FOOD MICROBIOLOGY

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Sources of contamination of fresh foods

- The internal tissues of whole, healthy plants, fruits and animals are usually free from microorganisms.
- However, the external surfaces of plant products and animal products are contaminated by microorganisms from various sources.

- 1) From Sewage –
- The domestic sewage contains human pathogens especially those causing gastrointestinal diseases and large number of other microorganisms.
- When sewage is used to fertilize the plant crops, there is a chance that raw plant food will be contaminated with human pathogens and others.
- Natural water contaminated with sewage contributes their microorganisms to seafood's such as shellfish, fish, prawns etc.

- 2) From Soil –
- The soil contains the great variety of microorganisms.
- The soil contaminates the surfaces of the plants growing on or in them, and the surfaces of animal roaming over the land.
- Root crops such as potatoes, beets, carrots etc are coated with soil microorganisms.
- Low growing leafy vegetables such as lettuce (spinach) and cabbage are also heavily contaminated with soil microorganisms.

- 3) From Water –
- Natural water contains its natural flora plus microorganisms from soil, animal and sewage.
- Water is used as an ingredient, for washing foods, for cooling heated foods, cleaning of containers etc.
- During these operations water contaminates the plant foods and animal foods.

- 4) From Air –
- Air may contain several spoilage organisms and disease producing organisms.
- Air microorganisms contaminate plant and animal foods.

- 5) During Handling and Processing:
- The contamination of food takes place before the food is harvested or gathered or during handling and processing of the food.
- Additional contamination may come from utensils and equipment coming in contact with food. e.g. cans, butchering instruments (killing instruments), gloves etc.
- Additional contamination may also come from packaging material and from personnel's.

- 6) From Animal Itself:
- The hides (skin), hoofs, hairs, intestines, faecal matter of animal itself contains large number of spoilage microorganisms.
- Operation during killing, slaughtering (sacrificing of animals), de-feathering introduce organisms on the surface of animal food e.g. fresh eggs are usually free from microorganisms.
- But the egg shell may be contaminated with microorganisms from feathers, nest material, faecal matter etc.
- These organisms get in through the shell pores and contaminate the interior of egg.

- 7) Insects and Birds:
- Insects and birds causes mechanical damage to fruits and vegetables and introduce many microorganisms in it.

Preservation of Foods:

- The variety of methods for food preservation can be used depends upon the food and that can be done without alternating its desirable characteristics.
- Preservation usually involves preventing the growth of bacteria, fungi(such as yeasts), and other microorganisms.
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- Modern methods of food preservation based on three general principles.
- 1) Elimination of sources of contamination.
- 2) Inhibition of the growth of spoilage causing microorganisms.
- 3) Destruction or removal of microorganisms present in food.

- The various methods employed for the food preservation are as follows:
- 1) Preservation of food by high temp.
- 2) Preservation of food by dehydration.
- 3) Preservation of food by low temp.
- 4) Preservation of food by high osmotic pressure.
- 5) Preservation of food by radiation.
- 6) Preservation of food by chemical preservative.

1) Preservation Of Food By Heat (High Temperature) :

- Many food products are preserved by the use of heat.
- It is one the safest and most reliable method of food preservation because heat is effective in destroying vegetative cells as well as spores.
- Temperature used during heat treatment is different for different foods.
- Heat treatment should maintain the test, flavor, texture and composition of food.
- It kills the Microorganisms by denaturating the microbial proteins, especially enzymes required for metabolism.
- Heat treatment processes may be classified as follows:
- Heating below 100°c (Pasteurization)
- Heating at about 100 °c (Boiling)
- Heating above 100° c (Canning)

- Heating above 100° c:
- Heating above 100° C is most effective and kills all vegetative cells and spores.
- It is generally applied to foods in the process of canning.
- Canning:
- Canning may be defined as a process of preservation of food packed in hermetically sealed containers by the application of heat above 100 °c.
- Preservation of foods by canning was apparently started in the United State in 1879 by Underwood in Boston.

- Canning process consists of following steps:
- 1) Cleaning:
- After receiving the raw food material in canning industry , it is cleaned by washing. It removes the dirt and as many microorganisms as possible. This reduces the microbial load
- 2) Sorting and Grading:
- Food is sorted to remove damaged food material.
- 3) Blanching and Scalding:
- The raw food materials are immersed in hot water at 87.5° c to 95 °c or exposed to the live steam (having temp. of 100° c). This removes adhering materials which cannot be removed with cold water during cleaning. Blanching further lowers down the microbial load.
- 4) Peeling and coring:
- It removes surface soiling and associated microbial contamination. Various methods are employed such as steam peeling, flame peeling, mechanical peeling etc.
- 5) Filling of the containers:
- The food is then filled in cans or jars. Tin coated steel containers are generally used for this purpose.

- 6) Exhausting:
- The open filled containers are passed through an exhaust box in which hot water or steam is used.
- Exhausting expands food, drives out air/ gas bubbles and provides and atmosphere of steam in the head space at the top of the cans or containers.
- This excludes oxygen which may react with the food materials and the interior of the containers and may affect the quality of food.
- 7) Sealing:
- Each container is immediately sealed, after exhausting, before it is subjected to heating process. This prevents re-contamination of the contents.
- 8) Heat processing:
- The heat treatment depends upon several factors such as nature of food, type of food and size of container.
- Microorganisms are more easily killed in acid environment than in non -acid one.
- Penetration of the heat to the centre of the container depends upon the nature of food, solid or liquid.
- Heat penetration of solid food is relatively slower than that of liquid foods.
- A long heating period is required for larger containers than for small ones.

- A long exposure at relatively low temperature is preferred to a shorter exposure at higher temperature to prevent damage by excessive heat.
- Acid foods are heated by steam under pressure at 212 °f for the period of 5 to 15 minutes.
- Non –acid foods are processed in retorts (cylindrical vessels) heated by steam under pressure at 240 °f to 250° f (116° c to 121° c) for a period as long as 1 to 2 hours.
- Meat fish, poultry are usually processed for 1½ to 2 hours at 250°f (non acid foods)
- 9) Cooling:
- The processed containers are immediately cooled in air or in cold water. This prevents undesirable changes in texture and flavour. The can should be cooled to an average temperature of 37 c.
- 10) Labeling:
- The cooled containers are then labeled.
- 11) Warehousing and packaging:
- The cans of food product are then ware house (stored) and packed.


Growing
Harvesting
Transporting
Reject
Good
Grading
Cold Storage
Washing
Peeling
Coring/Halving/Slicing
Blanching
Juice
or
Syrup
Added
Filling
Sealing
Cooking
Cooling
Storage
Labelling
safvca
Despatch

Preserved food

Spam is a canned and preserved meat product.

- **Heating at about 100 ^{0}c**
- Heating/boiling at about 100 ^{0}c is commonly used in the home as method of preservation.
- Boiling destroys vegetative cells rarely the spores.
- A temp. of approximately 100 ^{0}c is obtained by boiling a liquid food, by immersion of the container of food in boiling water or by exposure to flowing steam.

2) Preservation of food by Low Temperature

- Temperature around 0 ^{0}c or lower retards the growth and metabolic activities of microorganisms.
- This is mainly due to the formation of ice crystals in the cell of microorganisms.
- This cuts the membrane or coagulates the proteins of microorganisms.
- Due to this microorganisms at a low temperature does not perform any metabolic activity and cannot multiply.
- Thus preventing the spoilage, the low temperature is considered as microbiostatic.

- METHODS:-
- Two methods are employed in the preservation of food by low temperature.
- 1) Chilling 2) Freezing
- Chilling (Cold Storage) :-
- The ordinary household refrigerators operating at 4-7 ^{0}c keeps most foods in palatable condition for a few days.
- In this method the temperature is kept just above the freezing point.
- This involves cooling by ice, or mechanical refrigerators.
- This does not prevent multiplication of all organisms.
- Chilled foods therefore, cannot be kept for many weeks.
- Microbial growth ceases only when food is solidly frozen.
- This method is applied to preservation of most perishable foods including eggs, dairy products meats, sea foods, vegetables and fruits.

- Freezing (Frozen Storage) :-
- In this method, foods are frozen at the low temperature.
- By this method, foods can be stored for several months.
- In this method, properly prepared food is packed in containers or wrappers and subjected to freezing.
- Quick freezing is preferred to slow freezing.
- Quick freezing consist of freezing time of 30 minutes or less and the temperature between -18 c to -134 ^{0}C.
- Slow freezing requires 3-72 hours and temperature varies downward from -15 ^{0}C .
- Dehydrofreezing:- Certain foods such as fruits, vegetables, fish and mushrooms now are being frozen by means of liquid nitrogen (-196 ^{0}C) called dehydrofreezing. Deep freezers are readily available for this purpose.

C) Preservation of food by Drying Or Dehydration

- Preservation of food by drying has been practiced from several centuries.
- Most foods contain enough moisture which permits the action of enzymes and growth of microorganisms.
- This method is based upon the removal of water which is principle factor required for life.
- This dehydration or drying of food makes the product stable and inhibits the growth of microorganisms and their enzymes as well.
- Thus, the preservative effect of dehydration is mainly due to microbiostasis.
- Drying of food to less than 10% free water prevents the spoilage.

Methods of drying:-

There are various methods of drying.

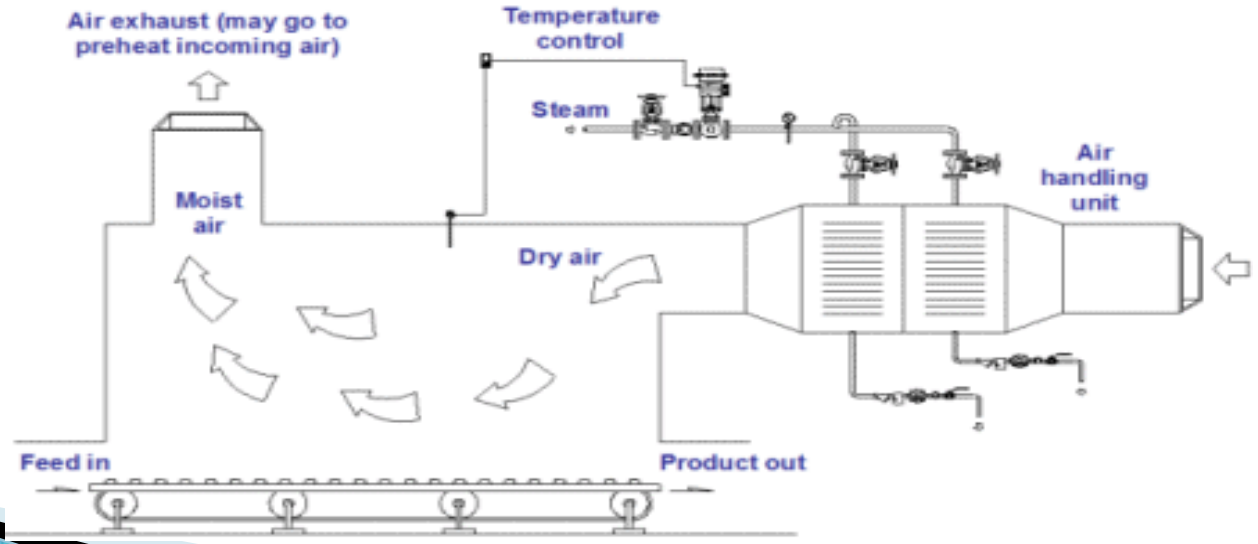
1) Sun-drying –

Sun drying is performed in climate with hot sun. This method is applied to certain fruits and vegetables. The fruits are spread out or trays and may be turned during drying. This is the natural method of drying.

Examples – dried fish and dried rice noodle

2) Drying by mechanical driers:-

This artificial drying method consists of the passing of heated air with controlled humidity, over the food to be dried. Number of devices is used for mechanical drying. The simplest drier is the evaporator or kiln. The tunnel drier is another mechanical drier used for thoroughly drying of fruits. Liquid foods such as milk, juices, soups, may be evaporated by using vaccum pan.



3) Freeze Drying (Lyophilization):-

- In this process, foods are frozen and then dried by means of vacuum and heat.
- This method is used for number of foods including meat, poultry, seafoods, fruits, vegetables and coffee.

Food-→freezing at low temp --→frozen food →Vaccum drying →Vaccum heated pan -→freeze dried food.

Preservation of Food By High Osmotic Pressure:-

- Some foods are protected from microbial spoilage by the addition of high concentration of salt or sugar.
- The osmotic pressure of a solution depends on concentration of dissolved substances. (Salt/sugar) in solution.
- Solutions having extremely high osmotic pressure must be used top prevent the spoilage.

- **Mechanism**: –
- High concentration of salt / sugar causes withdrawal of water from the cell. This causes shrinkage of the cytoplasmic content.
- This results in the inhibition of cell metabolism and it's growth, consequently followed by cell death.
- The salt concentration 20– 30 % usually prevents the growth of great majority of microbial species with the exception of few halophiles.
- Cane sugar in a concentration of 60–70% usually prevents growth of all the types of moicroorganisms.

- **Applications:-**
- Salt is widely used to preserve certain foods.
- The salting and brining of fish, coring of beef (flesh of animal) and brining of green olives are examples of the use of high salt concentration.
- Salts are used for the preservation of other foods such as bacon (meat of pig), pork (flesh of pig) & anchovies (small fish marine).
- In the process of pickling , high concentration of salt with a very acidic environment is quite effective in controlling the growth of most spoilage causing microorganisms.
- Preservation of jellies, jams, honey, sweetened condensed milk and syrup is because of high sugar content which produces high osmotic pressure.
- Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallisation and the resultant product is then stored dry.

Preservation of food by radiations (Radappertization)

- Foods can be sterilized by an appropriate radiation dosages.
- Radiations can sterilize the food with very little rise in temperature of the food product.
- This is frequently referred as cold sterilization.
- Radiations increases the storage life of food.
- Radiations both ionizing and non-ionizing radiations finds applications in the food preservation.