

16. QUALITY DEFECTS IN FISH AND FISHERY PRODUCTS

Jeyakumari, A.

Scientist, Fish Processing Division

Central Institute of Fisheries Technology, Cochin -29

The term 'quality' means "all those attributes which consciously or unconsciously the fish eater or buyer considers should be present" and which will embrace intrinsic composition, degree of spoilage, damage, deterioration during processing, storage, distribution, sale and presentation to the consumer, hazards to health, satisfaction on buying and eating, aesthetic consideration, yield and profitability to the producer and middle men. The quality of the fish and fishery products is one of the main indices in the activity of any processor. According to ISO, Quality is defined as the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs

Quality changes during chilled storage

Belly bursting

Enzymatic spoilage causes belly bursting of fish, especially during a period of high food intake. These fish will have large content of digestive enzymes in digestive tract. Such fish will degrade quickly & spoil easily soon after caught. In the dissolved gut components, bacteria proliferate and produces gases such as CO_2 & H_2 . This gas production leads to belly bursting after short storage period.

Gaping of fillet

Phenomenon observed in fish which are well fed at the time of capture and are frozen before or during rigor is called gaping. Gaping of fillet occur due to weakening of the connective tissues which bind together the muscle segments in the fish flesh.

Pink / Yellow discolouration in squid and cuttle fish

Pigment released from the disrupted chromatophores localized in the skin most likely stains the mantle during the handling or storage. Insufficient ice as well as under the stacking condition

Black discolouration

Black discolouration in shrimp lobster etc. occurs when stored fresh. Bruises and rough handling increase the occurrence of this discolouration, which is caused by polyphenolase enzyme, acting on polyphenolic compounds of aminoacids like Tyrosine and Phenylalanine. Sulphite preservatives are used to prevent black discolouration. Shrimps are dipped in 0.2-0.5 % sodium bisulphite for one minute

Quality changes during frozen storage

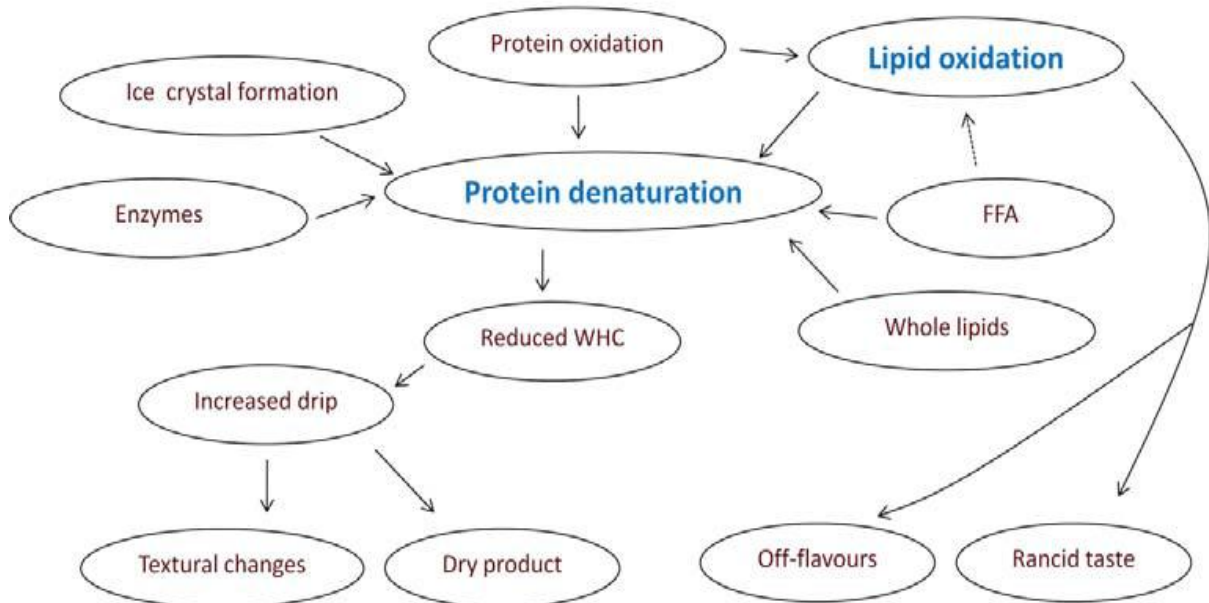
Physical changes

The physical changes which occur during freezing and storage of frozen products comprise crystallization of ice with expansion of the volume, and desiccation starting from the surface of the frozen fish.

Ice formation

The crystallization of ice is initiated when the temperature of the fish is lowered about -1°C . At the same time, concentration of various inorganic salts and organic components present in the fluid of the fish occurs and consequently the freezing point falls. There is also an increase in the volume of the fish when the water is converted to ice. The larger part of the water consequently freezes between -1°C to -5°C and it is the rate of cooling and this temperature interval determines the size of the ice crystals. It is well known that slow freezing results in formation of large ice crystals. These may cause the tissue of the fish to become so porous and perforation of the tissue can often be seen after the fish is thawed. It may even become even spongy. Rapid freezing on the other hand, results in small ice crystals, and the quality of quick frozen fish may be practically equivalent to that of fresh unfrozen fish.

Physical and chemical changes during frozen storage



Freezer burn/Desiccation

Freezer burn is a condition that occurs when frozen food has been damaged by dehydration and oxidation, due to air reaching the food. Change in fluctuation in storage temperature influences the desiccation, loss of weight and quality of the fish contributes to a poor appearance or results in “freezer burn”. If the desiccation is pronounced, the fish surface may become dry and fibrous. In some cases the skin may change the colour, several other factors influence the loss are, the kind of wrapping, it’s sealing and moisture transmission characteristics.

Discolouration

When frozen fish is in contact with air, oxidation of fat or oil in the fish takes place and these results in “rusting” or discolouration of the flesh and development of rancid odours and flavours.

Green/Brown discolouration

Frozen tuna and sword fish may exhibit green and brown discolouration. Uncooked fish meat contains three derivatives of myoglobin. The pigment responsible for the pink colour in normal cooked meat of tuna is hemochrome, derived from the reaction of myoglobin with non-heme constituents. Greening is due to pigments resulting from the oxidation of hemechrome that occurs when the meat is unduly exposed to oxidative condition during and after cooking. Greening of frozen sword fish may be related to up take of H₂S produced by putrefactive bacteria. Proper evisceration and removal of blood immediately after the catch reduce the risk of discolouration. The undesirable discolouration in yellow fin tuna meat can be averted, if the fish is frozen at full rigor, stored at a temperature of -23°C to -27°C, and defrosted by still air at 10°C.

Yellow discolouration

Frozen storage of some fish (cod) may result in yellowing of flesh below skin. Freezing process disrupt chromatophores and release carotenoids and their migration to the S/C fat layers causes yellowing. Cuttlefish muscle has very high phospholipid content and are susceptible to oxidation. Since phospholipids contain amine groups, their oxidation can lead to aldehyde–amine interactions that produce yellow colour. In crustaceans, like lobster, pigment is limited to the surface of the meat, the changes during frozen storage lead to yellow discolourations.

SPOILAGE OF CURED FISHERY PRODUCTS

Moulds and fungi:

Fungus usually grows well on unsalted and salted dried fish, which has high moisture content. Moulds usually grow at the optimum temperature of 30-35°C with a relative humidity above 75%. In salted fish, brownish black or yellow brown spots are seen on the fleshy parts. This mainly caused by the growth of Halophilic mould called *Sporendonema epizoom*. This gives a fish very bad appearance. Some of the fungi isolated from dried fish are *Aspergillus* spp. *A. niger*, *A. flavus*, *A. candidus*, *A. amstelodami*, *A. chevalieri*, *Rhizopus*, *Mucor*, *Penicillium* spp., *Polypaecilum pisce*.

Spoilage of fish by fungi

1. Colour change due to fungal growth
2. Smell/flavor change
3. Breakdown of fat and protein
4. Production of mycotoxin

Prevention of fungal spoilage

1. Chemical methods

- a) Use of preservatives: The main preservatives used are calcium propionate, potassium sorbate, sodium benzoate, parabens, sulphur dioxide, sodium nitrite.

- b) Use of fungicides: Probably expensive to use. Broad spectrum fungicide is toxic to humans too.
- c) Gamma irradiation: The main problem is recontamination if the product is not sealed properly. High cost of processing and packing is another problem.

2. Physical methods:

- a) Control of storage temperature
- b) Control of water activity by controlling moisture, salt and fat
- c) Keeping storage period as short as possible
- d) Adopting insect control measures like fumigation
- e) Applying proper curing method viz. drying quickly after brining avoiding contamination from soil,dust etc.

Rancidity

This is caused by the oxidation of fat, mostly in oil rich fishes like mackerel. Oxidation of fat imparts characteristics odour and colour of the fish change to brown. This is known as rust. Certain impurities in salt and traces of copper accelerate this.

Pink /red spoilage

Pink /red spoilage is mainly due to the presence of halophilic bacteria (*Halobacterium salinarum*, *H. cultrirubrum*, *Sarcina morrhuensis* and *S. litoralis* from the salt. Spoilage appears on the surface as slimy pink patches. They are aerobic and proteolytic in nature, grows best at 36°C by decomposing protein and giving out an ammoniacal odour

Prevention

- Usage of good quality salt

Insect Infestation

It occurs during initial drying stages & storage of the dried samples. Mainly blowflies belonging to the family are Calliphoridae and Sarcophagidae. Flies come and lay their eggs. These eggs develop into maggots, which bury within the gill region. They develop mainly when conditions are favourable with adequate moisture and intermittent rain. This results in both economic and nutritive loss to the fish processor. Infestation can be reduced by:

- Proper hygiene and sanitation
- Disposal of wastes and decaying matter
- Use of physical barriers like screens, covers for curing tanks etc
- Use of heat to physically drive away the insects and kill them at 45°C

Fragmentation

Fragmentation occurs due to denaturation and excess drying of fish results in breaking down of the fish during handling.

Prevention

- It is necessary that fresh fish be used as raw material to ensure a good finished product.

Quality assurance of dried fish

- fresh as possible
- The water used for washing and brining should be potable
- Salt used should be of good quality and should not contain high amounts of Magnesium and Calcium chlorides.

Quality changes canned products

Classification of Spoiled Cans

Flipper: This is a can of normal appearance in which one end flips out when the can is stuck against a solid object. The end snaps back to the normal position when very light pressure is applied

Springer: This refers to can in which one end is bulged but can be forced back in to normal position where upon the opposite end bulges

Soft Swell: It is a case in which the bulged ends can be moved by thump pressure but cannot be forced back to the normal position

Hard Swell: This is one in which the ends of the can are permanently and firmly distended

The chief defects and causes of spoilage may be listed as follows:

1. Microbial spoilage: This may result due to
 - a) Under processing
 - b) Inadequate cooling
 - c) Leaker infection/Leakage through seams
 - d) Pre-process spoilage
2. Chemical spoilage
 - a) Internal corrosion giving rise to hydrogen swells or pin holing
3. Physical: causes due to
 - a) Faulty retort operation
 - b) Under exhausting
 - c) Over filling
 - d) Internal vacuum too high (Panelling)
 - e) Use of cans of inadequate substances
 - f) Rough handling
4. Miscellaneous like: Rust, Damage et.c.,

Discolouration

Black discolouration

It is mainly encountered in packing crab, clams, shrimp and lobster. Sulfur compounds in the flesh unite with the iron base of the tin plate to form iron sulfide

Prevention:

- Addition of small amounts of organic acid
- use of parchment-paper can liners
- lacquer containing small amounts of zinc

Copper sulfide discoloration/Blue discolouration in crab meat

It is associated with hemocyanin, a biochemical component in crustacean blood. The degree of blue discolouration depends on the copper content of the meat and average copper level is higher in blue meat (2.8mg% wet wt.) than in normal meat.

Prevention

- Use of metal chelating agent such as citric acid, or ethylene diamine tetraacetic acid (EDTA).

Green discoloration

It occurs in cooked tuna. The TMA content in cooked tuna is closely related to the degree of green colour and that the development of green colour is closely correlated with the TMAO content of raw fish. TMAO content of more than 13mg% N was found to cause greening, a level below this occurrence of greening is unpredictable. It is recommended that tuna with high concentration of TMAO and myoglobin shall not be used for canning

Brown discolouration

Brown discolouration is caused by reaction of protein or amino acid with product of lipid oxidation. It is observed in variety of processed products including white pomfret, sardine etc. Discolouration due to protein-lipid browning is greater in fatty fish than lean fish.

Common defects

Stack burning

Stack burning is caused by over processing. A considerable amount of heat is retained over a long period when canned products are stacked

Perforation and Corrosion

Perforation and Corrosion in can is prevented by air should be expelled from product and headspace as completely as possible. It is dependent on the temperature. Cans should be thoroughly cooled before packing or stacking to reduce corrosion

Gaseous Spoilage

Can appears like Swelled or "bulging. It is caused by spore-formers of the anaerobic or facultative anaerobic types. Organisms found quite commonly are *Clostridium welchii* and *Clostridium sporogens*. and gas-forming heat-resistant organism is *Clostridium botulinum*

Non-Gaseous Spoilage

There is no external indication of non-gaseous spoilage. It is caused by aerobic spore formers, *Bacillus cereus*, *B. mesentericus* and *B. vulgatus*. Storage at temperatures between 40 and 30 F. will greatly reduce the possibility of flat souring

Honeycombing

Honeycombing is found in canned tuna meat that is processed from stale raw material. The meat in such cases presents the appearance of honeycomb. During steaming the volume of the meat will contract due to removal of water because of the coagulation of muscle protein that begins at the surface. Production of gas in the flesh expands and make little pockets in the flesh. On cooling, the pockets remain and the flesh seems to be filled with small holes or air paces. It also occur in canned salmon and sardines.

Mush

It is Flabby condition met with some species of pilchards caught at the end of its spawning. This is caused by the invansion of prasitic protozoan *chloromyxum* which decomposes the fish meat during storage such that it becomes entirely soft during canning

Struvite formation

Canned marine products such as brine packed shrimp,crab, tuna,salmon etc.are frequently seen to contain some glass like crystals,particulary when the temperature of storage is low.It occurs due to the formation of a chemical compound ,magnesium ammonium phosphate hexahydrate, $MgNH_4PO_4 \cdot 6H_2O$, called struvite. It can be prevented by adding chelating agent like hexametaphosphate.

Curd and adhesion

‘Curd’ is precipated protein often found in canned mackerel and salmon. This is more common with salmon, which is generally canned without pre-cooking. The meat coagulated by heat adheres to the inner side of the can ends and presents a poor appearance on opening the can. The lacquer may get peeled off while removing the curd from the can ends. Use of raw fish,which is not very fresh, and, inadequate brining and pre-cooking are some of the reasons responsible for formation of curd. It can be prevented if the raw fish is soaked in 10-15% brine for 20-30 minutes followed by thorough washing before filling.

Quality defects in Coated Fish Products

Coated product is one, which is coated with another foodstuff.Seafood specialties, fish portions (raw and precooked), shrimp, fish fingers, scallops, fish balls, fillets etc are the principal seafood products which are bettered and/or breaded

Shelling

- Separation of breading from substrate due to uncontrolled release of moisture
- Corrective Action –Controlled release of moisture from substrate and breading system

Blow Off

- Breading blows off in the fryer
- Corrective Action –Monitor free water/ice on the surface of the substrate

Poor Adhesion

- Breading system does not adhere to the substrate
- Corrective Action –Increase protein to perform binding

Gummy Interface

- Area between surface of the substrate and breading system is gummy
- Corrective Action –Ensure product is fully cooked