The ISO 9000 series can be applied to any business. The organisation may be large or small. The standard is simple to adhere to and apply. These quality standards help industries to adopt and disclose what the industry is manufacturing and how the process of manufacturing is carried out.

The industry achieves its certification through an audit process done by an independent agency who are approved by the International body. The head office of ISO (is situated) founded in 1946 in Switzerland who guides the certification bodies and controls their activities. The main idea to get certified is to enhance better customer relationship by supplying the best quality product/services. The European nations have made it mandatory to many countries to be ISO registered in order to do business with and do not entertain non–certified suppliers.

Once the industry adopts the standards, and maintains it, and keeps reviewing it, will help them to realize the continual improvement that it is achieving. The importance of applying the ISO 9000 series is to make new changes and improvements toward the organisation and the product/services.

To achieve the certification the organisation has to register itself with the accreditation body. Although it costs the companies quite an amount but finally the benefits are large. There are independent auditors appointed by the accredited body, to audit the registred company for their compliance to the International Standard. The auditors are well experienced having thorough knowledge of the product/services to be audited. The ISO certificate is valid for 3 years. The first audit is known as compliance audit, followed by surveillance audits every year. The standards are controlled in India with the help of Indian Standard, by the Bureau of Indian Standards (BIS), New Delhi who publishes the new as well as the revised standards book.

There are a number of ISO standards as per their application and requirements of organisations. Some of the ISO's best known management systems standards are

1. ISO 9001:2008 Quality Management System.
2. ISO 14001:2004 Environmental Management System.
3. ISO 22000:2005 Food Safety Management System.

These standards are implemented by over a million organisations in 175 countries.
There are a few steps that are necessary to implement a quality Management systems, which are as follows:

1. The top management commitment.
2. Appoint a management representative.
3. To bring awareness to all.
4. Appoint an implementation team.
5. Training to all.
6. Define a time schedule.
7. Select section/Division leaders.
8. Review the present system.
9. Write the documents [mostly by consultant.]
10. Install the new system.

11. Internal audits.
12. Management review.
13. Pre-assessment.
14. Registration.

ISO 9000 QUALITY MANAGEMENT SYSTEMS

The present ISO 9001:2008 (QMS) has undergone a number of revisions from 1987 when it was first published. The first revision was done in 1994 based on actual experiences of several thousand companies. The next revision came in 2000. This third revision of the standard was necessitated because of the publication of the revised version of ISO 9001:2008 in the year 2008. This quality standard is easy to apply and understand. It can be adopted by any organisation who is into manufacturing or in services. Without making any major changes within the organisation, one can reap the benefit to improve its actual system and also the quality of the product/services with 100% guarantee for the deliverance of defect free product/services.

The benefits an organisation gets by adopting ISO certification are as follows.

1. Increased business.
2. 100% utilization of time and materials.
3. Improved efficiency.
4. Consistent quality and timely delivery.
5. 100% customer satisfaction.
6. Improved control of quality, processes.
7. Motivated staff with consistency output.
8. The documented system helps in Back Tracking.
9. Less percentage of rejection.
10. Total control on quality and output.
11. Validated test records of equipments.
12. Valid records readily identifiable.

ISO 9000 and TQM

ISO 9000 is not TQM, but is a subcomponent of TQM and a good start on the TQM path. ISO 9000 is only the *minimum* required quality standard that a supplier must demonstrate to receive the ISO 9000 accreditation. TQM by contrast is much more comprehensive. TQM links quality to customer satisfaction by requiring action on four essentials:

(i) a strong customer orientation (internal and external in all activities in the organisation);
(ii) top management's direct involvement in the delivery of quality;
(iii) total company-wide participation in the delivery of quality; and
(iv) the systematic analysis of quality problems focused on continuous improvement of quality performance and the prevention of quality problems.

ISO 14000 ENVIRONMENTAL MANAGEMENT SYSTEMS

ISO 14000 is a series of international standards on environmental management. It provides a framework for the development of an environmental management system and the supporting audit programme.

The main thrust for its development came as a result of the Rio summit on the Environment held in 1992.

As a number of national standards emerged (BS 7750 being the first), the International Organisation for Standardisation (ISO) created a group to investigate how such standards might benefit business and industry. As a result this group recommended that an ISO committee be created to create an International standard.

ISO 14001 is the corner stone standard of the ISO 14000 series. It specifies a framework of control for an Environmental Management System against which an organisation can be certified by a third party.

Other ISO 14000 standards in the series are actually guidelines, many to help one achieve registration to ISO 14001.

- ISO 14004 provides guidance on the development and implementation of environmental management systems.
- ISO 14010 provides general principles of environmental auditing (now superseded by ISO 19011).
- ISO 14011 provides specific guidance on audit and environmental management system (now superseded by ISO 19011).
- ISO 14012 provides guidance on qualification criteria for environmental auditors and lead auditors (now superseded by ISO 19011).
- ISO 14013/5 provides audit program review and assessment material.
- ISO 14020 + labelling issues.
- ISO 14030 + provides guidance on performance targets and monitoring within an Environmental Management System.
- ISO 14040 + covers life cycle issues.

Of all these, ISO 14001 is not only the most well known, but is the only ISO 14000 standard against which it is currently possible to be certified by an external certification authority.

ISO 22000 FOOD SAFETY MANAGEMENT SYSTEM

ISO 22000 is an international standard that defines the requirements of a food safety management system covering all organisations in the food chain from farm to fork.

It is suitable for any business in the entire food chain, including inter–related organisations such as producers of equipment, packaging material, cleaning agents, additives and ingredients. ISO 22000:2005 is also for companies seeking to integrate their quality management system, e.g., ISO 9001:2000 and their food safety management system.

ISO 22000:2005 Provides

1. Interactive communication, internationally and across the supply chain.
2. Compliance with HACCP principles such as hazard analysis, identify critical control points (CCPs) establish critical links, monitor CCPs, establish corrective action, record keeping and verification.

3. Harmony with voluntary and pre-requisite standards.
4. A structure that is aligned with ISO 9001:2000.
5. Process control.

ISO 22000:2005 Certification Has the Following Advantages

- Improves the organisations profile and credibility.
- Provides a harmonised standard accepted all over the world.
- Simple to understand, apply and recognise because management system principles have been integrated with HACCP.
- Helps in ensuring compliance with all food safety legislations.
- Reduces possible risks of penalties and litigation.
- Transforms the organisations corporate image.
- Enhances the products quality and safety.
- Allows Continuous improvement of the food system.
- Enhances overall performance of organisation.
- Ensures to compete effectively in national and international markets.

ISO 22000:2005 specifies requirements for a food safety management system where an organisation in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption.

It is applicable to all organisations, regardless of size, which are involved in any aspect of food chain and want to implement systems that consistently provide safe products. The means of meeting any requirements of ISO 22000:2005 can be accomplished through the use of internal and/or external resources.

ISO 22000:2005 specifies requirements to enable an organisation.

—to plan, implement, operate, maintain and update a food safety management system aimed at providing products that, according to their intended use, are safe for the consumer,

—to demonstrate compliance with applicable statutory and regulatory food safety requirements,

—to evaluate and assess customer requirements and demonstrate conformity with those mutually agreed customer requirements that relate to food safety, in order to enhance customer satisfaction,

—to effectively communicate food safety issues to their suppliers, customers and relevant interested parties in the food chain,

—to ensure that the organisation conforms to its stated food safety policy,

—to demonstrate such conformity to relevant interested parties, and

—to seek certification or registration of its food safety management system by an external organisation, or make a self-assessment or self-declaration of conformity to ISO 22000:2005.

The ISO 22000, is the one universal food safety management standard that works across all other standards. This standard uses a common vocabulary and improves communications between everyone involved in the food industry.

Highlights of ISO 22000:2005

- Integrates the principles of Hazards Analysis and Critical Control Point (HACCP) system developed by Codex Alimentarius and combines the HACCP plan with prerequisite program (PRPs) and operational PRPs.

- Requires that all hazards that may be reasonably expected to occur in the food chain are identified, assessed and controlled.
- Can be applied independent of other management system standards or can be integrated with existing other management systems.
- Allows even small, tiny scale organisations to implement as externally developed combination of control measures.
- Intended for organisations seeking more focused, coherent and integrated food safety management systems.
- Emphasis on preventions of food safety hazards of all types.
- Ensures compliance with legislative and regulatory requirements.
- Provides for management of potential emergency situations and accidents that can impact food safety.

The key feature of the ISO 22000 standard is that the ISO 22000 standard is a management system standard that sets requirements for results without setting requirements for resources. The HACCP system is based on organisation and is guided by a policy and objectives with clearly defined responsibilities, allotted resources, and control over how objectives are met. This organisation is designed to ensure continual improvement in food safety. This standard sets out specific requirements for the five areas shown in Figs 18.7 and 18.8.

PRP, Operational PRP, CCP and Validation

ISO 22000 has made it possible to fill in, in a targeted manner, certain gaps that hindered proper understanding and use of the HACCP method, in particular, by introducing prerequisite programs (PRP), and operational PRP (oPRP). The standard makes it possible to prioritise control measures based on criteria linked to the probability of the occurrence of a certain type of hazard and its severity. In addition, ISO 22000 requires that control measures associated with oPRP and critical control points be validated before they are implemented.

ISO 22000 has also set up, around the HACCP method, all the system and organisational components, based on the principle of continual improvement that made ISO 9001 such a success.

In fact, once companies have met the challenge of setting up an HACCP the first year, they then face a new challenge — keeping it operational over the coming years, something that ISO 22000s ‘PDCA: (Plan-Do-Check-Act) system approach makes possible. By providing system components (procedures, audit, indicators, operating reports, management reviews, steering committees, etc.), this standard contributes to efforts to structure and improve management. These measures allow companies to avoid fixed HACCP systems and move towards dynamic systems that constantly adapt to the situation and to food safety needs.

Organisations want to opt for ISO 22000 mainly because some exporting companies want to adopt a common language to facilitate exchanges. Other companies want their hazard analysis and control techniques to be consolidated, validated and recognised by an outside agency. And other companies commit to an ISO 22000 approach in order to complete their ISO 9001, ISO 14001, HACCP plans through the implementation of an integrated system.

In all cases, everyone recognises the interest of the standard’s managerial dimension in moving their current fixed HACCP plans towards a well-adapted dynamic system that strongly involves staff and is constantly improving.

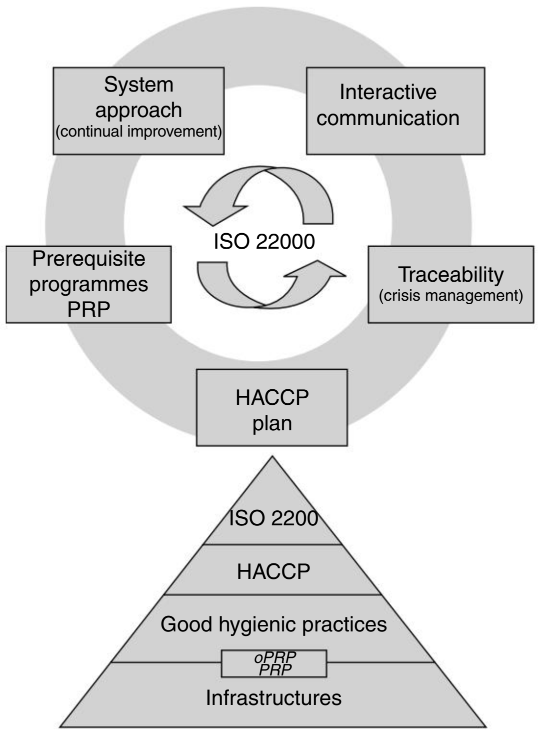

Fig. 18.7 *The ISO 22000 and HACCP link*

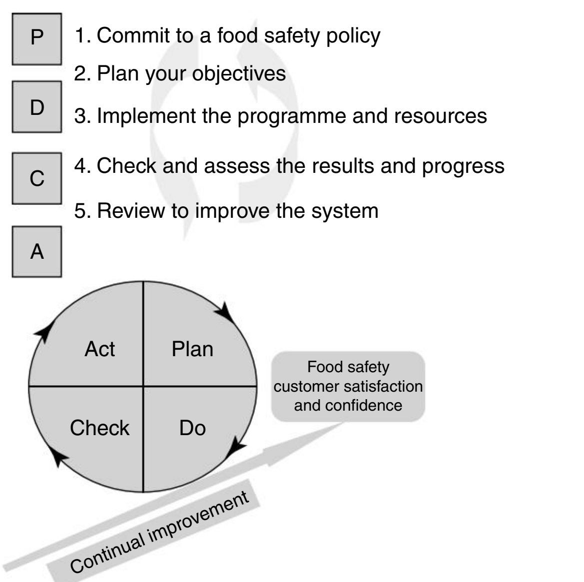

Fig. 18.8 *ISO 22000's 'PDCA' Plan-do-check-Act system approach*

ISO 22000 thus combines a series of advantages, involving quality management, external and in-house communications, designating responsibility, implementing crisis management, continual improvement, good health practices and differentiating between PRP, oPRP and CCP.

SUMMARY

The term quality and its significance in catering is being recognised and food establishments are taking measures to ensure that the food prepared and served in their organisation is safe and wholesome. Quality covers not only the final product but includes every aspect right from the farm to the fork. Quality is measured and maintained by following certain systems where procedures and processes are followed and audited. Adapting international standards like HACCP and ISO 22000 has many advantages. These agencies give certifications that ensure that systems and procedures are in line with the model systems and procedures. There are seven HACCP principles and the SRM programme is an HACCP based approach. The ISO is an international standard accepted by almost all countries around the world. They provide a series of guidelines to companies on what is required of a quality system. These standards are not mandatory and can be applied to any business whether large or small. Orgnisations are certified through an audit process. While ISO 9000 covers Quality Management Systems, ISO 14000 deals with Environmental Management Systems. The standard that affects food quality and safety is the ISO 22000 that defines the requirements of a Food Safety Management System. This universal food safety management standard works across all other standards.

The benefits of adhering to these standards are many giving the organisation a competitive edge in the international markets apart from safe food products and satisfied customers.

KEY TERMS

Audit Planned, independent and documented assessments to determine whether the requirements agreed upon are being met.

Auditor An individual who has the qualifications to perform quality audit.

CCPs Critical Control Points are the points at which control is essential to guarantee that potential hazards do not become actual hazards.

Certification The procedure by which a third party gives written assurance or certifies that a product, process or service conforms to specified requirements.

Control measures The actions and/or activities that are required to be taken to eliminate hazards or reduce their occurrence to an acceptable level.

Corrective action Action taken to ensure that the cause for a defect or undesirable situation does not recur.

Corrective action The specified prompt action that needs to be taken when the criteria are not met or when the results of monitoring the CCP indicates a trend towards loss of control.

Critical limit means the maximum or minimum value to which a physical, biological or chemical parameter must be controlled at a critical control point to minimise the risk of occurrence of the identified food safety hazard.

Decision tree A sequence of questions applied to each process step with a potential hazard to identify which process steps are critical to food safety.

External customer The end users of the goods or services, i.e., the guests.

Flow diagram A systematic reference of the sequence of steps or operations used in the production process of a particular product.

GAP Good agricultural practices

GHP Good hygiene practices

GMP Good manufacturing practices

HACCP Hazard Analysis Critical Control Point is a system that identifies, evaluates and controls hazards that are significant for food and safety.

HACCP plan An HACCP plan is a written document that describes the formal procedures for following HACCP principles.

Hazard A physical, chemical or biological agent in, or condition of food, which has the potential to cause an adverse effect on health.

Internal customer The employees of the company.

Lead auditor An individual who supervises auditors during an audit as the team leader.

Monitor The act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control.

OPRP Operational Prerequisite Programmes

PRP Prerequisite Programmes

Quality assurance The term quality assurance includes all of the activities that are performed to ensure that the product/service meets the customers satisfaction and are of the appropriate quality.

Quality The degree of excellence that a product or service provides.

Risk The probability with which a hazard may occur.

Sanitary risk management (SRM) A programme that identifies risks at each operating stage in a food service establishment and implements procedures for reducing those risks in daily operations thereby successfully reducing the overall risks of operating a food establishment.

TQM Total Quality Management is an approach to business that looks critically not only at the products and services a company provides in relation to the process it employs to create them, but also at the work force, to ensure that outputs fully satisfy customer requirements. TQM encompasses everything the company does, i.e., all processes and employees at all levels at all times. Hence, it is called total. The philosophy of TQM is also customer oriented.

Verification The application of methods and procedures, tests and other evaluations in addition to monitoring to determine compliance with the HACCP plan.

Zero defect "Defect-free work" most of the time also known as "right first time".

REVIEW QUESTIONS

1. List the seven HACCP principles.
2. What is an SRM programme and what are its advantages?
3. List the ten basic operating activities in a food service system and briefly explain the significance of each step.
4. Define the following terms
   CCP,
   hazard,
   risk.
5. What are the benefits of ISO certification/registration?
6. What are the various ISO standards available?
7. List the difference between ISO 14000 and ISO 9000.
8. Prepare a flow diagram depicting the various stages in the process for preparing chicken curry.

19

- **Emerging Diseases**
- **Genetically modified food**
- **Food labelling**
- **New trends in food packaging and technology**

Recent Concerns

INTRODUCTION

A number of new diseases have emerged lately, disrupting normal life and tourism across the world. These comparatively unheard of diseases are a threat to humans and have resulted in a large number of deaths in some countries. Some are airborne while others are transferred through contaminated food or mosquitoes breeding in unclean environments. Their spread can definitely be curtailed using hygienic practices. They have been included in this text so that everyone is aware of their mode of transmission and the measures that can be adopted to control them to prevent a pandemic.

EMERGING DISEASES

Chikungunya

This is a viral fever spread by the bite of the mosquito *Aedes egypti,* which is active during the daytime and bites during the day, unlike the common mosquitoes which bite at night.

The symptoms of chikungunya are high fever, headache, bodyache, joint pain and lethargy.

The treatment is symptomatic. Antipyretics are used to bring down fever, analgesics are prescribed for bodyache and antibiotics are administered as a prophylactic to prevent secondary bacterial infection. In severe cases, antiviral drugs are administered. Preventive measures include treating stagnant water by breeding guppy fish to eat the larvae of the mosquito. Use of full sleeve clothing, spraying insecticides and wire meshing of doors and windows to keep mosquitoes away, are advisable in mosquito infested areas or during an epidemic.

Mad Cow Disease

This is the name commonly used for Bovine Spongiform Encephalopathy (BSE), a slowly progressive, degenerative, fatal disease affecting the central nervous system of adult cattle. BSE in cattle was first reported in 1986 in the United Kingdom. The exact cause of BSE is not known but the likely cause is infectious forms of a type of protein, prions normally found in animals. In the initial stages, these abnormal prions occur in the small intestine and tonsils and the brain and spinal cord and other tissues in later stages. The first outbreak is likely to be caused when cattle may have initially been fed feed contaminated with scrapie-infected sheep meat-and-bone meal (MBM). The infectious prions accumulate in the neural tissues causing a fatal, degenerative, neurological disease. They are resistant to heat.

The US has instituted a ban on the use of most mammalian protein in feed for ruminant animals to prevent the spread of BSE in cattle.

A disease similar to BSE called Creutzfeldt-Jacob Disease (CJD) is found in humans. A variant form of CJD (vCJD) is believed to be caused by eating contaminated beef products from BSE-affected cattle. At least 155 confirmed and probable cases of vCJD have been reported worldwide.

To curb the spread of the disease, the US has taken some stern measures to protect people from possible exposure to BSE.

Since 1989 the USDA has banned the imports of live ruminants and their products from countries known to have BSE. In 1997 the FDA prohibited with some exceptions, the use of protein derived from mammalian tissue in animal feed. In 2004, the use of certain cattle material has been banned in human food and cosmetics. In 2005, the following material has been prohibited in human food and cosmetics.

- cattle material from disabled, nonambulatory cattle;
- cattle material from mechanically separated beef;
- cattle material from organs from cattle 30 months of age or older, and the tonsils and distal ileum of the small intestine of cattle of all ages;
- cattle material from cattle that are not inspected and passed for human consumption;
- cattle materials that have the highest risk of harbouring BSE infectivity are not to be used for making gelatin.

Since scientific research has shown that BSE is not transmitted in cows milk, even if the milk is from a BSE infected cow, milk and milk products, even in countries with a high incidence of BSE is considered safe. Also tallow made by rendering fat by exposing it to excessive heat and pressure may be used in cosmetics as proteins (prions) are separated from fat. Hide and hide – derived products and tallow derivatives are not considered "prohibited cattle material".

Bird Flu

Influenza A virus subtype H5Nl also simply called H5N1, is a subtype of the influenza A virus that can cause illness in humans and many other animal species. A bird-adapted strain of H5N1, called

HPAI A(H5N1) for "highly pathogenic avian influenza virus" of type A of subtype H5N1 is the causative agent of H5N1 flu commonly known as "avian influenza" or "bird flu". It is spreading globally killing tens of millions of birds and spurring the culling of another hundred of millions of poultry to stop its spread.

H5N1 is mainly spread by domestic poultry both through the movement of infected birds and poultry products and through the use of infected poultry manure as fertiliser or feed. Infected birds transmit H5N1 through their saliva, nasal secretions, faeces and blood. Humans with H5N1 have typically caught it from chickens, which were infected by other poultry or waterfowl. Migrating wild ducks, geese and swans may be carriers of H5N1 without developing any symptoms. These migratory birds are spreading this highly pathogenic H5N1 virus to all parts of the world and can be spread by animals other than poultry. H5N1 may be spread directly or indirectly.

H5N1 may be spread *directly* by secretions from infected birds or through contact with surfaces contaminated by them. The virus remains infectious for one week at 37°C or for over 30 days at 0°C. It remains in the environment for weeks and at subzero temperatures it does not degrade at all. The virus may sometimes stick to surfaces or get kicked up in fertiliser dust to infect people *indirectly*.

Studies of this virus indicate a high rate of mutation and increased environmental stability. It can pass through a pregnant woman's placenta to infect the foetus. The virus not only affects the lungs but also passes into the gastro-intestinal tract, brain, liver and blood cells.

H5N1 was first detected in humans at the same time when an epizootic (an epidemic in nonhumans) of the virus was seen in Hong Kong's poultry farms. A panzootic (a disease affecting animals of many species, over a wide area) outbreak was prevented by killing the entire poultry population within the territory.

In general, the symptoms include fever, cough, sore throat, muscle aches, conjunctivitis and in severe cases, breathing problems and pneumonia that may be fatal. WHO has reported a high mortality rate as 60% of cases classified as H5N1 resulted in death. There is no highly effective treatment for H5N1 flu. Doctors are prescribing oseltamivir, which is commercially marketed by Roche as Tamiflu to inhibit the influenza virus from spreading inside the users body. Vaccines for several avian H5N1 varieties have been developed, but the virus is constantly mutating, thereby limiting their usage. Table 19.1 depicts the number of laboratory confirmed cases and number of deaths in Southeast Asia as confirmed by WHO, the maximum being reported from Indonesia, Vietnam, Egypt and China.

Table 19.1 Cumulative number of confirmed human cases of avian influenza A/(H5N1) reported to WHO as on 10th Sept. 2008

Year	*Cases*	*Deaths*	*Mortality (%)*
2003	4	4	100
2004	46	32	70
2005	98	43	44
2006	115	79	69
2007	88	59	67
2008	36	28	76
Total	387	245	61

Control measures include curbing illegal trade of smuggled birds and culling poultry to prevent a panzootic.

Swine Flu

This is caused by a highly contagious virus Novelle Influenza A (NA H1N1) and not through contaminated pork or pork products. It has spread all over India with maximum cases. In the US 2,326 specimens tested positive for influenza A of which 1,395 60% were A (2009 H1N1) positive (Sept. 2009) (being reported from Pune—114 cases as on 5th Dec. 2009. The governments of various countries are taking active measures to control the spread of this epidemic.)

The incubation period for swine flu is 2–5 days. People are most infectious soon after they develop symptoms and can continue to shed the virus for up to 5 to 7 days. The spread of infection occurs by inhalation of respiratory droplets or from touching infected things. Younger persons are more likely to get infected with the rate being the highest in 5–24 year age group followed by 0–4 years.

Clinical Characteristics

- Fever or high temperature (over 38°C/100·4°F) and two or more of the following symptoms
- Cough
- Shortness of breath
- Unusual tiredness
- Chills
- Myalgias
- Rhinorrhoea
- Headache
- Sore throat
- Vomiting
- Wheezing
- Diarrhoea

The complications of swine flu are:

1. Secondary bacterial chest infection such as bronchitis or pneumonia.
2. Tonsillitis.
3. Otitis media.
4. Septic shock.
5. Meningitis.
6. Encephalitis.

The emergency warning signs that need prompt medical attention are

In children

- Fast breathing or trouble breathing
- Bluish skin color
- Not drinking enough fluids
- Not waking up or not interacting

- Being so irritable that the child does not want to be held
- Flu-like symptoms improve but then return with fever and worse cough
- Fever with a rash

In adults

- Difficulty breathing or shortness of breath
- Pain or pressure in the chest or abdomen
- Sudden dizziness
- Confusion
- Severe or persistent vomiting

Most patients with uncomplicated influenza do not need hospitalisation and can be isolated and treated at home.

Antiviral treatment should be initiated as soon as possible without waiting for influenza test results. It is effective when administered as early as possible in the course of the disease, i.e., within 12 to 48 hours of symptoms appearing.

The antiviral drug oseltamivir (Tamiflu) is approved for age one year and above and in emergency below one year. It acts by stopping the flu virus from entering our cells and blocks the release of new copies of the virus.

Prevention of spread of the virus – the following advice to be given to patients and their families

- Cover your nose and mouth with a tissue when you cough or sneeze. Throw the tissue in the trash after you use it.
- Wash your hands often with soap and water, especially after you cough or sneeze. Alcohol-based hands cleaners are also effective.
- Avoid touching your eyes, nose or mouth. Germs spread that way.
- Stay home if you get sick. CDC recommends that you stay home from work or school and limit contact with others to keep from infecting them.

Influenza A (H1N1) 2009 monovalent vaccine

- Licensed vaccine is available from mid-October 2009.
- Seasonal influenza vaccines will not provide protection against novel influenza A (H1N1) virus.
- If side effects occur, they will likely be similar to those experienced following seasonal influenza vaccine. Mild problems that may be experienced include soreness, redness, or swelling where the shot was given, fainting (mainly adolescents), headache, muscle aches, fever, and nausea.
- People who have a severe (life-threatening) allergy to chicken eggs or to any other substance in the vaccine should not be vaccinated.

2009 H1N1 vaccine should be given to

- Pregnant women.
- Household contacts and caregivers for children younger than 6 months of age.
- Healthcare and emergency medical services personnel.
- All people from 6 months through 24 years of age.
- Persons aged 25 through 64 years who have health conditions associated with higher risk of medical complications from Influenza.

Apart from the above precautions, the following measures should be put into practice.

- Good personal hygiene and habits.
- Avoid crowded places specially poorly ventilated public areas.
- Create public awareness.
- Eat ample good quality proteins, water soluble vitamins, i.e., vitamin B_6, B_{12} and vitamin C as well as selenium and zinc to keep the immune system healthy and strong.
- Daily exercise improves blood circulation and the white blood cells that fight infection work efficiently. Thirty minutes of aerobic activity such as walking, swimming, running, etc., is recommended.

To combat the spread of swine flu, many hotels have introduced the practice of washing hands with soap every hour. A bell is rung hourly and all employees are required to wash hands as per the handwashing procedure specified.

Side effects of antiviral drugs may include nervousness, poor concentration, nausea and vomiting. The drug Relenza is not recommended for people with a history of breathing problems such as asthma. Self medication and antibiotics should be avoided as they do not act against the flu virus and may do more harm than good. The risk of getting an infection later that resists antibiotic treatment is high.

Swine influenza viruses are not spread by food. Eating properly handled and cooked pork cooked to an internal temperature of 71°C/160°F is safe.

GENETICALLY MODIFIED FOOD

Genetically modified (GM) foods are foods that are derived from genetically modified organisms (GMO). In these foods, the DNA is modified through genetic engineering. Genetic modifications to include a desirable trait have been carried out in the past. Conventional methods of genetic modification used were selective breeding in plants and animals or mutation breeding to improve a desirable trait in them.

In genetic engineering, a gene that expresses a desirable trait is identified and isolated. A recipient plant or animal is selected, and the gene is inserted and incorporated into its genome. The recipient plant or animal genes get modified and exhibit the desired properties, for example, a large percent of corn available in the market has been genetically modified. The white corn variety to which new genes have been added has bright orange kernels, has a hundred fold increase in beta carotene, and significant increase in ascorbic acid and folic acid.

It is only through genetic engineering that genes that do not occur in the germplasm of the target species or its closely related species, can be successfully introduced. Most GM crops are grown in North America and approximately 75% of all processed foods in the US contain some GM ingredient. There is a significant increase in GM crops worldwide.

There is a controversy regarding the safety of GM foods. Some scientists feel that genetically modified food may not be safe and food that carries any degree of risk should not be offered to people. Apart from the perceived safety issue, ecological concerns and economic concerns cannot be ruled out. The United States and Canada do not require labelling of genetically modified foods.

Table 19.2 Some Genetically Modified Foods Available in the Market

Food	*Properties seen in GM variety*
Soybeans	Herbicide resistance
Corn	Insect resistant. Increase in nutritive value and colour
Cotton	Pest resistant
Hawaiian Papaya	Resistant to papaya ring-spot virus
Potatoes	Very high amylopectin starch component
Rice	High amount of beta-carotene in golden rice
Sweet corn	Produces its own bioinsecticide
Rapeseed(Canola)	Resistant to herbicides. High laurate canola
Sugarcane	Resistant to certain pesticides. High sucrose cane
Microorganisms(Bacteria and Fungi)	Source of enzymes alpha amylase for hydrolysing starch to simple sugars, pectinesterase from fungi to increase clarity in fruit juice

Other governments such as European Union, Japan, Australia and Malaysia, require labelling so that consumers can choose between genetically modified, conventional or organic foods. However, this is a difficult task as it requires a reliable separation of GM and non–GM foods at production level and throughout the entire processing chain.

Genetically engineered crops may require lower pesticide usage, have higher yields, and are profitable to farmers. In the United States, the FDA Centre for Food Safety and Applied Nutrition compares the nutritional value of GMO foods with conventionally grown foods before giving approval. The following foods have received FDA approval in 2002.

A large number of diverse GMO applications have been envisaged for the future. They include drugs in food, bananas that produce human vaccines against infectious diseases such as Hepatitis B, metabolically engineered fish that mature more quickly, fruit and nut trees that bear fruit at an earlier age, etc. Safety testing of all these will be required and a lot more research needs to be conducted.

Table 19.3 **GM Foods for Human Consumption Evaluated by FDA [No. of varieties evaluated in ()]**

Modified attribute			
Insect resistance	*Viral resistance*	*Herbicide tolerance*	*Modified oil*
Corn (8)	Squash (2)	Corn (9)	Soybean (1)
Tomato (1)	Papaya (1)	Rice (1)	Canola (1)
Potato (4)	Potato (1)	Canola (8)	
Cotton (2)		Sugarbeet (2)	
		Flax (1)	
		Cotton (4)	
		Raddish (1)	
		Soybean (2)	

FOOD LABELLING

The Government of India has issued a notification on labelling requirements for food processors, making it mandatory for all prepackaged food to carry a label clearly visible and adhering to the container with all necessary information mentioned in the notification.

Since the label is the first point of contact between the manufacturer and the consumer, it tells the consumer what they are purchasing in terms of nutritional value, helping the consumer to make a health conscious selection. It allows consumers to compare food products by value for money. Some products claim additional benefits to attract consumers in terms of health claims or nutritional claims. In such cases it is necessary to display the levels of nutrients, for example, cholesterol, MUFA (monounsaturated fatty acids), PUFA (polyunsaturated fatty acids), transfats, vitamins, minerals, dietary fibre and sugar alcohols. For example, if a product claims to be heart healthy, then to substantiate the claim it is necessary to mention cholesterol and all fats present per serving.

Internationally, food labels follow Codex Alimentarius guidelines that require detailed nutrient information. In India, the food regulations has so far restricted the label to total carbohydrates, sugar, fat, protein and energy facts. However, food manufacturers wishing to go global and benchmark their products with international brands prefer displaying information as per international standards.

General Guidelines for Labelling

In the interest of the general public, the following guidelines have been framed for a food label

1. Labelling should not get separated from the container, contents should be legible and the label in general should not be misleading.

2. Every food package should have the name of the food and list of ingredients in descending order of weight.
3. Symbol for vegetarian/non-vegetarian food should be displayed.

   Vegetarian food will have a green colour–filled circle having a diameter not smaller than 3 mm for a 100 sq cm package and as large as 8 mm for a package above 2500 sq cm, which is prominently displayed. The size of the symbol will depend on the size of the package. Non-vegetarian food in whole or in part but not including milk or milk products as an ingredient will have a brown colour–filled circle prominently displayed on the package.
4. Nutritional facts per 100 gm of the product should be mentioned.
   - Energy expressed in kcal per 100 gm/100 ml
   - Proteins
   - Carbohydrates (in gm/100 gm)
   - Fats
   - Amount and type of fatty acids:

     Saturated fatty acids
     Polyunsaturated fatty acids
     Monounsaturated fatty acids gm/100 gm
     Trans fatty acids
   - Cholesterol
   - Vitamins and minerals in metric units
5. Food additives should be mentioned by their respective class like anticaking agent, antioxidant, natural flavour, etc. The international numerical identification number of colours is also to be mentioned.
6. The name and complete address of the manufacturer and the manufacturing unit is to be mentioned.
7. Net contents and drained weight.
8. Lot/Code/Batch identification, number.
9. Date of manufacture or packing in terms of date, month and year in which the commodity is manufactured.
10. Use by date/Best before date/expiry date.
11. Irradiated foods shall carry a written statement indicating the treatment printed close to the name of the food. The international food irradiation symbol and licence number of irradiated units should be mentioned on the label.
12. Country of origin for imported food.
13. Instructions for using the product should be clearly indicated, along with instructions for disposing package. For example, crush the bottle after use for packaged drinking water. Small packages less than 10 sq cm need not have all the information but for the same product in a wholesale package, all such information is necessary. All information should be in English or local language for example in India in Hindi in Devnagri script. The label may have pictures and graphics printed or written on it.

Specific foods such as infant foods, fried snacks, etc., have additional items to be mentioned on the label. The reader could refer to 'Prevention of Food Adulteration Rules, 1955 for the same.

NEW TRENDS IN FOOD PACKAGING AND TECHNOLOGY

The packaging industry is growing at an alarming rate to keep pace with the customers demand for purchasing convenience foods in smaller portion packs. People are more adventurous and aspire to eat exotic foods from around the globe. With urbanisation, there are fewer people growing their own food or living close to farms, which makes it imperative for food to travel to far off places to reach the buyer. If food has to travel long distances, it needs to be packaged properly and the fact remains that the longer the distance, the more heavily it will need to be packaged to retain its freshness.

The waste generated from several layers of packaging is large and since food packaging is after all the stuff you peel off and throw, this waste could be effectively reduced if the packaging material is bio-degradable or by following the 3 Rs, i.e., Reduce, Re-use, Re-cycle.

Biodegradable packaging—These are biodegradable plastics made from plant–based cellulose extracted from grains like corn. This plastic breaks down easily and disappears into the soil or atmosphere, after some time.

Unwanted packaging like shrink wrapping vegetables or displaying them in polystyrene trays can be reduced. Reusing empty containers is a more viable option than recycling them. Paper, fibreboard, plastic, glass, steel and aluminium are the most common materials used for packaging. All these are recyclable. Paper is invaluable in the form of corrugated cardboard for food that needs to be transported long distance. Aluminium is used to package drink cans and in foils and laminates. Plastic packaging has the advantage of being light weight and sturdy. All packaging material should be recycled.

Apart from providing a physical barrier against injury and contamination, modern packaging has several objectives.

1. Physical protection of food from vibrations, compression, shock, temperature changes, etc.
2. Barrier formation to keep contents clean, fresh and wholesome throughout its intended shelf life. Oxygen, water vapour, dust, etc., is kept away by adding desiccants or antioxidants. The atmosphere in the package may be controlled or modified.
3. Containment or agglomeration are needed for powders and other small items. These are put into smaller packages.
4. Information transmission—This is a vital objective of packaging that often helps in providing mandatory information like instructions for use, nutrition facts, storage temperature, how package should be disposed after use, etc.
5. Conveniene in size, shape, design, use, etc, which help in stacking, opening and closing the package, etc.
6. Security—To prevent tampering of the contents or pilferage of the item, modern packaging has tamperproof seals, authentication seals, tamper resistant design, antitheft devices such as RFID tags, electronic article surveillance tags, that are not easy to deactivate.
7. Portion control and inventory control is simplified through single service packaging that has a fixed amount of contents to control usage.

Marketing

Packaging and labels can be so designed to attract potential buyers to purchase the product.

A wide variety of packaging machines with enhanced technical capabilities, safety, reliability, flexibility, serviceability, etc., are available for packaging all types of fresh and processed food items. Foods are often packaged in three types of packages.

1. Primary Packaging is the main package that holds the food that is being processed.
2. Secondary Packaging combines the primary packages into one box, e.g, cans of Diet coke put into one box.
3. Tertiary Packaging is that packaging that keeps a series of boxes together on a single pallet.

Smart Packaging

Smart or intelligent packaging, also known as active packaging, makes use of a new generation of self reading visual indicators to say if the product is safe for consumption or commercially sterile. Some help the producers or retailers monitor the temperatures throughout the cold supply chain using digital temperature data loggers and RFID (Radio frequency identification).

A number of smart indicators have been designed which will benefit the food manufactures, the retailers and the consumers as well.

Today, food packages include colour change smart indicators which can show us when the fruit reaches optimum ripeness. Other changes in the package which can be visible are microbial growth indicators, physical shock indicators, leakage and microbial spoilage indicators.

Smart packaging makes use of the following in the active package

- Oxygen Scavengers
- Carbon Dioxide Scavengers and Emitters
- Ethylene Scavengers
- Ethanol Emitters
- Preservative Releasers
- Moisture Absorbers
- Flavour and Odour Absorbers and Releasers
- Temperature Control Packaging
- Temperature Compensating Films

Temperature Recorders Temperature recorders are capable of measuring and recording the temperature of products shipped in a cold chain. Digital temperature data loggers are used to monitor the temperature of products and this information can be downloaded onto a computer. They can tell us how long food has remained in the danger zone and what is its remaining shelf life. Such information also helps in taking corrective measures during shipment. Temperature may be displayed on the indicator or by lights.

Time-temperature Indicators Time Temperature indicators are tailored to the specific shelf life and optimum storage conditions of the product it is designed to monitor. For example, a new generation time temperature indicator has been designed for meat, fish and convenience foods with a shelflife of five to six days at 5°C. See Fig. 19.1.

It integrates the time and temperature experienced by the indicator on the label and the adjacent food. They are currently available as labels and will soon be available as printing inks which can be applied directly on the package.

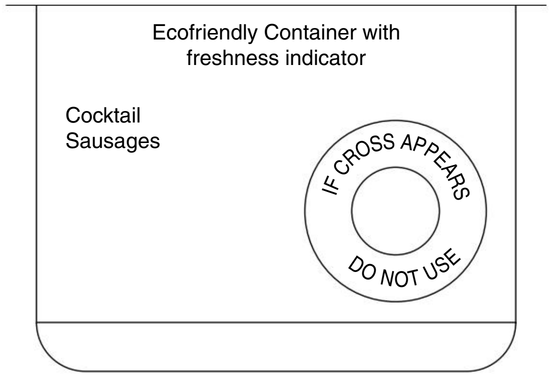

Fig. 19.1 *Biodegradable packaging with time/temperature visual indicators which change colour when food is no longer fresh*

RFID Radio frequency identification is applied to food packages giving food producers and retailers full time real visibility of their supply chain, enabling adequate controls.

Biodegradable packaging Plastic packaging is being replaced by biodegradable films and coatings synthesised from organic material and microbial polymers. Such packaging does not pose any waste disposal problems or cause ecological imbalance as biodegradable products can be completely decomposed by bacteria, fungi and algae.

These biodegradable packaging materials have a unique characteristic in which microbial action can decompose or breakdown the rugged polymer structure.

Research is going on to ensure that biodegradable packages meet the requirements of the modern packaging industry in terms of physical protection, barrier formation, convenience in use and security.

Common Plastics Used in Food Packaging

The plastics we generally come across are not considered to be toxic or harmful in any way. They are even safe even if they come in contact with food as they are inert and do not react with the chemicals in our body. However, one must remember that, even if a polymer is completely nontoxic, the monomer from which it is made may not be so. Some monomers are in fact harmful to human health particularly styrene (S) and vinyl chloride (VC). There is always a possibility that a small amount of monomer might be present in the plastic in an uncombined form if the unreacted monomer present is less than 1 ppm (that is one part of monomer per million parts of plastics by weight), in case of polystyrene or PVC. Therefore, the level of unreacted monomer has to be closely monitored in case of such plastics. Due permission has to be obtained from the Food and Drug Administration, Government of India before using any plastics as food packaging material.

Plastics such as polyethylene (PE), polypropylene (PP), oriented polystyrene, nylon, polyester, polyurethane, saran and polyethylene terephthalate (PET) are used as food packaging material.

Nylon Films The useful properties of nylon films are thermoformability, crack and abrasion resistance, and good low temperature properties. Its main applications include vacuum packs, processed meat and cheese, boil-in-pouch.

Polyester Film The main advantages of polyester films are that they are tough, sterilisable, very clear, chemical resistant and laminate base. Its main applications include metallised films, vacuum and gas packaging, shrink packaging, cured meat, boil-in-bag, throw-in-pack food.

Thermoplastic Urethane Film The main advantages of urethane are that it is very tough and elastic. The abrasion resistance of thermoplastic urethane is significantly higher than other conventional films and sheets. This property is not only only useful in free film package design, but also imparts excellent wear characteristics to laminates when this film is the laminating base film. The impact properties of these materials are excellent because of their elongation and puncture resistance. The main applications of urethane film includes packaging sharp objects, oil pouches, radiated food containers and military food packaging.

Saran Film Saran film have been developed specially to be used as food packaging. Saran, a copolymer of vinyl chloride and vinylidene chloride, is extensively used abroad for food packaging. Saran films are highly transparent and hence food items wrapped in saran film look very attractive. Moreover, these films are totally impermeable to air and greatly increase in the shelf life of the items wrapped in saran.

Polyethlene Terephthalate (PET) PET has been introduced in the Mainpur market a few years back. The transparent bottles in which some brands of mineral water, cooking oil, fruit juice, liquor and cola are sold at present are made from this plastic. Pet bottles are highly transparent, totally safe and completely impervious to air. PET is particularly recommended for bottling cooking oil, since oil is stored in the bottles for a long time. There is a chance that due to prolonged contact the harmful additives in ordinary plastic may dissolve in the oil, if bottles are made from cheap plastic. (PET bottle blowing machine is available at CIPET lmphal and any interested entrepreneurs can avail the facility for their commercial production).

Plastic in Packaging of

Produce Owing to perishability, the bulk of fresh fruit and vegetables are still sold unpacked at retail or wholesale level in perforated polyethylene bage or nets. Long term transport of these materials must remain minimal to avoid brushing and consequent decay of the loosely package product. When packaging is required at the source or when an extended storage life is desired, the packaging film should have a high gas permeability and anti-fog properties. The packaging of fresh vegetables and fruit provides the largest single use of printed polyethylene bags. The pre-packaging of potatoes, carrots, onions, parsnips, beets, radishes, etc, for market sales has become an important aspect of food distribution. Because of low water vapor permeability of polyethylene and propylene, both films and bags are sometimes perforated to allow the product to ‘breathe’ and extend fresh produce shelf life.

Fresh Meat The resurgence of the environmental movement has caused an upswing in the demand for environmentally friendly (green) packaging finds a new Trends Report from the Foodservice Packaging Institute.

Green packaging has garnered its place in the foodservice industry and demand is likely to grow as the national green movement and legislative changes continue to affect the foodservice packaging industry. The report says new alternative materials like biopolymers, starches and non-tree cellulose (such as sugarcane and bamboo) have entered the market touting biodegradable and/or compostable benefits. Materials such as paper, plastic and aluminum more green because of increased use of post-consumer recycled content and source reduction though light weighting and fillers.

Edible films are defined as a thin layer of edible materials formed on food as a coating or a self-supporting thin layer placed (pre-formed) on or in-between the food components, and in both case consumed along with the food. Though edible films in the form of coatings are traditionally used to extend the shelf life of food and maintain its quality by inhibiting the migration of moisture, oxygen, carbon dioxide, aromas and lipids, development of the self-supporting form has been the subject of tremendous research since the last decade.

The self-supporting films have been prepared by casting solutions of proteins, carbohydrates and lipids, in different combinations and compositions. The raw materials those have received attention include polysaccharides (e.g., cellulose, modified cellulose, starch, agar, carageenan, alginate, pectin, dextran, pollulan, curdlan, etc.), proteins (e.g., zein, gluten, collagen, gelatin, ovalbumin, myofibrillar proteins, etc.) and lipids (e.g., carnuba wax, bees wax, lauric acid, palmitic acid, stearic acid, etc.).

The properties of the edible films those have been mostly evaluated are mechanical properties, like ultimate tensile strength (UTS) and percent elongation at break (EL) and the barrier properties, like water vapour permeability (WVP) and oxygen permeability.

Thus, the favourable aspects of edible films are follows.

1. The films are completely biodegradable.
2. The films can be a part of a food/used as feed.
3. The films can reduce the consumption of naphtha-based polymeric films.

Therefore, development of edible films with good mechanical and barrier properties is undoubtedly a challenge in the modern food science.

SUMMARY

Unheard of diseases have emerged in the world and each day the media bombards us with new statistics and reports. There is apprehension and fear amongst people and no one knows where the disease will strike next. Chikungunya a viral fever spread by the bite of *Aedes egypti* a mosquito which bites during the day has emerged in parts of India. Mad cow disease, a fatal disease of cattle and CJD found in humans made people in UK and US to ban beef products from their diets, while Bird flu kept people looking suspiciously at poultry specially in South East Asia. While Swine flu is now in the country, cases are still being reported all over the world. Since it is an airborne virus, it can spread and its spread can be curtailed through simple precautions like staying away from people with respiratory illnesses, avoid touching your eyes, nose or mouth and using facemasks correctly.

Genetically modified foods are being viewed as a cause of concern and there is a controversy regarding the safety of such foods. Some countries require it to be mentioned on the label. The Government if India has laid down strict norms for food processors with regards to the label on the prepackaged food. Food items nowadays need to furnish detailed information about the product on the label to help consumers make the right choice. The packaging industry has progressed to keep pace with customers ready to buy foods from across the globe. New trends in packaging assure the customer of a fresh wholesome product below the many layers of packaging.

KEY TERMS

Biodegradable Packaging Packaging material that breaks down easily and disappears into the soil or atmosphere. These are plastics made from plant cellulose.

Codex Alimentarius A body of laws relating to food.

Creutzfeldt-Jacob Disease (CJD) It is a disease similar to BSE found in humans.

Epizootic An epidemic in non-humans.

GM Foods Foods derived from genetically modified organisms in which the DNA is modified through genetic engineering to introduce desirable traits.

Mutating A sudden variation or change in some inherent characteristic that differ from those of the parent.

Pandemic An epidemic spread over a whole area, country.

Panzootic A disease affecting animals of many species, over a wide area.

RFID Tags Radio frequency identification tags are tags put on food packages to monitor and control the food supply chain.

Scrapie Infected sheep meat-and-bone-meal (MBM).

Swine Flu A respiratory disease of pigs caused by Type A influenza virus that causes regular outbreaks in pigs and is recently spreading amongst humans.

REVIEW QUESTIONS

1. What precautions are being taken to prevent the spread of BSE?
2. How was the spread of bird flu curbed recently?
3. Discuss simple precautions to control the spread of chikungunya.
4. What all information is mandatory on a package of ready–to–eat chicken biriyani?
5. What are the advantages of packaging?
6. What do you understand by the term smart indicators in packaging? Explain with suitable examples.
7. List any five benefits of GM foods.

Appendix I

- **Case Study – 1: Food poisoning following a school picnic**
- **Case Study – 2: Lawsuit against airline caterer**
- **Case Study – 3: The negligent canteen contractor**
- **Case Study – 4: The tooth's on the house**
- **Case Study – 5: The problematic stew**
- **Case Study – 6: Overcrowding of the work place**
- **Case Study – 7: Food poisoning on board a luxury liner graded excellent**
- **Case Study – 8: Biodegradable waste management with a vermicompost plant**
- **Case Study – 9: Temporary closure of a Michelin-starred restaurant**
- **Case Study – 10: Hygiene audit of a four star hotel kitchen**

CASE STUDY – 1

Food Poisoning Following a School Picnic

XYZ caterers accepted an order from a local school to cater for 100 meals for an all-day outing. The menu for lunch was burgers on buns, coleslaw, bananas, chocolate cake and a fruit juice, packed individually in tetrapack containers. Most of the items were prepared the day before. The cutlets in the burgers were shaped the previous evening so that they would be ready to fry the next day. The chef mixed the minced meat with onions, herbs and seasoning and shaped the patties so that they would be ready to broil the next morning and ready to be delivered by 7.00 am. As some of the children were vegetarian, mixed vegetable cutlets were prepared for them. The patties were kept in the refrigerator along with the juice packs and salad ingredients. The refrigerator was heavily packed with food.

The patties were broiled the next morning and the salad was prepared. A few of the burgers were well done and each burger was individually wrapped. The children enjoyed the outdoor games in the park as well as the eats packed for the picnic lunch.

Later in the afternoon, some children stopped playing and complained of a stomach ache. The teacher thought that they must be over-tired as it was a very warm day. But soon the children began to vomit and had diarrhoea. Then one by one, almost half of the children began showing the same symptoms.

QUESTIONS

1. What food items might have contributed to the illness?
2. Which kind of bacteria was most likely to be responsible for the illness? Explain your answer.
3. Was the food-borne illness a food infection or a food poisoning? Give reasons for your answer.
4. How can you explain as to why all children did not become ill?
5. Although the chef had refrigerated the foods after they were prepared, some hygienic practices were obviously overlooked. List several that might explain the cause for this outbreak.

CASE STUDY – 2

Lawsuit against Airline Caterer

A lawsuit was filed last week against an airline caterer XYZ for serving contaminated meals on several flights which caused 50 people to suffer from food poisoning across four continents.

The company has two offices, one in the US and the other in UK and has been sent a warning letter last month citing violations observed during an inspection of its facility three months ago. The violations were presence of live cockroaches and flies in the kitchen, an unclean pot wash area, holding meat at temperatures within the danger zone, garbage bins which were overfull and uncovered in food preparation area with fruit flies on them. Dirty and sticky refrigerator handles with old food residue on them and mould growth in the walk-in refrigerator.

The Food and Drug Administration had warned the organisation to take major steps to clean the facility and follow hygienic procedures or else risk the unit being closed down.

XYZ is one of the largest airline caterers which provides meals to over 210 airlines worldwide through its 120 flight kitchens located in 32 countries. The FDA had given the caterers 15 days to respond after it received the letter.

The outlet provides meals to approximately 15,000 airline passengers every day, while the company serves approximately 195 million meals every year.

The problem was brought to light when ten passengers who had boarded the flight from destination A to destination B reported the matter to the Ministry of Health. All were suffering from severe bloody diarrhoea, fever, stomach cramps, nausea, and vomiting. All had consumed the macaroni salad and blancmange for lunch.

Some of the passengers had to cancel onward flights and alter travel plans resulting in heavy financial losses in terms of flight cancellations and hotel booking cancellations. Some passengers required hospitalisation and IV fluids as they were dehydrated. Two passengers needed bed rest for a week resulting in loss of leave and leave without pay.

QUESTIONS

1. Most cases of airline food poisoning go unreported because passengers often take onward flights. How was this case different?
2. Who is morally responsible for food safety on a flight and which organisation loses its reputation?
3. Which microorganism do you feel is the causative agent. Give reasons for your answer.
4. Explain the difficulties the passengers had to face because of the poor hygienic practices in the kitchen.

CASE STUDY – 3

The Negligent Canteen Contractor

The XYZ Institute of Business Management attracts students from all over the country wishing to pursue the prestigious MBA programme. Being a residential college, students rely on the college mess for all three meals. Students often complain that the food is oily, tasteless and pungent, while the canteen contractor tries to cater to the palate of a clientele with varied food habits. The menu consumed on that fateful day when 133 students needed to be admitted the night after they had dinner at the college canteen was *biriyani* and curds for lunch and sprouts salad and Chinese fried rice for dinner. Around midnight, many students found themselves vomiting and complained of severe stomach cramps and diarrhoea.

After frequent visits to the restroom throughout the night, some students developed high fever. They contacted the college authorities who shifted them to a hospital nearby. The hospital authorities found that they had an emergency situation on hand as the number of students increased from 5 to 133 over the next one and a half hours. Blood tests were conducted which revealed a high WBC count and presence of pus in the stool culture. Doctors identified it as an acute case of food poisoning. Detailed reports were sent to the Police and the Food and Drug Authority. The police reacted immediately, taking the canteen contractor and staff into custody. They were charged with negligence while preparing food and serving unsafe food to the students. They have also been charged with destroying vital evidence and thus hampering the investigations because the cooks had destroyed all the unused cooked food items left after students had consumed dinner.

There have been complaints regarding the quality of food being served in the college campus since a couple of months and students hope the quality of food improves after this incident. Student population depend on restaurants and messes for their meals and although the number of eating joints is growing rapidly, the number of food inspectors to maintain a hygienic check is dismally low. Also restaurant kitchens are filthy, and food handlers do not undergo any medical check-up prior to appointment and may often be carriers of disease. The cooks and waiters have never undergone any training in hygiene and cannot understand the need to follow hygienic procedures and temperature control for prepared food.

After this major incident of food poisoning, the authorities realised how grossly inadequate the food health monitoring services were as five food inspectors are required to monitor 3,500 grocery shops, 1,100 restaurants, 520 sweet-meat shops, 480 flour mills and 2,300 hand-carts and milk booths.

QUESTIONS

1. Who in your opinion is responsible for this outbreak of food poisoning?
2. How can health authorities help in preventing such outbreaks?
3. Which food items do you feel are responsible for this outbreak?
4. What simple hygienic measures would you suggest to the caterer to prevent such outbreaks in future?
5. What action is the caterer likely to face?

CASE STUDY – 4

The Tooth's on the House

Even when high hygiene standards are followed by airline caterers, a passenger aboard a domestic Mumbai–Delhi flight was in for a rude shock when he found a tooth implant in the pulao and *dal* served to him, as part of the lunch menu. The passenger was furious and he definitely had reason to be so. He had asked for a vegetarian meal which included a portion of yellow rice, dal, a vegetable and a sweet. While eating the rice, he found something hard and was horrified when it turned out to be a tooth implant. The irate passenger insisted on filing an official complaint, but the crew members apologised and offered him another meal, but the thought of food nauseated him.

The passenger was told that the meals were sourced from a reputed air caterer and all food was prepared and packaged under strict quality control. The passenger wrote down the complaint which was countersigned by a co-passenger and on landing in Delhi, the same was handed over at the duty manager's office. Apart from the hygienic point of view, had the passenger swallowed the implant along with the rice or broken a tooth while biting on the same, the consequences could have been worse, and the airline assured they would take action against those responsible. They promised to investigate how an extraneous matter could have entered the food packet because meals come straight from the flight kitchen. However, this news made headlines in all leading national newspapers, maligning the name of both the airlines and the air caterer.

QUESTIONS

1. What impact in your opinion will this news article have on the
   a) airline
   b) air caterer
   c) unfortunate passenger

2. It is said that even if one food handler is careless, it can overshadow the good work of other employees.
   Comment on this statement giving examples.
3. Is the implant a contaminant?
4. How in your opinion do you feel the implant could have entered the rice?
5. What measures would you suggest to ensure that such an incident does not recur?

CASE STUDY – 5

The Problematic Stew

The management of an established mess in a college happily agreed to serve mutton stew along with the menu which included *chapatti*, vegetables, salad, rice and curds on a Sunday. As it was a Sunday, the chef knew that all students of the hostel would enjoy the stew. It was prepared late evening the previous day. As the refrigerator was full, the stew was kept well covered in the kitchen overnight. The chef wanted the "stew" to be thick, so he added root vegetables to it. Just before the lunch hour, the prepared stew was warmed and served. All students who consumed the stew had abdominal pain and diarrhoea. The chef was puzzled because the stew was very well cooked.

QUESTIONS

1. What do you think would have gone wrong with the stew preparation? Give any 3 reasons.
2. What in your opinion is the causative organism of this food poisoning and its two probable modes of transmission?
3. How can this food poisoning be prevented? Give any two preventive measures.
4. Personal hygiene and environmental sanitation are very important in the catering business. Justify this assuming that this also might have caused food poisoning as stated in the case.

CASE STUDY – 6

Overcrowding of the Work Place Study

XYZ is a busy restaurant on main street in XYZ city which caters to students, office goers and shoppers throughout the day. The restaurant is popular for pizzas, hamburgers, sandwiches, *grilled* and *tandoori* items and has a salad bar and beverage counter. The restaurant has a small pantry where sandwiches are assembled and beverages are prepared, and a kitchen with a *Tandoor* for cooking.

Business has increased rapidly in the past few years, but there is no scope for expansion of the premises since it is in the heart of the town. The restroom and cloakroom facilities are inadequate and often overcrowded. Staff always occur to be in a hurry and if there is a queue at the handwash basin, they rush back to work without washing their hands after using the W.C. Very often they report for work in their uniforms or service attire and use the dish cloth for wiping perspiration or drying their hands. The washing up area and drinking water coolers are grossly inadequate. The atmosphere is stuffy, there is a lingering smell of smoke and food and the upholstery and carpets smell musty.

Of late, there has been a drop in sales and loss of productivity. Staff have been complaining of ill health, headaches and respiratory infections and have often been on leave without any prior notice. The management is at a loss to understand the sudden fall in profits and the disgruntled staff. They are concerned with the present setup and need the services of a consultant urgently if business has to pick up or they may be forced to shut down.

QUESTIONS

1. What do you feel are the reasons for staff absenteeism from work?
2. How would you improve the indoor air quality of the restaurant and kitchen?
3. How should the sanitation issue be tackled?
4. What changes would you suggest in the menu or crockery/cutlery being used keeping the given constraints in mind?
5. What type of illnesses could result from poor personal hygienic practices?
6. Prepare a plan of action in order of priority to solve the present problem.

CASE STUDY – 7

Food Poisoning on Board a Luxury Liner Graded Excellent

A holiday aboard a cruise liner is a luxury not everyone can afford. Sanitation plays a critical role because if any foodborne illness takes place, there is no way to control it and because of close proximity of people on the ship there are greater chances of the infection spreading.

USPH inspectors visit all cruise ships in US ports, and inspection is carried out in every US port. They are directed by the Centre for Disease Control in Atlanta. They inspect the cleanliness of the ship and the practices being followed regarding sanitation, food and beverage storage, preparation and service to ensure that safe procedures are being followed in order that guest and crew health are not affected.

Port authorities who come on board to inspect the ship, grade the ship out of 100 points. If a score of 100 is obtained it means food, water and sanitation is excellent. A minimum percentage of 86 is required to pass the inspection. Points are deducted if and when faults are discovered.

In spite of such stringent checks, the liner authorities were surprised when four kitchen crew members reported sick for work as they were suffering from severe vomiting, diarrhoea and stomach cramps. They were given treatment immediately by the two doctors on the ship and confined to their cabins while the doctors kept their fingers crossed hoping that no fresh cases would be reported.

The Executive Chef was puzzled because the ship had just been graded and given 100 points and all routine cleaning and sanitising procedures were regularly being followed. There were no signs of spoilt or rotting food, and all medical check-ups of crew had been in order. The Executive Chef decided to follow up the case and carried out a check of the cabins of the ill crew members. He found some remnants of cake, wafers and packets of instant noodles stacked in a paperbag in the closet. No outside food items are allowed in the cabin and from the packaging it was clear that these items were purchased from Port Belize from where the ship had sailed a few days ago. Further investigations revealed that one of the crew members had celebrated his birthday at Port Belize and had carried the leftover birthday cake which was a fresh cream Gateaux to share with colleagues who did not attend the celebration. The cream had turned rancid and the cake was sticky. Now that the cause of food poisoning was evident, the ill crew members were kept away from preparation and service of food to ensure that other crew members and guests were not at risk. He would deal with the offenders once they had recovered.

QUESTIONS

1. Why was the Executive Chef worried when the crew reported sick?
2. Which food item is most likely to cause the poisoning and why?
3. Where should leftover fresh cream Gateaux be stored and what is its shelflife?
4. Do you feel so many sanitation checks are required? Justify your answer giving suitable reasons.

CASE STUDY – 8

Biodegradable Waste Management with a Vermicompost Plant

The Maharashtra State Institute of Hotel Management and Catering Technology, Pune is a premier hospitality Institute, training approximately 1000 students per year under varions formal and nonformal training programmes. The Institute has six kitchens, three bakeries, two restaurants and a snacketeria, where food is prepared and served to all faculty and students. The Institute is surrounded by a garden and many trees and ample plant waste is generated everyday.

The municipal corporation bin located outside the campus was a cause of concern for the residents in the vicinity and the garbage bin was often overfull, with waste strewn on the roads, very often spread further by dogs, cattle and birds. The beautiful building was often shrouded by a foul stench of rotting garbage till the Pune Municipal Corporation made it mandatory for citizens to segregate dry and wet waste and collect all biodegradable waste in green-coloured bags. A fine would be imposed on defaulters and all residents in the locality were informed of the same.

Since the garbage was to be segregated at source and sufficient dry plant waste was available, the Institute went a step ahead and built seven pits, one for each day of the week and an additional pit to collect dry plant waste. The kitchen staff and students were responsible for collection of waste, its segregation and transferring the waste according to the day of the week. The kitchen waste consisted of skin, bones, fruit and vegetable peels, seeds, inedible parts of plant and animal products, damaged, dry and stale food, leftovers, plate waste, burnt or charred food items and spoiled food along with plate waste from the dining area. The food waste was covered with plant waste and sweepings from the garden and sprinkled with water. A year later, sufficient amount of biosanitiser was harvested, which would take care of the fertiliser needs of the Institute's garden. The problem of foul stench of rotting garbage and unsightly garbage strewn roads and pavements was apparently over.

Last month, the institute held its annual food festival, a mega event for two days with over a hundred items prepared. The volume of garbage generated was massive and as it was a Friday, all waste was dumped into the pit. Since there was no time to cover the waste, it was left in the pit uncovered, during the day. In the late evening, a strong putrid stench filled the air surrounding the pits and the organisers were concerned as the function was about to begin. The source of stench needed to be located and dealt with immediately. The garbage mounds which had nearly filled the bins, were covered with sacks and paper and the problem was tackled for the time being. A few days later, there was a strong letter from the nearby housing societies about the nuisance created by accumulated garbage criticising the good cause carried out by the Institute.

The institute, took prompt action and contacted the agency who had constructed the pits. They suggested the following course of action 1) whenever excess garbage was generated, either dig into the pit and bury the garbage or 2) use all pits on one day as the volume of garbage is high. They took an hour-long training session with the kitchen in-charges, laboratory attendants and utility workers, stressing on how biodegradable waste could be disposed. Thankfully, the problem has not arisen again.

QUESTIONS

1. List what type of solid waste can be used in the biosanitiser plant.
2. Why is segregation of waste at the source necessary?
3. What is the purpose of the biosanitiser crystals and sprinkling of water on the garbage?
4. Can paper be used to cover food waste in the bin? Substantiate your answer giving suitable reasons.
5. When and how often should training be given to the staff handling the waste?
6. Could the problem of foul smell emanating from the pit has been avoided?

CASE STUDY – 9

Temporary Closure of a Michelin-Starred Restaurant

A famous restaurant which is ranked second-best in the world and has been awarded three Michelin stars, has been temporarily closed last week after up to 40 diners feel ill.

The celebrity chef who owns the restaurant said he was likely to lose about £80,000 from the closure, while the environmental health officers investigated the case. Reservations for the next few days have been cancelled while the council officials and restaurants safety experts are desperately trying to identify the reason for the illness.

Testing of weekly food samples by their own food safety consultants is part of their routine. Samples from the chef and 70 staff have also been taken to try and identify the source of contamination. Some people feel that the diners could be suffering from typical food poisoning or norovirus, also known as the winter vomiting bug, which is a common seasonal complaint.

Although none of the diners needed to be admitted to hospital, they suffered from nausea and diarrhoea, and called up the restaurant to inform about the food poisoning.

The celebrity chef was perplexed as all his efforts for giving the best possible dining experience to customers has landed them being ill.

He plans to speak to the customers who have been ill and ask them to come back to the restaurant for the experience. Customers need to book at least three months in advance to dine at this restaurant which welcomes 400 people a week with an average spending per head of £200. The owner admits that the closure will cause heavy financial loss as it was peak business time and unless anything is detected, no insurance company would cover the losses. He hopes to open the restaurant next week.

QUESTIONS

1. What all losses do you feel, the restaurant will have to face apart from financial loss?
2. What in your opinion could have caused this outbreak of diarrhoea?
3. Do you agree with the action the owner is planning to take?

CASE STUDY – 10

Hygiene Audit of a Four Star Hotel Kitchen

A four-star hotel planning to apply for an HACCP certification decided to conduct a preliminary hygiene audit of their kitchen and contacted Polchem Hygiene Labs, Pune, to conduct the audit.

The professional team from the laboratory collected and tested air samples, hand impressions and food samples as per 15 standards.

The food samples, working surfaces such as table tops and chopping boards; crockery, cutlery and wiping cloths were tested for *E. coli*, coliforms, yeast, mould, *Staphylococcus aureus* and *Pseudomonas*. Sterile swabs were used and a 10 cm × 10 cm area was swabbed from each surface and hands of the food handler. Food samples were serially diluted and tested on agar plates. Air exposure tests were carried out by the settle plate technique in all sections of the kitchen. Water samples were also tested for coliform and non-coliform organisms.

The following report was submitted by the laboratory to the hotel.

1 Food

Sample	*SPC/ gm*	*E. coli/ gm*	*Coliforms/ gm*	*Yeast/ gm*	*Moulds/ gm*	*S. fecalis/ gm*	*S.aureus/ gm*	*Remark*
Meduwada with chutney		<100	<100	<100	<100	<100	7.8×10^4	B
Mutton chops		1.2×10^3	1×10^4	2.8×10^2	3.5×10^3	-	1.9×10^4	C
Chicken curry		<100	<100	<100	<100	<100	<100	A
Corn & iceberg lettuce salad		<100	1×10^4	2×10^3	1.3×10^2	4×10^3	1×10^3	C
Strawberry mousse		-	1.6×10^4	7.3×10^2	2.8×10^3	-	1×10^3	B
Vanilla icecream	<100	<100	<100	<100	<100	<100	<100	A
Butterscotch icecream	<100	<100	<100	<100	<100	<100	<100	A
Almond icecream	1×10^4	<100	1×10^4	<100	<100	1×10^4	5×10^3	C

Remark

A: Good
B: Satisfactory
C: Unacceptable

$\Big\}$ As per your standard

2 Water

Water Sample	*Coliforms/100 ml*	*Noncoliforms/100 ml*
Drinking water	00	00
Bottled water	00	00

3 Exposures

Department	*Sabouraud's Dextrose Agar*	*Mac Conkey's Agar*
Indian	+ Black, Yellow, Cottony mould (6)	+ L.F (2)
Tandoor	+ Black, Green, Cottony mould (8)	+ L.F (4)
Continental	++ Black, Cottony mould (12)	+ L.F (6)
Bakery	+ Cottony mould (3)	---
Pantry	+ Black, Cottony mould (8)	+ L.F (6)
Chinese	+ Black, Cottony mould (12)	+ L.F (3)

L.F – Lactose fermenting

4 Hand Impressions

Hand Impression	*Sabouraud's Dextrose Agar*	*Mac Conkey's Agar*
ABC	+ Cottony mould (2)	---
XYZ	+ Cottony mould (6)	---
DEF	Green cottony mould (2)	+ L.F (2)
GMI	+ Cottony mould (1)	+ L.F (5)
JKL	+ Cottony mould (1)	+ L.F (12)

5 Swab Test

Sample	*E. coli*	*Coliforms*	*Yeast*	*Mould*	*S. aureus*	*Pseudomonas*
Working table Indian	**10**	**25**	00	00	**10**	**10**
Chopping board Indian	00	00	00	00	00	00
Water glass	00	00	00	00	10	00
Wiping cloth	00	00	**30**	**10**	00	00
Spoon	00	00	00	00	00	00
Plate	00	00	00	00	00	00
Food pan	**05**	10	00	00	00	00
Fork	00	00	00	00	00	**10**
Pantry table	**08**	**10**	00	00	00	00
Platter	00	00	00	00	00	00

Legend

All counts are expressed in Colony Forming Units (CFU)

CFU Value <100 means microorganisms are totally absent

UC – Uncountable

SPC – Count of saprophytic microorganisms which may cause spoilage of food.

E. coli – *Escherichia coli*, indicator of faecal contamination. Should be absent

Coliforms – Gram negative lactose fermenting bacteria found in animal colon, indicate potential presence of enteric pathogens. <10 CFU/gm is permitted count, for example *Enterobacter*

Pse. – Pseudomonas. Non lactose fermenting microorganisms. Responsible for biofilm (slime) formation. Indicative of bad hygiene. Organisms causing spoilage of food.

Yeast and Moulds – Spoilage causing fungi

S. fecalis – *Streptococcus fecalis*, indicator of faecal contamination and unclean processing and handling

S. aureus – *Staphylococcus aureus*, commonly occurring on skin and nasal mucosa and potentially causing food poisoning by producing an enterotoxin.

B. cereus – *Bacillus cereus*, may cause food poisoning.

Swabs: Approximately 10 cm × 10 cm square is swabbed with the help of sterile swabs

Comment: This is with reference to the hygiene audit and food samples collected for testing of microbial quality from you.

Air exposures from different sites of the kitchen show presence of black, green, cottony mould. In view of such counts, the kitchen area should be properly cleaned and disinfected as per the SOP. Hand impressions show presence of yeast and moulds on hands of the kitchen staff. Intermittent washing with soap accompanied by hand sanitation should help reduce microbial growth.

Food samples were tested according to IS standards.

Mutton chops, corn and iceberg lettuce salad, strawberry mousse, samples show presence of yeasts and moulds. Their appearance in raw and cooked foods indicates uncovered foods or foods not properly covered after cooking. Minute dust particles suspended in the atmosphere carry spores of these microorganisms.

Mutton chops, corn and iceberg lettuce salad, strawberry mousse, almond icecream showed presence of coliforms indicating unacceptable hygiene. It may be necessary to investigate probable entry points of coliforms in the raw foods and in the process of food preparation.

Mutton chops shows presence of *Escherichia coli* indicating unacceptable hygiene standards.

Meduwada chutney and almond icecream shows presence of *Staphylococcus aureus*.

Water was found free from any pathogens.

Work tables, wiping cloth, water glasses and forks need to be properly cleaned and sanitised and hygienically handled.

QUESTIONS

1. How does a hygiene audit benefit the catering establishment?
2. From the hand impressions of food handlers, what conclusion can you derive?
3. What in your opinion could have gone wrong while preparing meduwadas and chutney?
4. What line of action would you suggest to the manager of the catering establishment?
5. What are coliform organisms and what does their presence indicate?
6. What does the presence of *S. aureus* on water glasses indicate?
7. How should work tables be sanitised?

Appendix II

Temperature Conversion

(I) *Degrees Celsius to degrees Fahrenheit*

Formula

(i) multiply by 9
(ii) divide by 5
(iii) add 32

Example: Convert 37 °C to °F

(i) $37 \times 9 = 333$
(ii) $333 \div 5 = 66.6$
(iii) $66.6 + 32 = 98.6$

$\therefore$ 37 °C = 98.6 °F (normal human body temperature)

(II) *Degrees Fahrenheit to degrees Celsius*

Formula

(i) subtract 32
(ii) multiply by 5
(iii) divide by 9

Example: Convert 145 °F to °C

(i) $145 - 32 = 113$
(ii) $113 \times 5 = 565$
(iii) $565 \div 9 = 62.7 = 63$

$\therefore$ 145 °F = 63 °C (upper limit for Danger Zone)

(III) *While converting minus temperatures remember the minus sign*

Example: Convert –18 °C to °F

(i) $-18 \times 9 = -162$
(ii) $-162 \div 5 = -32.4$
(iii) $-32.4 + 32 = -0.4$

$\therefore$ –18 °C = –0.4 °F i.e., 0 °F (ideal temperature of a freezer)

Appendix III

- Purpose of a check list
- Receiving and storage
- Food preparation and handling practices
- Service
- Dishwashing
- Waste disposal
- Pest control
- Employees facilities
- Personal practices
- Construction
- Water supply and plumbing
- Safety

Food Sanitation Check List

PURPOSE OF A CHECK LIST

1. To identify sanitation problems in the establishment
2. To take corrective action
3. To maintain sanitation records

Managers and supervisors in all departments should conduct an inspection to evaluate the sanitation standards. Ideally, this should be done once a week and at least once a month.

RECEIVING AND STORAGE

		Yes	No
1.	Are foods purchased from licenced standard suppliers only?	☐	☐
2.	Are all food and other supplies inspected for damage, spoilage or infestation upon receipt?	☐	☐
3.	Is the date of manufacture/expiry and temperature for perishables checked?	☐	☐
4.	Are perishables refrigerated promptly?	☐	☐
5.	Are empty crates, cartons, containers, etc. removed to the disposal area promptly?	☐	☐
6.	Are supplies stored in a neat and orderly manner?	☐	☐
7.	Is the receiving area kept clean?	☐	☐
8.	Are all foods and supplies stored on shelves, racks or platforms clear off the floor?	☐	☐
9.	Are shelves placed away from the wall?	☐	☐
10.	Are the dry stores cool, clean and well ventilated?	☐	☐
11.	Is the floor of the dry store clean and dry?	☐	☐
12.	Are shelves and racks free of dust and debris?	☐	☐
13.	Are any empty crates, cartons, trash or outdated supplies lying in the stores?	☐	☐
14.	Are the shelves designed to facilitate easy cleaning of the floor beneath?	☐	☐
15.	Is the dry store free from moisture or dampness?	☐	☐
16.	In the first-in, first-out policy being observed?	☐	☐
17.	Are non-food items stored separately from food supplies?	☐	☐
18.	Are all poisonous substances like pesticides, cleaning agents, etc., stored in their original containers or conspicuously labelled?	☐	☐
19.	Are these poisonous substances stored in a special cupboard well away from food?	☐	☐
20.	Are vegetables not requiring refrigeration stored in ventilated containers on elevated platforms?	☐	☐

Refrigeration

		Yes	No
1.	Are all refrigerators in use in good working condition?	☐	☐
2.	Do they have accurate thermometers?	☐	☐

		Yes	No
3.	Are high risk foods maintained at temperatures below 5 °C?	☐	☐
4.	Are refrigerators defrosted and cleaned regularly?	☐	☐
5.	Are they free from objectionable odour?	☐	☐
6.	Are foods stacked in such a way that it allows adequate ventilation and ample circulation of cold air?	☐	☐
7.	Are foods stored so as to allow first-in first-out use?	☐	☐
8.	Are any visibly spoilt foods stored in the refrigerator?	☐	☐
9.	Are cooked foods kept apart from raw foods?	☐	☐
10.	Are all parts of the refrigerator easily accessible for cleaning?	☐	☐
11.	Are shelves clean and free from spills?	☐	☐
12.	Are all foods covered to protect them from contamination?	☐	☐
13.	Are refrigerators overstacked?	☐	☐
14.	Is the refrigerator door opened frequently?	☐	☐
15.	Are raw foods stored below cooked foods?	☐	☐
16.	Are opened cans of food stored in the refrigerator?	☐	☐
17.	Are all parts of the refrigerator in a good state of repair?	☐	☐

Freezer

		Yes	No
1.	Are deep freezers in working condition (as per specifications)?	☐	☐
2.	Are they fitted with accurate thermometers?	☐	☐
3.	Is internal temperature maintained at −18 °C or lower?	☐	☐
4.	Is there excessive frost build-up?	☐	☐
5.	Is food stored in such a way that first-in, first-out can be followed?	☐	☐
6.	Are freezers opened very often?	☐	☐
7.	Are foods wrapped so as to prevent freezer burn?	☐	☐
8.	Is proper cleaning and maintenance being done?	☐	☐
9.	Are food items like raw meat and fish, placed in containers before being weighed?	☐	☐
10.	Is there a label and date on the frozen food.	☐	☐

FOOD PREPARATION AND HANDLING PRACTICES

		Yes	No
1.	Are hands used instead of tongs to pick up foods like ice, sugar cubes, butter pats, bread, *chappatis,* etc.?	☐	☐
2.	Is tasting of food done with a separate spoon?	☐	☐
3.	Do employees blow on paper/plastic bags to open them or on milk to remove cream?	☐	☐
4.	Is any cleaning operation like sweeping or dusting carried out during food preparation or service?	☐	☐
5.	Is proper care taken to keep raw and cooked food apart during preparation?	☐	☐
6.	Are high risk foods held at room temperature for long?	☐	☐
7.	Are fruits, vegetables, grains, etc. washed thoroughly before preparation?	☐	☐
8.	Are frozen foods left in the warm kitchen to thaw?	☐	☐
9.	Is the food warmer, bain-marie or steam table used to reheat food?	☐	☐
10.	Are foodstuffs or utensils containing food placed on the floor?	☐	☐
11.	Are pots and pans which are not in use clean, sanitised and stored in a manner so as to prevent contamination?	☐	☐
12.	Are toxic substances like pesticides or cleaning agents stored in food preparation or service areas?	☐	☐
13.	Are kitchen sinks used for employee handwashing or for emptying mop water?	☐	☐
14.	Are equipment and utensils not in use, stored behind larger equipment or on other floor spaces in the kitchen?	☐	☐
15.	Are all parts of the equipment kept clean, for example, drip trays, etc.?	☐	☐
16.	Is there any residual build-up in ovens, grills, *chappati* puffer, etc.?	☐	☐
17.	Are all work surfaces made of impervious material and are they free from cracks?	☐	☐
18.	Is any soiled linen or dirty dusters/rags lying around in the food preparation area?	☐	☐
19.	Are food sinks used for dishwashing?	☐	☐
20.	Are sharp equipment like knives, peelers, etc. cleaned well before keeping them away?	☐	☐
21.	Is all equipment which is not in regular use, clean?	☐	☐

		Yes	No
22.	Is equipment cleaned between changed use?	☐	☐
23.	Are separate chopping boards used for meat and vegetables?	☐	☐
24.	Are chopping boards in good condition—no splits, cuts or holes?	☐	☐
25.	Are chopping boards cleaned and sanitised between changed use?	☐	☐
26.	Is equipment used to process meat cleaned and sanitised after each use?	☐	☐
27.	Is meat cutting area clean and free from any objectionable odour?	☐	☐
28.	Is raw meat awaiting pre-preparation left at room temperature for long periods of time?	☐	☐
29.	Is warm water used to thaw frozen meat, fish or poultry?	☐	☐
30.	Is raw meat left on the floor at anytime?	☐	☐
31.	Is equipment in a good state of repair?	☐	☐
32.	Are all joints and seams on equipment closed?	☐	☐
33.	Can equipment be easily dismantled and reassembled for cleaning purpose?	☐	☐
34.	Are surfaces of utensils and equipment smooth and free from pits and crevices?	☐	☐
35.	Do all electrical gadgets have three pin plugs and are the cords intact?	☐	☐
36.	Is all electrical equipment properly earthed?	☐	☐
37.	Is hot holding equipment maintaining food at or above 63°C?	☐	☐
38.	Are cold foods held at 5°C or lower?	☐	☐
39.	Is the floor of the kitchen and other food preparation areas clean and dry?	☐	☐
40.	Are all prepared food items kept covered?	☐	☐

SERVICE

		Yes	No
1.	Is the dining area clean and dry?	☐	☐
2.	Is all tableware stored in such a way so as to prevent contamination and splashing?	☐	☐
3.	Are tables, chairs, etc. wiped with clean sanitised cloths?	☐	☐
4.	Is any dust visible in the service area?	☐	☐

		Yes	No
5.	Is table linen spotlessly clean and changed after each use?	☐	☐
6.	Is the food or mouth contact surface of glasses or cups touched during service?	☐	☐
7.	Are the prongs of forks clean?	☐	☐
8.	Is chipped or cracked chinaware in use?	☐	☐
9.	Are cloths used for wiping food contact surfaces kept separate from other wiping cloths?	☐	☐
10.	Are single service items (paper serviettes, straws, thermocol cups, etc.) stored and dispensed in a sanitary manner?	☐	☐
11.	Are single service items used more than once?	☐	☐
12.	Is silverware and serving utensils handled and stored hygienically?	☐	☐
13.	Are all food containers emptied after service and are leftovers disposed off or stored immediately?	☐	☐
14.	Is the cargo area of trolleys/vehicles used for transporting food absolutely clean and free from spills or refuse?	☐	☐
15.	Are all food spills on shelves or floor of trolley washed off after each use?	☐	☐
16.	Is food carried in well insulated containers?	☐	☐
17.	Is temperature control being maintained for potentially hazardous food?	☐	☐
18.	Are service lifts cleaned regularly?	☐	☐
19.	Is garbage and food carried in the lift at the same time?	☐	☐
20.	Are sauce bottles, cruet sets, sugar, cream containers, etc. unclean?	☐	☐
21.	Are soiled dish trays left near the customers table?	☐	☐
22.	Are water glasses spotlessly clean and free from food odours?	☐	☐
23.	Are all china, glassware and silverware wiped with a clean sanitised cloth, kept aside specifically for this purpose only?	☐	☐

DISHWASHING

		Yes	No
1.	Are dishwashers functioning well?	☐	☐
2.	Is hot water supply sufficient to meet dishwashing requirements?	☐	☐

	Yes	No
3. Are temperatures for wash, rinse and sanitising being maintained?	☐	☐
4. Is the temperature of the final rinse water at least 77°C?	☐	☐
5. Are dishes scraped and prerinsed before being washed?	☐	☐
6. Are dishes with a dried residue soaked before washing?	☐	☐
7. Is detergent concentration being maintained at all times?	☐	☐
8. Is detergent dispenser kept full at all times?	☐	☐
9. Are separate people handling clean and dirty ware?	☐	☐
10. Is accessory equipment like dishwashing baskets, racks, scrapers, brushes, etc., kept clean?	☐	☐
11. Is the concentration of sanitiser solution as per specifications?	☐	☐
12. Are clean wares touched on food or mouth contact areas?	☐	☐
13. Are lime deposits on the machine removed from time to time?	☐	☐
14. Are dishes dry prior to storage?	☐	☐
15. Are dishes stored in a sanitary manner to prevent later contamination?	☐	☐
16. Is any food residue, detergent residue or food odour left on washed wares?	☐	☐

WASTE DISPOSAL

	Yes	No
1. Is refuse and food waste collected separately?	☐	☐
2. Are garbage containers adequate in number and size?	☐	☐
3. Are they lined with plastic or wet strength bags?	☐	☐
4. Are containers emptied frequently into the main garbage bin?	☐	☐
5. After garbage containers are emptied, are they cleaned well?	☐	☐
6. Are they covered and in a good state of repair?	☐	☐
7. Is garbage removed from premises at frequent intervals?	☐	☐
8. Is garbage lying around in the vicinity?	☐	☐

9. Are bins in the kitchen foot-operated or self-closing?	☐	☐
10. Are adequate vents and exhaust facilities provided?	☐	☐
11. Are grease filters on hoods and exhausts cleaned regularly?	☐	☐
12. Is any food or liquid spillage seen near the garbage container?	☐	☐
13. Are there any signs of pests breeding near garbage storage or collection areas?	☐	☐
14. Are there any empty crates, boxes, etc. lying in corners, under staircases, etc.	☐	☐
15. Are garbage containers clean on the outside?	☐	☐

PEST CONTROL

	Yes	No
1. Are any pests visible in or around the establishment?	☐	☐
2. Are there any signs of pest infestation (droppings, eggs, marks, etc.) in the premises?	☐	☐
3. Are there any areas indoors which could harbour pests?	☐	☐
4. Are adequate precautionary measures taken in the construction to keep pests away?	☐	☐
5. Is there any stagnant water or tall grass in the compound?	☐	☐
6. Is regular pest control carried out?	☐	☐

EMPLOYEES FACILITIES

	Yes	No
1. Are adequate cloakroom facilities provided?	☐	☐
2. Are they well maintained?	☐	☐
3. Is a laundry box provided for soiled uniforms?	☐	☐
4. Is all sanitary equipment in working condition?	☐	☐
5. Are sufficient handwash basins provided with hot and cold running water round the clock?	☐	☐
6. Are soap and drying facilities provided?	☐	☐
7. Are washbasins located near sanitary accommodation?	☐	☐

	Yes	No
8. Are containers provided for waste?	☐	☐
9. Are there any signs of pests?	☐	☐
10. Is ventilation and lighting adequate in these areas?	☐	☐

PERSONAL PRACTICES

	Yes	No
1. Are the hands of food handlers washed clean at the start of the day and whenever required?	☐	☐
2. Are the hands of food handlers clean and free from cracks?	☐	☐
3. Are hands sanitised with potassium permanganate ($KMnO_4$) or sanitiser solution?	☐	☐
4. Do any food handlers have infected cuts, burns, boils, etc.?	☐	☐
5. Are food handlers observed picking nose or pimples, scratching head or face?	☐	☐
6. Are hands washed after blowing the nose and coughing even when a handkerchief is used?	☐	☐
7. Are adequate handwashing facilities provided?	☐	☐
8. Are fingernails clean, trimmed and unvarnished?	☐	☐
9. Are all employees in uniform?	☐	☐
10. Are uniforms/outer garments clean?	☐	☐
11. Are all males clean shaven and is hair cut short (up to mid ear level)?	☐	☐
12. Is hair covered by a cap, hair net or scarf (any hair restraint)?	☐	☐
13. Do any food handlers suffer from ailments of the respiratory tract?	☐	☐
14. Are any food handlers suffering from or just recovered from any contagious or food-borne disease?	☐	☐
15. Are food handlers free of body odour?	☐	☐
16. Are food handlers observed smoking or eating in food preparation or service areas?	☐	☐
17. Do employees chew gum or take snuff in food preparation or service areas?	☐	☐
18. Are employees observed coughing or sneezing on food?	☐	☐
19. Have employees been observed spitting on the floor, in sinks or in garbage bins?	☐	☐
20. Are hands washed in sinks used for food preparation?	☐	☐
21. Is the dishcloth used to wipe perspiration or as a hand towel after using the toilet?	☐	☐

	Yes	No
22. Do food handlers use clean handkerchiefs?	☐	☐
23. Are mops, serviettes, dish cloths, handkerchiefs, etc. used for the purpose intended only?	☐	☐
24. Do food handlers wear wrist watches, dangling bracelets, bangles, earrings or any other jewellery (only a plain wedding ring is allowed)?	☐	☐

CONSTRUCTION

	Yes	No
1. Are there any depressions and low areas on floors and work surfaces?	☐	☐
2. Are walls near cooking and wash-up area adequately tiled?	☐	☐
3. Are all tiled areas and walls clean?	☐	☐
4. Are walls non-porous, free from cracks and cobwebs?	☐	☐
5. Are broken tiles and torn carpeting repaired immediately?	☐	☐
6. Are ceilings brushed and swept regularly?	☐	☐
7. Are proper vents installed to prevent moisture accumulation over areas and equipment that release steam?	☐	☐
8. Are floors durable, impervious and easy to clean?	☐	☐

WATER SUPPLY AND PLUMBING

	Yes	No
1. Are floors well sloped with clean and open drains?	☐	☐
2. Do sinks have hot and cold running water?	☐	☐
3. Are any sinks, basins or drains choked?	☐	☐
4. Are overhead pipes free from leakage and condensation and are they well insulated?	☐	☐
5. Is ice purchased from an approved source?	☐	☐
6. Are ice and ice containers handled and stored properly?	☐	☐
7. Is non-potable water used in the kitchen for any purpose?	☐	☐

	Yes	No
8. Is the water purification system in working condition?	☐	☐
9. Is ice used for chilling bottles and food consumed?	☐	☐

SAFETY

	Yes	No
1. Are floors kept dry during food preparation?	☐	☐
2. Are safety guards used for equipment like coconut scraper, slicing machines, etc.?	☐	☐
3. Are fire extinguishers provided?	☐	☐
4. Are employees trained to use fire extinguishers?	☐	☐
5. Are all aisles clear for passage?	☐	☐
6. Is equipment used in a safe manner by employees?	☐	☐
7. Are sharp tools like knives, etc. carried and stored in a safe manner?	☐	☐
8. Is there adequate lighting and ventilation?	☐	☐
9. Are gas cylinders turned off when not in use?	☐	☐

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