

Evaluation of fish / fishery products for organoleptic, chemical and microbial quality

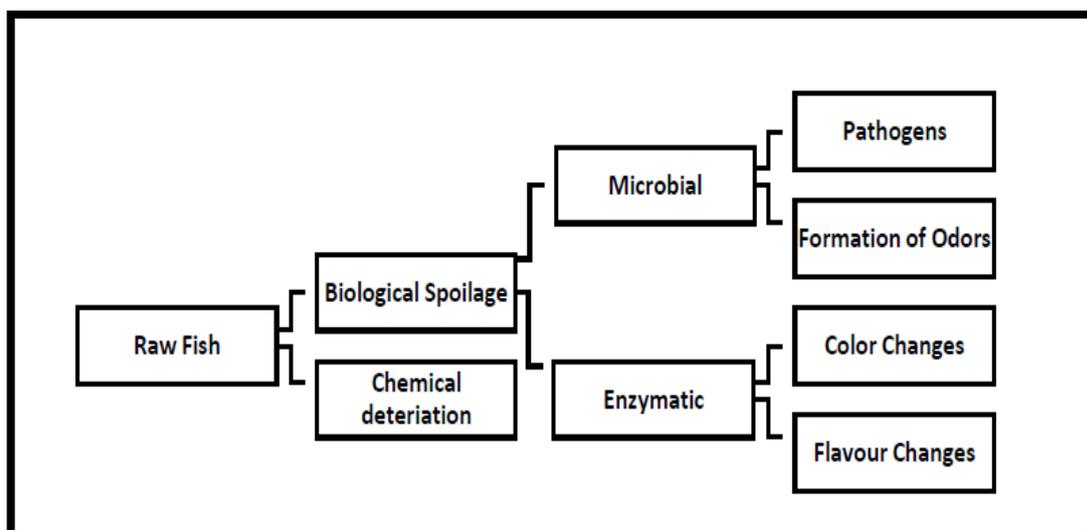
Fish is low in fat but high quality protein filled with omega-3 fatty acids and vitamins such as D and B diet. Fish is an important source of minerals such as calcium and phosphorus, iron, zinc, iodine, magnesium, and potassium. Thus the demand for fish and its products are consumed in large numbers worldwide. As many countries, do not have the conditions to cultivate the desired fishes so are imported from coastal countries. Other than its nutritive value, fish is also an item of international trade and foreign exchange earner.

Fish being a highly perishable product, the quality of the fish starts to deteriorate after the fish is brought to the landing

sites. The deterioration of the fish occurs due to:

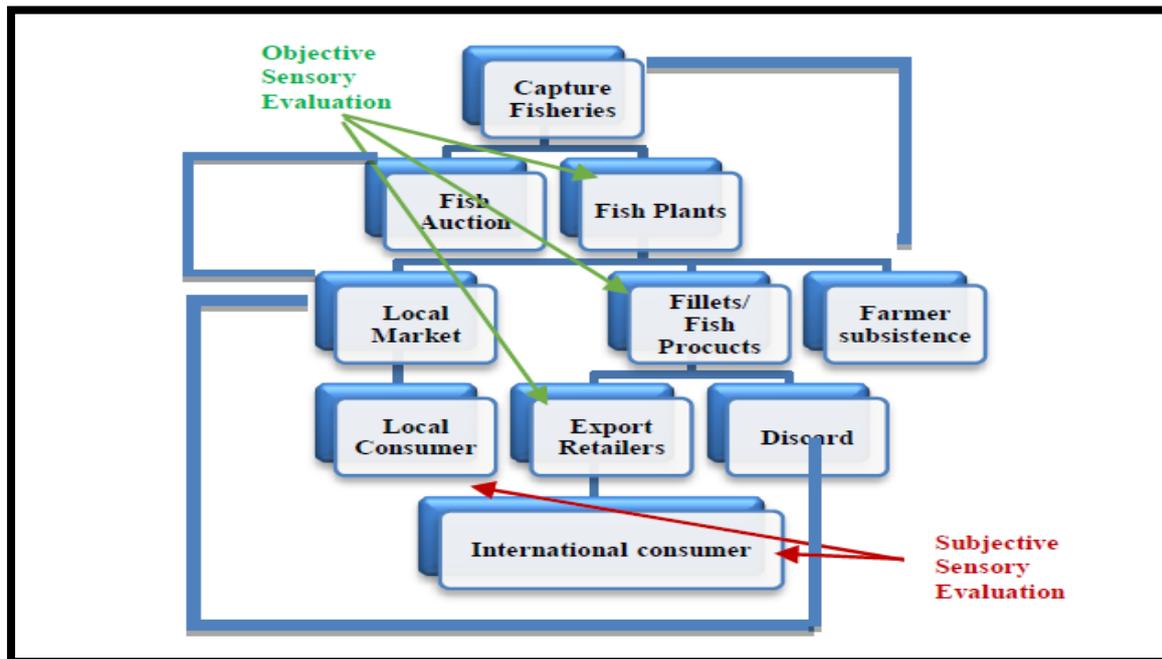
- (1) Bacterial invasion and putrefication,
- (2) enzymatic autolysis,
- (3) chemical oxidation and
- (4) Mechanical damage and environmental optimization aggregating growth of microbes.

EXISTING TECHNIQUES FOR QUALITY CONTROL



Attributes for assuring the quality of fish

Sensory evaluation measures the freshness of fish and fish products with respect to the five distinct senses including taste, smell, feel and appearance. Sensory evaluation of freshness are widely used attributes for ensuring quality of fish. Sensory assessment can either be objective or subjective but for successful marketing, both are considered. In case of objective sensory assessment, trained personnel are used to classify freshness, whereas, in subjective sensing, one is based upon consumer satisfaction and market analysis of fish markets.



Fish Supply Chain and Sensory evaluation

ORGANOLEPTIC METHODS

Sensory methods are used to assess the degree of freshness based on organoleptic characteristics such as general consistency of flesh, odour, color also eye and gill condition etc.

These characteristics are judged by panel members. i.e. subjective judgment are made by individuals.

Various numerical scoring or ranking systems have been developed to evaluate the judgments or results.

Sensory methods have advantages that it can be adapted by the human being easily and the quality can be assessed by odour or visual inspection for quality defects. Human senses indeed are more efficient in some complex tasks than the instruments.

The method is described more in chapter 16. There is, however, no single satisfactory test developed for the quality assessment of fish. A combination of chemical, biological and organoleptic tests would be the best procedure to assess such freshness.

MICROBIAL ASSESSMENT/BIOLOGICAL EVALUATION:

Fish decomposition starts after catch starts and changes occur in pH, atmosphere, nutrient composition have effects on micro flora. Raw fish consists of its own unique flora, determined by the microbial content of the surrounded water, which still remain despite food processing and subsequent cooling. Categorization of fish with similar microflora is considered when assuring the quality of Fish and its products. Microbes play a vital role in the shelf life of fish as gram-negative, fermentative bacteria (such as *Vibrionaceae*) spoil unpreserved fish, whereas psychrotolerant gram negative bacteria (*Pseudomonas* spp. and *Shewanella* spp) can continue growth in chillers. Several standards are utilized to judge its freshness and adequacy. EU advised Bangladesh Government to implement the Hazard Analysis Critical Control Point (HACCP) in the processing of frozen fishes.

Total viable counts or TVC's are utilized widely as a part of microbiological allowing one to identify the active number of growing/dividing microbes.

TVC ranges from $10^2 - 10^6$ cfu/g in case of fish and the range determines its acceptability.

TVC limit varies greatly upon its conditions (temp, atmosphere, pH etc).

The maximum microbiological limit for the TVAC is 5×10^5 cfu/g and TVAC mostly ranged from 2.8×10^5 to 4.9×10^5 cfu/g for exported frozen fish which was below the maximum acceptable. Research has co related, food spoilage is with changes in spoilage micro-organisms depending storage conditions. Development of modelling of microbial spoilage dynamics in shelf-life prediction introduced the concept of **specific spoilage organisms (SSO)** allowing the formulation of microbial spoilage models. SSO has been defined as the part of the total microbe (*Pseudomonas* spp, *Photobacterium phosphoreum*, *Shewanella*) responsible for spoilage of fish and the spoilage domain as the range of product characteristics and storage conditions within which a given SSO causes product rejection. Currently the detection of SSO is accurate using PCR method other than the Immono

methods and rRNA probe based methods.

MICROBIAL EVALUATIONS:

Total plate count (TPC): Total number of microbial flora is changed with the time in fish or fish products. The numbers per gram of fish or fish products or per square centimeter of the surface area indicate the quality of fish from the microbiological view point. Total plate count or viable bacterial count is determined by the culture of bacteria present in fish sample using a suitable bacteriological media that could recover maximum number of bacteria in fish tissue. A known weight of fish sample is minced aseptically and serial decimal dilutions are pour-plated with the media. For marine fish agar agar and for processed fish products tryptone glucose beef extract agar media are commonly used. Inoculated plates are incubated at 37°C for 24 hours and the bacterial colonies are counted.

From the colony counts, TPC is calculated by multiplying with appropriate dilution factor. TPC does not strictly indicate the edibility of the fish. Fish with low TPC may bear pathogen that would have more dangerous if consumed. Therefore, qualitative analysis is done to determine the presence of any pathogenic or health hazard bacteria. Different types of selective or ordinary media are used for the identification of pathogenic organisms in fish. For example, SS-agar or XLD agar medium are used to detect coliform bacteria like *Salmonella*, *Shigella*, *E. Coli*.

NON SENSORY METHOD

Since sensory methods of assessment apply the same senses as the consumer uses when deciding whether a piece of fish is pleasant to eat, they are likely to predict the consumer's reaction better than non-sensory methods; the latter do, however, have certain advantages. Since sensory assessment may require the use of a taste panel, non-sensory methods can be cheaper and often quicker.

Taste panels need to be trained and kept in training, which can be time-consuming. Non-sensory assessments should give the same result no matter where they are carried out, whereas sensory evaluations may depend on subjective responses of the panellists to the fish being examined.

Non-sensory methods can appear more objective and reliable than sensory methods, although this need not be the case. When specifications are being prepared it is easier to insert numerical limits based on non-sensory tests than on sensory tests, especially in international trade, and this is widely done.

Courts of law may find it easier to accept the results of chemical or physical tests, being based on impartial instrumental readings, than the results of sensory tests. There is different kind of non sensory or instrumental method, they are described below:

Biochemical methods

A variety of chemical compounds or groups of compounds accumulate post-mortem fish muscles. These chemicals are either intermediate or end products of biochemical changes occurring in the muscles of fish after death.

Proximate composition: Because of influence of chemical composition on keeping quality, proximate chemical composition like moisture, lipid, protein and ash contents of fish samples from the time or day of harvest to different storage periods or conditions are often investigated. Proximate composition may vary with species, sex, season, place of harvest, feeding condition, etc. So, conclusive results are very difficult to obtain.

Hypoxanthin value: As a consequence of post-mortem changes, breakdown of ATP to ADP, AMP, IMP and finally to hypoxanthin takes place. Hypoxanthin content of muscle increases on storage of fish. Estimation of hypoxanthin is an objective test of freshness of fish. However, the estimation of hypoxanthin is too cumbersome and it is seldom employed in practice. Fish with a hypoxanthin value of 7-8 micro moles/g is considered spoiled.

Histamine content: Histamine develops in freshly caught fish after 40-50 hours of death, if the fish is not properly iced. To avoid histamine formation in tuna, skipjack and mackerel, care is taken to ice or freeze fish as quickly as possible. Histamin is a major problem in warm water pelagic species that causes a form of food poisoning known as scombroid poisoning, as the name derived from the family name of tuna and mackerel, scombroidae. The term is also applied to other family members too. The symptoms of scombroid poisoning are facial flushing, rashes, headache and gastro-intestinal disorders. Histamin is produced from histidine which is one of the constituents of muscle protein of all fishes. Generally, pelagic fishes contain sizable amount of histidine in free state as well as bound state within protein.

Upon death, histidine in fish muscle is converted to histamine by bacterial enzymes. Histamin content over 20mg/100g in canned fish is prohibited by the USFDA standard.

pH: Change in pH of the fish muscle is an usual good index for freshness assessment.

Trimethylamine: Marine fish contains sizable amount of trimethylamine oxide (TMAO) which is reduced to trimethylamine (TMA) during the spoilage of fish. TMA determination is a useful index to measure the quality of stored fish. Fish with a level of 1.5 mg TMA nitrogen/100 g fish is considered acceptable, while 10-15 mg/100 g limit is set for moderately spoiled fish and beyond this range is set for highly spoiled fish.

Ammonia: Bacteria can generate small amounts of ammonia in spoiling fish, mainly from free amino acids; the amount of ammonia can give an indication, though not a particularly accurate one, of the extent of spoilage. Much larger amounts of ammonia are produced during spoilage of the elasmobranch fishes, skate and dogfish for example, because they have large amounts of urea in their flesh. Shellfish, also, may develop more ammonia than most marine fish and at an earlier stage. There are several chemical and enzymic methods for measuring ammonia.

Peroxide value: Oxidative rancidity developed in fish tissue is determined by the estimation of peroxide value. Good quality fish should have a peroxide value quite less than 10. Peroxide value above 20 for any fish is considered rancid.

Thiobarbituric acid value (TBA): It is also determined as an index of oxidative rancidity in fish. For a good quality moderate lipid fish, TBA value of less than 2 is usually accepted.

K value: High level of adenosine related compounds or inosine mono phosphate in fish muscle imparts sweet, meaty flavour and is regarded as a reliable index of freshness. Postmortem accumulation of inosine or hypoxanthin generally reflects poor quality. The conversion of ATP to IMP is very fast and is usually complete within a day. Subsequent accumulation of inosine or hypoxanthin is related to both autolytic and microbial action. Based on hypoxanthin values and their correlation with freshness of fish, Saito et al first proposed the K value as an index of the freshness of fish. K value is calculated from the values of hypoxanthin, inosine and total nucleotide levels in fish at the point of measurement as shown in the equation (i) However in practical situation adenosine compounds are deleted because of their conversion into IMP, HxR and Hx, shown in equation (ii) In freshly caught fish K value would be as low as zero, in moderate quality fish the value could be 10 to 20 but

in spoiled fish it can go up to 90. The K values are found to have excellent agreement with sensory data of fish. K values also rise with the ice storage period of fish.