DNR(A) COLLEGE

Dept OF Zoology

Paper-7 MANUAL

POST HARVEST TECHNOLOGY IN FISH & FISHERIES

. I. EVALUATION OF FISH /FISH PRODUCTS

Fish and fishery products are not only nutritionally important but also important in global trade as foreign exchange earner for a number of countries in the world. Fisheries and aquaculture sectors have become the second most important contributors in export earnings all over the world. So it is very important to maintain the quality of the frozen fish for its acceptance in international trade as well as avoiding the health problems of consumers.

Fish are of great concern for export earnings because of their higher nutritive value suchas high protein content, with little or no carbohydrate and fat value. But fish may be contaminated at various stages of transport, handling, and processing. This contamination may be related to the raw materials, personnel, and processing tools such as forklifts through leakage, insect, and pest harborage. Additionally, seafood can become contaminated during storage and processing. Contamination may be caused by food borne pathogens which are naturally present in aquatic environments, such as Vibrio spp., or derived from sewage contaminated water such as Salmonella spp. Consumption of these contaminated fish may cause infection or intoxication to the consumers.

Vibrio cholerae is responsible for the third-highest number of shell fish related illnesses, after non cholera Vibrio spp. In contrast to Vibrio spp.,the incidence of Salmonella infections due to sea food consumption is still low compared with salmonellosis associated with other foods. However, detection of Salmonella spp. in seafood cannot be skipped as it is responsible for most of the food borne diseases or gastroenteritis characterized by diarrhea, abdominal cramp, vomiting, nausea, and fever. According to Centers for Disease Control and Prevention, Salmonella is the leading cause of bacterialfood borne illness.

Wäter and ice quality is also an important factor for good quality fish, because water and ice used for fish processing may contaminate the whole processing plant. So it is important to find out the quality of fish we consume as well as of the frozen fish which are export

Fishery products have been recognized as a major carrier of food-borne pathogens, pathogenic bacteria associated with fish and fishery product can be categorized into three general groups: Indigenous bacteria that belong to the natural micro-flora of fish

(Clostridium botulinum, pathogenic Vibrio spp., Aeromonas hydrophila); Enteric bacteria (Non- Indigenous bacteria) that are present due to fecal contamination (Salmonella spp., Shigella spp., pathogenic Escherichia coli, Staphylococcus aureus); and bacterial contamination during processing,

Considering all the developments in instrumental method have occurred in the last decade, sensory methods remain the most satisfactory way of assessing the freshness of fish and fishery products. Objectives seafood sensory tests, based on certain attribute of raw fish (skin, eyes, gills, texture, etc.), are the most commonly used methods for quality assessment of raw whole fish in the inspection service and fishing industry.

Sensory Evaluation

Sensory evaluation of food is defined as the scientific means of quantifying and interpreting the variations in food characteristics (odour, taste, tactile, appearance) by using human senses of sight, smell, taste, touch and hearing.

Studies have shown that assessment of food freshness/ characteristics using sensory methods are capable of giving objective and/reliable results when assessments are done under controlled conditions. Generally, trained and experienced taste panel is essential to obtain accurate and reproducible result. Sensory methods are divided into two groups; discriminative and descriptive tests however, the most commonly used is the descriptive test which measures the difference or absolute value indicating the different quantitative levels. There are several grading methods used to assess freshness in fish and fish products for instance the European Union (EU) scheme and the Torry system Nonetheless, other new sensory schemes exist like the quality index method (QIM), originally developed in Tasmania However, sensory methods in general are known to be irrationally expensive due to the high training requirement of the panel; cost of running, need for individual scheme for individual fish species given the different spoilage patterns and physiological and psychological limitations of the analyst.

Microbiological methods

The major changes in fish freshness for instance unattractive change food characteristics such as, flavours, odours and colour are largely due to bacterial growth andactivity. Microbiological methods are used to estimate bacterial numbers, in order to determine fish freshness, hygiene and or evaluate the possible presence of bacteria or organisms of public health. Microbiological prediction/estimation of bacterial numbers therefore, in order to serve the purpose of food safety and shelf life determination, is expected to relate quantitatively to the characteristics of the food during storage

II. Fishery By-products

A. Extraction Of Fish Oil

Fish oil is extracted from fatty tissues of the fishes. It is a mixture of triglycerides containing cholesterols, other allcohols, pigments, vitamins, glycerides, ethers and fatty alcohols. Fish oil is of two types, the liver oil and the body oil.

(a) Fish-liver oil-

It is extracted from the liver of fishes and is of great medicinal value since ancient times. It is the main source of vitamin A but in some species of fishes liver oil contains vitamin C, D and E also. They were used for therapeutic purposes in the treatment of vitamin A and D deficiencies. The therapeutic values of fish-liver oil were discovered in 18th century, and fish liver oil became a common medicinal product. Both vitamin A and D are found in certain fish-liver oils. The most important fish-liver oils obtained are from cod, haddock and shark. Halibut and tuna livers are also rich sources of vitamin A and D. The weight of liver, fat content and presence of vitamins dependent on a number of factors like species, age, sex, nutritional status, stage of spawning and area from where it was caught.

(b) Fish Body oil Body oil is extracted from the whole fish body and further sub-grouped into following as:

(i) Dry oil: It is obtained from Sardine, Salmon, Herring, Mackerel, Anchovy and white fish.

(ii) Semi drying oil: It can be obtained from carps and sparts containing very low iodine percentage. Body oil is generally used for industrial purposes, like lubricants, cosmetics, paints, etc. Body oils have recently won much attention because of the content of polyunsaturated fatty acids (PUFA), particularly η3 PUFA used in the control of heart aliments in humans.

Principle

Fish is cut up into small particles and cooked. These steps help in the release of oil and water. Oil is then separated from the aqueous fraction. Oil is finally washed free of impurities and dehydrated to remove moisture.

Requirements

• Fish – any fatty fish like oil sardine

• Anhydrous sodium sulphate

• Stainless steel vessel, ladle

• Knife, cloth bag, cutting board, trays, stoppered bottle

• Balance

• Grinder

• Stove

• Basket press

• Centrifuge or separating funnel

Procedure

1) Wash, drain and weigh the given fish.

2) Slit open the belly. Remove gut and gills. Cut into pieces.

3) Grind using a suitable grinder.

4) Boil water in a stainless steel vessel (fish : water = 1 : 1 approximately).

5) Add the ground fish; continue boiling for about 30 minutes, with occasional stirring. In case water level drops, add sufficient water to maintain it as and when required.

6) Collect oil floating and keep aside.

7) Stop heating; allow particles to settle; decant supernatant (water-oil mixture).

8) Transfer solids to a cloth bag. Press using a basket press. Collect the water oil mixture.

9) Pool the water-oil mixtures, transfer to a separating funnel. Allow oil and aqueous layers to separate. In case an emulsion has occurred, add sufficient quantity of table salt to break the emulsion.

10) Drain out the aqueous layer and collect the oil layer. (Instead of separating funnel, a centrifuge can be used for separation of oil from the aqueous fraction).

11) Mix the oil so separated with the oil collected earlier. Transfer to another separating funnel.

12) Add sufficient hot water and shake the funnel vigorously in order to wash the oil.

13) Allow the oil and water layers to separate. Then drain out the water.

14) Repeat washing, if necessary.

15) Transfer oil to a vessel, place it on a boiling water bath until all traces of moisture from the oil is evaporated off. (Instead of heating, oil can be mixed with about 5% anhydrous sodium sulphate and kept overnight. This will absorb traces of moisture and can then be removed by filtration).

16) Transfer oil to a pre-weighed, clean, dry, stoppered bottle of suitable size. Fill to minimum head space and close the bottle air-tight.

17) Weigh the bottle with oil. Calculate yield of oil from fish.

18) Examine the oil and familiarize with its odour, colour, etc.

Observations

Name of fish used :

Weight of fish (x) =

Weight of empty bottle (a) =

Weight of oil + bottle (b) =

Weight of oil = (b – a) = y =

Yield of oil = y/x × 100 = ……%

B.PREPARTION OF FISH MEAL

Fish and fish products is consumed as food all over the world. With other seafoods, it provides the world's prime source of high-quality protein; 14–16 % of the animal protein consumed worldwide. Over one billion people rely on fish as their primary source of animal protein. 1. Fish meal: Fishmeal is a traditionally used livestock feed supplement. Fishmeal has high quality protein containing high levels of lysine, methionine and cysteine, three of the essential amino acids which the animal bodies cannot synthesize, and this makes it an unrivalled constituent of feed stuff. It is also a good source of B-group vitamins like cyanocobalamine (B12), chlorine, niacin, pantothenic acid and riboflavin.

Fishmeal is rich in minerals like calcium, phosphorus, copper and iron and is also the source of some trace element. It is produced by cooking---presssing----drying----and grinding skeletal remains along with adhering proteinaceous tissues of fish from filleting and canning operations. Or by processing whole miscellaneous fish mainly caught along with prawns, which include jew fish, sole, silver-bellies, ribbonfish and the like. The composition of fish meal differs considerably due to variations in raw materials used, processing methods and conditions employed. The main raw material for fish meal is abundant but sporadic catches of oil-sardine on the west coast.

Raw materials High-fat like anchovies, sardines, herring, menhaden etc. are traditionally used as raw materials to manufacture fishmeal. Small by catch fish from shrimp trawling generally not marketable as fresh fish due to various reasons like very small size, bony nature, etc. also can be used. Juveniles of commercially important fish and waste from fish processing and filleting plants, cannery wastes, carcasses of fish like shark and other fish wastes are also used as raw material for fish meal and oil production.

Traditional fish meal production in India was from sundried fish collected from various drying Centres all along the coast, and the product was chiefly used as manure. Better quality fish meal has been a prominent item of export from very beginning of this industry. The importance of improving quality for better use was felt, and the Ministry of Food and Agriculture has, as early as in 1959, laid down specifications regarding quality fish meal. Later the Bureau of Indian Standards (BIS) has brought out the specification (IS:4307-1967) for fish meal as livestock feed for facilitating proper quality control.

Composition of Fish Meal

The range of proximate analysis generally obtained is as follows: Protein: 50-70%; Fat: 05-10%; Ash:12-33%; moisture, 06-10%. Fish meal is rich in all the essential amino acids, B- group vitamins and minerals particularly phosphorus and calcium.

Manufacturing process

Fish can be reduced to fish meal by 2 general processes:

Dry-rendering and wet-rendering

Dry-rendering

Dry rendering or dry reduction is the process employed to process fishmeal from non-oily fish e.g. silver-bellies, jew fish, ribbonfish, sole, anchoviella and carcasses of shark, fish offal and filleting waste. In this process if quantity of fish processed is very small, it is dries to moisture content of 10% and pulverized. If quantity to be handled is sufficiently large, a steamjacketed cooker-dryer equipped with power-driven stirring device is used. Being a batch operation, the process will have only limited capacity and labour costs will be high. However, water-soluble materials are retained in meal.

Wet-rendering

Wet-rendering or wet reduction process is normally applied to fatty fish or offal where simultaneous production of fish meal and fish-body oil is envisaged. The process consists of: Grinding---cooking to soften flesh and bones and to release oil,-- -- pressing to expel liquor and oil,----fluffing press-cake,---- drying,---- grinding---- and packing meal (moisture 8%),----- centrifuging press liquor to remove suspended particles and to separate oil and concentrating stick water. The process requires elaborated equipments and is normally a continuous one and thereforeadaptable to reduction of large quantities of fish.

Use of fish Meal

It is used as an ingredient in the livestock feed. Fish meal is often supplemented at the following levels in the ratios of animals and poultry: Cattle - 907/ g/ day/kg live weight Pig - 113-127 g/ day according to weight Sheep - 45-91 g/ day 45.4 kg live weight Poultry - Not more than 10 per cent of the total ration for hens and more than 5 per cent for chicks.

C. Fish Glue

Fish gelatin and fish glue are more or less same and can be prepared from fish skin and fish head. If required, fish skin can be preserved by salting and drying before processing into glue however, fish head should be processed fresh.

Process

Production of Glue from fish skin -

Skin whether fresh or salted is washed and soaked in fresh water for the periods in the range of 1- 18 hrs depending on the condition of the material (fresh or salted). Washed skins are immersed in 0.2% caustic soda solution to open the fibre bundles and remove cementing materials. It is then neutralised with HCl and washed again in cold running water. Swollen skin is then transferred to steam jacketed double bottomed kettle covered with an equal weight of water and is heated with steam. Small quantities of acetic acid also may be added to the mixture to hasten the hydrolysis of the stock into glue and to act as a catalyst. Cooking is continued for about 8 hrs and the glue liquid is drawn off from the bottom of the cooker. The second run is made in a similar manner which is then concentrated in open heated pans at atmospheric pressure until the solid content reaches to 50- 55 % and cooled. Sometimes small quantities of volatile essential oils may be added to preserve the glue and to mask the fishy odour.
Glue from fish head: It should be processed fresh with addition of some bleaching agents like sulphurous acid during cooking of the skin some glacial acetic acid is added which softens the head bones.

Production of Glue from fish head -

For glue fresh fish head are used. It should be processed fresh with addition of Some bleaching agent like Sulfurous acid or Sodium bisulphite is added while processing fish head. whereas addition of some glacial acetic acid is considered desirable during. cooking of skin, addition of glacial acetic acid in substantial quantities say 4.5-9 liters/tonne of head, is an essential requirement in processing fish head Acetic acid is particularly useful for soften the head bones. Larger amount of preservatives and essential oil are needed for preservation of the glue from skin.

Uses

- Can be used in furniture
- Box making
- Sizing agent

- Can be used in special cements
- Photo engraving plate manufacture
- Book binding and small repair work etc

III. Value added fishery products

A. Fish Cutlets Preparation

Ingredients
Flesh of the fish : 200gms
Onion chopped : 3nos.
Green chillies chopped: 4nos
Garlic chopped finely : 5 nos. (bigger size)Ginger chopped finely : 1 medium size
Potatoes boiled & smashed : 3nos
Pepper powder : 1 tea spoon
Coriander leaves : as per your taste
Garam masala: 2 teaspoon.
Oil : 4 table spoon.
Bread crumbs: 1/2 cup
Egg: 3nos
Oil for deep frying : 2 cups

Preparation –

Boil fish flesh with little salt till they are cooked.Pour oil in a pan, as the oil becomes hot put onion, ginger,garlic & green chillies and half fry. . You have to stir it continously. Now add fish to it & mix well. Dont addwater to it. Make this mixture dry. Cook till it dry.Now add pepper powder & garam masalas. Fry well.Addsmashed potatoes & mix well .Turn off the gas &spread some coriander leaves. if u need salt u can add asper the taste.Allow to cool and then make small round balls . Make patties with that.Take a bowl beat the eggs and inanother plate take bread crumbs. Dip this balls in the egg mixture & then put bread crumbs on both sides of the cutlet. Now deep fry the cutlets in oil. Serve hot with tomato ketchup.

B. Fish Fingers preparation

Fish fingers are regular sized portions cut from rectangular frozen blocks of fish fillet or fish mince. Fish fingers are made into different shapes such as rectangular, square, wedge and french cuts. A typical British fish finger normally weighs about 28 g (1 oz) of which up to 40% of the total weight is contributed by the batter and crumb

Requirements
Fish Fillet/Mince prepared from White fleshed, lean fish
Sodium tripolyphosphate
• Sodium chloride
• Batter mix
• Bread crumbs
• Potable water
• Processing table
Coated Products
• Analytical balance
• Refined vegetable oil
• Petri dishes
• Cutting boards
• Knives
• Plastic trays
• SS tray
• Plastic film
• Thermoform containers/Pouches made of 12 μ plain polyester laminated with 118μ LDPE • Digital thermometer
• Small Fryer (Electrical/Gas)
• Air blast freezer
• Deep Freezer

Procedure
1) Take 500g Fish fillets in a plastic tray.
2) Mix thoroughly with 0.6% sodium tripolyphosphate and 1% sodium chloride.
3) The mixed fillet is spread in an SS tray lined with plastic film to form slab of approximately 2 cm thick and frozen.
4) The frozen slab is cut into pieces of uniform dimensions using a vertical band saw.
5) The pieces are then pre dusted, battered, breaded and pre-fried.
6) The pre-fried fingers are cooled, packed, blast frozen and stored in a deep freezer.

PRECAUTIONS

- Always use fresh fish for the experiment.
- While taking sample weight, make sure that representative samples are taken at each stage.
- Keep the fillets and mince at different stages of processing in iced/ chilled condition to avoid temperature abuse.
- The cut pieces from block should be kept in chilled condition and coating should be carried out immediately to avoid thawing and loss of shape.
- During breading, care should be taken to remove "clumps" formed in the bread crumbs These have to be replaced by fresh crumbs. Use aprons, headgear and mouth gear for hygienic handling of the product. Ensure minimum handling of the material.

C.Fish Curry preparation

Ingredients

Fish - 1/2 kgCurry leaves – 2

Stems Green chillies - 5 nos

(cut lengthwise)

Red chilly powder - 1 tbsp

Coriander powder - 3 tbsp

Turmeric powder - 1/2 tsp

Mustard seeds - 1 tsp

Salt - As req

Tamarind

Oil - 4 tbsp

For grinding: Onion (medium) - 2 nos, Tomato (medium) - 2 nos, Ginger - A small piece , Garlic pods - 3 nos, Grated coconut - 1/2 of a coconutbsp

Preparation Method of Meen curry - fish curry Recipe

1)Heat oil in a pan
.2)Add mustard seeds and when they splutter, add curry leaves.
3)Add the ground paste and stir for 2 min.
4)Add coriander powder, red chilly powder and turmeric powder.
5)Take the coconut paste in another vessel and add 500 ml of water and salt.
6)Add the above coconut paste into the pan.
7)After 2 minutes, add the fish pieces.8)Stir slowly so that the fish doesn`t break up and close the lid and cook it for 10 min.

IV. Examination of Salt in dried/cured products

Introduction -

Sodium chloride (Food grade) is an important additive for the production of fish jelly products. Its main function is to extract the salt soluble protein to give the gel strength of the final product. The amount of sodium chloride present in such products can be determined by titrating the extract containing the chloride ion with silver nitrate, AgNO3. Potassium chromate (K2CrO4) is used as the indicator and the end point is indicated by the change in colour from yellow to reddish brown

Reagents-

1. Standard Silver Nitrate - 0.1 N

2. Dilute Nitric acid 20 ml

3. Ferric alum indicator - Prepare a saturated solution of Ferric ammonium sulphate

4. Standard Potassium thiocyanate solution - 0.1 N

Procedure -

Take 1-2 gm of the dried material (obtained after determination of moisture) in a 250 ml beaker and add 50 ml of distilled water free from chloride and heat on a water bath till all the Sod. Chloride goes into solution. Filter in a 250 ml conical flask and wash with distilled water till the washings are free from chloride. Add 20 ml of dilute nitric acid and a known volume of standard silver nitrate sufficient to precipitate all the chloride. Add 1 ml of ferric alum indicator and titrate with standard Potassium thiocyanate solution until a permanent light brown colour appears

Calculation-

Sodium Chloride (on dry basis) m/m = 5.85 X (V1N1-V2N2) / M

Where, VI = Vol of standard solution of silver nitrate

N1 = Normality of standard silver nitrate solution

V2= Vol of standard Pot. Thiocyanate solution

N2 = Normality of standard Pot. Thiocyanate sol

M = Mass of dried material taken for test

Sodium Chloride (on dry basis) m/m = 5.85 X (V1N1-V2N2) / M

M (Mass of dried material) = 2 gms

Where as (V1NI-V2N2) = 20 X 0.1-2.5 X0.1=1.75

$$\frac{5.85 \text{ X } 1.75}{2}$$

= 6.725 mg.

V. Examination of Protein in dried/cured products

Introduction

Fish is considered as an energetic food that plays an imperious role in the human diet, contributing almost (20%) of protein needs for developing countries while the requirement is much higher in the emerging countries. Apart from fish protein products consumed by humans, that is only 40% while other 60% parts of fishes including skin, head, frames, fins, trimmings, roes and viscera, which are considered as a waste, comprising a handsome amount of protein.

These parts are used by fish processing industries for the production of many well-known protein hydrolysates (PHs) such as fish head , fish skin , fish visceral , fish bone fish roe or egg fish liver , fish frame and many more. Fishes have been extensively used for the production of various kinds of proteins due to their outstanding biological activities such as anti-inflammatory, anticancer, antioxidant against free radicals as well as antihypertensive properties.

Reagents -

a) Kjeldahl catalyst:- 15gm Pot. Sulphate - 0.5 gm copper sulphate

b) Sulphuric Acid – Concentrated

c) NaOH solution- 50% (1+1).

d) Standard NaOH solution-0.1 N=0.1 M (4.00gm/litre)

e) Standard acid solution- Prepare either HCI or H2SO4 solution HC1 sol-0.1

f) N= 0.1 M (3.646 gm/litre)

g) H2SO4 sol-0.1N=0.05 M (4.9gm/litre)

h) Methyl Red Indicator - 0.5gm in 100ml ethanol

Procedure -

Weigh 1-1.5 gm of prepared sample and transfer to a kjeldahl digestion flask. Add 15gm of Pot sulphate, 0.5gm of copper sulphate and 25-40ml of Sulphuric acid. Heat the flask gently in an inclined position until froathing ceases then boil briskly for 2 hours. Allow to cool. Add approx 200ml of water and 25ml of Sod. thiosulphate solution (80gm/l) and mix. Add a piece of granulated Zinc or anti bump granules and carefully pour down the side of the flask sufficient Sodium Hydroxide sol (1+1) to make the contents strongly alkaline (about 110ml). Before mixing the acid and alkaline layers connect the flask to a distillation apparatus incorporating an efficient splash head and condenser. To the condenser fit a delivery tube which dips just below the surface of a pipette vol of the digestion flask and boil until about 150ml of the distillate has been collected. Add 5 drops of methyl red indicator and titrate with 0.IN NaOH. Carry out a blank, 1 ml of 0.1 HC1 or H2SO4 is equivalent to 0.0014 of N.

Calculate the protein nitrogen (mgN/100 g or 100 ml sample) as follows:-

a) solid/semi-solid fish sample protein nitrogen = $\frac{(b - a) \times 0.1 \times 14.00}{Ws} \times 100$ (1)

where Ws = weight (g) or volume (ml) of sample

a = volume (ml) of 0.1N H2SO4 used in blank titration

b = volume (ml) of 0.1N H2SO4 used in sample titration

14.00 = atomic weight of nitrogen

b) Calculation of percentage protein

The above protein nitrogen (mgN/100 g or 100 ml sample) can also be presented as percentage protein nitrogen fraction and is expressed as follows:-

% protein = $\frac{(b - a) \times 0.1 \times 14.00}{W}$ X 100X 6.25/1000

where (b - a) x 0.1 x 14.00 x 100/Ws is similar to formula (1)

1000 : the conversion of mgN/100 g to gN/100 g sample

6.25 : the protein-nitrogen conversion factor for fish and its by-products.

Final Calculation

a. solid/semi-solid fish sample protein nitrogen = $\frac{(b - a) \times 0.1 \times 14.00}{Ws} \times 100$ (1)

$$\frac{(2.8-1.2) \times 0.1 \times 14}{1.5} \times 100$$

fish sample protein nitrogen = 149 mg

b. % protein = $\frac{(b - a) \times 0.1 \times 14.00}{Ws} \times 100 \times 6.25/1000$

$$\frac{(2.8-1.2) \times 0.1 \times 14.00}{1.5} \times 100 \times 6.25/1000$$

% protein = 93.12%

VI. Lay out of processing unit