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Factors affecting quality of fresh fish and shellfish- Intrinsic and Extrinsic factors

INTRINSIC FACTORS AFFECTING QUALITY OF FISH

- Quality is a character or attribute
- Quality of a food product is a combination of such characteristics as wholesomeness, integrity and freshness.
- In the case of fish, the quality depends on intrinsic composition, nutritive value, degree of contamination, spoilage, deterioration etc.

INTRINSIC PARAMETERS

- Intrinsic quality means the sum of attributes that are inherent in the harvested raw material

(Connel, 1980)

- It is more difficult to control the inherent properties of fish tissues that influence enzymatic and microbial spoilage of fish
- The Intrinsic moisture content, pH, physical and chemical nature of fish(fresh or marine) control the number and types of microorganisms involved in the spoilage process.

FACTORS AFFECT INTRINSIC QUALITY

- Species
- Size
- Sex
- Condition and composition
- Parasites and other organisms
- Naturally toxic fish
- Contamination with pollutants

SPECIES

- Certain fishes are generally costly as they are rated as “good fish”
- Ex.–Rohu & Catla
- Catla fetches more price than Mrigal, Silver carp, common carp, Tilapia
- Marine fishes contains more lipid than freshwater fishes.
- Therefore, chances of rancidity is higher in marine fishes than freshwater fishes.

- The time rigor mortis begins and its duration depend on the fish species.
- For carp at 0°C, it starts after 48 hours,
- For perch at 0 °C after 24 hours
- It was also found that fast swimmers, for example trout, undergo rigor mortis faster

- Fish which secrete great quantities of slime have poorly developed scales; very often the quantity of slime reaches 2-3% of the fish mass and that in turn creates problems during processing.
- Slime contains large amounts of nitrogenous compounds and these provide good nourishment for microorganisms originating from the environment.
- During storage Non -fatty (or white fish) keep longer than fatty fish.
- Freshwater fish keep longer than marine fish

SIZE

In general, large fish of a given species fetch the higher price, for example, shrimp, Scampi, crab, lobster.

- The % yield of edible material is higher and handling cost per unit weight is lower in large fish of a given species

- It is a fact that large fish keep better than small fish. This can be attributed to:
 - ❑ the interior of large fish is affected by spoilage microorganisms penetrated from the surface to the interior slowly
 - ❑ Small fish of a given species tend to have a higher post-rigor pH than large fish of the same species, thus giving rise to the greater bacterial action.

SEX

- In certain species, the females are of very poor quality soon after spawning.
- The canned product made from female Capelin (*Malloters villosus*) is very different from that made from male capelin.

CONDITION & COMPOSITION

- During certain period fish appear thinner, flabbier and less lively, the flesh being more watery and softer and containing less protein and fat.
- The fat content of many species vary considerably throughout the year.
- After spawning the fat content of many fishes vary considerably.

PARASITES, BACTERIA

- Sea fishes can harbour protozoa and intestinal worms and can transmit these parasitic pathogens to human, resulting in serious illness
- Intrinsic bacteria and viruses in the slime, gill, guts and intestine of the fish

NATURALLY TOXIC FISH

- Majority of the fishes are intrinsically safe to eat, but some are biotoxic and mainly caught from tropical or sub-tropical areas
- Due to Ciguatera toxicity in the flesh of fish & shellfish inhabiting shallow waters in or near subtropical coral reefs.
- Paralytic shellfish poisoning in molluscs & calms during the period of in the high concentration of dinoflagellates in sea.
- These poisoning spoil the fishes in source.

CONTAMINATION WITH POLLUTANTS

- Metals (Hg), chlorinated hydrocarbons, Mineral oils, radioactive isotopes, antibiotic residues etc. contaminate the fishes in source and are therefore, intrinsic in nature

MOISTURE CONTENT OF FISH BODY

- Higher the moisture content higher will be the spoilage.
- Bacteria need water for growth and multiplication. Below a minimum level of water activity (a_w), microorganisms cannot grow.
- When we dry fish, water is removed from the fish muscle to a level below 0.9, so that bacterial action is completely prevented.

- By drying & salting, the moisture content of fish is brought around 38% when bacterial growth is inhibited.
- When the moisture content of fish is reduced to 25%, autolytic activity is greatly reduced, while mould growth is prevented if moisture level is reduced to 15%.

pH

- Lower the pH lower the decomposition by bacteria.
- Acidophiles - Bacteria which can survive at a pH of 4.5 and below. e. g. Lactic acid bacteria.
- Example: Fish silage is preserved against the microbial spoilage mainly by the lowered pH, obtained by the added or in-situ produced acid.
- Once the rigor mortis ceases, bacterial spoilage becomes rapid.
- This is accompanied by the rise of muscle pH from acidic range to alkaline range (sometimes upto pH 8) due to accumulation of volatile bases like ammonia and trimethylamine (TMA) produced by spoilage of fish.
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- ❑ To reduce the spoilage of fish during storage;
 - Reduce the temperature of storage ($< 20\text{ C}$)
 - Reduce the moisture content of the fish ($< 20\%$)
 - Reduce the pH (< 7) of stored fish
 - Reduce the rough handling of fish during catching, packing, storing etc.
 - Reduce R.H., O_2 during storage
 - Reduce storing of smaller sized fish
 - Reduce the time lag between catching of fish and preservation

EXTRINSIC FACTORS

- Location of catch
- Seasons
- Method of catch
- Onboard handling
- Hygienic condition on fishing vessel
- Processing
- Storage condition

LOCATION OF CATCH

- Tropical fish keeps longer than temperate or cold water fish.
- There is an apparent difference between tropical and temperate fishes during ice storage as bacterial enzymatic system are more adaptable to low temperature in cold water fishes
- Temperature drop in tropical water fish is more than temperate and cold water fishes.
- This cause more shock to bacteria and their enzymes in tropical fish .

Cont...

- Fresh water fish have a longer shelf life in ice than marine sp
- Fresh water fish contains antibacterial membrane in their flesh, which inhibits the invasion of bacteria.
- TMAO present only in marine water fishes, breaks down after death into TMA leads to production of ammonia like odour and flavour.
- Non fatty fish keeps longer than fatty fish

SEASON

- Catching technique and season influence colour, odour, injury, blood clot and over all grade of fish.
- Influence texture of cooked fish
- Most of the fish show optimum health during period between end of feeding and initial stages of gonad development.
- Poorest just after spawning.
- Fat content can go up to 30% in some fishes.

METHOD OF CATCH

- Affect colour, texture in over all grade.
- Rigor mortis commence earlier and last longer in trawled fish than fish caught by hand line.
- Handling of fish is more in seine and gill net than in trawler caught fish.
- Larger catch in nets should be hauled carefully.
- Small lots should be pumped out of net.

ON BOARD HANDLING OF CATCH

CHILLING ON BOARD

- Immediate chilling provides good quality
- For every 10°C reduction in temperature rate of deterioration decreased by a factor of 2-3
- If icing delayed; resulting in belly bursting.

DRESSING

- Dressing operation include heading, bleeding and gutting
- Should be done as soon as possible.

HYGIENE

- Possibility of contamination and survival of psychrotropic bacteria have a determinant effect on hygiene quality of catch.
- 90% of bacteria present on the surface of fish can be removed by proper washing
- All working surfaces and equipments should be cleaned
- Preservative for wooden structure in fishing vessel should be selected with care because the odour from some can contaminate stored fish.
- Personal hygiene of the workers are also very important.
- Rational design of fishing vessel ,use of easily cleanable material that resist bacterial attack, strict sanitizing etc are the major steps to improve hygiene.

ON BOARD STORAGE

- layers of fish and ice
- Fish and ice are mixed in ratio 1:2 in temperate region and 1:1 in tropical climate.
- Anaerobic condition prevails in bulk storage.
- Odour and colour are some times transferred from one species to another.
- Ammonia generated in spoilage elasmobranches may contaminate other bony fishes.

STORAGE TEMPERATURE

- Higher the temperature quicker the onset and resolution of rigor and onset of autolysis and bacterial decomposition.
- Each bacterial species has a range of the temperature in which it has optimum growth.
- Most of the spoilage bacteria grows faster with rise in temperature there by produce unpleasant end products.
- After catching, fish should be immediately cooled down to lower temperature to retard quality loss.
- Chilling only slows down bacterial action; psychrophilic bacteria are able to survive in chilled fish.

TEMPERATURE

- Rate at which bacteria grows and multiply depends on temperature.
- Lowering temperature slows down spoilage there by extend shelf life.
- Drop in temperature of 5°C might half the rate of spoilage

PROCESSING

- Most important requirement is the adequate supply of clean water and ice.
- Water used should be clean and chlorinated, otherwise it may induce bacteria to the flesh of bacteria.
- Personal hygiene of staff is necessary.
- Handling of fish during preparation will affect the quality of product.

DO'S AND DON'TS

- Avoid condition which might speeds up the normal spoilage
- Precaution should be taken to avoid the fish warming.
- Fish should be kept cool by use of ice and refrigerated vehicles during storage.
- Proper mixing of ice should be needed; small pieces of ice are best.
- Keep fishes caught at different times separate.
- Separate small fishes ,which tend to spoil more quickly from large fishes
- Any part of boat which come in contact with fish should be thoroughly washed after each catch
- Ice containers , boxes etc should be thoroughly cleaned.

CONCLUSION

- Keeping the fish cool
- Keeping the fish undamaged.
- Keeping the fish clean