Food preservation techniques and microorganisms

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The foods of plant and animal origin contain several microorganisms and these along with natural food enzymes become active soon after the death of animal and harvest of plant foods. The intrinsic characters of the food and the environmental conditions influence the type and extent of microbial activity leading to spoilage which is characterized by deteriorative changes in food quality making it unfit for human consumption. The different preservation techniques have mainly aimed at reducing or eliminating microorganisms in food thereby prolonging or preventing the spoilage of foods. The preservation of foods is commonly done by use of low temperature, high temperature, drying, radiation and chemicals.

Preservation of foods with low temperature

Low temperature preservation of food is based on the principle of reducing the microbial activity by subjecting to low temperature condition. As all metabolic activities of microorganisms are catalyzed by enzymes, and enzyme reactions are dependent on temperature, the low temperature slows down enzyme activity, thereby brings about reduction in microbial activity. The reduced microbial activity prolongs shelf life of foods.

Shelflife of temperate and tropical water fish

Activity of microorganisms is known to decrease by two fold with every 10^{o}C decrease in temperature. Fresh fish from temperate waters generally have prolonged shelflife than tropical fishes. This is because of the low ambient temperature in temperate waters coupled with low body temperature of fish, being cold blooded, lowers both enzymatic and bacterial growth, thereby reduces deteriorative change and helps in extending the shelflife.

In tropical waters, the high ambient temperature and high body temperature of harvested fish promotes deteriorative changes by enzymes and microorganisms and thus hastens the spoilage.

Methods of low temperature presentation

Low temperature preservation is generally attained by employing three different temperature conditions. They are;

- **Chilling temperature:** keeping foods at 10-15^{o}C (slightly above refrigerated temperature).
- **Refrigerator temperature :** Keeping foods at 0~7^{o}C
- **Freezer temperature:** Storage of foods below -18^{o}C.

In Fisheries, fish are preserved by keeping at chilling temperature and by freezing.

Chill storage of fish

Chill storage is a process by which temperature of fish is reduced close to freezing point of water (0^oC). This delays both biochemical and bacteriological processes, thus prolongs shelf life. Deteriorative changes are retarded as long as low temperature is maintained. This ensures preserving natural nutritional and functional properties of food.

Factors influencing quality of chilled food

- Quality of chilled food depends upon factors such as;
- Raw material quality
- Method and duration of chilling
- Efficiency of storage method

Chilling can be achieved by use of ice (crushed/flake ice) and use of homogenous coolant (cold air or cold liquid), and refrigerated temperature. Use of cold liquid may be in the form of chilled freshwater for light chilling or refrigerated seawater/brine to attain temperature of 0-1^oC.

Bacteria associated with low temperature storage

Several microorganisms are capable of surviving and growing at low temperature and cause spoilage. Bacteria capable of a growing at or below 7^oC are widely distributed. Gram negative bacteria are more common than Gram positive. Psychrotrophs grow well at this temperature. Growth at temperature below 00C is caused mainly by yeasts and molds than bacteria because of low water activity. The lowest recorded temperature for growth of microorganisms in food is -34^oC, by yeast.

The composition of microorganisms associated with fish changes during chill storage. Proportion of mesophiles decrease and psychrophiles dominate. Common bacterial genera associated with chilling temperature condition of foods are; *Acinetobacter, Aeromonas, Enterococcus, Pseudomonas, Vibrio, Erwinia, Moraxella, Enterobacter, Achromobacter, Flavobacterium, Micrococcus* etc.

Extension of shelf life varying from 6 days to 30 days for different fish species has been reported by ice storage.

Preservation by Freezing

Freezing involves lowering of temperature of food to -20^oC and storage at same temperature. At this temperature the water in food as well as in microorganism is converted to ice crystals which affect fluidity of cell. This ensures prolonged shelflife as microbial activity is completely stopped at this temperature condition.

Freezing is achieved by

- Quick freezing: where temperature is lowered to -20^oC within 30 min.
- Slow freezing: where temperature is lowered to -20^oC within 3~72 hours.

Quick freezing is more advantageous than slow freezing in achieving product quality. During freezing water in food is converted to ice crystals of variable size. Freezing also brings about changes in properties of food such as pH, titratable acidity, ionic strength, viscosity, osmotic pressure, freezing point, O/R potential etc. These changes along with non-availability of water make the environment unsuitable for microbial growth and activity.

Comparison of effect of freezing methods on microorganisms

Quick freezing	Slow freezing
Small ice crystals formed	Large ice crystals formed
Suppresses microbial metabolism	Break down of metabolic rapport and causes cell damage
Brief exposure to adverse conditions	Longer exposure to injurious factors
No adaptation to low temperature	Gradual adaptation
Causes thermal shock to microbes	No thermal shock effect
No protective effect	Accumulation of concentrated solutes with beneficial effects.
Drip loss is less	Drip loss is more

Shelf life of frozen foods

Frozen foods can be stored indefinitely without microbial spoilage, but not done so as they lose original flavour and texture after thawing. Thus frozen foods are assigned freezer life. Freezer life for frozen foods is determined based on texture, flavor, tenderness, colour and nutritional quality upon thawing and cooking. Freezer life of frozen stored food does not depend on microbiology of frozen foods.

Effect of freezing on microorganisms

Freezing causes sudden mortality immediately on freezing, varying with microbial species. The number of surviving microorganisms after freezing die gradually when stored in frozen condition. Decline in microbial number is rapid at temperature below freezing point (-2^{o}C) than at lower

temperature, and is slow below -20^{o}C. Bacteria differ greatly in their capacity to survive during freezing. Generally cocci are more resistant than Gram negative bacteria. Food poisoning bacteria are less resistant to freezing while, microbial endospores and toxins are not affected by freezing.