

## Assurance and management quality of fish

### Expected Learning Outcome

- Parameters useful in assessing the quality of fish.
- Factors involved in attaining product quality.
- Role and importance of various national and international agencies in establishing and monitoring seafood quality.
- Kinds of wastes generated by the fish processing industries, their characters and impact.
- Need for the treatment of wastes and methods available and principle involved in treating the wastes.

### 9.1. Assessment of fish quality

Assessment of quality is necessary to safeguard consumers against any risk associated with consumption of fresh and processed fishery products. Several methods have been developed and are available for measuring fish quality. However, only some have been found to be suitable for assessing the quality while others failed to be used in routine analysis due to the limitations in the form of inaccuracy, impracticability, high cost, need for specialist, and suitability only for research or product development.

#### Methods for assessing quality

The methods of assessing fish quality can be conveniently classified into following groups:

- Sensory methods.
- Physical methods.
- Biochemical methods.
- Microbiological methods.
- Statistical methods.

Quality assessment methods have undergone a rapid change since early days of introduction of quality control programme wherein product quality evaluation mainly based on sensory methods. However, scientific developments in food quality assessment accompanied with innovations in instrumentation techniques have become very useful in measuring product quality. Further, statistical methods have also been introduced to ensure collection of representative sample for analysis and to interpret the results.

#### 9.1.1. Sensory methods

Sensory evaluation has been defined as a scientific discipline used to evoke, measure, analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing. These are also referred to as organoleptic methods.

#### Categories of sensory evaluation

Sensory evaluation tests can be divided into two general categories

##### 1. Affective or subjective evaluation tests

The affective tests help to evaluate preference and / or acceptance of products. In these tests, the spontaneous personal reaction of the panelist is evoked in order to determine preference or acceptance. These are subjective tests designed to obtain the original and spontaneous impressions of the panelists.

##### 2. Analytical or objective evaluation tests

Analytical or objective tests help in evaluating the sensory characteristics of products such as similarities or differences, quality and / or quantity. The analytical tests consider only some aspect of sensory quality of the product itself and not the personal reaction of the panelist. The panel serves as the analytical tool. The International Organization for Standardization (ISO) defines an objective method as "a method in which the effects of personal influence are minimized".

### **Advantages of sensory evaluation of quality**

- Sensory or organoleptic methods are fully dependent upon the human senses for assessing the quality. All the senses except hearing are used in fish industries to judge quality by sight (appearance), touch (texture), smell (odour) and taste (flavour).
- Considered as a best method since the consumer can decide what he/ she likes only based on his/ her senses.
- Sensory methods have the great advantage as human beings are very adaptable and assess quality attributes such as odours, appearance, defects etc simultaneously.
- Human senses are better than instruments in discriminating and recognizing complexities involved in assessing product quality.

### **Factors involved in assessing sensory quality**

Quality factors assessed by sensory methods include sight and touch, and odour and flavour.

#### **Sight and touch**

This involves evaluating the quality by sight and touch for quality parameters such as size, colour, defects and spoilage. This can be accomplished with minimum training by fishermen to segregate catch by species and size. Testing with fingers and eyes remains the only effective way for detecting the bones in the fish flesh and matching of colour. The sense of touch in fingers or mouth are useful in assessing textural attributes such as firmness, softness, mushiness, rubberiness, woodiness, mealiness, succulence and dryness

#### **Odour and flavour**

Odour and flavour of a product is assessed by smelling through nose and tasting through tongue. Any one with some practice can distinguish the whole pattern of changes in odour between very fresh and very spoiled fish easily and rapidly thereby enabling accurate determination of degree of freshness. Similarly, the intensity of off-odours, taints and unusual intrinsic odours can be readily detected.

#### **Judges or panelists**

A judge or panelist is an experienced or trained person who carries out sensory assessments of products. One or more judges assessing the quality of same product independently eliminates the the risk of major mistakes through prejudice or bias. The average results of a panel of judges for a product give a correct measure of the attribute in question than is possible with a single judge. A group of judges involved in quality testing is often called as a taste panel when their judgements involve tasting the product.

### **Precautions to be taken fo conducting sensory tests**

- Sensory tests should be conducted in a separate area or room isolated from processing and other industrial operations.
- Standardized lighting conditions should be used for carrying out colour comparisons as colour of a product appears different under different types of lighting.
- Interference from external sources should be avoided or minimized.

- Identical heating or cooking process should be carried out on every occasion when samples are to be tasted.
- Distractions to the panelists should be avoided as sensory assessments require a certain amount of concentration.

### **9.1.2. Physical/mechanical/instrumental methods**

The physical method of quality evaluation involves the use of mechanical devices or instruments for size grading fish and shellfish, separating males and females of certain fishes, and for measuring moisture and fat content, degree of spoilage, colour, defects, pH, firmness etc.

#### **Measuring degree of spoilage**

Degree of spoilage in most types of chilled whole fish is determined by measuring progressive and marked changes in the electrical properties of the skin and underlying tissue. The instruments developed on this principle are Torrymeter (TM) of UK, Intelectron Fish Tester (IFT) of Germany, and RT- Freshness Grader (RTFG) of Iceland.

These provide a meter reading that can be calibrated in terms of the degree of spoilage or the shelf life remaining before the fish is inedible. However, the readings shown by these instruments should be standardized for different species and for same species at different geographic locations due to the possible difference in the proximate composition of fish.

The clock and thermometer are the two most important and commonly used physical instruments in any processing industry for maintenance of quality by controlling the processing time and temperature.

### **9.1.3. Biochemical / chemical methods**

Biochemical or chemical methods are useful in determining the composition of raw material and products and also in detecting the deteriorations in the products.

#### **Determining chemical composition**

Chemical composition involves determining the proximate composition of fish and fishery products by employing standard protocols. These include measurement of moisture, protein, fat, ash or mineral content, and acid content in marinated fishes. Determination of metal contents such as mercury, lead, cadmium, zinc, etc., and chlorinated hydrocarbons, radioactive isotopes, colouring matters, additives and preservatives are done by analytical methods that involve complex procedures.

#### **Detecting product deterioration**

The extent of spoilage and oxidative rancidity in the chilled fish can be measured by chemical and biochemical methods by measuring the complex series of changes in flesh constituents brought about by autolytic enzymes and putrefactive microorganisms.

The spoilage microorganisms such as *Pseudomonas*, *Alteromonas*, *Flavobacterium*, *Acinetobacter*, *Aeromonas* and *Moraxella* in tropical fish cause deterioration by their ability to produce  $H_2S$ , reduce trimethylamine oxide (TMAO) to trimethylamine (TMA) and convert urea to ammonia. Members of *Pseudomonas* also produce many volatile sulphur compounds. Thus, the degree of spoilage can be indicated by quantitative measurement of these compounds. Generally, fish flesh show visible signs of spoilage when bacterial load rises to above  $10^7$  organisms/ g.

#### **Chemical indicators of quality**

In chemical assessment of quality, the various products of spoilage in fish muscle are quantitatively determined and correlated with sensory characteristics.

Several chemical compounds produced in fish muscle by autolytic enzymes, putrefactive microorganisms or by chemical reactions like lipid oxidation can be used as indicators of spoilage. During spoilage, these compounds gradually accumulate in the flesh and hence their determination provides a measure of the progress of spoilage.

The compounds useful as quality indices are

### 1. Volatile bases

Basic nitrogenous compounds such as ammonia, trimethylamine (TMA), dimethylamine (DMA) etc.

### 2. Nucleotides

Degradation products from adenosine triphosphate (ATP) eg. inosine monophosphate (IMP), hypoxanthine (Hx), etc.

### 3. Lipid oxidation

Peroxides, hydroperoxides, aldehydes, etc.

#### 9.1.4. Microbiological methods

Microbiological methods assess the quality of the product by enumerating the total numbers of microorganisms, or presence or absence of specific microorganisms as indicators of quality in a fixed quantity of product. These methods involve growing microorganisms in specific nutrient agar media or in special media that support only particular microorganisms. The total number of living bacteria present in a food is variously reported as the total viable count (TVC), standard plate count (SPC), surface total plate count (TPC), aerobic plate count (APC) or as colony forming units (CFU).

#### Significance of microbial load in foods

The total microbial load provides an estimate of the total number of aerobic organisms in a particular food. The microbial load of products reflects on;

- Microbiological quality of the food.
- Potential indicator of spoilage of the perishable food products.
- Indicator of the sanitary conditions under which the food was produced and / or processed
- Indicator of level of Good Manufacturing Practices (GMP) adopted during processing.
- Generally, TPC values of 10<sup>7</sup>/g is an indicative of fish being spoiled.

#### Microbes to be enumerated

Microbiological investigations generally involve enumerating total microbial load responsible for spoilage, human pathogenic microorganisms such as *V. cholerae*, *V. parahaemolyticus*, *Salmonella* sp, *Listeria* etc, indicators of sewage contamination such as faecal coliforms, *E. Coli*, faecal streptococci, and indicators of personnel hygiene such as *Staphylococcus aureus* in fresh and processed products by employing appropriate standard enumeration methods. Microbiological methods are generally laborious but are required for monitoring sanitary practices and levels of hygiene in fish processing plants.

#### 9.1.5. Statistical methods

Assessing the quality of the product involves drawing representative samples for analysis and decision making. For this purpose statistical principles are to be followed which help in sampling correct number, size and kind of samples for analysis as it is not possible to examine every item in a batch of product. Further, making decision as to whether to accept or reject a batch or to place a batch in a particular grade is determined by following statistical principles.

End product inspection of fish products uses the practices of acceptance sampling by attributes. A sample of 'n' items is taken from the lot and tested according to the product specification. After examination, each item is declared as having passed or failed. The lot is accepted if 'c' (maximum acceptable number) or fewer items in the sample fail. The sampling plan generally specifies values of 'n' and 'c'.

## **9.2. Concept of Quality Management**

The term quality broadly refers to degree of excellence of any product. The processing industries can ensure quality product to the consumer by outlining and adopting strict quality control measures during handling and processing of the product. This becomes necessary not only to protect consumer interests but also to develop brand name to the product. The industries involved in processing fish and fishery products have to follow several concepts involved in quality management system so as to produce a quality product.

Quality is defined as those characters in a product which have significance in consumer acceptability. The quality of a product is influenced and controlled by several factors. The quality in fishery products is the result of physical, chemical, biochemical, organoleptic and bacteriological characteristics of the product. Thus, the quality depends on factors such as intrinsic composition, nutritive value, degree of spoilage, damage, deterioration during processing, storage and distribution, hazards to health, consumer satisfaction, aesthetic consideration, product yield and profitability to producer and seller. In general, the quality of fish means all that attributes which consciously or unconsciously the consumer/ buyer considers should be present. However, the decision on quality ultimately rests with fish consumer.

### **Quality types**

Based on the origin of the factors controlling the quality, the quality of a product can be grouped in to intrinsic quality and extrinsic quality.

#### **Intrinsic quality**

Intrinsic quality refers to sum of attributes that are inherent in raw material. It is affected by factors such as fish species, size, sex, condition, composition, parasites and other organisms, naturally occurring toxins, contamination with pollutants etc. Factors affecting intrinsic quality can not be controlled.

#### **Extrinsic quality**

Refers to sum of effects of all the treatments that the fish receives after catch till it reaches consumer. It is affected by degree of freshness, conformity with declared mode of presentation/ product style, weight, size, ingredients, food additives, acceptability of processing methods, suitability of containers and packaging methods, extent of cleanliness and sanitary conditions followed during handling and processing. The factors controlling extrinsic quality can be controlled.