

UNIT 10: HYGIENE AND SANITATION IN **FOOD SECTOR**

The word sanitation comes from the Latin word *sanitas*, which means “health”. Sanitation means creating and maintaining hygienic and healthful conditions. It is an applied science and relates physical, chemical, biological, and microbial principles to food, the environment and health. Sanitation is more than just cleanliness. Food or equipment can be free of visible dirt and still be contaminated with microorganisms or chemicals that can cause illness or food spoilage.

Sanitary practices and hygienic conditions are becoming more and more important because food is being processed, prepared and sold in larger volumes than before. Some microorganisms cause food spoilage and food-borne illness, but others are beneficial in food processing and preparation. Sanitation can reduce the growth of microorganisms on equipment and dirt on food. This can reduce contamination of food by microorganisms that cause food-borne illness and food spoilage. Sanitary principles also apply to waste disposal and can help reduce pollution and improve ecological balance.

A sanitation program is a planned way of practicing sanitation. The benefits of a good sanitation program include the following:

- Compliance with statutory regulations.
- Preventing food-borne illness outbreaks.
- Improving quality and shelf life of foods.
- Reducing energy and maintenance costs.
- Increasing quality and confidence.

10.1 SOURCES OF FOOD CONTAMINATION

10.1.1 Raw Materials

The raw material itself is the most common source of contamination. For example, the muscles of healthy animals are nearly free of microorganisms while alive as its white blood cells and antibodies control infection. These mechanisms are, however, lost during slaughter whereby microorganisms first reach the meat if contaminated knives are used to bleed animals. Since the blood is still circulating, it quickly carries these microorganisms through out the animal's body. In case of poultry, microorganisms are easily spread from one carcass to another during de-feathering and evisceration (removal of the intestines). Thus the ingredients including spices can carry harmful or potentially harmful microorganisms and toxins. The amount and types of these microbes and toxins depends on where and how the ingredient was harvested and how the ingredient was processed and handled.

10.1.2 Equipment

Equipment can be contaminated during production and while it is not being used. While equipment may be designed to be hygienic, it still can collect microorganisms and other debris if not cleaned regularly and thoroughly. Therefore, it is necessary that an appropriate cleaning programme is developed and implemented. Wherever, equipment cannot be removed, 'Cleaning-in-place' system should be implemented.

10.1.3 Employees

Besides the foreign objects, the most common source of microbial contamination in foods is the employees. The hands, hair, nose and mouth carry microorganisms that can be transferred to food during processing, preparation, packaging and service by touching, breathing, coughing or sneezing. Therefore, sanitary practices such as hand washing, use of hairnets and disposable plastic gloves are essential.

10.1.4 Air and Water

Water is used for cleaning and as an ingredient in many processed foods. However, if the water is not pure, it can contaminate foods. If the water source is contaminated it should be treated by suitable means.

Microorganisms in air can contaminate foods during processing, preparation, packaging and storage. It therefore becomes vital to reduce air contamination by using air filters for air entering processing and preparation areas and to cover food products to reduce contact with air.

10.1.5 Insects and rodents

Food and food waste attract flies and cockroaches to kitchens, foodservice operations, food-processing facilities, toilets and garbage. The insects transfer dirt from contaminated areas to food through their waste products; mouth, feet, other body parts and saliva. Rats and mice carry dirt and disease with their feet, fur and faeces. They transfer dirt from garbage dumps and sewers to food or food processing and foodservice areas. It is vital that an appropriate pest management system is developed and implemented

10.1.6 Sewage

Raw, untreated sewage carries high microbial load and may contaminate water, food or equipment through faulty plumbing. If raw sewage drains or flows into drinking water lines, wells, rivers, lakes and ocean bays, the water and seafood will be contaminated. To prevent this kind of contamination, toilet facilities and septic tanks should be separated from wells, streams and other water sources.

10.2 CLEANING

Cleaning compounds are made for specific jobs, such as washing floors and walls or use in high-pressure dishwashers. Good cleaning compounds are economical, easy to measure, and dissolve well. They are approved for use on food surfaces, are not corrosive, and do not cake, leave dust, or break during storage.

Different cleaning compounds work well for different areas and different types of equipment. When choosing a cleaning compound, it is important to consider the type of soil (dirt), the water supply, how the cleaning compound will be used, the area and the kind of equipment being cleaned.

10.2.1 Cleaning-agent terms

The hygiene personnel need to understand the following terms used to describe cleaning compounds:

- **Chelating agent** (sequestering agent or sequestrant): Chemical added to cleaning Compounds to prevent the salts of calcium and magnesium in hard water from forming deposits on equipment surfaces.
- **Emulsification:** Breakdown of fat and oil drops into smaller droplets that are dispersed in the cleaning solution. The soil is still there, but the particles are smaller and are dispersed in the solution, rather than settling on the surface.
- **Rinsibility:**The ability of a cleaning compound to be removed from a surface without leaving a residue.
- **Surfactant:** A complex molecule that is blended with a cleaning compound to reduce the energy of the bonds around the soil and allow closer contact between the soil and the cleaning compound.
- **Suspension:** The process of loosening, lifting, and holding soil particles in solution.
- **Water hardness:** The amount of inorganic salts (such as calcium chloride, magnesium chloride , sulphates, and bicarbonates) in water
- **Water softening:** Removes or inactivates the calcium and magnesium ions in water.
- **Wetting (penetration.):** Caused by a surfactant that allows the cleaning compound to wet or penetrate the soil deposit and loosen it from the surface.

10.2.2 Types of cleaning agents

Most cleaning agents used in the food industry are blended products. Manufacturers combine ingredients to make a specific product for a particular type of surface or dirt.

The following types of cleaning agents are used most often in foodservice facilities and processing plants:

(a) Alkaline Cleaning Agents

Alkaline cleaning solutions have a pH between 7 (neutral) and 14 (most alkaline). There are several types of alkaline cleaners viz.

- ***Strongly alkaline cleaners.***

These cleaners have strong dissolving powers and are very corrosive. If these cleaners come in contact with skin they can cause burns, ulcers, and scarring; prolonged contact may cause permanent damage. Inhaling the fumes or mist damages the lungs.

An example of a strongly alkaline compound is sodium hydroxide (caustic soda), which destroys microbes, dissolves protein, and is good at dispersing and emulsifying soil. Silicates make sodium hydroxide less corrosive, better at penetrating soil, and better at rinsing away soil. These cleaners are used to remove heavy soils, such as those in commercial ovens and smokehouses, but they are not good at removing mineral deposits.

- **Heavy-Duty Alkaline Cleaners**

These compounds have moderate dissolving powers and are either slightly corrosive not corrosive at all. However, if they are in contact with the skin for long, they may remove necessary oils from the skin, leaving it open to infections.

These cleaners are often used for cleaning in place or high-pressure or other mechanized systems. They are very good at removing fats but do not remove mineral deposits. Sodium carbonate is quite low in cost, is widely used in

heavy-duty and manual cleaning procedures, and is used to buffer many cleaning compounds.

- **Mild Alkaline Cleaners**

Mild alkaline cleaning solutions such as sodium bicarbonate are used to clean lightly soiled areas by hand. These compounds are good at softening water but do not remove mineral deposits.

(b) Acid Cleaning Agents

Acid cleaning agents remove materials that are dried on or encrusted on surfaces and dissolve mineral scale. They are especially good at removing mineral deposits formed by alkaline cleaning compounds. When hard water is heated above 80°C, some of the minerals are deposited. These deposits stick to metal surfaces and leave a rusty or whitish scale. Acid cleaners dissolve the minerals in the deposits so that they can be easily removed.

Organic acids (such as citric, tartaric acids) are also excellent water softeners, rinse off easily and do not corrode surfaces or irritate the skin. Inorganic acids are excellent at removing and controlling mineral deposits, but they can be very corrosive to surfaces and irritating to the skin. Acid cleaning compounds are used for special purposes rather than for all-purpose cleaning. Acid cleaning agents are less effective than alkaline ones against the soil caused by fats, oils, and proteins.

- **Strongly Acid Cleaners**

These agents corrode concrete, most metals, and fabrics. Heating some acid cleaners produces corrosive, toxic gases, which can damage the lungs. Strongly

acid cleaners remove encrusted surface matter and mineral scale from steam equipment, boilers, and some food-processing equipment. When the solution is too hot, the mineral scale may redeposit and form a tarnish or whitish film on the equipment being cleaned.

Phosphoric acid and hydrofluoric acid both clean and brighten certain metals. However, hydrofluoric acid is corrosive to stainless steel and dangerous to handle because it tends to release hydrogen gas. Phosphoric acid is more used as it is not very corrosive and works well with many surfactants.

- **Mildly Acid Cleaners**

These agents are slightly corrosive and may cause sensitively reactions Some acid cleaners attack skin and eyes. Examples of mildly acid cleaning agents are hydroxyacetic, acetic, and gluconic acids. Organic acids are good manual cleaners, are expensive than the other acid cleaning compounds, and can soften water.

(c) Solvent Cleaners

Solvent cleaners are based on ether or alcohol. They work well on soils caused by petroleum products, such as lubricating oils and greases. Most of the time, food establishments use alkaline cleaners to remove organic soils. But they use solvent cleaners to remove large amounts of petroleum deposits in areas free of protein-based and greasy soils, i.e, in the maintenance shop and on motors, gear boxes, pallet trucks, and fork trucks. Solvent cleaners may be mixed with wetting agents, water softeners, and other additives.

(d) Soaps and Detergents

Soaps and detergents emulsify fats, oils, and grease so that they are easily washed away. Soaps and detergents usually contain chemical builders to make them clean more effectively. Soaps and detergents for household cleaning have a pH of 8 to 9.5.

(e) Choosing A Cleaning agent

It is important to choose the right cleaning agent for the type of soil. A good rule to remember is that ***like cleans like***. Therefore, an acid soil requires an acid cleaner, while an alkaline cleaning agent works best to remove an alkaline soil. Alkaline, general-purpose cleaning agent work best to remove organic soils. Heavy-duty alkaline cleaning agents work best for heavy deposits of fats and proteins (organic soil). Acid cleaning agents remove mineral deposits (inorganic soil) and other soils that are not removed by alkaline cleaning compounds. Phosphates complexed with organic chlorine are the most common types of cleaner-sanitizers.

10.3 SANITIZING

The cleaning process removes the soil deposits. Sanitizing, on the other hand, destroys microbes that are left on the cleaned surface. If the surface is still dirty, the soil protects the microbes from sanitizing agents. Therefore, the equipment and surfaces must be thoroughly clean for sanitizers to work properly.

The major types of sanitizers are:

10.3.1 Heat

Heat is an inefficient sanitizer because it takes so much energy. The efficiency of heat depends on the humidity, the temperature required and the length of time it takes to destroy microbes at that temperature. Steam and hot water are the most common types of heat used for sanitization (sterilization). However, sanitizing with steam is expensive because of high energy costs. Hot water (heated to 82°C or higher) immersing is a good way to sterilize cleaned small components viz. knives, tongs, spoons, utensils. The time needed to sterilize an item depends on the temperature of water. If equipment or surfaces are sterilized at lower temperature, they must be kept at heat temperature for longer duration. If they are sterilized for a shorter duration, the temperatures must be higher. This is known as 'time-temperature relationship'. Examples of time and temperature combinations used for sterilization are 15 minutes of heat at 85°C or 20 minutes at 82°C.

10.3.2 Radiation

Radiation in the form of ultraviolet light or energy cathode or gamma rays destroys microorganisms. It, however, is not entirely effective in food processing and food service facilities as the light rays must actually hit the microorganisms and therefore kills only the microorganisms that are very close by. Further, some bacteria are more resistant to radiation and need a longer exposure for the radiation to destroy them. Moreover, dust, grease and opaque or cloudy solutions absorb radiation and prevent it from killing microbes.

10.3.3 Chemicals

Food processing and food service operations use various chemical sanitizers for different areas and types of equipment. The effectiveness of chemical sanitizers depends on:

- **Exposure Time** – Colonies of microbes die in a logarithmic pattern i.e. if 90% of microbes die in 10 minutes, 90% of the remaining microbes die in next 10 minutes and so on. Therefore, in this example only 1% of the original number of microbes is still alive after 20 minutes.
- **Temperature** – Chemical sanitizers kill microorganisms more quickly at higher temperatures. While bacteria also grow quickly when temperature is moderate and warm but higher temperatures usually speed up their death more than their growth, so that overall microbes die more quickly at higher temperatures.
- **Concentration** – Sanitizers at higher concentration kill microorganisms more quickly.
- **pH** – Even small changes in acidity or alkalinity can effect the activity of sanitizers. Chlorine and iodine compounds are generally less effective when the pH is higher.
- **Cleanliness** – If equipment and surfaces are not thoroughly clean, soil can react with hypochlorites, other chlorine compounds, iodine compounds and other sanitizers. This reaction neutralizes the sanitizer such that it does not work properly.
- **Water hardness** – Hard water makes sanitizers less effective. The calcium and magnesium salts in hard water neutralize quaternary ammonium compounds. If the water has over 200ppm of calcium, the hygiene staff should add a sequestering or chelating agent.

The major types of chemical sanitizers are as under:

(i) Chlorine Sanitizers

Examples of chlorine based sanitizers are liquid chlorine, hypochlorites and inorganic or organic chloramines. These compounds have different antimicrobial activities. Hypochlorites are the most active of the chlorine compounds and are the most widely used. Calcium hypochlorite and sodium hypochlorite are the most commonly used compounds.

Chlorine compounds are often preferred over other sanitizers because of the following:

- They include compounds that kill all types of vegetative cells i.e. all cells except spores.
- Easily available as liquid or granules.
- Hard water usually does not make them less effective.
- Usually cheap.

However, chlorine based sanitizers have some disadvantages viz.

- They are unstable, heat breaks them down and organic soil makes them less effective.
- Light breaks them down so they need to be stored in the dark.
- They corrode stainless steel and other metals.
- They can only be in contact with food handling equipment for a short time, otherwise they corrode the food handling equipment.

(ii) Iodine Compounds

The most common iodine –based sanitizers are iodophors, alcohol-iodine solutions and aqueous iodine solutions. In concentrated form, iodophors have a long shelf life but once they are dissolved the iodine may vapourize. Iodine is lost rapidly when the temperature is above 50°C. The amber colour of iodine solution shows when the sanitizer is there. The solution loses iodine during storage and use and therefore the hygiene personnel should check and adjust the strength of iodine solutions before use. Iodine is a very good hand sanitizer and hand-dipping agent because it does not irritate the skin.

Iodine compounds, however, have following disadvantages:

- They are more expensive than chlorine compounds
- They may cause off-flavours in some food products.
- They vaporize at approximately 50°C
- They are very sensitive to pH changes.

(iii) Quaternary Ammonium Compounds

The quaternary ammonium compounds, often called quats, are good for cleaning and sanitizing floors, walls, furnishings and equipment. They are especially good at penetrating porous surfaces. Quats are natural wetting agents and also work as detergents. The most common quats are the cationic detergents, which are poor detergents but excellent germicides. Quaternary ammonium compounds are very effective against *Listeria monocytogenes* and reduce mould growth.

Quaternary ammonium compounds form a bacteriostatic film over surfaces; in other words they have some residual action. This film is better at killing some bacteria than other sanitizers. Quats do not kill bacterial spores but inhibit their growth. Quaternary ammonium compounds work better than chlorine and iodine sanitizers on soiled surfaces, although they work best on surfaces that are thoroughly clean.

Quats are not corrosive, are stable when heated, do not irritate the skin and have no taste or odour when they are properly diluted. They work at a high pH and work well against molds. However, they do not work so well against certain bacteria and also react with anionic type synthetic detergents.

10.4 PERSONAL HYGIENE

The word *hygiene* means using sanitary principles to maintain health. Personal hygiene refers to the cleanliness of a person's body and clothes. Food workers need to be healthy and clean to prepare safe food. Hands, breath, hair, sweat, coughs, and sneezes all carry microorganisms. Even if a food handler does not feel sick, he or she could still be carrying microorganisms that can cause illness if they get into food.

Employees who are ill should not come to work. They should not touch food or equipment and utensils used to process, prepare, and serve food. Food can carry several illnesses, including:

- Respiratory diseases, e.g., colds, sore throats, pneumonia, scarlet fever, and tuberculosis
- Gastrointestinal diseases, e.g., vomiting, diarrhea, dysentery
- Typhoid fever
- Infectious hepatitis

After people recover from the disease, they often become carriers. This means that they still carry the disease-causing microorganisms in or on their body. When employees are ill, they carry many more microorganisms, so they are much more likely to contaminate food. Anyone with a sinus infection, sore throat, nagging cough or other cold symptom is probably carrying a heavy load of a virus. People who have diarrhea or an upset stomach are also probably carrying large numbers of microbes. Even after the symptoms have gone away, some of the microorganisms that caused the illness may stay in the person's body and could contaminate food. For example, an employee may carry *Salmonellae* for several months after recovering from salmonellosis. The virus that causes hepatitis may still be in the intestinal tract over 5 years after the symptoms are over.

To understand why employees need good personal hygiene it is vital to consider the following sources of microbial contamination:

10.4.1 Skin

The skin constantly deposits sweat, oil, and dead cells on its outer surface. When these materials mix with dust, dirt, and grease, they form an ideal place for bacteria to grow. Therefore, bacteria from skin can contaminate food. If secretions build up and bacteria continue to grow, the skin can become itchy or irritated. Food handlers may rub or scratch the area and then transfer bacteria to food when they touch it. Contaminated food has a shorter shelf life or may cause foodborne illness. Poor skin care and skin disorders also cause bacterial infections like boils.

Boils are severe local infections caused by infections in hair follicles or skin glands after the outer layer of skin (epidermis) is damaged, for example by irritating clothing. *Staphylococci* or other microorganisms multiply in the hair

follicle or skin gland and produce a toxin that kills the cells around it and causes swelling and soreness. The body collects lymph, blood cells, and tissue cells in the infected area to counteract the toxin. The body forms a barrier around the boil to prevent the infection from spreading. A boil should never be squeezed. If it is squeezed, the infection may spread and cause a cluster of boils called a carbuncle. If staphylococci get into the bloodstream, they may be carried to other parts of the body causing meningitis (infection of the membranes around the brain), bone infections, or other problems. Employees with boils should be very careful if they have to handle food, because the boil is a major source of pathogenic *staphylococci*.

Similarly cuts and septic spots also provide an ideal place for bacterial multiplication. To prevent contamination of food by harmful bacteria, employees should therefore cover boils, cuts, and septic spots with waterproof dressings.

10.4.2 Hands

The hands may pick up bacteria when they touch dirty equipment, contaminated food, clothing, or various parts of the body. Employees should wash hands frequently with soap and use a hand-dip sanitizer after touching these things so that they do not contaminate food.

Food handlers must wash their hands regularly and especially:

- after going to the toilet;
- on entering the food processing / preparation area and before handling any food or equipment;
- in between handling raw and cooked food;
- after combing or touching the hair;

- after eating, smoking, coughing or blowing the nose;
- after handling waste food or refuse;
- after handling cleaning chemicals

10.4.3 Fingernails

One of the easiest ways to spread bacteria is through dirt under the fingernails. Employees should never handle food if their fingernails are dirty. Food handlers should not have long fingernails or artificial fingernails. Washing the hands with soap and water removes transient bacteria (bacteria that have been picked up but are not growing and multiplying), and using a hand soap that contains an antiseptic or sanitizer controls resident bacteria (bacteria that live and grow there).

10.4.4 Nose, Mouth and ears

Up to 40 percent of adults carry *staphylococci* in the nose and mouth. Coughs and sneezes can carry droplet infection for a considerable distance and persons with bad colds should preferably not handle open food. If unavoidable, an employee who has a cold should use a hand-dip sanitizer after blowing his or her nose or else the bacteria from the nose can be transferred to the food being handled. Picking or scratching the nose is not acceptable.

As the mouth is likely to harbor staphylococci, food handlers, while working should not eat sweets, chew gum, tobacco, pan masala, gutka, taste food with finger or an unwashed spoon or blow into glasses to polish them. Discharges from the ears, eyes and nose may contaminate food and employees must report these ailments to their supervisor and medical clearance should be sought.

10.4.5 Jewellery and perfume

Employees should not wear jewelry especially stone rings, watches in food-processing or foodservice areas as they harbour dirt and bacteria. Further, these can get caught in machinery, causing a safety hazard. Also, contaminated jewelry can fall into or come in contact with food.

Strong smelling perfume or aftershave should not be used by food handlers as it may taint foods, especially those with high fat content.

10.4.6 Hair

Hair is constantly falling out and along with dandruff, can result in contamination of food. Furthermore, the scalp often carries microorganisms; especially staphylococci and hair must be thus shampooed regularly. While handling food, the personnel should wear a hairnet or suitable head covering which completely encloses the hair. Combing of hair and adjustments to head covering should only take place in cloakrooms and should not be carried out whilst wearing protective clothing, as hairs may end up on the shoulders and then in the product.

10.4.7 Smoking

Smoking should be prohibited in food processing, handling and packing areas. Not only is this to prevent cigarette ends and ash contaminating food but also because:

- People touch their lips whilst smoking and they may transfer harmful bacteria to food.
- Smoking leads to coughing and droplet infection ;

- Cigarette ends contaminated with saliva are placed on working surfaces
- An unpleasant environment may be created for non-smokers.

The only place to smoke in a food premises should be the rest room.

10.4.8 Protective clothing

Persons handling food must wear clean and washable overclothing, preferably light coloured, without external pockets. Press studs or velcro fastening are preferable to buttons. Protective garments should be appropriate for the work being carried out and should completely cover ordinary clothing. Suitable footwear should be worn to prevent slipping and to protect the feet.

Food handlers should be made aware that protective clothing is worn to protect the food from risk of contamination and not to keep their own clothes clean. Protective clothing should not be worn outside the food premises, not used to travel to and from work and not worn during lunch time sporting activities.

Outdoor clothing and personal effects must not be brought into food rooms unless stored in suitable lockers.

10.4.9 Requirements for Hygiene

Management must have a protocol to make sure employees use hygienic practices. Supervisors and managers should set an example for employees by using excellent hygiene and health practices themselves. They should provide proper laundry, locker-room, and handwashing facilities to make it easy for employees to stay clean and hygienic.

All employees should have a physical examination before they are employed to check that they have good physical, mental, and emotional health. All employees who work with food should be checked regularly for signs of illness and infection, and other signs of poor health. Employees should maintain personal hygiene in the following ways. They should:

- a) Maintain good physical health through good nutrition, enough rest, and physical cleanliness
- b) Report illness to their employer before working with food so that assignments can be adjusted to protect food from being contaminated
- c) Practice good hygiene so that they do not contaminate food
- d) Wash their hands during their work shift after using the toilet; after handling garbage or other dirty items; after handling uncooked meats, egg products, or dairy products; after handling money; after smoking; after coughing and sneezing; and when leaving or returning to food production/service areas
- e) Maintain personal cleanliness through daily bathing, washing hair at least twice a week, cleaning fingernails daily, use of a cap or hairnet while handling food, and wearing clean underclothing and uniforms
- f) Not touch foodservice equipment and utensils with their hands, and use disposable gloves if they have to touch food other than dough)
- g) Follow rules, such as “no smoking,” and do anything else needed to protect the food from being contaminated

10.5 PEST CONTROL

Pests contaminate food with hair, fur, droppings, eggs and dead bodies. The common pests found in food processing and food service establishments include:

- Insects: flies, cockroaches, wasps, silverfish, ants, weevils etc.
- Rodents: rats and mice;
- Birds : pigeons and sparrows

Regular survey of food premises must be carried out to ensure that they are pest free. In particular, food storage rooms and dark, undisturbed areas should be examined.

The Pest Control is essential for the following reasons:

- To prevent the spread of disease;
- To prevent the wastage of food;
- To prevent damage generally caused by gnawing of electric cables or pipes.
- To prevent loss of customers who would detest eating in premises infested with cockroaches, flies, rodents etc.

10.5.1 General Pest Control

Pests require food, shelter and security. Denial of these environmental factors will prevent their survival and is the first line of defence against possible infestations. Following environmental controls need to be exercised:

- Food premises must be designed and constructed to minimize the risk of contamination from pests.
- External windows, where necessary, must be fitted with removable insect-proof screens.

- Doorways should be protected with hanging plastic strips or air curtains and the bottom of doors should be protected with rubber padding to prevent any pest entrance from below.
- Access holes and other openings should be sealed with mortar, metal sheets or mesh.

10.5.2 Good Housekeeping

To reduce the risk of infestation, it is important to prevent breeding and deny pests the condition they like and in particular to ensure that :

- Premises and refuse areas are kept in a clean and tidy condition. Lids are always kept on waste bins, which should be washed after emptying, together with the surrounding area. Waste must not be allowed to accumulate;
- Food on display or awaiting preparation should always be kept covered;
- Spillages are cleared away promptly;
- Drains are kept clean and in good condition;
- Sightings of pests or pest damage are reported to management immediately.

10.5.3 Physical and chemical pest control

Physically control methods are generally preferred as the pest is caught, either dead or alive and is consequently not able to die in food, equipment or in some inaccessible place. Examples of physical control include ultra violet, electric fly-killers (insectocuters)and rodent traps.

Unfortunately, physical methods are not always successful and poisons have to be used. Rodenticides are used to kill rats and mice and insecticides to kill

insects. Care must always be exercised when using chemicals to ensure there is no risk of contaminating food. Food and small utensils must always be removed when using insecticide, especially sprays and the premises and fixed equipment must be thoroughly cleaned after use.

10.5.4 Pest Control for Stored raw material

The following pest control measures should be enforced to protect stored raw materials from pest infestation:

- All deliveries of raw materials and packaging material should be checked to ensure their freedom from pest infestation;
- Food should be stored off the floor and clear of walls to facilitate proper cleaning at all times and prevent any pests like rodents, cockroaches, silverfish and ants from finding a hiding place.
- Food should be stored well covered, in rodent proof containers with lids that are always replaced after use;
- Stored material should be checked regularly for gnawing marks, holes, chewed pieces of cardboard or paper and damaged stock removed;
- The storage area should be well lit and any cracks in walls and ceilings should be sealed to ward off any pests, particularly cockroaches.
- As far as possible the above preventive measures and physical controls should be applied to control pest infestation. However, in unavoidable situations, the insecticides should be used carefully ensuring that they do not contaminate the stored food material.
- Professional pest controllers should be engaged for undertaking safe usage of insecticides. Staff should also be trained in pest control and made aware of the dangers of insecticides and its proper usage.

10.5.5 Common Insecticides for Pest Control

Insecticides are defined as any substance or mixture of substances intended for preventing, killing, repelling or controlling insects.

10.6 STORAGE AND DISPOSAL OF WASTE

Suitable receptacles should be provided, both inside and outside food premises, for the disposal of waste food and debris. Disposable polythene sacks or plastic bins are usually provided for internal use and dustbins for external use.

Refuse containers used internally must be emptied as frequently as necessary and always at least once a shift. After emptying, reusable containers must be thoroughly cleaned before being brought back into the food processing area. Care should be taken that receptacles used for storage or collection of refuse should not be reused for the storage of food.

10.7 WATER STANDARDS

The food production and processing industries are concerned particularly with three broad aspects of water technology, namely

1. Its microbiological purity and safety.
2. Its chemical impurities which affect suitability in processing
3. Its contamination load after use.

Water entering a food processing plant should meet health standards for potable water. There must be limitation on harmful chemicals for safety of

potable water. This water must be free from contamination with sewage, pathogenic organisms, and organisms of intestinal origin. Microorganisms have an absolute demand for water, for without water, no growth can occur.

The water-borne diseases include the enteric fevers, salmonellosis, cholera, shigellosis (rarely) and viral agents including poliomyelitis and hepatitis-B. The role of water is important in the spread of diarrhoeal disease in the tropics. The use of polluted water for food manufacturing and in kitchens for food preparation and the washing of vegetables, equipment and premises, is dangerous. Infection of food or water will increase in hot climates, because of rapid growth of bacteria in food and the necessity to drink large volumes of water. Therefore, various regulatory agencies have laid down, standards for the different types as shown in Table 10.1 and 10.2.

Table 10.1 : Constituents of Drinking Water Having Significance to Health

Constituent	Unit	Limit of WHO Guideline (1984)
Mercury	mg/l	0.001
Cadmium	mg/l	0.005
Selenium	mg/l	0.01
Arsenic	mg/l	0.05
Chromium	mg/l	0.05
Silver	mg/l	—
Cyanide	mg/l	0.1
Lead	mg/l	0.5
Barium	mg/l	—
Fluoride	mg/l	1.5

Nitrate	mg/l	10.0
Hexachlorobenzene	□g/l	0.01
Aldrin	□g/l	0.03
Heptachlor	□g/l	0.1
Chlorodane	□g/l	0.3
1-1 dichloroethane	□g/l	0.3
DDT	□g/l	1.0
Carbon tetrachloride	□g/l	3.0
Lindane	□g/l	3.0
Benzene	□g/l	10.0
Gross a	pci/l	NIL
Ra226 + Ra228	pci/l	—
B + photon emitters	mrem/y	—

Table 10.2 : WHO Guidelines (1984) for Aesthetic Quality of Drinking Water

Constituent	Unit	Guideline Value
Aluminium	mg/l	0.2
Chloride	mg/l	250
Copper	mg/l	1.0
Hardness	mg/l	500 (as CaCO ₃)
Hydrogen Sulphide	—	Odour not to be detected at all

Iron	mg/l	0.3
Manganese	mg/l	0.1
pH	—	6.5 to 8.5
Sodium	mg/l	200
Sulphate	mg/l	400
Turbidity	NTU	5
Zinc	mg/l	5