FOOD SAFETY

&

NUTRITION

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CHAPTER 01

INTROUDCUTION TO HYGIENE

PERSONAL HYGIENE

The word hygiene means using sanitary principles to maintain health. Just as food hygiene refers to all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain, personal hygiene refers to all conditions and measures necessary to ensure the cleanliness of a person ‘s clothes and body.

Food worker need t be healthy and clean to prepare safe food. The food handler should keep his hands, arms and exposed parts very clean. They should wash their hands after touching bare human body and after using the toilet room. 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 the microorganisms that can cause illness if they get into the food. Hence, it becomes vital to consider the sources of microbial contamination. All food handlers should remember the following:

- Scrupulous personal cleanliness is essential for those responsible for food storage, preparation, cooking and service
- Food should be touched by hand only when there is no alternative
- Refrain from behavior which could result in contamination of food, for example smoking, spitting, chewing or eating, sneezing or coughing over unprotected food.
- Eating and drinking, while working, can spread germs from the person’s mouth to hands
- Hands should be clean at all times with short nails and no nail paint
- Personal effects such as jewellery, - watches, pins or other items should not be worn or brought into food handling areas, if they pose a threat to the Safety and suitability of food.

- Illness must be immediately reported.

Personnel should always wash their hands when personal cleanliness may affect food safety, for example:

- At the start of food handling activities.
- Immediately after using the toilet, and
- After handling raw food or any contaminated material, where this could result in contamination of other food items. They should avoid handling ready-to-eat food, where appropriate.

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

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 medium for the bacteria to grow. Therefore, bacteria from skin can contaminate food. If the secretions build up and bacteria continuously grow, the skin can become itchy and irritated. Food handlers rub or scratch the skin and transfer bacteria when they touch it.

Regular bathing and washing often reduces the number of microorganisms. Poor skin care and skin disorders can also cause bacterial infections like boils. Boils, you may already know, are severe local infections caused by the infections in hair follicles or skin glands after the outer layers of skin get damaged. 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 forms a barrier around the boil to prevent the infection from spreading. Hence, a boil should never be squeezed. If it is squeezed, it will spread the infections and cause a cluster of boils called as a carbuncle. Food handlers should use a hand dip for disinfection after touching boil or pimple. To prevent contamination of food by harmful bacteria, employee should where appropriate, wear suitable protective clothing, head covering and foot wear, cover boils, cuts, wounds and septic spots with suitable water-proof dressings.

Hands

Bacteria may be picked up by the hands when they touch dirty equipment, contaminated food, clothing or parts of the body. Food handlers should wash hands frequently and use a hand deep sanitize after touching these things so that they do not contaminate food. Food handlers must wash their hands regularly and especially:

- Before starting work
- On returning work after each break
- After going to the toilet
- On entering the food processing/preparation area
- In-between handling of raw and cooked foods
- After combing or touching the hair
- After eating, smoking, coughing or blowing the nose
- After handling waste food or refuse
- After handling cleaning chemicals, and
- After contact with pests or contaminated food.

Washing the hands with soap and water removes transient bacteria and using a hand soap that contains an antiseptic or sanitizer controls resident bacteria.

Finger nails

One of the easiest ways to spread bacteria is through dirt under the finger nails. Food handlers should never handle food if their finger nails are dirty. Food handlers should not have long finger nails or artificial finger nails, while working.

Jewellery

Food handlers should not wear jewellery in food processing or food service areas, as they harbor dirt and bacteria. It can fall into the food and can contaminate the food, further it can also get caught in machinery, causing a physical and safety hazard.

Hair

Hair is constantly falling out and along with dandruff, can result in the contamination of food. Scalp carries microorganisms especially Staphylococci. While handling food, food handler should wear a hairnet or suitable head covering such as a cap or scarf which completely encloses the hair. Combing of hair near the work area should be avoided and take place only in the cloak room and should not be carried out while wearing the protective clothing, as hair may end up on the shoulders and then in the product. Lastly, the workers should always wash their hands whenever they scratch their heads.

Eyes

Normally, eyes do not carry bacteria. But whenever there is an eye infection, food handlers may rub their eyes with hands and thereby there is a chance of the food getting contaminated.

Mouth

Mouth carries, many bacteria, particularly Staphylococci. Many bacteria and viruses found in mouth can cause disease, especially if the employee is ill. Food handlers, while working, should not eat sweets, chew gums, tobacco, pan masala, gutkha etc. or blow into glasses to polish them. Tasting food by licking finger or an unwashed spoon is a bad practice and should be avoided.

Smoking should not be allowed in food service establishments. Smoke can cause transmission of bacteria from mouth to the food. Smoking leaves an irritating taste in the mouth which makes the person to spit. Spitting should not be allowed in the food processing operation.

Nose, Throat and Lungs

Compared to mouth, nose and throat have fewer bacteria. Up to 40% of adults carry Staphylococci bacteria in the nose and mouth. Employees who have sinus infection will be suffering from nasal discharges, they should be careful in handling the food, They should use decongestants to reduce discharge, wash and disinfect their hands after blowing, their noses. Picking or scratching the nose is not acceptable. Cough and sneezing can carry droplet infection for a considerable distance and person with bad cold should preferably not handle open food.

Sore throat is usually caused by a type of Streptococci. Streptococci cause scarlet fever, rheumatic fever and tonsillitis. These diseases spread if employees' personal hygiene is poor.

Influenza infects the body through lungs, secondary bacterial infections by Staphylococci, Streptococci or Pneumococci can cause death. All such ailments must be reported to the supervisors and medical clearance should be sought.

Personal habits

Do you know that apart from personal hygiene, faulty personal habits of the food handlers have an adverse effect on the quality and safety of foods? Personnel engaged in food handling activities should refrain from behaviors which could result in contamination of food. What are these habits or activities? Let's find out.

Smoking, pan chewing, eating etc. should not be done in food handling areas. Smoking in fact, should be prohibited in the work area. 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 infections, and
- Cigarette ends contaminated with saliva are placed on working surfaces and hence can contaminate food .

Food handlers should not have bad hygiene practices like nail biting, keeping the fingers in ears or nose, tasting food through finger etc. Supervisory staff should carefully observe the food handlers for their behavior while carrying out the job and should be suitably advised.

Food handlers should wear protective clothing while they are in food handling areas. Clothing should be light in colour, mostly white is preferred. It should be made up of a material that can be easily washed and kept clean. Nylon clothing has an advantage that it can be washed at the end of working day, dried overnight and needs no ironing. But in our hot climate, cotton clothing is preferred, but it has to be washed and ironed regularly. Cooks should wear white caps/protective headgear to protect the food from hair, as well as, to protect the hair and scalp from the effects of steamy heat. This helps to ensure that hair and dandruff does not contaminate food or surfaces. The long hair should be tied back.

These clothing's should not be worn outside the food premises not used to and from work and not worn during lunch time sporting activities. This is to prevent contamination from bacteria and dirt and physical contamination from buttons etc. falling into open food. Also, outdoor clothing and personal effects must not be brought into food rooms unless stored in suitable lockers. Suitable footwear should be worn to prevent slipping and to the feet.

Necessity for Personal Hygiene :-

Personal hygiene is necessary for everybody but more so for the food handler because the health and well-being of hundreds of people is in his or her 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 whole someone's of food supplied by him or her. 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 establishments. An employee suffering from a 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 micro–organisms from an infected area to one that previously had no harmful micro-organisms.

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 realized 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 micro–organisms that can be transmitted to food. For these reasons, personal hygiene is very necessary and should be practiced by every food handler.

HEALTH OF STAFF :-

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 checkups every six months and a checkup 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 de-worming (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) Restrooms and lockers used by employees should be inspected fro 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.

A weekly off is compulsory.

SANITARY PRACTICES:-

Bathing :- with respect to Hair, eye, mouth & teeth, hands, Jewelry, furnishers & foot & footwear.

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. Smokes 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 & 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.

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.3

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.

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 fro external heat, grease and vapors 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 warn 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.

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 right duty require 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 undistributed 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 he 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 fir 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 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.

Pests and Rodent Control

In any food establishment, varieties of insects, pests and rodents pose a big threat to the maintenance of hygienic surroundings. They contaminate food with hairs fur, droppings, eggs and dead bodies, as you have already learnt earlier. They can also cause considerable damage to food stocks and premises.

The common pests found in food processing and food service establishments include two groups of insects, *the flies and cockroaches*, which are the important carriers of food borne diseases. Flies feed indiscriminately on waste matter, animal wastes an on food from kitchens. The housefly may successively visit a dirty cup, clean glass, a waste material and a dish containing cooked food. The flies leave an invisible trail to bacterial and other disease causing germs. Remember, housefly can spread typhoid, dysentery and diarrhoea. They may also have a part in spreading cholera and many other diseases.

Ants are considered harmless but they too create nuisance. They live in walls and soil. They eat a wide variety of foods. The cereal mite which is widely distributed is found stored in dry food commodities like *flour*, *suji* etc. There are other insects borers which can cause damage and contamination of foods due to their, quick movements from place to place.

Preventive measures are ideal. It should be ensured that no food scraps are left lying out. No dirt or rubbish is allowed to accumulate. All holes, gaps, drains and air ducts should be covered with thick wire mesh or grating.

Drying the raw materials like grains, adequately preserving commodities like suji, maida (refined flour) at low temperature are ideal. Regular checkups must be made to ensure that the premises are free from pests. The persons responsible for pest control should:

- Inspect all internal and external areas of food premises
- Revisit if there are signs of infestation
- Ensure that insects are properly identified to carry out effective treatment, and
- Maintain the records of chemicals, pest problems, indications of infestation.

Insect control

The insects can breed and hide in garbage and other places where there is availability of waste materials. The cockroach lives and breed in moist dark places, around plumbing cupboard, pantries and under refrigerators. The best .prevention approach is to fit all the doors, windows and ventilation with wire-mesh. The flying insects can be destroyed by employing fluorescent tubes which attract and destroy them due to an electrified field. They are collected in a collecting tray. The crawling insect hideout should be sealed by blocking all the cracks etc. which harbor insects. They are generally destroyed by spraying and using commercial insecticides like *pyrethrum.* The cockroaches can be prevented entry by painting a band of insecticide between the joints of wall and floor. Of late, aerosol sprays have become very popular in eliminating flying insects. But care has to be taken to avoid contamination of foods and food contact surfaces getting sprayed with the aerosols.

Rodent control

Rats and mice are destructive and cause huge loss of stored food commodities. They transmit pathogenic bacteria. Rats and mice are generally most active during twilight hours. If food and wastes are stored and handled properly, the rodent infestation could be reduced or eliminated. They can squeeze past narrow openings and gnaw the edges of wooden doors.

Rodents gain entry into the premises in bags of flour in straw packages, boxes, cartons etc. If proper storage practices are not adopted and things are scattered, rodent infestation is sure to occur. Rats need lots of water, in fact, they drink three times the amount they eat. Signs of rodent infestations are evident by presence of droppings, greasy foot prints and rat odour. Baited traps and other tracking methods could be followed to ensure that rodents are not present in the food area.

Other control measures include:

- Regular checking of new deliveries, stored stock and equipment for signs of infestation
- Storage of open dry foods in solid with close-fitting lids
- Storage of goods off the ground and clear of walls, with adequate space between stocks
- Clear spoilage as soon as possible, and
- Empty bins in the kitchen frequently and keep them clean.

Prevention

Best preventive measure is to correct all dripping taps, repair defective gutters and also make the food unavailable by proper storage of foods in metal containers. The empty cartons, boxes should be stacked on a pallet and away from walls, as rats prefer to move nearer to the walls.

Here, it can be summarized that pest control is essential in any food service establishment because of:

- Preventing the spread of disease
- Preventing the wastage of food

- Preventing damage generally caused by gnawing of electric cables or pipes, and
- Preventing loss of customers who are well-aware and educated about hazards of eating in infested premises.

Food refuse container should be cleaned after discarding. Care has to be taken to remove food scraps, crumbs, vegetable peelings etc. They should not be left on the floor and ensure that premises is as clean and neat as possible. The rodents can be refused to gain entry into the building by rodent proofing the building by changing the changing doors, windows, cupboards and covering up of small openings especially the corners of doors and windows, pipes, floor drains, exhaust fan openings. To control the rodents, either traps or poisoning is employed. Care has to be taken while rodenticides of are employed as their poisons are harmful to human beings. The rodent eradication programme has to be undertaken by an experienced and trained person.

Apart from all these measures, a properly planned maintenance of premises with periodic checks of food storage, preparation areas and efficient handling of wastes helps in preventing the pests' entry into the food service establishment.

To protect the premises from insects, rodents and pests and reduce the risk of infestation, the following points have to be kept in mind:

- Keep the premises clean
- Clean all spillages promptly
- Check all incoming goods and boxes
- Keep doors and windows screened
- Keep reusable boxes, crates etc. out of the kitchen
- Keep drains clean and in good condition

- Cover the waste bin. Empty accumulated wastes promptly and wash it regularly along with the surrounding area
- Keep the shelves, cupboards and drawers in good repair.

CLEANING OF THE FOOD PREPARATION AREA AND DISH WASHING

Food preparation area should be impervious and smooth and so designed that thorough cleaning is possible. Wooden surface are not recommended for preparation of food because it is difficult to maintain.

Wood absorbs stains and odour and holds moisture and swells. It encourages the growth of micro- organisms and pests, and the surface gets cracked and chipped easily.

Wooden surfaces should be covered with Formica.

Aluminum 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 platform and work table tops are ideal. They are durable and easy to clean. Platform built into the wall should have edges covered and sealed. The supporting structure of all tables should be easy to clean.

DISH WASHING:

Dishes are washed in sink or in the dishwashing machine. Dishwashing is one of the most important tasks in any food service establishment.

The sink method dishes, pots, pans, chopping boards, containers, knives, spoons and other small utensils are washed and sanitized in sinks. Sinks should ideally have three compartments so that washing, rinsing and sanitizing can be done in separate sinks. A one or two compartment is not very hygienic as all steps are carried out in the same sink.

Procedures for Three-sink method:

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.

3. The detergent solution is no longer effective when a scum or grease layer forms on water and should be changed. Brushed and scourers should be cleaned sanitized and dried. Grease is removed at 52°c

4. **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 until all traces of detergent are removed. A basket must be used to sanitize dishes because

   (a) It reduces hand contact with eating surface of dishes

   (b) temperature of water needed for sanitization is too high for the use of hands.

5. **Sanitizing:** this step removes any soil and micro-organisms that remains after rinsing and has a bacteriostatic effect. Sanitizers used may be chemical or water at specific temperature and pressure. The concentration and duration of immersion should be strictly followed.

6. **Drying:** no item should be touched on the food or mouth contact surface. All items should be air dried to retain the effect of sanitization. They can be left in the basket to dry. Glasses should be inverted on a well ventilated drain board. Towel or dish cloth drying is not recommended.

THE THREE BUCKET METHOD:

This method is used to clean and sanitize 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 sanitizing solution are required. All buckets should have different colors.

Procedure for the three bucket method:

1. **Wash:** Remove food scrape 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.
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 steps.
3. **Sanitize:** 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 sanitized by rinsing carefully with boiling water or live steam from a hose of equipment in which steam can be confined.

MECHANICAL DISHWASHING

A dishwashing machine is used to clean and sanitize all plates, glasses, cups, saucers, knives, forks and spoons which are used in the dining area equipment and utensils that fit in the machine can also be cleaned and sanitized. 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 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 racks 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 sanitizing. 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 degree Celsius. 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 t rinse tank to rinse the dishes free of most of the detergent solution. The rack then passes through the machine on the pretimed conveyor at a speed set by a 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 to remove soil; by revolving brushes that scrub soil off the dishes; or by mechanically agitating the detergent solution to help in removing soil.

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 sometime 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.

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 sanitization. Because of the built-up 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 sanitization: At this stage, any remaining detergent is removed and the dishes are sanitized. If water is used as a sanitizer, then it should be sprayed in adequate volumes and at a correct pressure with temperatures varying between 77 degree and 82 degree Celsius. Ideally, as it leaves the nozzles it should have a temperature of 83 degree C. However, it should not exceed 90 to 93 degree Celsius, as the water at that temperature under pressure would atomize and become vapour.

If chemical sanitizers are used, dishes should be immersed for at least one minute at concentrations. The hotter water is used for sanitizing, the faster drying and lesser chances of water spotting. A drying agent may be injected in this cycle.

8) Drying: Crockery and utensils must be left in racks to drain and air dry. Although dishwashing machines are boon to us, they can create problems if not selected well. Some of the common causes of failure are:

    a) machines located in wrong place

    b) improper plumbing

    c) untrained employees

    d) water is not adequately hot

    e) water pressure is low

    f) wrong selection of detergent

While selecting a new machine the following points should be kept in mind:

a) select a machine from a reliable, standard company

b) two small machines are better than a big one. During slack periods only one machine can be operated, or if one machine breaks down, the other can be used.

c) Number of operators required and the kind of technical knowledge they must possess to operate the machine.

d) Whether servicing the machines needs outside technicians or it can be serviced by available staff.

e) The power consumption.

f) Clean ability and durability of the material used and the design.

g) Whether the machine is silent or noisy when switched on.

h) Whether large trays and glasses can be washed in it.

i) Whether it has a detergent feeder fitted in.

j) Whether there is a strainer pan to collect food debris.

STORAGE AND DISPOSAL OF WASTE

INTRODUCTION

Cleanliness and sanitation of catering establishments and premises includes not only maintenance of clean and well sanitized surfaces of all equipment in contact with food but also good housekeeping treatment and proper disposal of all 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 off 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

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 biogradable wastes, and stored separately. They may be compacted or concentrated before disposal. Agricultural wastes can be used as feed or fertilizer after appropriate treatment.

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. Pilled 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.

It is therefore necessary that the refuse from catering establishments is properly collected, sorted and disposed off in a sanitary manner. If it is not disposed off 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.

STORAGE OF GARBAGE

It is important to store garbage correctly before it is disposed off . It should not be left overnight near the kitchen area. The kitchen area is warmer than the other areas and decau 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 galvanized
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

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 (18n 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.

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. The methods of disposing garbage may be broadly classified as follows.

Land filling, burial, composting, incineration, mechanically disposing, biogas plants vermiculture and recycling.

LAND FILLING

Dumping refuse is dumped in low lying land depressions like pits and hollows for reclaiming low lying land. This is the easiest method of disposing 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 done during the dry season under proper supervision it is called controlled dumping. It is used to fill land depressions, discussed quarries and empty pits. The land selected should be outside town limits. 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 1.8m(6 feet) in height . Each layer is sealed with a mud cover of atleast 23cm (9 inches) in thickness. Dumping is done till the level reaches 60cm (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 alternative 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 take 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 off garbage by this method.

COMPOSTING

This is 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 an aerobically by micro organisms in the absence of air. The waste is decomposed and stabilized by bacteria and fungi to form a humus like material called compost. Compost is rich in nutrients and fertilizes the soils

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 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 combination, 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 fertilizer 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 it s original weight. The residue is a mass of hard material called clinkers and is used for road making. The cost of transporting refuse is minimized. 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 or 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.

The machine are fitted under the existing sink or may be purchased as a self – contained unit. The pulper or disintegrator grinds food waste into tiny participles 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 off along with sewage.

The cut or ground , it is flushed into the kitchen drain and disposed off 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.

DISPOSAL OF BIODEGRADABLE WASTES

Bacteria act on organic matter and decompose it either aerobically an aerobically. In aerobic decomposition complete combustion of organic matter take place. This happens in vermiculture.

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 oblongata. Aerobic bacteria multiply in the gut of the earth worm 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 tem 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.

RECYCLING

Recycling is the reprocessing of waste products so that they can be re –used. Recycling food waste one way of utilizing 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.

CHAPTER 02- HACCP

Hazard Analysis Critical Control Point

What is HACCP?

HACCP is an acronym that stands for Hazard Analysis Critical Control Point, a systematic, science-based approach used in food production as a means to assure food safety.

The concept for HACCP was developed in the 1960's by the Pillsbury Company in consultation with the US National Aeronautics and Space Administration (NASA) and the U.S. Army Laboratories at Natick. While it was originally developed to ensure microbiological safety of food stuffs, it has been further broadened to include chemical and physical hazards in foods. In 1993, the Codex Alimentarius Commission endorsed the HACCP system as the most cost-effective approach devised to date for ensuring the safety of food.

HACCP, therefore, is a preventive system of food control. It involves examining and analyzing every stage of a food-related operation to identify and assess hazards, determining the 'critical control points' at which action is required to control the identified hazards, establishing the critical limits that must be met at, and procedures to monitor, each critical control point, establishing corrective procedures when a deviation is identified by monitoring, documenting the HACCP plan and verifying procedures to establish that it is working correctly.

HACCP is a food-related operation to:

- Identify and assess hazard at every stage of operation, right from start to finish
- Determine the critical control points
- Establish the critical limit and procedures to monitor each critical control point and
- Establish corrective procedures.

Need for HACCP:

HACCP, a recent proactive, preventive technique, focuses on identifying potential problems and controlling them during the design and the production process itself.

HACCP offers a number of advantages over the current system. Most importantly HACCP:

- Focuses on identifying and preventing hazards from contaminating food
- Is based on sound science
- Permits more efficient and effective government oversight, primarily because the recordkeeping allows investigators to see how well a firm is complying with good safety laws over a period rather than how well it is doing on any given day
- Places responsibility for ensuring food safety appropriately on the good manufacturer or distributor
- Helps food companies compete more effectively in the world market, and
- Reduces barriers to international trade.

Benefits of HACCP:

HACCP, so far, we can generalize that HACCP provides a systemic approach to food safety. It is a proactive strategy, aimed at continuous problem prevention and is cost effective.

However, the responsibility for safe and nutritious food needs to be shared by all players in the food chain, which includes those who produce, transform or handle the good from production to storage and to its ultimate consumption. Besides, it involves the interplay of scientific, legal/regulatory, social and economic agencies, both nationally and globally.

The challenge, therefore, for us as a nation is to build comprehensive HACCP food safety system that ensures the long term involvement and commitment of all concerned parties to ensure that the result is the provision of safe food and nutritious diet for the common man. The benefits of HACCP can be summarized as under:

a) Benefit to Consumers:

- Reduced risk of food borne diseases
- Increased confidence in food supply
- Increased awareness of basic hygiene
- Increased quality of life (health and social-economic)

b) Benefits to Industry:

- Increased market access
- Reduction in production costs through reduced wastage and recall of food
- Increased consumer and government confidence
- Mitigating the business risk.

c) Benefit to Governments

- Improved public health
- Reduced public health costs
- Enhanced facilitation of International Trade
- Increased confidence of the community in the food supply

Principles of HACCP:

The HACCP system involves the following seven principles:

Principle-1: Conduct a Hazard Analysis

Principle 1 describes where the HACCP team should start. A process flow diagram is put together, detailing all the steps in the process, from incoming raw materials to finished product. When compete, the HACCP team identifies all the hazards which could occur at each stage and described preventative measures for their control.

Principle-2: Determine the Critical Control Points (CCPs):

When all the hazards and preventative measures have been described, the HACCP team establishes the points where control is critical to managing the safety of the product. Theses are points in a food's production – from its raw state through processing and shipping to consumption by the consumer – at which the potential hazard can be controlled or eliminated. Examples are cooking, cooling, packaging, metal detection etc.

Principle-3: Establish Critical Limit (s):

The third step establishes preventive measures with critical limits for each control point. For a cooked food, for example, this might include setting the minimum cooking temperature and time required to ensure the elimination of any harmful microbes.

The critical limits describe the difference between safe and unsafe product at the CCPs. These must involve a measurable parameter and may also be known as the absolute tolerance for the CCP.

Principle-4: Establish a System to Monitor Control of the CCP

The HACCP team should specify monitoring requirements for management of the CCP within its critical limits. This will involve specifying monitoring actions along with frequency and responsibility. Such procedures might include determining how and by whom cooking time and temperature should be monitored.

Principle-5: Establish the corrective Action to be taken when Monitoring Indicates that a particular CCP is not Under Control.

Corrective action procedures and responsibilities for their implementation need to be specified. This will include action to bring the process back under control and action to deal with product manufactured while the process was out of control. For example, reprocessing or disposing of food if the minimum cooking temperature is not met.

Principle-6: Establish procedures for Verification to Confirm that the HACCP System is Working Effectively.

Verification procedure must be developed to maintain the HACCP system and ensure that it continues to work effectively. For example, testing time-and-temperature recording devices to verify that a cooking unit is working properly.

Principle-7: Establish Documentation Concerning all Procedures and Records Appropriate to these Principles and their Application.

Records must be kept to demonstrate that the HACCP system is operating under control and that appropriate corrective action has been taken for any deviations from the critical limits.

The HACCP Status in India:

The HACCP situation in the overall food industry in India is still very dismissal. What ever small efforts that have been made have been limited to the organized sector which, as such, has a small share in the overall industry.

In the Indian context, where the food safety management systems is not fully developed and the resources are scare, there is a need to develop a strategy for implementing the HACCP system in a phased manner across all pertinent sectors and scales of the industry, particularly the unorganized sector. The various barriers being faced to the implementation of HACCP include:

- Lack of customer and business demand
- Financial constraints
- Human resource constraints, and
- Inadequate infrastructure and facilities.

CHAPTER 3

MICROBES

INTRODUCTION:

In order to understand the chain of events that cause a disease it is essential to know the microbes involved in this. These organisms are too small and cannot be seen with naked eyes. This is why they are called as micro- organisms. A compound microscope magnifies up to 1500 times, while an electron microscope up to 5 lakh times. Certain microorganisms are useful to us & some are harmful. That's why its very important for food handlers to study them.

Classification of microbes -

Types of Micro organism :- There are 5 groups of micro-organisms which are important in food industry. They are bacteria , fungi, viruses, algae & protozoa.

1) Viruses - Viruses are strictly parasitic & cannot be cultivated outside the living host cell. They feed on living cells of plants & animals.

Poliomyelitis & infectious hepatitis are viral disease caused by contaminated food & drinking water. Shell fish such as oysters, cockles & mussels from sewage polluted waters can cause viral food poisoning if food is not cooked thoroughly. Other common viral disease are influenza, common cold, mumps measles & chicken pox. Viruses are present in the nose & throat discharges & in the faces of infected person.

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

Bacteria :- Bacteria area both useful and harmful to humans. They are found every where in soil, water and air. They are important to manufacture curds, yoghurts, and cheese. Some bacteria help to leaven idli, dosas and dhokla batter. Many bacteria are

pathogenic to humans and animals. Canned foods, fruit juice and alcoholic beverages are spoiled by bacteria.

SHAPE AND SIZE OF BACTERIA:

Bacteria are minute, unicellar organism of variable shape and activity. The size of bacteria cell range from 0.2-10 micron. They can be identified by their shape, size and cell arrangement.

1. Rod shape bacteria: they may or may not have organs called flagella. The bacteria in this group cause typhoid, tuberculosis and food poisoning. They are undesirable in food because their presence may indicate the possibility of other pathogens.

2. Spherical bacterial:They are also called as Cocci

I) Pair of cocci are called diplococci and causes pneumonia

II) Chain of cocci are called streptococci and causes sore throat and tonsillitis.

III) Irregular cluster are known as staphylococci and causes staph food posioning.

IV) Tetrade are cubes of four to eight cocci, causes spoilage of food.

3. Sprial bacteria: they are also called spirilla and cause syphillis which is a sexually transmitted diseases.

4. Comma shape bacteria: they are also called as vibrios and causes cholera.

Reproduction:

Binary fission when conditions are suitable for growth bacteria reproduce by dividing themselves into 2 every 20-30 mins.

When a bacterial cells grows to maximum size a wall appears wall grows further and divides the cell into two new cells. By this division of binary fission. A bacterium can produce 2 million bacterial in 7 hours; therefore the food handler should realize that a single bacterium cans alone cause health hazards.

FUNGI

Fungi includes lower plants which do not have roots, stems or leaves. It can be aerobic condition and anaerobic condition.

YEAST

Yeast is unicellular & found naturally in soil & dust Yeast is much larger in size than bacterial cell. Size of yeast is 5-10 micron

REPRODUCTION:

They reproduce either asexually or by budding. During budding a small outgrowth appears on the mother cell. This bud grows in size and breaks from the mother cell. Budding is common method for reproduction in yeast.

Yeast is able to ferment sugar to alcohol and carbon dioxide. This is very important to prepare bread and alcoholic drinks. Temperature of around 25°c to 30 degree Celsius are best for their growth. They are not pathogenic they require a moisture level above 20% to survive. They spoil dry fruits, fruit juices, honey, Soya sauce and squashes.

MOULDS:

Moulds are multi cellular their bodies are thread like structure. They are anerobic condition

SHAPE AND SIZE OF MOULDS:

They are 2 to 10 micron in size. They grow on dead material or on plant bodies. They grow easily on bread, jam, cheese, cow dung, leather etc,

REPROUDUCTION:

Reproduction in mould is mainly by spores. Spore are form in hundred on the end of hyphae. These spores are very light. They settle on suitable organic matter and produce new cells. Moulds are useful to humans they are used to ripen cheese. E.g. blue cheese or Roquefort cheese is ripened by Penicillium roqueforti some species of Penicillium produce life saving antibiotics.

Some moulds are harmful because they produce toxins some are parasitic for e.g. ringworm, certain mushrooms are highly toxic & can cause death.

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 growth of bacteria is represented as follows :-

Growth Phases:

- The **initial phase** is called the **lag phase** during which there is no growth. The number of bacteria remains constant and the cells gets adjusted to their new environment. Bacteria show an increase in size but not in number.
- In the exponential growth phase 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.
- 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.
- 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 (d) alteration of pH etc,.

Factors Affecting Growth of Microbes - Various environmental conditions affect the growth & multiplication microbes.

1. **Food & nutrients** :- The microbial flora present on food depends to a great extent upon its composition. They use our food supply as a source of nutrients for their growth. They need carbohydrates & proteins as a source of carbon & nitrogen respectively.

2. **pH level** :- Most bacteria prefer a neutral pH between 6.5 to 7.5 but some can grow at low or high pH. Moulds & yeast grow better in acidic medium of pH 4 to 4.5 as compared to bacteria.
3. **Moisture** :- Water or any kind of moisture encourages growth of most micro organism. Food should be stored in well ventilated place.
4. **Temperature** :- Most of the micro-organisms can be destroyed above 65ºC & the growth is retarded below 5ºC.
5. **Oxygen** :- Oxygen is necessary for all aerobic micro-organisms. Anaerobic micro-organisms do not require it. Moulds & yeasts are aerobic while bacteria aerobic, an aerobic or facultative.
6. **Time** :- If conditions are favorable for the microbs they grow faster in short span of time.
7. **Osmotic pressure** :- The osmotic pressure of food varies with the kind & amount of solute dissolved in food. The amount of sugar or salt in solution has an osmotic effect on micro-organisms. Bacteria cannot grow in high concentration of sugar & salt . Yeast can grow in fairly high concentration & moulds in highest concentration.
8. **Sunlight or ultraviolet rays** - Microbial growth is encourage in dark humid places & not in well lit & naturally ventilated place because ultraviolet rays are present in sunlight & they destroy.

ROLE OF MICROORGANISMS IN FERMENTED FOODS

Fermentation is one of the oldest forms of food preservation technologies in the world. Indigenous fermented foods such as bread, cheese and wine have been prepared and consumed for thousands of years and are strongly linked to culture and tradition, especially in the rural households and village communities.

You know that microorganisms are naturally found in foods, since there is no environment where some type of microbes cannot live. These microbes either living or dead and their cellular byproducts all have specific uses in some foods. These include such products as fermented food products. Fermented foods use microbes to convert the original food into a fermented product by the use of specific microbes. These microorganisms use the original product for growth and reproduction, and in the process, they excrete byproducts into the environment surrounding themselves and the food. *These byproducts plus the part of the original product that is not consumed is the fermented food.* Fermented foods include fermented dairy, meat, fish, cereals, fruits, vegetable products etc. They may be fermented separately or in conjunction with each other to produce the desirable end product.

Although fermentation of foods has been in use for thousands of years, it is likely that the microbial and enzymatic processes responsible for the transformations were largely unknown. It is only recently that there has been a development in the understanding of these processes and their adaptation for commercialization. Let us now get to know about a few of the fermented food preparation used commercially. We shall begin our study on fermentation products with the baked preparations.

DAIRY PRODUCT:

1] Fermented milk cannot be covered adequately but important of them include cultured buttermilk, yoghurt, etc.

2] Cheese is also an important fermented dairy product.

1. CULTURED BUTTERMILK AND SOUR CREAM:

These employ the action of mixed culture one strain is usually responsible for the production of lactic acid as a result of fermentation by lactic acid, while another strain provides aroma forming bacteria.

PRODUCTION OF:

1. LACTIC ACID: By streptococcus lactic

2. YOGHURT:

It employs a mixed culture of streptococcus thermopiles and lacto bacillus bulgaricus.

3. CHEESE:

A lactic acid fermentation is involved in making most kinds of cheese.

VEGETABLE PREPARATION:

Vegetable are fermented by lactic acid fermentation. Growth of lactic acid bacteria during vegetable fermentation result in

1) Restriction of growth of undesirable organism

2) Increase of shell-life of the product.

3) Production of organic acids or by products.

SAUERKRAURT FERMENTATION

Sauerkraut is defined as the clean round product of characteristic flavor obtained by full fermentation chiefly lactics, of properly prepared and shredded cabbage in the presence of not less than 2% nor more than 3% of salt

Upon complete fermentation, it should contain not less than 1.5% of lactic acid.

BAKERY PRODUCTS:

A] BREAD:

Micro-organism are useful in two chief ways in bread making:

1. They may produce gas to leaven or raise the dough giving the bread the desired loose, porous texture.
2. They may produce desirable flavorings substance.
3. They may condition the dough.

a) LEAVENING: 1. Dough is usually leavened by yeast in bread.

2. They ferment the sugar in dough (starch is broken down) and produce mainly CO2 and alcohol

3. *Saccharomyces cerevisiae* is mainly responsible for leavening by carbon dioxide production

b) FLAVOUR PRODUCTION:

c) 1. Yeast are reported to contribute to flavor of food

2. The yeast produces alcohol, esters acids and aldehydes which add in the desired flavor to the bread.

CHAPTER NO 4

FOOD-BORNE ILLNESS

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 micro-organisms. The natural decay that occurs in animal or plant tissues is accompanied by foul odors, 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 micro-organisms like Staphylococci and Salmonella. This may result in food poisoning or food infection. These micro-organisms 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 micro-organisms. 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.

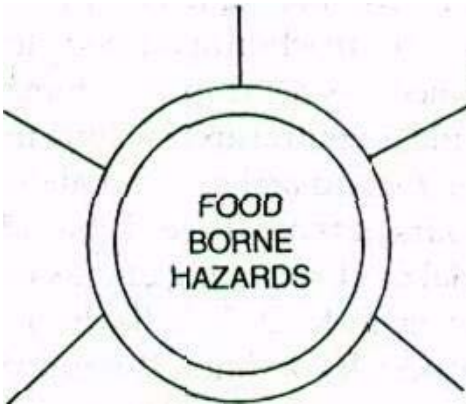
Food-borne hazards may thus result from microbial action, toxic metals and pesticides, animal parasites, natural poisons in foods or allergic reactions of a person due to sensitivity to a particular food.

Of all the food-borne hazards listed above, diseases caused by microbial action in food are most widespread. Micro-organisms 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. Micro-organisms which cause food-borne illnesses are bacteria, viruses, protozoan and nematodes. Among all these micro-organisms, bacterial contamination is the most common cause of food poisoning in the catering industry. It usually results from mishandling of food.

These illnesses are characterized 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 illness are broadly divided into two categories: food poisonings and food infections.

Natural toxins In Food

Animal parasites



Microbial action

Food allergies

Toxic Metals &

Chemicals

FOOD-BORNE HAZARDS RESULT IN FOOD-BORNE ILLNESSES

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 diarrhea. The incubation period for such food poisonings is comparatively shorter (one-six hrs) than that for bacterial food infections. The offensive food may not contain any living bacteria, which may have been destroyed during heating.

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 micro-organisms. 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 micro-organisms 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, diarrhea and abdominal pains. The incubation period for an infection to occur is 12 hours or more (Refer Table 3.1).

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 favorable, these bacteria could multiply to over onemillion in a short span of three to four hours (Refer Fig. 3.5).

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 3.1 **Difference between Food Poisoning and Infection**

Food Poisoning	*Food Infection*
• Caused by toxin • Incubation period: two hours • Symptoms: nausea and vomiting diarrhea, usually no fever. • Duration: one day, sometimes longer.	• Caused by living micro-organisms • Symptoms: diarrhea, abdominal pain, vomiting, fever • 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 cold.

On the skin, 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 micro-organisms.

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 practice 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.

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

Clostridium Botulism

This is an uncommon type of food poisoning. It is produced by an anaerobic spore-forming bacterium 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 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 botulium*

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, diarrhea, 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.

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 micro-organisms 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.

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 thermo labile.

Clostridium 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 micro-organisms 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 micro-organisms have been ingested.

Organism: Clostridium per-fringens (welchii)
Duration of illness*:* one to two days

Mode of transmission*:* from human feces 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, diarrhea 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. Cuisine dishes or reheated dishes kept at warm temperatures for considerable periods of times.
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

Incubation period*:* 12 to 24 hours

Duration of illness*:* one to seven day

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 sanitize 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

Symptoms*:* diarrhea, 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. high risk foods exposed to warm temperatures for long hours, for example, milk, fish, mutton biriyani

3. seafood from polluted waters

4. canned foods that are opened, have got contaminated and are held without refrigeration once opened.

Prevention:

1. Purchase meat, poultry, eggs and fish that have been thoroughly inspected for wholesome-ness.

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.

NATURAL TOXINS

Certain plants and animals may contain natural substances that are poisounious and may produce gastro-intestinal disturbances

i) Lathyrus Sativus or kesari dal:-
Kesari dal contains a toxin which affects the nervous system and may result in paralysis of lower limbs. This dal is often used to adulterate tur dal. The toxin can be removed by parboiling the grains before cooking.

ii) Soybnean-
Soybeans contain trypsin inhibitors which inhibit the breakdown and availability of proteins in digestive system. This may cause intestinal disorders. Trypsin inhibitor can be destroyed by adequate heat treatment.

iii) Green Potatoes-
Green, sprouting and damaged potatoes contain high amount of solanine which is toxic. It causes vomiting, abdominal pain and diarrhea within eight hours.

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 micro-organisms. A healthy food handler may transmit micro-organisms 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 to 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.

Cross-contamination

Harmful micro-organisms present in one food can contaminate another food. This process is known as cross-contamination and is defined as the transfer of bacteria 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 sanitizing 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:

1. storing raw and cooked meat separately and not next to or on top of each other, to prevent drops of liquid oozing

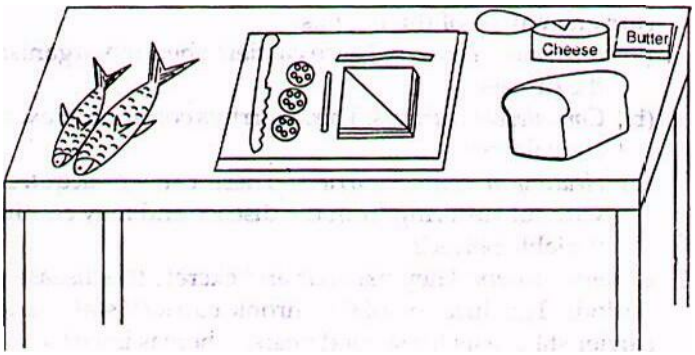
2. Colour coding equipment such as chopping boards and knives for handling only one type of food, for example using pink for raw meat and poultry and brown for cooked meat and poultry

3. Preparing cooked and raw meats on separate tables

Other examples of cross-contamination are:

1. When a dishwasher places dean and sanitized plates on a table reserved for dirty plates, the plates gel 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.

CHAPTER NO 5

FOOD ADULTRATION

Adulteration is defined as a process by which the quality and nature of a given substance is reduced due to the addition of a foreign or inferior substance or the removal of a vital elements substance. E.g. Addition of water to milk or removal of fat from milk.

Adulteration may be intended or accidentally done. The former is a useful act on the part of adultery intended to increase the margin of profit. The intentional adulteration is usually due to ignorance, negligence or lack of proper facility. To check such malpractices the proper practices to be taken place. The first central act called the prevention of food adulteration act was passed in 1964 and came into force from 1st June 1966.

They are appointed by the government & report to the local health authority i.e. the medical officer of health.

COMMON FOOD ADULTRANT AND THEIR PREVENTION:

Some of the commonly used substance used to adulterate the food so as to increase profit includes sand, marble chips, stones, etc. They are mainly found in food grain, pulses, spices etc. They can be removed by sorting, picking and washing. Stones and sand if present in food can have the adverse effect on the teeth and the soft lining of the digestive tract. Chalk powder and talcum powder are sometimes added to wheat flour and they effect normal digestion of food. Water can be added to milk and its product and the addition of contaminated water may result in gastro-intestinal disturbance like diarrhea, vomiting etc.

CONTROL OF FOOD QUALITY:-

Food Standards: - To protect people from health hazards because of adulteration it is necessary to impose control & check over the quality of food available to consumers. Standards are yardsticks established by an authority for necessary quantity, weight or quality. This system ensures that each food stuff is what it purpose to be or what its lable claims it to be & assures uniformity.

National official standards are set to safeguard the consumers health and ensure fair food trade practices. In 1963, the FAO & WHO established a commission for setting up international food standards.

Codex alimentarins are international standards set by FAO & WHO for all the principal foods, whether processed semi-processed or raw. It includes standards regarding food hygiene, food additives, pesticides residues, contaminants labeling & presentation & methods of analysis & sampling.

Indian Standards :- These are based on the international codex alimentarius with suitable modifications. They include

a) Compuleroy & standards

b) Voluntary standards

Compulsory standards:- Prevention of food adulteration Act 1954 (PFA). These standards prescribe the minimum requirements for all types & categories of food. Any food does not conform to the minimum standards laid down by PFA rules is said to be adulterated. Essential commodities Act 1954. There are number of content orders. The following orders are included under this act.

1) **The fruit products order 1955 (FPO) :–** The manufacture & distribution of all fruit & vegetable products, synthetic syrup created beverages & vinegar is regulated under this order. It lays the limits for the presence of poisons elements, permitted food colours, preservatives & additives. It gives directions regarding packing, marking, & labeling of categories.

2) **Meat products control order 1973 :-** This order controls the manufacture, quality, & distribution of all raw & processed meat & meat products. Directorate of marketing & inspection& requires that the meat be obtained from healthy animals, slaughtered in a licensed slaughter house & is fit for human consumption.

3) **Milk & Milk products order 1992:-** The production sale, purchase & distribution of milk powder & milk products is covered under this.

4) **Solvent Extracted oils, De-oiled Meal & Edible Flour control order 1967 & vegetable products control order 1976:-** The manufacture & distribution of solvent extracted oils de-oiled meals, edible flours & hyelrognated vegetable oils is controlled by this order.

5) **Standards on weights & Measures (Packaged commodities) Rules 1977 :-** under this rule it is obligatory to declare the quantity of the packed commodity on the lable.

Voluntary Standards :-

1) **Bureau of Indian standards (BIS)** :- The BIS has formulated Indian standards for processed foods with respect raw material, hygiene, packaging & labeling, manufactures. Who comply with the standards laid down by BIS can obtain in Indian Standards Institute (ISI) mark.

2) **Agricultural produce (Grading & marketing) Act 1933 (Agmark)** :- Agmark provides standards for grading& marketing agricultural commodities. The consumer is assured of the quality as per standards laid down. Agricultural & allied commodities are graded 1,2,3, & 4 or special good, fair & ordinary.

PREVENTION OF FOOD ADULTTRANT:

1. Purchase food from authorized dealers only. Children should be discouraged from purchasing sweets, kulfis, and ice-creams from hawkers as they are likely to contain harmful colors and artificial sweeter.
2. Before purchasing processed food items like masala powders, canned foods, bottled preserves, etc, check the expiry date and Agmark/ISImark/FPO license.
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 foods stuff.

5. Keep drugs, preservative and detergents away from foods stuffs to prevent accidents adulteration.
6. Always purchase food article in sealed, intact package.
7. Insist of Agmark, ISI mark or FPO license.

SIMPLE PHYSICAL TEST TO DETECT THE PRESENCE OF FOOD ADULTRANT:

1. Substance like sand, stones, pebbles, dirt, and mud can be seen and removed easily.

2. Kesari dal is used to adulterate tur dal and chana dal. It has a characteristic shape which is in different form which can be seen and thus kesari dal can be removed.

3. Insect eaten food grain, they are normally light and when soaked in water they will float.

4. Coal tar dyes: They may be present along with used tea leaves to adulterate tea powder these tea leaves are placed on a moistened cloth or on a wet blotting paper. Then the presence of coal tar dye can be seen by reddish color.

5. Grit/ Fine particles of dust: They are normally used to adulterate salt and sugar. If a sample of adulteration of salt or sugar is mixed with water then the grains of salt or sugar will dissolve in water but the grit will not.

6. Iron filling: Normally used to adulterate tea leaves and sometimes semolina. The iron filling can be removed by passing a magnet over the food samples. Due to attraction the tiny particles of iron will adhere to the piece of magnet thereby indicating that the food sample has been contaminated.

7. To detect metalline yellow in turmeric powder, whole turmeric, jaggery takes 2 gms of sample, 5 ml of alcohol and a drop of concentrate hydrochloride acid if a reddish color develop it indicates the presence of metalline yellow.

8. Artificial red color used to adulterate whole red chilies reaches the outside layer of the chilli with a piece of cotton soaked in oil. If the cotton becomes red it indicates the presence of artificial color.

9. Addition of starch powder to milk or butter and a drop of iodine solution to a small quantity of milk or butter. The blue color formed indicates the presence of starch.

10. For coffee powder first make a coffee to decolorize and on discoloring add a drop of iodine solution the formation of blue colour indicates the presence of starch powder in the coffee sample.

11. Take 5 ml of a sample mineral oil and add to 5 ml of lactic acid on heating for 2-3 mins the red colour appears which indicates the presence of argemonic oil which is toxic.

FOOD ADULTRANTS:

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 substance to food.

Food adulterations have an economic significance and with increasing price the unscrupulous trader 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 adultered if it has any ingredient which is injurious to health.

A food is said to be adulated if,

1. It contains any poisonous substance which may render it injurious to health
2. It bears any added poisonous or added substance which is unsafe
3. It contains in whole or in part any filthy, or decomposed substance or if it is otherwise unfit for consumption.
4. It has been prepared, packed or held under in sanitary condition.
5. It is, in whole or in part, the product of a diseased animal or of an animal which as died otherwise than by slaughter.
6. If its container is composed, in whole or in part of any poisonous substance which my render the content injurious to health.

CHAPTER NO 6

FOOD ADDITIVES

Types of Additives

Food additive is any substance not naturally present in a food but added during its preparation and remaining in the finished product.

Food additives are all substances added (intentionally or unintentionally) to basic food products. They include anything added during the production, processing, treatment, packaging, transport and storage if a food. In general, food additives are used to decrease the risk of contamination by certain microbes, maintain or improve nutritional quality, enhance appearance, increase shelf life, reduce waste or contribute to convenience.

Additives described as Generally Recognized as safe (GRAS), mean that they have been used for many years without any known adverse effects, for example, salt, sugar and vinegar.

In the present context, the use of food additives is imperative. Additives provide protection against food spoilage during storage, transportation, distribution or processing. With the present degree of urbanization, it would be impossible to maintain food distribution without the processing and packing with which many additives are involved. The convenience food revolution would not have been possible without food additives.

What are food additive?

The National Academy of Science-National Research Council (NAS/NCR) defines a food additive a **"a substance or mixture of substance other than a basic food stuff, which is present in food as a result of an aspect of production, processing, storage or packaging"** (Food Protection Committee-1965)

Intentional Additives: By far, the broadest definition of a food additive is any substance that becomes part of a food product when added either intentionally or incidentally to foods for a defined purpose.

To be a approved, a food additive must be both safe and useful

Incidental additives: About 10,000 compounds or combination of compounds occurs in foods as a result of processing, storage, or packaging. Infinitesimal amounts of pesticides used to treat crops, drugs fed to animals and chemical that migrate from plastic or paper packaging materials are examples of incidental additives.

Sources of food additives:

Food additives may come from foods or can be synthesized chemically or produced by biological processes. Additives from food include lecithin form soybean color from turmeric, hydrolyzed vegetable proteins derived from grains, starch from grains and tubers, gums (plant exudates), gums (seaweed extracts), sugar from sugarcane, lactose from milk, casein from very low concentration.

TYPES OF ADDITIVES:

- **Antioxidation:**

Processes of deterioration in food that is usually independent of bacterial attack foods, and the enzymatic browning of some fruits and vegetables. Such processes may be delayed, but not halted by an antioxidant, which may either occur naturally in food or may be added artificially.

The permitted natural antioxidants are ascorbic acid (sodium and calcium salt or other derivative and tocopherol and its derivatives.)

Enrichment:

Enrichment is the addition of one or more dietary essentials to foods so as to restore the nutrients lost in processing. Many foodstuffs have very low levels of vitamins

and for particular groups such as young children; the dietary intake requires a supplement.

This can be achieved by enriching the foodstuff with added vitamins, especially ascorbic acid and B-complex. E.g. milk powders, baby foods evaporated milk, condensed milk. The water-soluble B-complex vitamins can be lost in processing particularly thiamin, which is hat sensitive. Many foods, especially breakfast cereals and bread are enriched with B-complex vitamin for this reason.

Considerable amounts of ascorbic acid are lost during processing of such foods as fruit juices, pulps and the like. Enrichment with ascorbic acid overcomes the loss.

Iron and calcium levels are low in many foods, since very often the minerals cannot be metabolized easily. Thus, calcium and iron are added to flour, breads and other cereals based product.

Fortification:

Definition:

Fortification is the addition of one or more dietary essentials to foods in amounts higher than those present in the foods in the natural state and also addition of nutrients not present in the natural state.

Fortifying agents:

The problems of overcoming malnutrition among the low income groups of population in the developing countries have been the attention of food scientists all over the world. It is now possible to fortify essential food commodities with the nutrients lacking in the diet, at low cost in the developing countries and thus helps in overcoming malnutrition. This is achieved by enrichment and fortification.

The addition of vitamin A and D to margarine and hydrogenated fats is an example of fortification. Since butter is relatively rich in these vitamin and the vegetable oils in margarine contains little, if any a sufficient amount is added to bring the nutritional value of margarine equivalent to that of butter. Such an addition is mandatory by law.

Modification of appearance:

Many processing and preparative techniques alter the appearance of food. Flavor, color and texture may be modified to an extent that reduces consumer acceptability and it is common practice to restore original quality- or in some cases give an appearance of a particular quality with food additives. Therefore, in the broad context, flavorings, coloring and textural aids, may be considered “aesthetic” additives.

Flavoring:

Some 1,500 flavoring agents are used by the food industry for enhancement, replacement of stimulation of flavor.

These flavors fall into four main groups:

1. Natural foods.
2. Herbs and spices.
3. Essences and extracts.
4. Synthetic chemicals.

Essences and extracts form a very large category of flavoring agents and are important in many types of foods as are herbs and spices. Synthetic chemicals which are widely used fall into two main types (a) the synthetic analogs of natural flavors and (b) completely synthetic substances such a s non-nutritive sweeteners

The most common flavor enhancer is monosodium glutamate(MSG). Although it has no flavor of its own, MSG is able to intensify flavor in foods in which it has been added. The high MSG content of fresh mushrooms and carrots is probably the reason they are so commonly added to soups and stews for flavor. Some individual are quite sensitive to MSG and within half an hour of eating it, develops sever headache and dizziness, known as the **Chinese Restaurant Syndrome.**

Flavor enhancers: are becoming more important with the increase of synthetic foods. The most widely sold simulated foods are meat substitutes made form spun soybeans protein or proteins form other vegetables with the addition of flavors, color, vitamins, emulsifiers, acidifying agent and preservatives. These proteins are manufactured to sell as “steak” and “bacon bits”.

Sweeteners: there is clearly a consumer need for low or reduced calorie food products, providing they taste as good as normal products. In addition there is a requirement for packaging portable sweeteners and “tabletop” sweeteners to add to tea or coffee or even sprinkle on cereals and desserts.

Considerable controversy surrounds the use of artificial sweeteners-saccharin and cyclamate, in terms of their being toxic. The main disadvantage of saccharin is its bitter after taste and its decomposition by heat.

Coloring:

The acceptance of a food product is determined largely by its appearance. The undesirable color changes brought about in some food by processing or cooking can be overcome by the appropriate use of coloring agents.

A number of natural substance, some of them foodstuff in their own right, have long been used as coloring agents, this turmeric in curry, caramel in confectionery, annatto extract to color margarine. Similarly inorganic materials have been widely used for decorative use in bak9ing and confectionery. Metallic silver and gold come into this category with titanium dioxide (white) and iron oxide (red/brown) as other examples.

The problem with many of these natural coloring agents, has led to the adoption of many synthetic colors based upon the coal tar dyes. These coal tar based dyes are very powerful and only minute traces are required.

Bleaches:

Color additives are used to restore or simulate natural colors, but bleaches are used as additives to destroy color, particularly in flour. Freshly milled flour, which is golden yellow in color, lacks the capacity to form elastic stable dough. It the flour is allowed to age, it will oxide loses its color and improve its baking performance. Oxidizing agents strengthen the gluten network to produce a firmer, taller loaf. Chlorine dioxide, potassium bromate, ammonium persulphate and chlorine are used. Chlorine dioxide and potassium bromate are very widely used, either separately or as mixtures, sometimes with ascorbic acid. Chlorine itself, along with sulfur dioxide is only permitted in cake and biscuit flours in small concentration. Chlorine is useful in cake flours because it soften the texture when sugar content is high.

CHAPTER NO 7

FLAVORS

Flavor is very important in healthy cooking because they help replace missing ingredient such as fat and salt. Seasoning are used to bring out flavor already present in the dish whereas, flavoring add a new or modify the original one

Definination: It is the substance used in cooking to add a new flavor or modify the original flavor.

Herbs and spices:-

Herbs are the leafy parts of certain plants that grow in temperate climates. Spices are the roots, bark, seeds, flowers, buds and fruits of certain tropical plants. Herbs are generally available fresh and dried. Spices are mostly available in dried form.

Fresh herbs as opposed to dry are far superior and more versatile when creating recipes. Herbs commonly available fresh include parsley, basil, dill, chives, oregano. Fresh herbs are great when you a crisp clean taste and maximum flavor

Although the use of fresh herbs is not always possible, dry herbs can be substituted with better than average results. Dried herbs work well in longer cooking-such as in stocks, stews and sauces.

Spices and herbs are basically flavor builders.

TYPES OF FLAVOURS:

There are many herbs and spices used in the kitchen

1. Pepper: pepper comes in three forms: black, white and green. White and black pepper both come from the oriental pepper plant. Black pepper is the dried unripe berry; white pepper is the kernel of the ripe berry. Green pepper corn are picked before ripeness and preserved.
2. Basil: it has a warm, sweet flavor that is welcome in many soups, sauces etc, as well as with vegetables such as tomatoes, peppers, eggplant and squash. It blends especially well with tomato, lemons and organs.

3. Oregano: it belongs to the same herbs family as basil but it makes a very different contribution to dish a strong bittersweet taste and aroma you may have met in spaghetti sauce.

4. Rosemary: rosemary is like bay leaf is used in dishes where a liquid is involved soups, stock, sauces, stew. The leaf of an evergreen shrub of the mint family, it has a pungent, hardy flavor and fragrance. Fresh or dried it looks and feels like pine needles. It is used mostly with meats, poultry, and mushroom.
5. Dill and mustard have flavor that will be very familiar to you: dill as in pickle and mustard as in the hot dog condiment (mustard sauce). Fresh and dried leaves, often called dill weed, are used in soups, fish dishes, stews, salads and butters. Whole dill seed is used in some soups and sauerkraut. Dry mustard, a powdered spice made from the seed of the mustard plant, comes in three varieties: white, yellow and brown. Brown has the sharper and more pungent flavor.
6. Paprika is another powdered spice that comes in two flavors, mild and hot. Both kinds are made from fried pods of the same pepper family as red pepper and they something like the seasoning peppers, but they do not do the work of seasonings. Paprika's are sensitive to heat and will turn brown if exposed to direct heat.
7. Chili powder is one which is a combination of toasted ground dried chill peppers. Chili powder varies from mild to very hot.
8. Curry powder is a blend of up to 20 spices. In India, where it originated, cooks blend their own curry powered comes premixed in various blends from mild to hot. Curry powders usually include cloves, black and red peppers, cumin, garlic, ginger, cinnamon, coriander, cardamom, fenugreek, mustard, turmeric.
9. Cinnamon comes form the dried bark of the cinnamon, nutmeg and mace form the seed of the nutmeg tree, and ginger for the dried root of the ginger plant. Ground cinnamon and ginger are used in a variety of cuisines, both sweet and savory. Cinnamon us also available in stick.
10. Mint is a sweet herb with the familiar you meet in toothpaste and chewing gum. Mint is available in many varieties. The most popular are spearmint laned peppermint. Other includes chocolate, orange and pineapple. The flavor of a mint sauce offers are freshing complement to lamb. Fresh mint makes a good flavoring and garnish for fruits, vegetables, salsas, salads dressing, iced tea, desserts and sorbet.

BROWNING.

INTRODUCTION:

During cooking or processing, the colour of many foods darken, a change known as browning. In coffee, maple syrup, the brown crust of bread and all baked goods, potato chips, roasted nuts and many other processed foods, browning is necessary and desirable. Yet in other foods browning during processing is undesirable and forms off flavour and dulled or even objection able colours. In drying fruits or vegetable and in canning or concentrating orange juice, it is highly desirable to avoid browning.

TYPES OF BROWNING: Various types of Browning take place in foods depending on their composition. In each types, browning take place in a series of reactions rather than in one step. Three general types of browning reactions have been recognized to occur in foods during processing:-

1. Enzymatic Browning
2. Non-enzymatic Browning/Maillard reaction.
3. Caramelization.

Certain fresh fruit and vegetable-apples, pears, peaches, bananas, potatoes, brinjal, raw banana and sweet potato discolour when cut and exposed to air. When such fruits and vegetable are cut and the surface exposed to the atmosphere, phenol containing compound undergo oxidation by enzymes present in the tissue. This chemical reaction results in the formation of ‘quinone’ which is responsible for the surface discolouration. It may further be degraded by oxidation and polymerization to melanin or brownish black pigment. Besides exposure of the cut surface the chemical reaction may also be hastened by the use of rusted knife or an iron knife. The iron catalyzes the oxidation reaction to form quinines.

This browning reaction is undesirable as it detracts from the overall acceptability namely in terms of appearance and colors.

<u>Prevention of enzymatic browing</u> – Enzymatic browing can be prevented by following methods.

1] By inactivating enzymes – Enzymetic action can be prevented by following methods.

a) **Application of heat** - Blanching or cooking fruits & vegetables which are prone to discolouration. Enzymes are protein in nature & heat denatures proteins by inactivating enzymes.
b) **Addition of salt –** Vegetables may be immersed in a solution of salt. This is a temporary measure as the amount of salt required to prevent browning temporarily would make the food unacceptable.

c) **Lowering the pH -** Enzymatic browning can be prevented by lowering the pH to 2.5 to 2.7 by addition of acid. Acids used are ascorbic acid, malice acid, citric acid and lime juice.
d) Chilling food below temperatures optimum for enzymetic activity.

2] By avoiding contact with oxygen – This can be achieved by following measures.

a) Coating fruit with sugar or converting it with syrup.
b) When cutting fruits like apple, apply a light ascorbic acid solution on the surface. If ascorbic acid is not available, then lemon juice solution or a light citric acid solution may be used. The reason behind using an organic acid solution is that the coating on the surface prevents oxidation of the phenol containing reaction if the quinines have already formed. For example, if an acid solution is applied the quinines get converted back to phenol and the acid undergoes oxidation.
c) Immersing vegetable in water.
d) Vacuum packing.

3] Sulphuring of fruits prior to dehydration – Sulphur prevents oxidative browning due to enzyme activity fruits is treated to sulphur fumes prior to drying.

NON-ENYZMATICE REACTION:

This type of browning is more common than enzymatic browning, being responsible for changes both desirable and underisble, that take place during the cooking, processing and storage of many foods. This type of browning is also referred to as **"MAILLARD'S REACTION"**. The reaction takes place between the carbonyl group (aldehyde/carbonyl) of reducing sugar and the amino group of protein, amino acid or peptide, when adequate heat is present, it need not involve oxygen.

The brown pigment formed contributes to aroma, flavour & colour of many ready-to-eat cereals, toffees & bakery products.

Millard's reaction can cause deteriorative changes that are highly undesirable. The off-colour that develops is orange juice and dried fruits after long storage are thought to be caused by the browning reaction. These changes could be due to oxygen uptake either during processing or during storage.

CARAMELIZATION:

Caramelization is a chemical change that occurs in compounds containing sugar when they are heated to high temperature 160 to 177°C (320to 350°F).

When heated without water i.e. with the application of dry heat sucrose crystals melt, heating beyond the melting point brings about a number of decomopositional changes/chemical breakdowns begin. Continued heating then creates many different chemical compounds as a result of the breaking of the ring structure of both mono-saccharides. This then leads to caramelisation of the organic acids. This browning reaction does not require oxygen. Browning in vegetables with a high sugar content-onion, potatoes, carrots may probably be caused by caramelisation. Caramelisation is a complex reaction, involving the water and eventual polymerization.

Granulated sugar when heated in a heavy pan caramelizes. When hot liquid is added the caramelized sugar dissolved and can be used to flavour puddings, custards, cakes and sauces. It is also used to make brittle and candy.

Coffee: the caramelization of sugar present in the bean may be responsible for the color change in roasted coffee. Under or over roasting result in inferior coffee.

Coffee blended after blended after roasting, since the roasting time differs for each variety.

Maple syrup: is made by evaporating the sap obtained from the sugar maple tree. Sucrose is the chief sugar in maple syrup. Flavour is formed from the organic acids present in the sap. Dark syrup is made from the last run of the sap and has an intense flavour.

Bread: baking of bread involves production and expansion of gases, coagulation of protein, gelatinization of starch, evaporation of water and browning of the crust. The starch in the flour gets gelatinized. Evaporation of liquid from the surface during baking brings about development of crust and the caramelization of sugar contributes to surface browning.

ROLE OF BROWNING IN FOOD PREPARATION -

Browning can be desirable or undesirable affecting the appearance flavour and aroma of food. Enzymatic browning is considered unsightly & undesirable especially while preparing salads & fruit salads. Normal processes such as roasting grilling or baking bring about brown colouring.The aroma of freshly baked bread & roasted coffee beans is due to desirable maillard reaction.

CHAPTER NO 8

FOOD PRESERVATION AND STORAGE

Introduction: -

Food Preservation can be defined as the science which deals with the process of prevention of decay or spoilage of food, thus allowing it to be stored in a fit condition for future use. The process used varies with the length of storage intended. It may be simple as boiling milk so that it may for 24 hours or picking of mango or lemon where the Intended may be as long as a year.

Importance of Food Preservation

Food supply has to keep pace with the needs of the population. There is always a shortage of food in developing countries like India because of the demands of the increasing population. Increasing food, production to meet this shortage re-suits in wastage due 10 inadequate facilities available for storage and preservation. It is therefore, important to improve and expand facilities for the storage and preservation of food. Preservation of food helps in:

1. Increasing the shelf4ife of foods thus increasing the supply.
2. Making the seasonal food available throughout the year.
3. Adding variety to the diet.
4. Saving time by reducing preparation time and energy
5. Stabilizing prices of foods.
6. Improving the nutrition of the population.

Preservation increases availability pf foods, thus improving the nutrition of the people. Availability of seasonal foods throughout the year also helps in stabilizing prices of such foods.

Causes of Food Spoilage

Food spoilage usually refers to undesirable changes occurring in food due to the action of microorganisms, insects and enzymes. Foods vary greatly in the length of time for which they can be held in their natural form without spoilage.

For purposes of food preservation, foods are classified as perishable, semi-perishable and non-perishable. Perishable foods such as milk, meat, sea foods and many fruits and vegetables begin to deteriorate almost immediately after harvest if not preserved. These foods have high moisture content and arc highly susceptible to spoilage. Foods are spoiled by the action of: (1) microorganisms, (ii) enzymes, and (iii) insects.)

Methods of Food Preservation

Food preservation methods can be broadly divided into two categories:

I. Bacteriostatic method in which microorganisms are unable to grow the food, e.g., in dehydration, pickling, salting, smoking, freezing. etc

2. Bactericidal methods in which most of the microorganisms present in the food arc killed, e.g., in canning, cooking, irradiation, etc.

Removal of Wafer (Dehydration) Microorganisms need moisture to grow. When the moisture in the food is removed and the concentration of water brought below a certain level, they are unable to grow and spoil the food.' Moisture can be removed by the application of heat as in sun-drying and in mechanical heating or by binding the moisture with addition of sugar or salt and making it unavailable to the microorganisms.

Sun Drying in tropical countries like India, direct rays of' the sun are used Notes for drying a variety of foods, Vegetables and fruits are washed, peeled, prepared and placed on flat bottom trays under in the sun. Vegetables like beans, peas, potatoes, cauliflower, ladies fingers, garlic, onion, and all leafy vegetables can be sun-dried this way. Fruits like apricots, bananas, dates, figs; grapes (raisins), raw mango (amchur), peaches, pears, pomegranate seeds cinardana are also preserved by sun-drying. Fish (Bombay duck-'bombil') and shrimp are dried by exposing them to the sun on the seashore. Preparations using cereals and pulses are also sun dried. An example is "papad" which is a very popular snack throughout the country. As foods

dried this way are exposed to dirt, insects and to the air, there is always a risk of contamination and spoilage.

Smoking Foods can also be dried by exposing them to smoke by burning some special kinds of wood. In this method, while the heat from the smoke helps in removal of moisture, exposure to smoke imparts a characteristic flavour to the food In addition to the removal at' moisture, certain bactericidal substances may be form during smoking. This also helps in preserving the food to a limited extent. Fish and meat are the foods usually preserved by this method.

Mechanical Dying Dehydrators, rollers dryers and spray dryers arc exam- CS 0 mechanical devices used for drying food. Temperature and humidity are controlled in such equipment and so a product of superior quality with better colour, correct texture and the right flavour can be obtained. Solid foods such vegetables such as green peas, onions, potatoes arc spread in thin layers on metal trays, inserted in the dehydrator and then dried by heat. Food in the form of a fine dry powder can be obtained, by using either roller drying or spray drying. In roller drying, the finely ground wet suspension of the food is spread as a thin layer on a revolving drum which is heated. Then resultant dry powder is then scraped off with a blunt knife and packed.

In the spray drying process the food in the form of a liquid or a finely ground suspension is pumped through find jets and falls as a spray into a chamber through which hot air is circulated. The fine droplets of the liquid quickly lose their moisture by evaporation and fall on the floor of the chamber as a fine powder. The food is thus dried at a much lower temperature than in roller drying as it floats in air and does not come in contact with hot surfaces. This is useful for drying foods such as milk, eggs and gelatin as it prevents them from getting denatured. Spray dried foods reconstitute much better on addition of water than roller dried foods. Hence, beverages powders like instant coffee and tea are spray dried.

Addition of Salt or Sugar Tying up moisture by addition of solutes such as salt or sugar also prevents growth of microorganisms and helps preserve foods. Dry salting is use in India for the preservation of tamarind, raw mango, amla, fish and meat. Lemon, mango and other such pickles also owe their keeping quality partly to the large amount {15 to 20 per cent) of salt added.

Jams and marmalades are prepared by boiling the fruit pulp or shredded fruit peels with sufficient quantity of sugar (about 55 per cent by weight) to a reasonably thick consistency, firm enough to hold the fruit tissues in position. The same process is used for jellies except that fruit juices are used in place of fruit pulp. The high concentration of sugar and other solids about 68 percent binds the moisture making it unavailable for microorganisms to grow. Anaerobic conditions prevail on scaling and the application of heat kills most of the yeast and moulds. All these factors contribute to an increased shelf-life of the product.

Use of Oil and Spices A layer of oil on top of any food prevents growth of microorganisms like moulds and yeasts by preventing exposure to air. Thus certain pickles in which enough oil is added to form a layer at the top can be preserved for long periods. Spices like turmeric, pepper and asafetida have little bacteriostatic effect and their ability to prevent growth of microorganisms is questionable. Their primary function is to impart their characteristic flavour.

Use of Acid: Acid conditions inhibits growth, of many microorganisms. Organic acids are added or allowed to form in the food to preserve them. Acetic (vinegar), citric (time juice) and lactic acids arc commonly used as preservatives. Onions arc bottled in vinegar, with a little salt. Vinegar is also added to pickles, chutneys, sauces and ketchups. Citric acid is added to many fruit squashes, jams and jellies to increase the acidity and prevent mould growth. Lactic acid is usually produced from lactose by the action of lactic acid bacteria in the food. Formation of ‘dahi’ from milk affords a good example of lactic acid produced from lactose increasing its shelf life.

Use of Chemical Preservatives Certain chemicals when added in small quantities can hinder undesirable chemical reaction in food by: (1) interfering with the cell membrane of the microorganism, their enzyme activity or their genetic mechanisms; (ii) acting as antioxidants.

Law regulates maximum amounts allowed to be added to each type of food because higher concentrations can be a health. hazard. Benzoic acid in the form of its sodium salt is an effective inhibitor of moulds and is used extensively for the preservation of jams and jellies.

Use of Low Temperatures Microbial growth and enzyme reaction are retarded in foods stored at low temperatures. The lower the temperature, the greater the retardation. Low tempera-; lures employed can be:

I. Cellar storage temperatures (about 15°C)

2. Refrigerator or chilling temperature (0°C to 5°C)

3. Freezing temperatures (-18°C to-40°C).

Refrigerator or Chilling Temperatures (0°C to 5°C) Chilling (refrigerator) temperatures are obtained and maintained by means of ice or mechanical refrigeration. Fruits and vegetables, meats, poultry, fresh milk and milk products, fish and eggs can be preserved from two days to a week when held at this temperature. In addition to the foods mentioned above foods prepared for serving or leftover may also be stored in the household refrigerator. The best storage temperature for many foods, eggs, for example, is slightly above 0°C. The optimum temperature of storage varies with the product and is fairly specific for any given food. Besides temperature, the relative humidity and the composition of the atmosphere can affect the preservation of the food. Commercial cold storages with proper ventilation and automatic control of temperatures are now used throughout the country (mostly in cities) for the storage of semi-perishable products such as potatoes. and apples. This has made such foods available throughout the year and has also stabilized their prices in these cities.

Use of Freezing Temperatures At temperatures below the freezing point of water (-18°C to -40°C) growth of microorganisms and enzyme activity are reduced to the minimum. Most perishable foods can be preserved for several months if the temperature is brought down quickly (called “quick freezing”) and the food held at these temperatures. Foods can be quick frozen in about 90 minutes or less; (i) by placing them in contact with the coil through which the refrigerant flows (II) by blast freezing in which cold air is blown across the food; (iii) by dipping in liquid nitrogen.

Quick frozen foods maintain their identity and freshness when they are thawed (brought to room temperature) because very small ice crystals are formed when foods arc frozen by these methods.

Many microorganisms can survive this treatment and may become active and spoil the food if the foods are held at higher temperatures below 5°C. Enzymes in certain vegetables can continue to act even after being quick frozen and so vegetables have to be given a mild heat treatment called “blanching” (above 80°C) before they are frozen to prevent development of off- flavours.

Freeze Drying In this method, the food is frozen and the water from the food removed under vacuum. The water sublimes, i.e., it is converted into Vapour without passing through the liquid stage. The food is preserved in its natural state without any loss of texture or flavour. The food is packed in plastic or aluminium foil packets in an atmosphere of nitrogen. Some foods like instant coffee may be packed in bottles. Foods preserved by this method can be preserved at room temperature. However, correct packaging, of freeze dried; food is important as air and moisture must be excluded. Some of the foods, which can be p by this method, include prawns, green peas, potatoes and instant coffee.

USE of High Temperatures

Coagulation of proteins and inactivation of their metabolic enzymes by the application of heat leads to the destruction of microorganisms present in foods. Further exposure to high temperatures can also inactivate the enzymes present in the food. Heating food to high temperatures can, therefore, help preserve, them. The specific heat treatment varies with (a) the organism that has to be. Killed, (b) the nature of the food to be preserved and (e) other means of preservation that may he used in addition to high temperature. High temperatures used for preservations are usually classified for convenience as follows:

1) Temperatures below 100°C (pasteurizations)
2) Temperatures of boiling water (100°C)
3) Temperatures above 100°C

Pasteurization (Temperatures below 100°C) Pasteurization is the name given to the method employing temperatures below 100°C for the preservation of foods. It is used where drastic hc4t treatment may bring about undesirable changes in the food. It is usually supplemented by other methods to prolong shelf.

However, pasteurization temperatures are, so calculated as to kill all the pathogens that may be present in the food, Pa is used widely in the treatment of market milk and other dairy products, Milk is nowadays mostly pasteurized by the high temperature short time (HTST) method. Here the milk is heated to 72°C or higher and kept at that temperature for at least 15 seconds. After pasteurization, the milk is rapidly cooled to 10°C or lower and held at that temperature. This temperature inhibits the growth of microorganisms that may have survived. Beer, fruit juices and aerated chinks are preserved by pasteurization. Dried fruits like raisins (dried grapes), apricots can also be pasteurize before packing.

Boiling-- Cooking of rice, vegetables, meat, etc. at home is usually done by boiling the food with water and Involves a temp ground 100°C. Boiling food at 100°C kills all the vegetative cells and spores of yeasts and moulds and only the vegetative cells of bacteria.

Boiling al home, e.g., milk, can preserve many foods, usually cooked food can be preserved from 12 24 hours at room temperature.

Treatment with flowing steam or boiling the cans in water is also used for canning acid foods like tomatoes, pineapple and cherries. The yeasts and moulds that grow on acid foods such as tomatoes have low resistance to heat and are destroyed at boiling water temperature. Bacteria though not killed at this temperature are not able to grow in an acid medium without oxygen and thus can spoil the food.

Canning-- Canning usually employs temperatures above 100°C to kill spoilage organisms and to inactivate enzyme action, though in certain acid, foods as seen above, the temperature of boiling water is sufficient to do this. The food is scaled in sterile, airtight containers and then subjected to temperatures above 100°C. Low acid foods such as fish, poultry, meat and most vegetables have to be processed at temperatures higher than 100°C. Temperatures above 100°C can only be obtained by using steam pressure sterilizer such as pressure cooker or i autoclaves. The time and temperature necessary for sterilization vary with the type of food. Most of the bacteria and their spores are killed the course of this treatment and any surviving spores arc not able to grow because of the anaerobic conditions prevailing in the can. Some of the vegetables canned using temperatures above 100°C are green, peas, Ia4ies fingers and beans.

Examples of canned fish are shrimp, sardines and mackerel; that of poultry is chicken noodle soup; that of meat canned ham.

Sterilization--Sterilization is a term referring to any process that eliminates (removes) or kills all forms of life, including transmissible agents (such as fungi, bacteria, viruses, spore forms, etc.) present in a specified region, such as a surface or a volume of fluid. Sterilization can be achieved with one or more of the following: heat, chemicals, irradiation, high pressure, and filtration. Sterilization is distinct from disinfection, sanitization and pasteurization in that sterilization kills or inactivates all forms of life.

Commercial milk sterilization techniques have been developed which expose milk to ultrahigh temperatures for very short period of time, e.g. 300degree Fahrenheit(148.9 degree Celsius) for 1 to 2 seconds. The sterile milk product does not require refrigeration and has indefinite shelf life.

CHAPTER NO 9

INTRODUCTION TO NUTRITION

DEFINITION OF NURTITION:

"the science of food nutrients other substance therein, their action, interaction and balance in relation to health and disease and the manner in which an organism ingests, digest, absorbs and transport, utilizes, metabolizes and excretes food substance.

The Science of Food:

The statement that Nutrition is the science of food means that it is the study of the chemistry, physics, biology and economics of food and food production.

NUTRIENTS:

Nutrients means the chemicals in food needed to maintain life. These may be categorized as major and minor nutrients. Major nutrients include carbohydrates, proteins and lipids.

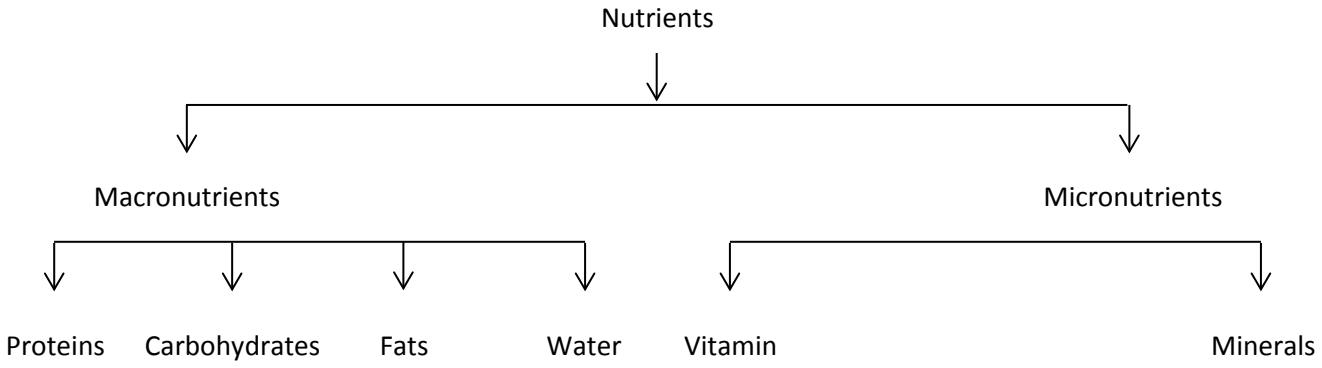
Minor nutrients are vitamins and minerals.

Balance:

A balanced diet is essential to provide all the nutrients in the required proportion to promote good health. Unbalanced means too few or too many of specific nutrients. Too little of a nutrient can produce unpleasant deficiency symptoms, lack of iron for instance can produce weakness.

CLASSIFICATION OF NURTRIENTS:

Food is chemically composed of carbohydrates, fats, proteins, minerals water, vitamins, pigments, enzymes, organic acids and miscellaneous compounds like ester, colloids.



The six chemical components of food which are termed nutrients with their main function are:

1. Carbohydrate: provision of energy.
2. Fats and oils: provision of energy.
3. Protein: repairs, maintenance, growth and regulatory function, provision of energy.
4. Water: body building, regulation of bodily processes.
5. Vitamins: regulation of body processes.
6. Minerals: body building and regulation of bodily processes.

Functions of food

Food has many functions besides providing energy. They are as follows:

1) **Physiological Function**
2) **Psychological Function**
3) **Social Function**

1) **Physiological Function:** Each nutrients has specific function in the body. The physiological functions performed by food are as follows.
   a) **Providing Energy:** The body needs energy to carry out voluntary & involuntary work, involuntary work includes all process, which are not under the control of our will such as digestion, respiration, circulation & go on contemptuously, we are asleep or a wake, voluntary securities or activities, which are wish to do such as walking, playing games & working requires energy, amount of energy required depend on the nature of activity. Energy required by activities is supplied by carbohydrates & fate.
   b) **Bodybuilding or Growth:** It is one of the most important functions of food. Our body is made of up of millions of cells & cells increase in size & they require energy of the cell growth.
   c) **Maintenance & repair:** The workout cells in the body are replaced by new cells, proteins, minerals & water are the cuqen nutrients required for growth as well as maintenance of all cells & tissue in the body.
   d) **Regulation of body process:** Food regulator under of activities in the body such as beating of heart, maintenance of body temperature, clotting of blood & excretion of wastes. These processes are controlled & carried out by specific nutrients. e.g. vitamin K & Calcium are necessary for clotting of blood.
   e) **Protective function:** Nutrients keep body cells in a healthy condition to ward of infection. They help in a building up body resistance to diseases & help the body restore rapidly from any infection.

2) **Psychological function:** Human beings have emotional needs such as need for love, attention & security. Food can play an important role in full feeling these needs. e.g. a mother can express her love for her child by preparing the child's favorite meal.
3) **Social function:** Food carries a lot of significance; warmth & friendship are expressed through sharing guest food & inviting people to drive. Food is significant part of special occasions & festivals.

CHAPTER NO 10

PROTEINS

INTRODUCTION:

Proteins are the most important nutrient in the diet next to water. They are most essential and are present in each and every cell of the body. All tissues, muscles, skin, hair and nails comprises of protein. Protein are made up of carbon, nitrogen, iron, sulphur, phosphorus etc. the presence of nitrogen makes protein different in the structure from carbohydrates and fats.

COMPOSITION:

Proteins are complex organic compounds containing carbon, hydrogen and oxygen. But unlike carbohydrate and fats, proteins contain in addition, nitrogen, usually sulphur and sometimes iron, phosphorus, iodine and copper. Amino acids are the building blocks which unite to form a protein molecule. Protein formation is quite similar to that of polysaccharides which are formed from simple sugar. The protein may contain hundreds or thousands of amino acids molecules. However, they are the same 21 amino acids repeated to form the huge protein molecule.

Proteins are the building blocks of the body because no tissue can be built without them. E.g. children need more proteins because growth demands more and faster tissue buildup.

CLASSIFICATION:

Proteins are classified into three types:

1. **Simple protein:** They are protein which gives only amino acids when broken down

E.g. albumin from egg white.

2. **Complex protein**: Are those proteins which is made up of protein group and non-

protein group.

E.g.. Casein in milk. Which has a phosphate group attached. Blood protein hemoglobin which contains a haeme (iron) group attached.

3**. Derived protein:** They result from a partial hydrolysis or breakdown of simple protein

E.g. Peptones and Peptide are formed when digestive enzymes begin their action on Protein.

Proteins are made up of amino acids which are called as body building blocks of protein. There are 20 different types of amino acids which combines together to form different protein. Amino acids are classified as:

1. **Essential Amino Acids (EAA):**

They are required by the body, but cannot be made by the body and hence they have to be supplied through the diet by the protein in the diet. There are 8 amino acids which are essential for all age groups. Arginine & Histidine are required only by infants.

2. **Non-Essential Amino Acids (NEAA):**

They are those which are synthesized by the body in adequate amount and hence do not have to be supplied by the diet

Classification of proteins :-

Proteins are also classified depending upon amino acid present in it.

A] Complete Protein:

The complete protein contains the EAA in the right amount that are required by the body. These protein maintain life which promotes growth& repairs tissues. These proteins have high biological value (i.e. they retain more nitrogen)

E.g. Protein found in egg white, milk, meat and fish.

B] Partial Protein:

They maintain life but cannot promote growth because they lack certain amino acid. They cannot synthesize tissues without the help of other proteins. The value of each is increased when it is consumed in combination with another incomplete protein at the same meal.

C] Incomplete Protein :

These proteins are incapable of growth & repair of body cells. They cannot maintain life. One or more essential amino acids may be completely lacking in these proteins e.g. gelatin & zein in corn. Gelatin lacks 3 essential amino acids & is only animal protein which is incomplete.

SOURCES:

Dietary Sources -Proteins are present in both plant & animal foods. Animal food sources provide the high quality or complete proteins such as eggs, milk & milk products – cheese, paneer, mawa, milk powder, curds, condensed milk, meat, fish, shell fish, poultry & organ meats, vegetarian source are pulses, nuts & oilseeds, soyabean is the richest vegetarian source of protein.

Functions :-

1. Growth – All body tissues & fluids except urine & bile are made up of protein. Proteins are the major constituent of muscles, organs, endocrine glands & collagen. Collagen is the main structural protein of bones, tendons, ligaments, skin, blood vessels & corrective tissue. Proteins are required for the formation & growth of all these substances. During periods of rapid growth additional growth proteins requirement increases.
2. Maintenance or wear & tear- Body cells have a varying lifespan & proteins are needed to replace the old or worn out cells.
3. Hemoglobin, an iron containing protein in the red blood cells, perform an important role by transporting oxygen to the tissue cells.
4. Plasma proteins maintain water balance & regulate the osmotic pressure in the body.
5. Antibodies that are protein perform a protective function by increasing the body's resistance to disease.
6. All enzymes & some hormones e.g. insulin are made up of protein.

7. Some amino acids have specific functions e. g. tryptophan serves as a precursor for niacin.

Energy - Proteins also provide 4 kcal / gm. when broken down in the body. If the diet does not supply adequate calories from carbohydrates & fats, the proteins from diet will be oxidized to meet the energy needs of the body.

DAILY REQUIREMENT:

The requirement of protein for adult man is 55 gm/day, for adult women it is 45gm/day, adolscent55-60gm/day. Adults require 1 gm of protein 1 kg. Body weight.

PROTEIN DEFICIENCY: A reduced protein intake over a prolonged period of time leads to loss of weight, fatigue, anemia, lowered resistance to infection & poor healing of wounds.

1. During pregnancy if a women's diet is deficient in proteins it results in any one of the following:

a] still birth (the baby is born dead)

b] Premature birth

c] A baby born with a specific deficiency disease like anemia.

2. During infancy and childhood a protein deficiency diet would result in protein energy malnutrition (PEM), or protein calorie malnutrition (PCM). These are of two types:

1**. KWASHIRORKAR:**

It results when a child is weaned (introducing new foods to the baby apart from milk). On to the traditional family diet after a prolong period of breast feeding. This traditional diet may be deficient in protein. A child suffering from kwashiorkor is anemic (having low hemoglobin level), anorexic (loss of appetite) and suffer from diarrhea and edema (retention of water in body).

2. **MARASMUS:**

It is the childhood counter part of starvation in child. Its symptoms include an irritable child who does not grow properly is inactive (thin and weak) and has continuous diarrhea. The abdomen or stomach of the child may be shrunken or pot belly with gas formation.

Excess –

1) If protein is consumed in excess it is used as energy or converted into fat & stored in the adipose tissue in the body.

2) Once the body needs have been taken care of, the excess protein is deaminated by the liver & urea is synthesized. The kidneys have to work more to excrete the additional amount of urea. A high protein intake is an unnecessary burden on two vital organs. i.e. liver & the kidneys. If these organs are diseased toxic wastes tend to accumulate in the body.

3) High protein diet increases the loss of calcium through urine.

4) When animal protein is a major part of the high protein diet, there is a risk of high blood levels of cholesterol.

DENATURATION OF PROTEINS

- Proteins are complex organic molecules made up of carbon, hydrogen, oxygen and nitrogen. Most proteins also contain sulphur and phosphorus along with traces of other elements. Proteins are not only essential for life but also play an important role in food preparation.

DENATURED PROTEINS

- ❖ Denaturation is defined as any non-proteolytic modification in the original structure of the native protein, giving rise to definite changes in physical, chemical and biological properties. Denaturation is brought about by following :-

1) Denaturing agents such as Acids, Alkalis and Salts.
2) Increase in temperature.
3) Extensive beating

EFFECTS OF DENATURATION :-

Properties of denaturated proteins are completely different from their native form:-

1) Denatured proteins are easily attacked by proteolytic enzymes. Eg.:- Cooked meats are some easily digested than raw meats.
2) They show decreased solubility. For eg:- Cooked egg white is not soluble in water.
3) They loose their biological activity as enzymes are destroyed. Browning does not take place in boiled potato.
4) Denaturated proteins loose their ability to crystallize.
5) There is an increase in viscosity of food.
6) Heat denaturation results in improved flavor & texture. E.g:- cooking improves flavour in meat & egg gives structure & texture to cakes.
7) Denaturation of food is irreversible unless it occurs under very mild conditions.

CHAPTER NO 11

CARBOHYDRATES

COMPOSITION:

Carbohydrates are major source of energy for humans. Carbohydrates are composed of carbon, hydrogen and oxygen. They are the cheapest source of energy. Each gram of carbohydrate yields 4 calories. In some Indian diet as much as 90% calories are obtained from carbohydrate. In a normal balanced diet 70% of the total calories are obtained from carbohydrates.

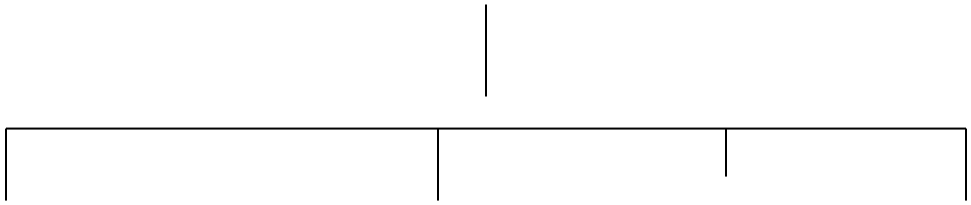
CLASSIFICATION:

Carbohydrates are broadly classified into:

1. Monosaccharide
2. Disaccharide
3. Polysaccharide

Monosaccharides are the simplest form of carbohydrate and they cannot be hydrolyzed or broken further. They include glucose, galactose and fructose.

Carbohydrates



Oligosaccharides

Monosaccharide	**Disaccharide**	**Polysachharide**
1) Glucose	**1) Sucrose (Glucose + Fructose)**	**1) Starch**
2) Fructose	**2) Maltose (glucose + glucose)**	
3) Galactose	**3) Lactose (glucose + galactose)**	**2) Glycogen**
		3) Cellulose
		4) Hemicellulose

1. **MONOSACCHARIDE:** These are the simplest forms of carbohydrates found in nature. Three monosaccharides are of importance in human nutrition they are glucose, fructose and galactose.

a] **GLUCOSE:**

It is also known as dextrose or corn sugar, it is less sweet as compared to cane sugar and it is soluble in hot and cold water. It is found in fruit like grapes, berries and vegetable like sweet corn, carrot etc. it is commercially prepared from corn syrup and is available in the crystallized form. It is the chief end product of digestion of disaccharide and polysaccharide. It is the only form in which the brains obtain energy.

b] **FRUCTOSE:**

It is highly soluble and available in crystalline form. It is sweeter than cane sugar and is found in honey and ripened fruit. In human body it is converted to glucose & oxidized as a source of energy.

c] **GALACTOSE:**

It is found fairly in nature and also from the hydrolysis of lactose which is found in animal milk.

2. **DISACCHARIDE:**

They are the sugar formed when two molecule monosaccharide combine together with a release of one molecule of water in presence of dilute hydrochloric acid,. They include maltose, lactose and sucrose.

a] **MALTOSE:**

It is also known as malt sugar and found in germinating seeds like barely. Maltose along with dextrin is used as a carbohydrate. In the body maltose is formed during digestion of starch.

Glucose + glucose ⟶ maltose

b] **SUCROSE:**

It is also known as table sugar and found in sugar cane and beet root and also is some fruits & vegetables. It is made up of one molecule of glucose and one molecule of fructose. It is most common of all diasacchacedes

Glucose + Fructose ⟶ Sucrose.

c] **LACTOSE:**

It is known as milk sugar. It is found in human and animals milk and is made up of galactose and glucose.

Glucose + Galactose ⟶ Lactose.

It is the least sweet of all sugars & is easily fermented to lactic acid by lactic acid bacteria while preparing curds & cheese. Lactic acid which is formed from lactose helps in setting curds.

OLIGOSACCHARIDES : They are composed of three to ten monosaccharide units linked to each other by the removal of a molecule of water. They are not as common in food as the mono, di & polysaccharides, but are formed during breakdown of starch into simple sugars e.g. raffinose & stachyose.

3. POLYSACCHARIDE:

These polysaccharides take a long time for digestion. They include starch, cellulose, hemicelluloses and pectin. When more than one molecule of monosaccharide combines together it releases one molecule of water forming polysaccharide. The number of glucose units, their arrangements, & linkage to one another influence the properties of the polysaccharide.

a**] STARCH:**

It is the storage form of carbohydrate found in plant. Each molecule of starch is made up of numerous molecule of glucose or monosaccharide linked together. They form approximately half the dietary, carbohydrates which are consumed. They are present in plenty of amount in cereals, pulses, tapioca sago, root & tubers.

b] **GLYCOGEN:**

It is called as animal sugar because it is only storage form or carbohydrate in human being and in animal. Carbohydrates are used in muscle and in liver. Muscle glycogen is used directly for voluntary activities. While liver glycogen is converted into glucose and is transported through the blood stream to the tissue for involuntary activity. Approximately 340 gm. of glycogen is stored in the body. However animal liver or muscle is not a source of glycogen in the diet as it is immediately converted to lactic acid when the animal is slaughtered.

FUNCTIONS OF CARBOHYDRATES:

1. The main function is to serve as a source of energy. Each gram of carbohydrate provides 4 kcal of energy. It is the cheapest source of energy

2. Protein sparing action – Carbohydrates spare proteins from being broken down for energy and are used for body building and repair. In carbohydrate deficient diets, proteins meant for bodybuilding and repair are oxidized to meet the most important & first need of the body i.e. energy.

3. Carbohydrate is also essential for the normal break down of fats.

4. Cellulose and relative compounds help in the elimination of waste product by stimulating the peristaltic action of the gastro-intestinal tract. Dietary fiber plays an important role of increasing feacel mass by absorbing & holding water.

5. Glucose is the soul form of energy required for the proper functioning of the brain, muscle, and nerve and lung tissue. When the glucose level in blood falls, the brain does not get energy & conclusions may occur.

6. Lactose is less soluble than any other sugar it remain in the intestine for a longer period to stimulate the growth of certain beneficial bacteria. This bacterial flora helps in synthesis of B-complex vitamins in the gut.

7. Carbohydrate rich food like cereal also provide sufficient amount of protein, mineral and complex vitamin like B1, B2, B3.

8. Fiber also helps in lowering blood cholesterol by binding bile acids & cholesterol.

FOOD SOURCES OF CARBOHYDRATE:

This includes grain, roots, vegetable, milk and concentrated sugar or sweets. Refined sugar has 100% carbohydrate, syrup, jams, jelly have 65-80% carbohydrate

Cereals have more than 65% carbohydrate.

EXCESS OF CARBOHYDRATE:-

1. Increase the incidence of tooth decay or dental carries.

2. Causes obesity because more calories are taken than required.

3. Excessive fiber could irritate the intestinal living causing cramps or bloating due to gas formation.

4. Depress appetite – Excessive sugar depresses appetite provide empty calories or hollow calories & could result in malnutrition.

5. Increase the blood cholesterol level which leads to heart disease.

6. Excessive fiber interferes with absorption & availability of mineral elements such as iron & calcium.

*D*EFICIENCY OF CARBOHYDRATE:

A mild deficiency of carbohydrate in diet results in utilization of fats for energy purpose. In case of sever deficiency of carbohydrate fats too cannot be oxidized completely which result in the accumulation of large amount of keton bodies in the body. Carbohydrate deficiency is uncommon in our country as diets are cereal based.

EFFECTS OF HEAT ON STARCH

- Starch is stored as granules with leucoplasts in plant cells.
- Each type of starch has different shapes & sizes of granules.
- Amylose and amylopectin are closely packed in orderly manner in the starch in two regions.
- The armophous region contains mostly amylopectin arrange randomly.
- In the crystalline region both amylase and amylopectin are arranged in a definite manner.
- Crystalline & armophous areas alternate with each other.

EFFECT: -

1) Gelatinization & Viscosity: - When starch granules are mixed with cold water, they do not dissolve but form a suspension.
2) When the water is heated, the granules begin to swell.
3) The heat energy breaks the hydrogen bonds in the starch granules and facilitates the entry of water in the granules.
4) As the same time, some amylase from the granule reaches into the cooking water.
5) The temperature at which the granule swells is called gelatinization temperature and is characteristics of each starch.
6) The starch chain in the granules absorbs moisture & begins to uncoil from their tightly packed configuration.
7) The size of the granule increase as more & more water increases.
8) The size of the granule gets bonded to amylase & amylopectin. The increase in viscosity is due to water bonded to starch and increase in size of starch granule as well as reduction in free water in the mixture.
9) The mixture becomes viscous & translucent after continuous heating.
10) Swollen grains find it difficult to more past each other, adding to the viscosity of the mixture.
11) The process of swelling of the starch grains & formation of viscous starch pastes is called gelatinization.

DEXTRINIZATION

When starch is heated without any water, the temperature rises rapidly beyond 100ºC. Water is naturally present in flour and the high temperature brings about chemical degradation of flour splitting glucodidic linkages. This reaction is called dextrinization and the short chain starch molecules of varying length formed are called dextrin's. Dextrinization is seen when flour is browned while making brown roux for grains and sauces. Browned flour has lesser thickening ability of formation of shorter chain dextrins.

CHAPTER NO 12

LIPIDS (fats and oils)

Composition

Fats are also called as Lipids/ Triglycerides, esters of fatty acids and glycerol. They are organic compounds composed of carbon, hydrogen and oxygen. They however, differ from carbohydrate and proteins as they contain less oxygen as compared to carbohydrates and protein (CnH2nO2)

Fatty acids: fats and oils have two components-glycerol and fatty acids. Since glycerol is the common component it is the different types of fatty acid that gives a variety of fats.

Fatty acids are composed of even number of carbon atoms 4 to22 carbon atoms in length.

Depending on the number of hydrogen atoms attached to the carbon chain there are two types:-

1. **Saturated fatty acids**: These contain as many hydrogen atoms as carbon atoms are capable of holding and are stable compounds. They range from short carbon chain to long carbon chain compounds.
2. **Unsaturated fatty acids**: These have fewer than the maximum number of hydrogen atoms attached to the carbon chain. The point of unsaturation is depicted by a double bond at which it can hold two hydrogen atoms.

Mono saturated fatty acids (MUFA) contains one double bond per molecule whereas **poly unsaturated** (PUFA) contain more than double bond per molecules.

Essential fatty acids: Polyunsaturated fatty acids that cannot be synthesized by the body and must be provided in the diet are called essential fatty acids. E.g. Linoleic acid, Linolenic acid and arachidonic acids.

Non- essential fatty acids: Fatty acids that can be synthesized by the body and need not be provided in the diet are called Non-essential fatty acids.

CLASSIFICATION:

Lipids are classified as follow:

Simple lipids: These are esters of fatty acids with certain alcohols. E.g. triglycerides which are the main form fat in foods. They are ester of fatty acids and glycerol (alcohol).

1. **Compound lipids:** these are esters of fatty acids which on hydrolysis produce other substance in addition to fatty acids and alcohol. **E.g.** phospholipids, glycolipids, sulpholipids.
2. **Derived lipids :** these are substance liberated on the hydrolysis of simple and compound lipids. **E.g.** steroids, carotenoids.

Fats are classified into two broad groups on the basis of their sources.

- **Vegetable fats and oils**
- **Animal fats and oils.**

1. Vegetable fats and oils are of plant origin and are known as invisible fats. These form a chemical component of foods like nuts, oilseeds, cereals like corn, legumes like soybean, flower like sunflower, and certain fruits like olives. These are extracted out of the raw material, refined, modified and are available as- visible fats e.g. coconut oil, corn oil etc.
2. Animal fats and oils are largely of the invisible variety except in some meats they can be seen in certain parts other sources include milk, fish, liver, egg, drippings of lamb, pork, beef.

Visible fats which are commonly available and used: Butter, fish liver oils.

FUNCTIONS OF FAT:

1. **Satiety Value**: Fats tend to leave the stomach relatively slowly. This delay in emptying time of the stomach helps to delay the onset of hunger sensation and contributes to a feeling of satisfaction after a meal.
2. **Palatability:** Fats improves palatability of a meal i.e. it makes a preparation tasty. It improves the flavour as most of the flavours are fat soluble.
3. **Lubricating Effect**: They help in lubrication of foods making their ingestion easier.

4. **Energy Reserve**: Body fat represent the primary force in which energy is stored in the body, particularly in the adipose tissue. This body fat is used as a source of energy, when the caloric intake is less than the requirement. Fats are a concentrated source of energy. 1 gm of fat / oil gives 9 kcal.
5. **Body Regulator**; Fat is an essential constituent of cell membranes and regulates the absorption and excretion of nutrient by the cell.
6. **Insulation**: A certain minimum deposit of fat beneath the skin serves as an insulating material for the body is protecting it against shocks form changes in the environmental temperature, but too thick a fat layer as in obese individual slow down the rate of heat loss during hot weather causing discomfort to the individual.
7. **Protection Of Vital Body Organ**: The fat deposit which surrounds certain vital organs serves to hold them in position and protect them against physical shock.
8. An adequate intake of fats & oils is necessary to meet the body's requirements for linoleic & linolenic acids.
9. Synthesis of hormones – The lipid cholesterol is necessary for synthesis of some hormones.
10. Absorption of fat soluble vitamins fat is necessary for the absorption of fat soluble vitamins A, D, E, & K.
11. Protein sparing action – An adequate intake of fat in the diet allows proteins to perform their main function of growth & maintenance.

FOOD SOURCES

the visible fats account for about forty percent of the daily diet and are obtained from foods like milk, cereals like corn, legumes like soybean, nuts , oilseeds, flowers like sunflower and fruits like olives.

The invisible fats account for the major daily intake and are mainly consumed in the form of whole milk, nuts, meat, ham, cocoa, fish and egg yolk.

Egg yolk, organ meats such as liver, kidney, brain are rich in cholesterol content. These should be consumed in moderation by individuals having a family history of cardiovascular diseases.

DAILY REQUIREMENT

Daily requirement of an individual is app 20-25 gm/day.

EXCESS:

High fat diets are always high in energy. The extra calories are ultimately converted into body fat. This gradually causes obesity, which in itself is a nutritional disorder. This could further predispose a person to hypertension atherosclerosis, heart disease, diabetes.

DEFICIENCY:

Low fat diet lack in the desirable psychological value like taste and aroma. The satiety value of the diet is also lowered. Such diets may cause specific deficiency symptoms of fat soluble vitamins.

Low fat diets also cause deficiency of essential fatty acids and may cause dermatitis like infantile eczema and **toad skin** in school going children.

EFFECTS OF HEAT ON FATS AND OILS :

While the fat is cooked or prolonged heating is given certain changes are to be seen in the fats & oil:-

1) There is an increase in the free fatty acid content.
2) Smoke point is lowered.
3) Melting point falls.
4) Fat turns darker in colour.
5) The viscosity of the fats increases.

HYDROGENATION OF OILS

Liquid oils can be converted to solid fats by a process known as Hydrogenation. In this process, hydrogen is added to unsaturated and melting point of the fat increases. The Hot oil and finely divided nickel catalyst is stinned together under an atmosphere of hydrogen. Hydrogen is introduced under pressure so that maximum is dissolved in oil. The oil and catalyst are heated under vacuum. The reaction is continued till the desired consistency of fat is obtained. The oil is cooled, filtered to

remove catalyst and chilled rapidly. By chilling small crystals be formed and the fat gets a grainy texture.

Hydrogenation is utilized in the manufacture of a wide variety of facts such as Vanaspati & Margarine. These can replace costly animal fats such as butter & classified butter. The hardness of a fat depends on the degree of hydrogenation. Sometimes addition such as antioxidant monoglyceride and vitamin A and vitamin D are added to fat. Air may be whipped in to impart a snow white colour.

Palm Oil, Palmolerm, Rice bran, cotton seed, sunflower, Maize, Soybean, groundnut and sesame oil are generally hydrogenated.

RANCIDITY:

The development of any disagreeable odor and flavor in fats and oil causing spoilage is known as rancidity. This change is observed when fats and oils are stored for sometime. Rancidity develops in fats, oils and the fatty phases for foods such as pickles, fried snacks, cakes, cheese and salad dressing.

Different types of oil and fat show varying degree of resistance to spoilage thus most vegetable oils deteriorate only whereas animal fats deteriorate more rapidly and marine fish oil which contains a relatively high proportion of highly unsaturated fatty acids deteriorate most rapidly.

Vegetable Oil resist oxidation because of the presence of antioxidant which occurs naturally in the tissues and which are present in all when it is pressed. Eg. : Vitamin E on tocopherols.

The Antioxidant get readily oxidized themselves and protect the oil from oxidation.

CHAPTER NO 13

VITAMINS.

The tern vitamin was coined from the words 'vital amine' as early scientists felt these chemicals which are vital for life were amines. Towards the end of the 19th century it was realized that in addition of carbohydrates, fats and proteins small quantities of unknown substances were also essential for life. The term 'vitamin' was 1st named by a polish chemist Funk-1912.

DEFINE:

Vitamins are organic compounds present in small amounts in foods are required for a normal growth, maintenance and group reproduction. They perform specific and vital functions in the body in both the cells and tissues.

CLASSIFICATION:

1] Fat soluble- A, D, E, K.

2] Water soluble- B-complex, C.

1] FAT SOLUBLE VITAMINS:-

They require fat for their absorption & can be stored in the body. They are generally associated with fatty foods such as butter, cream, vegetable oil, meat, etc. they are most stable to eat and less likely to be lost during cooking and processing. They are absorbed from the intestine along with lipids with the foods. Excess intake of these vitamins can lead to hyper toxin.

VITAMIN A:-

Vitamin A also called as Retinol. It was discovered in 1909 by McCollum and Davis. They observed that a fat soluble substance was essential for growth.

B carotene servers as a pre-cursor of vitamin A. It was discovered by Moore-1930. ß Carotene can be directly converted into Retinol in the body and forms a major lively source in India. Plant foods contains yellow orange & red color pigments called carotene. Carotene pigments are converted to vitamin A.

FUNCTION: Vision – Vitamin A maintains normal vision in dim light. Vitamin A plays an important role in the retina of the eye. Retinol supplied to the retina is converted to

2. Growth: - Vitamin A is required for normal bone & tooth development & proper growth.

3. Maintenance of integrity epithelial lining:-

Epithelial cells are found in the skin, eyes, digestive system, and respiratory system. The mucus secreting the tissue are covered with cilia which protects the body against infection and micro-organisms. In vitamin A deficiency, the cilia are absent and the epithelial cells become dry and hardened. [Keratinization].

3. **Immunity: -** The regulation of antibodies and immune response requires vitamin A It helps the body to fight against infections by keeping mucos membranes in healthy condition which act as barrier to infection.

DEFICIENCY:-

1. NIGHT BLINDNESS-

It is one of the early signs of Vitamin A deficiency. In this condition an individual is unable to see well in dim light, especially after coming from bright light.

2. CHANGES IN EYE-

a) Secretion of tears decrease
b) Eye ball becomes dry & lusterless
c) Bitot spot (Pigmented spots) are seen on conjunctiva.
d) Photophobia or sensitivity to bright light.
e) Xeropthalmia – cornea becomes dry & inflamed.
f) Keratomalacia – This is due to softening tissue of the cornea leading to total blindness. Other vitamin A include loss of appetite rough scaly skin, infection & reproduction problems.

SOURCES:

Spinach, carrots, mangoes, coriander leaves, yellow and orange fruits, liver, butter

HYPERVITAMINOSIS A

A high dose of Vitamin A is not recommended as excess is stored in the liver. This excessive accumulation of vitamin A in the body is toxic. Symptoms of toxicity are nausea, vomiting, abdominal pain, loss of hair, thickening of long bones and joint pain.

VITAMIN D:-

The beneficial effect of sun lights in curing rickets was known since early 19th century. Sir Edward Mellanbe was the 1st nutritional disease McCollon designated that it was a steroid and termed it vitamin D.

1. Vitamin D helps in absorbing of calcium and phosphorus from the small intestine.

2. Vitamin D affects the bone forming cells (osteoplasts) which plays in important role in

bone formation.

3. Vitamin D helps in regulation of specific genes and control clean activities.

4. Vitamin D is required for insuline secration,

DEFICIENCY:-

1. Rickets - occurs in children between 1-3 years. It is caused when the mother is unable to supply the vitamin to the foetus or even later in breast milk.

Signs and symptoms of Rickets:-

1. The child is restless, irritable flabby muscles. There is respiratory infection and inability to sit crawl or stand at normal ages.

2. Bony charges are also unidentified. There is widening of bone junctions. Softening of skull, bulging of the forehead, bowheads and knock knees, beading of the ribs called as rickety rosary, building of the chest (pigeon chested) and spinal curvature.

2. Tetany- This is manifested by enlargement of the wrist and ankle joint, muscle cramps and convulsions, delay in teeth developments.

3. Ostomalacia or adult ricket - More common in women. The softening of bones leads to deformed spine rheumatic pain in the legs & lower back & spontaneous fractures.

SOURCE

Exposure to sunlight is best sources, egg yolk and milk are poor sources, and cod - liver oil is highest in vitamin D.

HYPERVITAMINOSIS D: Large doses of Vitamin D can be toxic. Excessive use of fortified foods lead to loss of appetite, vomiting, diarrhea, growth failure, and calcification of soft tissues and kidney stones.

VITAMIN E

It was discovered in 1922 by Evans and Bisnop. It is obtained from plant foods and contains substances known as tocopherol. It requires the presence of fat and bile for its absorption. It is stable to heat & acids.

FUNCTIONS

1. The main function of vitamin E is as Antioxidants. Anti-oxidants are substance that protects the body from damage by certain oxidation reaction. Vit E itself gets oxidized & protects cell membranes from oxidative damage. It performs following functions:

1. Prevents oxidation of vitamin A in the in intestine.
2. Protects normal cell membrane by preventing their breakdown.
3. Prevents hemolysis of RBC
4. Prevents oxidation of PUFAs.
5. Vitamin E is involved in a metabolism of nucleic acid protein and various hormones. It is required for the normal functioning of the immune system.

DEFICIENCY

1. Vitamin E deficiency is very rare but in new born premature infants vitamin E deficiency could lead to hemolytic anemia wherein there is a breakdown of RBC and lung cells.

2. Neurological disorders like uncoordinated movements and muscular breakdowns (premature infants).

3. Retinopathy: - Defective functioning of the retina.

SOURCES

Vegetable oils, nuts, whole gram, wheat germ oil. & dark green leafy vegetables.

VITAMIN K

It was 1st isolated in 1939 by scientist Dam and Swiss chemist Karrier. It was found in putrid fish meal alfalfa.

FUNCTION

It is required for the formation of prothrombin & several other proteins involved in clotting of blood. The ability of blood to clot is dependant upon a high blood level of prothrombin.

DEFICIENCY

Deficiency occurs in children or infants called as Neonates haemolage. It is rare in adults.

SOURCES

Dark green leafy vegetable, milk and milk products, fruits, alfalfa.

WATER SOLUBLE VITAMINS

Being water soluble they are easily absorbed & the excess consumed in excreted in urine.

Vitamin B1 (Thiamine) :-

Besides begin water soluble, it is destroyed in an alkaline medium. Thus, use of soda in cooking leads to some loss of thiamin from the foods.

FUNCTION:

1. Thiamin is essential for carbohydrate metabolism. It acts as a coenzyme thiamin pyrophosphate (TPP) is required in the breakdown of glucose to yield energy.
2. TPP is also essential for protein and fat metabolism.
3. It is essential for growth.
4. TPP is present in the peripheral nerve cells. It is essential to maintain the normal condition of the nervous system.

SOURCES:

Parboiled rice, Soya bean and wheat germ are rich source of Vitamin B1. Whole cereals like wheat, oats, legumes, oil seeds and nuts are good sources. Milled cereals, vegetable, fruits, milk, meat and fish are fair sources.

DEFICIENCY:

In mild deficiency loss of appetite (anorexia), fatigue, irritability, depression, indigestion and constipation occur.

Severe deficiency causes beriberi

“DRY BERIBERI” Here the peripheral nerves of the legs and arms are affected first (pins and needles sensation in extremities. Calf muscles become tender and there is numbness in the toes and ankles. There is restlessness, sleeplessness, anorexia, vomiting and

“WET BERIBERI” In addition to the symptoms seen in the dry beriberi, edema, in legs and in between cardiac muscle fibers is observed. These changes in the heart muscles lead to enlargement of the heart.

Other symptoms include breathlessness, loss of appetite and dermatitis.

2) RIBOFLAVIN (B2)

This vitamin also is easily destroyed in alkaline medium; bit is stable in acids medium. Bright light also destroys riboflavin.

FUNCTTION:

1. It is closely related to biological oxidation in cells. The presence of riboflavin is essential for cellular growth.
2. Vitamin B2 takes part in carbohydrate, fat and protein metabolism.
3. It helps to maintain health of the delicate tissues, lining of the mouth, lips and the eyes.
4. It helps to transmit the nerve impulse from the eyes to the brain and therefore helps in vision.
5. It is essential for healthy skin, mucous membranes structure of eyes and alimentary canal.

EFFECT OF DEFICIENCY:

In mild deficiency weakness, anorexia, apathy, burning at the angles of mouth, in the eyes and the skin occur. Normal metabolism of protein and carbohydrates is affected.

One can see fissures at the corners of the mouth (cheillosis)

Redness/magenta tint on the surface of the tongue (glossitis)

Eye look bloodshot eye fatigue itching, burning, watering & sensitivity to bright light i.e. photophobia.

SOURCES:

Fleshy foods like liver and egg, skimmed milk powder and milk products are rich sources of riboflavin. Milk, meat, fish, whole cereals, legumes, fats, oilseeds, nuts and leafy vegetable are good sources while milled cereals and flours, roots and tubers and other vegetable are fair sources.

3) NIACIN (Nicotinic acid)

It is most stable off all B complex vitamins. It is stable to heat, light, acids and alkalis. In the body, niacin is converted into niacin amide.

FUNCTION:

1. Niacin also takes place in the metabolism of carbohydrates, protein and fats
2. It also takes part in tissue oxidation.
3. It is essential for normal functioning of skin, intestinal and nervous system.

SOURCES:

Cereals, especially whole cereals, dried yeast, liver, groundnut, legumes, fleshy foods and fish are good sources. Milk eggs and vegetable are fair sources.

DEFICIENCY:

Deficiency of niacin leads to “pellagra” which is known as a disease of 3’Ds-dermatitis, diarrhea and dementia.

Dermatitis occurs on those portions of the body which are exposed to sunlight; face, elbow, neckline, etc and on both sides of the body simultaneously and the skin lesion are symmetric in size and shape.

The other symptoms are nausea, vomiting and diarrhea.

Dementia-changes in the functioning of the brain and nervous system.

Earlier symptoms of nervous disturbance are depression, dizziness and insomnia.

Niacin deficiency can lead to death.

VITAMIN C / ASCORBIC ACID:

It is easily destroyed on exposure to heat and light. Oxidation and alkalis destroyed it. During cooking much of it is destroyed. Iron and copper act as catalysts and cooking in these vessels increases the loss of vitamin c.

FUNCTION:

1. Synthesis of collagen which is the intercellular cementing substance that keeps cells in bone & muscle tissue together.
2. Ascorbic acid is necessary for proper growth during rapid growth or increased used.
3. It is essential for cholesterol metabolism.
4. Ascorbic acid reduces ferric iron to ferrous iron, in which form iron is absorbed in the body.
5. It is also essential for rapid healing of wound as it helps in the formation of connective tissues.
6. As an antioxidant, like vitamin E, prevents the oxidation of vitamin A & unsaturated fatty acids.

SOURCES:

Citrus fruits like lime and orange, pineapple ripe mango, papaya and tomatoes are good sources. Amla or Indian gooseberry is the richest source of Vitamin C. Guava; sprouted legumes and leafy vegetable are also good source of this vitamin.

DEFICIENCY:

Increased suseptipility to infections - Prolonged deficiency of Vitamin C produces **'Scurvy'**. Fatigue, weaknes, irritability and pain in bones are common. Spongy bleeding gums, loose teeth, swollen joints and hemorrhages in various tissues occur.

CHAPTER NO 14

MINERALS

Like vitamins minerals also perform regulatory & protective functions although they constitute only a small portion of the body tissue. Minerals are classified as major minerals & minor / trace minerals. Major minerals are calcium, phosphorus magnesium, sodium, potassium & chloride. Trace minerals are iron, iodine, copper, fluoride, zinc selenium & chromium but the most important ones are iron, iodine & fluoride.

1. CALCIUM

Calcium makes up 2% of body weight, 99% of calcium found in bones and teeth. Remaining is distillated in blood, muscles and heart.

FUNCTION

1. Calcium is responsible for bone formation; bones consist of collagen and mixture of protein polysaccharides (bone metric). The metrics gains strength because of mineral crystals (calcium phosphate). This process is known as calcification or ossification.

2. Calcium also help in tooth formation enamel of tooth contains a mixture of calcium phosphate and calcium hydroxide.

3. Calcium is required for growth and functioning of body cells.

4. It is also required for blood clotting during the conversion of pro thrombin to thrombin.

5. It increases permeability of cell membranes thus helping absorption.

6. It regulates contraction & relaxation of muscles including heart beat.

DEFIENCNEY – A severe deficiency leads to rickets in children & Octeomalacia and osteoporosis in adults

Osteoporosis – It is associated with lower bone density & bone mass. This is generally seen in middle age & old people. The bones become porous because of bone mineral loss. This causes compression of the vertebrae resulting in loss of height, back & hip pain, and the increased susceptibility to fractures. Bones become weak & fragile.

OSTEOMALACIA – A condition of damaged mineralization caused by vitamin D and calcium deficiency. This condition involves generalized reduction in bone density & presence of pesudofractures specially of the spine fever & humerus.

Tetany – This condition is caused by a decrease in serum calcium. In this condition there are severe intermittent muscular spasms of hands & feet accompanied by muscle pain.

Sources :- Milk & milk products excluding butter, ghee, & cream. Green leafy vegetables ragi, small dries fish, nuts & oilseeds such as gingerly seeds.

2) Phosphorus: - Phosphorus comprises 1% of total body weight. It occurs along with calcium in human nutrition & also has many other functions in the body

1) Building bones & teeth along with calcium & magnesium

2) DNA & RNA, the nucleic acids needed for genetic coding contain phosphorus.

3) As phospholipids they regulate the absorption & transport fats.

4) Adenosine triphosphate (ATP) & adenosine diphosphate (ADP) are necessary for storing & releasing energy according to body needs.

5) As part of enzymes needed for the metabolism of carbohydrates fats & proteins.

Deficiency :- Phosphorus deficiency is rare since a diet that contains proteins & calcium will be rich in phosphorus. Deficiency symptoms are similar to calcium deficiency.

Sources :- Phosphorus is widely distributed in diet milk & milk products, beans, carrots, beans, cauliflower, Corn, Peas, Potato, Banana, Liver, Egg, Fish, & Meat.

3) Sodium :-

The adult body contains 180 gm of sodium most of which is present in the extra cellular fluid of our body.

FUNCTION:

1. Sodium is the principal electrolyte in the extra cellular fluid which maintains normal osmotic pressure and water balance. It serves as a base in the extra cellular fluid.
2. It contributes alkalinity to the gastro-intestinal secretion.
3. Along with other ions, it maintains the normal irritability of nerve cells and helps muscle contraction.
4. It regulates cell permeability.
5. It maintains electrolyte differences between intracellular and extra cellular compartment.

SOURCES:

Table salt is the main source of sodium containing about 40 %of it. It is used in cooking for preserving and improving the taste of the food. One teaspoon salt contains about 200 mg to 2400mg sodium. Other sources of sodium are milk, egg-while, meat, fish and some vegetable such as spinach, beets, celery, etc.

In India, awareness about sodium and hypertension is not much. The commonly used sodium compound in prepared foods is baking soda, baking powder, monosodium glutamate (ajinomoto), sodium citrate and sodium propionate, Milk meat poultry, green leafy vegetables, Bengal gram dal etc are good sources.

2. IRON :

It is found in the body as hemoglobin (blood) myglobin (muscle). Iron in the body exists along with the protein molecules. The human body contains 3-5 gm of iron of which 70% is in the circulating hemoglobin.

FUNCTION :

1. Hemoglobin and myglobin helps in transport of oxygen through blood and storage in the muscle.

2. Iron is required as a factor for conversion of β carotene into an active vitamin A.

3. It is required for the synthesis of collagen.

4. It helps in specific brain functions such as a good attention span & capacity to learn memorize.

5. It helps in detoxication of drugs and other toxic substance in the liver and intestine.

DEFICIENCY

Iron deficiency anemia is very common among infants and children. Signs of anemia are:

- Pale skin.
- Dark circles beneath the eyes
- Thin and brittle finger nails.
- Redness and burning sensation in the mouth and tongue.
- Fatigue and dizziness
- Dry skin
- Acidity.

SOURCE

1. Green leafy vegetables legumes whole grains & enriched cereals.

2. Animal foods have better quality iron as compared to vegetable.

3. Liver organ meats, prawns, crabs dried fish, & egg yolks are good sources.

4. Peaches, Apricots, figs & Manukas.

5. Use of iron vessels also contributes to iron content in diet.

4. IODINE

Iodine is important for normal functioning of thyroid gland. Deficiency of iodine is associated with many physical and neurological disorders called as **IDD** [Iodine Deficiency Disorders].

1. **Goiter**: It is an enlargement of thyroid gland due to lack of iodine in the body.

2. **Cretinism**: Two types of cretinism are neurological cretinism characterized by mental retardation, deaf and mute and spastic. Other cretinism affects the skin it is characterized by post and dry skin, a swollen tongue, growth retardation and weak muscles. Such children may not be able to overcome this deficiency.

3**. Hypo thyroidism**: only way to prevent deficiency is addition of fortified salt.

5.FLUORINE OR FLUORIDE

Fluoride is the term for the ionized form of the element fluorine, as it occurs in drinking water. Fluorine is present in small but widely varying concentration in practically all soils, water supplies, plants and animals. It is therefore, a constitute of all normal diet.

The adult human contain less than 1.4mg of fluorine most of which is in the bone and teeth. In small amount fluorides help develop bones become porous and soft and teeth become mottled and easily worn down.

FUNCTION

1. It is found in various parts of the body particularly abundant in bones and teeth.
2. Fluorine in proper intake prevents dental carrier.
3. It also inactive oral bacterial enzymes which create acid from carbohydrate.
4. Dietary fluorine is essential for optimal bone structure and for prevention of osteoporosis in human.

DEFICIENCY

Deficiency of fluorine result in excess of dental carries. Also there is indication that its deficiency result in osteoporosis in the aged.

Fluorine is a cumulative poison; hence chronic fluorine toxicity, known as fluoriosis. The enamel of the teeth is likely to lose luster and become chalky.

SOURCE

Seafood and tea are the richest dietary source.

POTASSIUM

It is present as the major electrolyte in all body cells.

FUNCTIONS

1. As a component of all cell in the intracellular fluid it helps in regulating the water balance along with sodium.
2. It regulates the acid-base balance like sodium
3. It helps in transmitting nerve impulses and contraction of muscle tissue.

SOURCE

Fruits, vegetable, pulses, nuts, flesh food and whole grains are rich in potassium.

DEFICIENCY

Deficiency of potassium is unlikely in normal circumstances but may occur in severe malnutrition, chronic alcoholism, surgery and prolonged infection.

WATER

INTRODUCTION

Water is the most essential constituent of our body. It accounts for 55-70% our total body weight. Lean individuals have more water than the obese, infants and children have a greater proportion of water than adults.

Water present in the body is never plain water but has electrolytes dissolved in it. Similarly, when the body loses water, it loses electrolytes as well.

Sodium is the principal electrolyte of the extra cellular fluid while potassium is predominant in the intracellular spaces.

FUNCTIONS

1) Water quenches thirst and is the most refreshing and cooling of all liquids.
2) It is a structural component of all cells. In the bone, water is tightly bound, but in most tissues, a constant interchange takes place between the body compartments of water.
3) Water is the medium in which all chemical reactions take place.
4) It is an essential component of all body fluids such as blood, lymph, cerebrospinal fluid, bile, digestive juices, and urine.
5) It acts as a lubricant and helps food to be swallowed and digested food to pass through the gastro intestinal tract.
6) It acts as a solvent for the products of digestion and helps in transporting these products to different tissues.
7) Water regulates body temperature by taking up and distributing heat produced in cells when metabolic reactions take place.
8) It helps in excreting waste products of metabolic reactions.
9) Water is essential to maintain the turgidity of cells.

COLLOIDAL CHEMISTRY

INTROUDCTION

Most food preparation have been subjected to different processes before they are brought to the table. Large masses of food may be subdivided into smaller particles by processes like mincing, grinding, pulping and homogenizing and ingredients may be mixed in different way like beating, cutting and folding, blending, whipping, stirring, emulsifying etc,.

The kind of process food is subjected to will have a bearing on the final quality of the product. Foods are mixtures or dispersions of two or more types of substance. These substances are present as particles of various sizes. Depending on the particle size or size of the molecule in the mixture, these substance may be classified as a true solution, a colloidal dispersion, or a coarse suspension.

TRUE SOLUTION

A crystalline substance like sugar, salt are called crystalloid. They are soluble in water and there aqueous solution is called **true solution.** It is a homogenous solution as crystalloids particles are not seen under ultra microscope solution is clear and transparent.

SUSPENSION

It is insoluble solid like substance when added to water suspension is obtained. It is a heterogeneous mixture and turbid. Solid particles are visible to the naked eye. Suspension consist of discontinue phase. The particles settled down the under gravity.

DISPERSION OR COLLOIDAL SOLUTION

In Greek word Kolla means ‘Glue’ and old means ‘ like’. Therefore colloid means glue like substance like starch, glue, etc, is added to boiling water in a beaker with continues stirring. Colloid solution or dispersion is obtained. The particle are visible under ultra microscope, therefore colloidal dispersion is a heterogenous substance consisting of tow immisible phases

1. Starch in water is continous phase
2. While water is dispersion phase or discontinuous phase.

GEL:

A gel is a colloidal system in which liquid forms the dispersed phase and solid forms the continuous phase. It is also called a reverse sol.

SOL

Sols and gels are reverse colloidal systems and many can be changed from type to another. Many gels are first sols which on cooling form gels provided this concentration of solid is adequate.

EMULSION

An emulsion is defined as colloidal substance in which both the dispersed phase and the dispersion medium are immisible liquids.

Eg: milk, cod liver oil, cold drinks, oil paints.

In emulsion one liquid is water and the term is used to designate any liquid which is immisible in water. The liquid is excess dispersion medium and the liquid which forms droplets is dispersed phase.

EMULSIFYING AGENT

To obtain a stable emulsion a small quality of a third substance is added along with the two immisible liquids. The third substance is called as an emulisifying agent. Emulisifying agent forms a protective layer around the dispersed phase droplet and prevents coagulation.

Eg: soaps, detergent etc,.

TYPES OF EMULSION

1. OIL IN WATER
   In this type of emulsion oil is dispered phase and water is the dispersion medium.

2. WATER IN OIL
   In this type of emulsion water is the dispersed phase and oil is the dispersion medium