Vocational Higher Secondary Education (VHSE)

SECOND YEAR

MARINE FISHERIES AND SEA FOOD PROCESSING

Reference Book

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Department of Education

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FOREWORD

Dear Learners,

This book is intended to serve as a ready reference for learners of vocational higher secondary schools. It offers suggested guidelines for the transaction of the concepts highlighted in the course content. It is expected that the learners achieve significant learning outcomes at the end of the course as envisaged in the curriculum if it is followed properly.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of this reference book has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. P. A. Fathima
Director, SCERT, Kerala

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Module 3: FISH QUALITY CONTROL AND INSPECTION SYSTEMS

PART - A

MARINE FISHERIES AND SEAFOOD PROCESSING

ABOUT THE COURSE

Vocational education, a dream of Mahatma Gandhi, was realized by the central government in the year 1983 to address the problem of massive unemployment among the youth in our country. Among the different vocational courses introduced, Fisheries courses have great relevance. Being a country with a vast coastline of about 8000 km, fishing and allied industries play an important role in providing employment to a vast majority of the population, as well as sustaining the economy with the foreign exchange earned from the export of various fisheries products. Among the maritime states of India, Kerala holds a remarkable position in fisheries sector. That is why the importance of fisheries in the economic development of Kerala was emphasized by Dr. APJ Abdul Kalam.

The course 'Marine Fisheries & Sea food Processing' (MFSP) is a two year vocational course introduced in Kerala VHSE curriculum as an updated, modified, multi skilled course. Since Kerala has a large coast line and an active fishing community relying on the marine fisheries, the course will enable the students to acquire various skills needed for the industry. It offers scope in studying new technologies, and help to improve the fishing industry, which directly or indirectly helps to improve the standard of living of fisher folk and also generate employment opportunities.

Since the sea food processing industry is deeply connected with marine fish resources, the introduction of multi skilled modular based **'Marine Fisheries & Sea food Processing'** course with four modules namely **Fishing Technology, Fish Processing Technology, Fish Quality Control and Inspection Systems** and **Fishery Value Added and Byproducts** has great importance in vocational education.

MAJOR SKILLS

After completing the course, the learner achieves the following skills in:

1. Quality Control and Inspection system
    - Bacterial cell structure, growth phases, and classification.
    - Different growth phase of a bacteria and plotting the growth curve.

- Sampling methods for microbial examination, methods of sterilization, identification of different media for bacterial culture and TPC of Fishery products.
- Seafood quality control standards.
- Use of different lab equipments used in microbiological laboratory.
- Use of dfferent glassware used in Fishery microbiology lab.
- Personal hygiene, factory hygiene, temperature maintenance during processing.
- Freezing and packing related to production and process control.
- Cleaning schedule, estimation of available chlorine, evaluation of chlorination levels of different areas of processing plant.
- National and International standards in sea food industry, explanation of various Inspection systems.
- Hazard Analysis Critical Control Point in Sea food industry.
- Keeping records maintained in processing plants.

2. Fishery Value added and Byproduct and packaging of sea foods

- Preparation of fish marinades, fish /clam/prawn pickle, fish /clam/ prawn cutlet, Fish wafers, Fish sausage, Fish Ball, Fish Finger, Fish momos, Fish Protein Concentrate, Fish soup powder, Dried Prawn pulp, Masmin flakes.
- Preparation of various fishery byproducts like chitin & chitosan, shrimp extract, Fish meal, Fish body oil, Pearl essence, Isinglass, Fish silage
- Various aquatic products like Algin, Agar agar, Carrageenan, Beche-de-mer, Ambergris.
- Packing materials like Glass containers, Metal cans, Types of paper packages, Cellophane, LDPE, HDPE, Aluminium foil and Retort pouch
- Packing of IQF products and Block Frozen Products
- Packing of various value added fishery products and byproducts.
- Packing of canned fish and fish pickle.
- Modern packing methods like MAP, CAP, Vacuum packing.

SYLLABUS

Module 3: FISH QUALITY CONTROL AND INSPECTION SYSTEMS

Unit No.	Name of units	Periods
3.1	**Basic Microbiology** • Bacterial structure • Growth of bacteria • Classification of bacteria • Pathogenic and non pathogenic bacteria	60
3.2	**Fishery Microbiology** • Sampling methods • Media used for bacterial culture • Methods of sterilisation • Total Plate count • Laboratory equipments	90
3.3	**Microbes in Public health** • *Clostridium botulinum* • *Salmonella typhi* • *Vibrio cholerae* • *Vibrio parahaemolyticus* • *Escherichia coli* • *Staphylococcus aureus* • *Streptococcus* • *Shigella* • Microbial limits	*50*
3.4	**Hygiene and Sanitation in Fish Processing Plants** • Good Manufacturing Practices (GMP) • Standard Sanitary Operating Procedures (SSOP) • Chlorination • Cleaning schedule	70
3.5	**Quality Standards for Fish and Fishery Products** • National and International standards • Various inspection systems • Hazard Analysis and Critical Control Point (HACCP) • Records maintained in processing plants	70
	TOTAL	**340**

Module 4 : FISHERY VALUE ADDED AND BYPRODUCTS

Unit No.	Name of units	Periods
4.1	**Value Added Fishery Products**	
	• Fish marinades • Fish cutlet • Fish wafers • Fish sausage • Fish ball • Fish finger • Fish momos • FPC • Fish soup powder • Dried prawn pulp • Masmin flakes	150
4.2	**Fishery Byproducts** • Chitin and chitosan • Shrimp extract • Fish meal • Fish body oil • Pearl essence • Isinglass • Fish silage	130
4.3	**Miscellaneous Fishery Products** • Algin • Agar agar • Carrageenan • Beche-de-mer • Ambergris	10
4.4	**Packing of fishery products** • Packing materials • Packaging of frozen products • Packaging of dried products • Packaging of value added fishery products and byproducts • Modern packaging techniques	50
	TOTAL PERIODS	**340**

PART – B

MODULE . 3. FISH QUALITY CONTROL AND INSPECTION SYSTEMS

Bacteria are widely distributed in nature. They are present in animals, plants, soil, air and water. There are both useful and pathogenic bacteria, the former one brings changes including decomposition of dead tissues of both plants and animals and the latter causes various types of diseases.

Indian marine products are preferred in the markets of developed countries due to our constant efforts in quality maintenance. Various quality inspection systems are enforced in our country to ensure seafood quality. These regulations are intended to ensure that the marine products are wholesome, safe and produced under hygienic conditions.

This module highlights both the basic and applied aspects of fishery microbiology and quality assurance in sea food processing and equips the learners with understanding on microbial hazards and appropriate control measures.

UNIT NO. 3.1 BASIC MICROBIOLOGY

Introduction

This unit provides an overall idea of bacteria. Learners get acquainted with the structure of a bacterial cell, growth phase and classification based on preference to various environmental parameters and Gram's staining. On completion of the unit the learners get the concept of preventing bacterial spoilage by altering different environmental conditions.

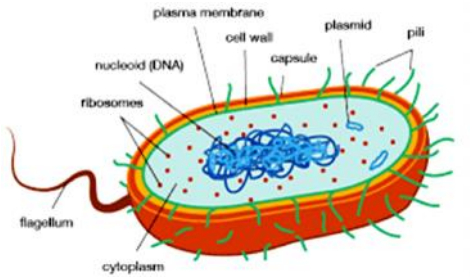
Microbiology is the study of microscopic organisms and how they interact with humans and environment. This unit describes the structure of a bacterial cell, different growth phases of bacteria, classification of the bacteria based on shape, temperature tolerance, oxygen requirement, nutrient requirement, salinity tolerance, and gram staining. This unit also deals with pathogenic and non pathogenic bacteria.

Learning Outcomes

The learner :

- Describes the structure of a bacterial cell
- Describes the different growth phase of a bacteria and plots the growth curve
- Classifies bacteria based on shape, temperature tolerance, oxygen requirement, salt requirement, nutrient requirement, Gram staining
- Differentiates pathogenic and non pathogenic bacteria

STRUCTURE OF A BACTERIAL CELL



Bacteria are prokaryotic, unicellular and microscopic organisms. They are found everywhere from the ocean to guts of animals. They are the most abundant micro-organisms. Though the bacterial structure is very simple, they are very complex in behaviour. The bacterial cell is enclosed in a rigid cell wall. Cytoplasmic membrane is the compound membrane enclosing the protoplasm. There is no well differentiated nucleus. Their genetic material is very long molecule of DNA. Some bacteria have an extra circle of genetic material called a plasmid.

Summary of characteristics of typical bacterial cell structures

Structure	Function
Flagella	Locomotion
Pili/fimbriae	Attachment to surfaces
Capsule	Attachment to surfaces; protection against phagocytic engulfment; reserve of nutrients or protection against desiccation
Cell wall	Prevents osmotic lysis of cell protoplast and provides rigidity and shape to cells
Plasma membrane	Permeability barrier; transport of solutes; energy generation; location of numerous enzyme systems
Ribosomes	Sites of translation (protein synthesis)
Chromosome	Genetic material of cell

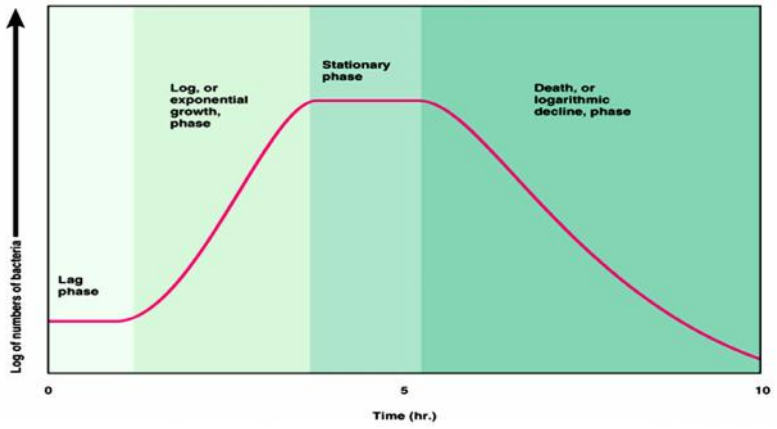
GROWTH OF BACTERIA

Bacteria multiply by simple division called binary fission. When the bacteria are grown in a suitable medium under favourable condition, the bacterial cell grow in size. Usually the cell elongates to twice its original length and it divides into two. Thus two daughter cells are formed. Under favourable condition the growth and division are repeated very rapidly. To study the bacterial growth population, the viable cells of the bacterium should be inoculated on to the sterile broth. The dynamics of the bacterial growth can be studied by plotting the cell growth versus the incubation

time or log of cell number versus time. The curve thus obtained is a sigmoid curve and known as a standard growth curve of bacteria. This growth curve has four distinct phases.

- **Lag phase**: When a micro organism is introduced into the fresh media it takes some time to adjust with the new environment. There is no multiplication at this stage. This phase is termed as lag phase.
- **Logarithmic phase (Log phase):** During this phase the micro organisms are in a rapidly growing and dividing state. The culture reaches the maximum growth rate and the number of bacteria increases exponentially. This will result in a balanced growth. The time taken by the bacterium to double in number during a specified time period is known as the generation time.
- **Stationary phase**: As the bacterial population continues to grow, all the nutrients in the growth medium are used up by the micro organisms for their rapid multiplication. This results in the accumulation of waste materials, toxic metabolites and inhibitory compounds such as antibiotics in the medium. This shifts the conditions of the medium such as pH and temperature, thereby creating an unfavourable environment for the bacterial growth.
- **Decline or death phase**: The depletion of nutrients and the subsequent accumulation of metabolic waste products and other toxic materials in the media will facilitate the bacterium to move on to the Death phase. During this phase, the bacterium completely loses its ability to reproduce. Individual bacteria begin to die due to the unfavourable conditions and the death is rapid and at uniform rate. The number of dead cells exceeds the number of live cells. Some organisms resist this condition and survive in the environment by producing endo spores.

Graph showing growth phase of bacteria



CLASSIFICATION OF BACTERIA BASED ON SHAPE

Bacteria are classified into 4 categories based on their shape

1. Spherical / coccus: They are spherical or oval shaped

   Eg. *Staphylococcus*

2. Baccilus: They are filament or rod shaped

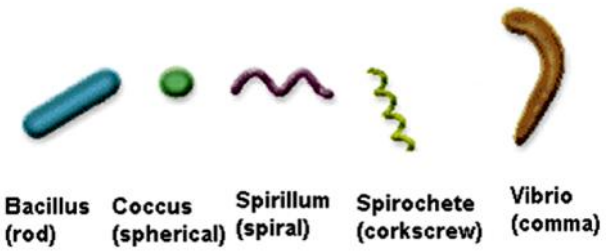
   Eg. *Salmonella*

3. Comma: They are shaped like slightly curved rods or comma shaped

   Eg. *Vibrio*

4. Spiral: These bacterial cells are twisted and resemble like corkscrews

   Eg. *Spirillum*



CLASSIFICATION OF BACTERIA BASED ON TEMPERATURE REQUIREMENT

Each bacterium has a range of temperature in which it has optimum growth. There is a minimum temperature below which the bacterial growth does not take place and a maximum temperature above which bacteria cannot grow. The optimum temperature is the most favourable temperature for growth.

Depending on their temperature preferences, bacteria are broadly classified as Psychrophiles,Mesophiles and Thermophiles.

Psychrophiles (Psychro=Cold, Philes=Love): Psychrophiles are cold loving bacteria They grow best between temperature range of 0-20^{0}C, the optimum being 15^{0}C. Many fish spoilage bacteria belong to this group.

Eg: *Pseudomonas sp*

Mesophiles: Mesophiles grow best at moderate temperature. Most mesophiles prefer temperature range of 20^{0}c -45^{0}c with an optimum of 30^{0}c – 37^{0}c. Most of the pathogenic bacteria belongs to this group.

Eg. *Salmonella,Staphylococcus*

Thermophiles (Thermo =Temperature, Philes = Love)

Thermophiles are those bacteria which grow best in higher temperature. They prefer temperature range of 40^0C – 90^0C with an optimum temperature of 55^0C

Eg. *Clostridium*

CLASSIFICATION OF BACTERIA BASED ON OXYGEN REQUIREMENT

Bacteria can be broadly classified into four major categories based on their oxygen/ air requirement.

1. **Aerobic** -Bacteria which require the presence of oxygen for their growth are called aerobic bacteria or aerobes.

   Eg. *Staphylicoccus, E.coli*

2. **Anaerobic** - Bacteria which can grow only in the absence of free oxygen are called anaerobic bacteria or anaerobes.

   Eg. *Clostridium*

3. **Facultatively anaerobic –** Bacteria capable of growing both in the presence and absence of oxygen are called facultatively anaerobic bacteria.

   Eg. *Listeria, Salmonella*

4. **Micro aerophilic –** These bacteria require extremely low concentration of oxygen for their growth.

   Eg. *Lactobacillus, Streptococcus*

CLASSIFICATION OF BACTERIA BASED ON THE NUTRITION REQUIREMENT

Based on their nutritional requirement bacteria are broadly classified into three.They are autotrophs, chemo autotrophs and heterotrophs.

- **Autotrophs** : These are bacteria which prepare their own food. Due to the presence of chlorophyll like pigment they perform photosynthesis.

Eg:Cyanobacteria

- **Chemo autotrophs** – As the name indicates they survive on chemicals. These are bacteria which synthesize their own food by use of energy obtained from chemical sources.
- **Heterotrophs** – These are bacteria which do not synthesize their own food but obtain it from others.

CLASSIFICATION OF BACTERIA BASED ON SALINITY TOLERANCE

Based on the salinity tolerance bacteria are classified into

- **Halophilic bacteria** –They are highly salt tolerant. So they flourish in environments with high level of salts. They need less water than other non halophilic organisms.

  Eg. *Serratia salinaria*

- **Halophobic bacteria**- These bacteria die at salt concentrations above 1%. They are salt hating bacteria

  Eg. *E.coli*

- **Halotolerant bacteria-** Halotolerant bacteria would be able to survive in salty environment, but can also live outside of this environment. Halophilic and

  Halotolerant bacteria cause spoilage in salted fish products.

CLASSIFICATION OF BACTERIA BASED ON GRAM STAINING

Bacteria can be classified into two groups on the basis of Gram staining.

1. Gram positive bacteria (G^{+ve})

   Eg. *Staphylococcus*

2. Gram negative bacteria (G^{-ve})

   Eg. *E.coli*

Gram staining :Gram staining is a differential staining process developed by Christian Gram. Crystal violet and safranine are two stains used in this process. A dilute solution of crystal violet and ammonium oxalate is used as the primary stain to act on the bacterial film for a minute. After washing away the stain with water, a dilute solution of iodine is added on the film and allowed to act for one minute. This is destained by washing with alcohol. Finally safranine is added as counterstain and allowed to act for one minute. It is washed with water, dried and observed under microscope.Some bacteria retain the violet stain even after treatment with destaining agent like alcohol. They are called Gram positive and others which fail to retain crystal violet, but take the counter stain safranine and appear red are called Gram negative.

PATHOGENIC AND NON PATHOGENIC BACTERIA

The terms pathogenic and non-pathogenic are often applied to various microbes. A pathogen causes disease, while non-pathogen is considered harmless. Our bodies are host to many microbes, most of which do not cause disease and many of them are beneficial.

Pathogenic bacteria

The bacteria which cause a disease is called a pathogenic bacteria. Virulence is the term used to describe the ability of a pathogen to cause disease. The degree of pathogenicity of a bacteria depends on its invasiveness and ability to produce toxins. Pathogenic bacteria can be spread to human population in a range of ways. Air, water, and soil are all common vectors, and people may also pass bacteria directly among one another through physical contact.

Examples: *Streptococcus*, *Salmonella*, *Staphylococcus*, *Vibrio cholerae*

Non pathogenic bacteria

These are bacteria incapable of causing disease. For example, non pathogenic *E.coli* live naturally in the large intestine of human being. It aids digestion by breaking down undigested sugars, also produces biotin and vitamin K. Non pathogenic *Staphylococcus epidermis* found in human skin, saliva, sweat glands. *Lactobacillus sp.* helps in food fermentation process such as yogurt production. Nitrogen fixing bacteria such as *Nitrosomonas*, *Nitrosococcus* present in the soil or in plant roots change nitrogen gas in atmosphere into solid nitrogen compounds.

Practicals

Preparation of a bacterial cell model

Draw and label the parts of a bacterial cell

Assessment Activities

Class test

Quiz based on the classification of bacteria

Group discussion on pathogenic and non pathogenic bacteria

TE QUESTIONS

1. Given below are the important parts of a bacterial cell.
   - Cell Wall
   - Flagella
   - Plasma Membrane

   Draw a neat diagram of bacterial cell and label the above parts.

2. Different phases of bacterial growth are given below:
   - Lag phase
   - Log phase
   - Stationary phase
   - Death phase

   Draw a graph showing different growth phases of bacteria.

3. Listed below are different bacteria

   (*Staphylococci, Vibrio cholerae, Salmonella*).
   - Classify these bacteria according to their shape.

4. Select the correct statement related to mesophilic bacteria from below.
   - Optimum temperature for its growth is 37^{o}C
   - They are cold loving bacteria.
   - They grow best in higher temperature above 40^{o}C
   - Most of them are spore forming bacteria.

5. Pick the odd man from the list below.

   Aerobes, Anaerobes, Micro aerophiles, Halophilic

UNIT 3.2- FISHERY MICROBIOLOGY

Introduction

In this unit the learners get an idea about the different bacterial species present in fish and fishery products. The sampling methods for microbial examination practised in a fish processing plant, estimation of the total plate count, colony characters of various pathogenic bacteria, different media used for bacterial culture and the safe limits of different bacteria in sea food are dealt with.

Learning Outcomes

The learner :

- Employs sampling methods for microbial, physical, organoleptic and chemical examination
- Identifies different culture media such as Stock buffer, Nutrient Agar, B P Agar, T 7 agar, Alkaline Peptone Water, TCBS Agar, Peptone water, Lactose Broth, BS Agar / X L D Agar, Mac Conkey broth
- Employs the methods of sterilization such as heat sterilization, chemical sterilization, filtration and radiation sterilization
- Employs TPC of Fishery products
- Identifies and operates different lab equipments used in microbiological laboratory such as: Autoclave, Hot air oven, Incubator, Colony counter, Water bath, Water still, BOD incubator
- Identifies and handles different glasswares used in Fishery microbiology lab

SAMPLING METHODS

Samples of seafood are collected for the estimation of different quality parameters. Inspections are carried out for four types of parameters. They are

- Physical parameters of the products like type of pack, size, grade, quality of the packing material etc.
- Organoleptic parameters like appearance, colour, odour, texture, etc. which are assessed by sensory evaluation.
- Chemical parameters like heavy metals, antibiotics and pesticides in cephalopods and crustaceans (Shrimps), which are assessed by the chemical analysis conducted by the EIC approved external laboratory.
- Microbiological parameters which indicates the sanitary / hygienic conditions of the processing unit, bacterial load in the processed product and presence of

pathogenic bacteria by contaminations. These are assessed by the microbiological testing in the in house Laboratory.

Inspection of the final product is done code wise and grade wise of the production. Sampling is done as per the sampling scale given below.

Sampling Scale

Number of cartons (Lot Size)	Number of cartons to be selected (samples)
Up to 12	2
13 – 24	3
25 – 40	4
41 – 80	5
81 – 120	6
121 – 180	7
181 – 250	8
251 – 350	10
351 – 500	12
501 – 750	14
751 – 1000	18
1001 – 1300	22
1301 – 1600	26
1601 – 2000	30
2001 & above	40

The number of cases /master cartons produced under each type of production is called a "lot". From each master carton, one slab is drawn as a sample. In case of block frozen products 20 % of the number of pieces subject to a minimum of 25 pieces are drawn as samples. If the number of pieces is less than 25 the entire contents of the carton is considered as a sample.When more than 10 packets are there in a carton, 10% of the packets are drawn as samples.

Drawing of bacteriological samples: Approximately 100 grams of the samples are drawn for the testing at the in-house lab for the following parameters:

- Total plate Count
- *E. coli*
- *Staphylococcus*
- *Salmonella*
- *Vibrio cholerae*
- *Vibrio parahaemoliticus*

Drawing of samples for chemical residues.

For chemical residual parameters, a composite sample of 150 grams are drawn from each variety of consignment of the products covering all the codes of production and it is then sent to the EIC approved labs (CIFT Kochi) for the analysis. Analysis for the physical parameters and the organoleptic parameters are conducted after melting the products and spreading on a table. The quality factors are recorded in the registers for organoleptic analysis.

Media used for bacteriological analysis

SlNo.	Bacteriologycal analysis	Media
1	Total plate count	Buffer, Nutrient Agar
2	*Stapyhlococcus*	Baird Parker Agar
3	*E.coli*	Tergitol 7 agar
4	*Vibrio cholerae*	Alkaline Peptone Water, TCBS agar (Thiosulphate-Citrate-Bile slats-Sucrose agar)
5	*Vibrio parahaemolyticus*	Peptone water ,TCBS Agar
6	*Salmonella*	Lactose Broth, BSA (Bismuth Sulphite Agar) / XLDA (Xylose Lysine Dextrose Agar)
7	Coliform Bacteria	Mac Conkey broth

METHODS OF STERILIZATION

There are mainly three kinds of sterilization methods followed in seafood quality control lab. They are

1. Heat sterilization
2. Chemical sterilization
3. Filtration

Heat sterilization: There are two methods of heat sterilisation. They are *Moist heat sterilisation* and *Dry heat sterilisation.*

- *Moist heat sterilization:* This is done by autoclaving the items to be sterilized. Culture media are usually sterilized by this method
- *Dry heat sterilization:* This is done by using hot air oven. Hot air oven is a thermostatically controlled metal chamber, heated electrically. Thermostat maintains the temperature at the required level. The recommended time temp. pattern is 145°C for 2 hrs. Glass wares are sterilized by this method.

Chemical sterilization: Disinfectants, antiseptics, germicides and sanitizers, alcohols, aldehyde etc. are used for local sterilization

Filtration: Heat labile liquids can be sterilized by filtration. Eg membrane filter, asbestos disc filter.

TOTAL PLATE COUNT

Total plate count gives information about the total number of aerobic bacteria present in a sample. A high bacterial count indicates the level of contamination of the product, conditions of storage, the extent of spoilage, etc.

Procedure:

Aseptically collect 10 g of sample in a sterile sample dish.Transfer the sample into a sterile mortar. Homogenise with 90 ml sterile phosphate buffer.Take this as 10^{-1} dilution. Pipette 1 ml of this to 9 ml diluent and mix well. Take this as 10^{-2} dilution. Pipette I ml of this to 9 ml buffer and take this as 10^{-3} dilution. Pipette 1 ml of this to 9 ml buffer and take this as 10^{-4} dilution.

10 g sample+90 ml buffer————(1ml)——>9 ml buffer——(1 ml)——>9 ml buffer——1 ml——>9ml buffer

1 ml each from the required dilutions is transfered to separate sterile petri dishes. Add to each petridish 10-15 ml of sterile Tryptone glucose Beef Extract Agar, mix well and allow to solidify. The plates are then incubated at 37°C for 48 hours and the colonies are counted.

$$\text{TPC per gram} = \frac{\text{Number of colonies X dilutions}}{\text{Weight of the sample}}$$

Preparation of stock buffer and working buffer in lab

Stock buffer: Take 34 gm of Potassium dihydrogen phosphate (KH2PO4) in 500ml distilled water. Adjust the PH to 7.2 with 1N NaOH. Bring the volume to 1000ml with distilled water. Autoclave 15 minutes at 15 lbs (121 C)

Working buffer: Take 1.25ml of stock solution and bring volume to 1000ml with distilled water. Dispense in to conical flasks (90ml), and test tubes (9ml). Sterilize 15 minutes at 15 lbs.

LABORATORY EQUIPMENTS

AUTOCLAVE: An autoclave is a pressurised device designed to heat aqueous solutions above their boiling point at normal atmospheric pressure to achieve sterilization. It was invented by Charles Chamberland in 1879. The term **autoclave** is also used to describe an industrial machine in which elevated temperature and pressure are used in processing materials.

A simple autoclave is a cylindrical vessel with a heavy lid fastened with screws. It is provided with an outer safety jacket and an electrical heating coil. A pressure gauge is provided on the lid. The cylinder should contain water to a level above the heating coils. On heating steam arises and mixes with air inside and carries it out through the discharge tap. When the air is completely expelled the valve is closed. The steam pressure rises to the desired level of 15 lbs per sq inch, the temperature reaches 121^{o}C.

The equipments to be sterilized shall be autoclaved at 121^{o}C for not less than 15 minutes. The following precautions shall be observed here.

Distribute the items with in the autoclave so that steam will be able to circulate freely. Make sure that there is enough water in the autoclave so that the coil is fully immersed in water. Ensure that all the air in the autoclave is expelled before it is closed.

Uses

Autoclaves are widely used in microbiology, sterilizing instruments for body piercing, veterinary science and dentistry. As damp heat is used, heat-labile products (such as some plastics) cannot be sterilized by autoclaving as they will melt; paper or other products get charred.

Hot Air Oven: Hot air oven is a double walled thermostatically controlled equipment with inner chamber made of Aluminium/stainless steel and outer body with mild steel. Beaded heating elements are placed under the ribs at the bottom and sides.

Temperature is controlled by hydraulic thermostat from 10º C above ambient to 240º C. Temperature is measured using a thermometer fitted on the front panel at the top. It is suitable to work on 220 volt A.C supply.

The equipments to be sterilized shall be placed in the oven in such a way that hot air will be able to circulate freely around each item. Switch on the oven and note the time when temperature reaches 165º C . Maintain the oven temperature at 160 to 165º C for 60 to 90 minutes, then cool before opening the door.

Incubator: Incubator is a warm cabinet in which you can set the temperature ideal for the growth of bacteria. About 35º C is ideal temperature for most bacteria. This is close to the human body temperature. The incubator temperature shall be correctly recorded using a standard thermometer, well inserted in the equipment and check the temperature of the water bath used for incubation regularly by immersing a standard thermometer in water

Practicals

Practise sampling procedure during OJT.

Practise TPC in school laboratory.

Identify and operate different laboratory equipments.

TE QUESTIONS

1.Match the bacterial organisms given in column A with the culture medium given in B column.

A	B
TPC	TCBS Agar
E. coli	BSA, HEA, XLDA
Vibrio cholerae	TGBE Agar
Salmonella	BP Agar
Streptococci	T 7 Agar
Staphylococcus	KF Agar

2. Moist heat sterilisation

   Dry heat sterilisation

   Chemical sterilisation

   - Listed are important sterilisation methods followed in quality control lab.

Identify its importance and explain the methods in brief.

4. Select the exact use of the medium given in A column from column B.

A	B
TCBS	• Culture medium of *Vibrio cholerae*
	• Culture medium of *E.coli*
	• Culture medium of *Staphylococcus*

5. Choose the correct statement related to TPC from those given below.

   - It is the total number of anaerobic organisms found in a gram of seafood
   - It is the total number of Aerobic bacteria found per gram of seafood sample
   - It is the measure of total faecal indicator organisms.

UNIT NO. 3. 3

MICROBES IN PUBLIC HEALTH

Introduction

Certain micro organisms are pathogenic and cause diseases in man, animals and plants. This unit gives an idea about some of the pathogens of public health importance. The learner gets an idea of the symptoms of diseases caused by sea food borne pathogens and their control measures.

Learning Outcomes

The learner :

- Observes the characteristics and identifies the sources of contamination and control measures of *E. coli.*
- Observes the characteristics and identifies the sources of contamination and control measures of *Faecal Streptococcus*
- Observes the characteristics and identifies the sources of contamination, disease and symptoms and control measures of *Staphylococcus aureus.*
- Observes the characteristics and identifies the sources of contamination, disease and symptoms and control measures of *Salmonella typhi*
- Observes the characteristics and identifies the sources of contamination, disease and symptoms and control measures of *V. cholerae*
- Observes the characteristics and identifies the sources of contamination, disease and symptoms and control measures of *V. parahaemoliticus*
- Observes the characteristics and identifies sources of contamination, disease and symptoms and control measures of *Clostridium botulinum*
- Observes the characteristics and identifies the sources of contamination, disease and symptoms and control measures of *Shigella*

Escherichia coli

Characteristics: It is a Gram negative, rod shaped and non-spore forming bacterium.

Primary habitat : The primary habitat of E.coli is the intestinal tracts of man, animals and birds. Therefore, its presence in seafood is genererally considered as an indication of faecal contamination. These organisms are not present in off-shore waters and in fish collected from such waters.

Sources of contamination :- Near-shore waters, contaminated boat deck, fish boxes and other contact surfaces, polluted process water, unclean workers, poor sanitary conditions in processing units. Natural water get contaminated with *E.coli* either by direct contact or mixing up with terrestrial sewage.When this water is used for fish processing, these organisms get entry into the product. Similar possibilities arise when ice used for preservation or the utensils used for processing are contaminated with *E.coli.* When the temperature is also favourable, the contaminated organisms multiply rapidly and further aggravate the condition.

Control measures: Since the presence of *E.coli* in seafood indicates the faecal contamination. It is adviced to adopt hygienic fish handling practises and avoid fishing from polluted coastal waters. Use only chlorinated water for processing and ice manufacturing. Proper time temperature maintenance is also essential to avoid contamination and multiplication of this bacterium.

Faecal Streptococci

Characteristics: They are Gram positive, non-spore forming non motile cocci.

Primary habitat: The primary habitat of *Faecal Streptococci* is the intestinal tracts of man, animals and birds.Their presence in fish food is considered as an indication of faecal contamination just like *E.coli*.These organisms are not present in off-shore waters and in fish collected from such waters.

Sources of contamination: Near-shore waters, contaminated boat deck, fish boxes and other contact surfaces, polluted process water, unclean workers, poor sanitary conditions in processing units.

Control measures: Practise hygienic fish handling and avoid fishing from polluted coastal waters. Use only chlorinated water for processing and ice manufacturing.

Staphylococcus aureus

Characteristics: They are Gram positive, non-motile cocci occurring singly, in pairs or in the form of irregular cluster resembling bunches of grapes.

Primary habitat: - The main reservoirs of *S.aureus* is man. Hands, face, sweat, boils, ulcers, nasal cavities, ear gum and nasal drips of man contain this organism in considerable numbers. About 30% of human population is known to be the nasal carriers of this organism. Skin of 30% of food handlers is known to harbours *S.aureus*. Therefore this organism is a useful indicator of human hygiene in a process involving human handling. Shrimp processing is a good example of such a situation.

Food poisoning due to *S. aureus:-*

Staphylococcus food poisoning is due to consumption of various fishery products like shrimps canned in brine, smoked cod in oil, fish sausage, salted herring, frozen fish sticks have been reported. Food poisoning outbreak may happen if the product is handled carelessly during later processing which leads to multiplication of these organisms to dangerous level. Toxins once produced cannot be destroyed by heating even at 100^0C. So it is clear that if sufficient quantity of toxin is formed in a food material, food poisoning can follow even if the material is consumed after cooking. Hence hygeine and adequate refrigeration of the material during handling and processing is highly essential in preventing multiplication and toxin production.

Diseases and symptoms

Nausea, vomiting, abdominal pain, diarrhea, absence of fever and sub-normal blood pressure are the usual symptoms which start within 1-6 hours after consuming the infected food. Complete cure is possible within 48 hours.

Control measures: Since *Staphylococcus aureus* is a useful indicator of human hygiene in the process involving human handling, adequate control over the health and hygiene of fish handlers, adequate refrigeration (always below 5^0C) of the material during handling and processing is essential to prevent this bacterium from seafood.

Salmonella

Characteristics : Salmonella is aerobic, Gram negative, rod shaped, non-spore forming mostly motile.

Primary habitat : The primary habitat is the gut of infected man, animals, birds, insects, rodents, lizards and snakes. From the gut it is excreted out through faeces and is found in sewage. Fresh fish collected from the open sea is free from *Salmonella*. However, fish from polluted coastal waters are usually infected.

Diseases and Symptoms

Salmonella food poisoning symptoms are nausea, vomiting, abdominal pain, diarrhoea, fever and headache accompanied by prostration, muscular pain, restlessness and drowsiness which last for 2-3 days. Complete recovery is possible only in about 20 days. At this stage these organisms disappear from the intestinal tract of most of the patients. But upto 5% of the victims may become the carriers of the organisms for about 3 to 4 months. “Carriers” are known to be the main source of *Salmonella* contamination in many types of food materials.

Control measures: Since incidence of salmonella is associated with polluted coastal waters, avoid fishing from polluted and near shore waters. Avoid sorting the catch on sea beaches. Use only chlorinated water for processing and for ice manufacture. Health check up can be carried out periodically to detect potential carriers and avoid such carriers from handling food. Follow good sanitary practices and proper hygiene in seafood factory.

Vibrio cholerae

Characteristics: *Vibrio cholerae* are shaped like coma or curved rods. They are Gram negative, non-spore forming and motile. It is aerobic and the optimum growth temperature is 30^0c.

Primary habitat: The only known natural habitat of *V.cholerae* is man and it is transmitted from man to man through the environment. Usually food, water, flies and contaminated hands play prominent role in the transmission of this organism.

Diseases and Symptoms: After an incubation period of 1-4 days, there is a sudden onset of nausea , vomiting, profuse diarrhoea with abdominal cramps. The stools resemble "rice water" and contain mucus, epithelial cells and large number of vibrios. The morality rate, without treatment, is between 25 and 50%.

Control measures: Environmental hygiene and sanitation plays a significant role in the contamination of seafood with *Vibrio cholerae*. So great importance should be given for sanitation and hygiene. The surroundings of processing plant should be kept clean and disinfected. Only potable water should be used and the water used for different purposes should be properly chlorinated. Due importance should be given to personal hygiene and periodical medical check ups of the workers are also advised.

Vibrio parahaemolyticus

Characteristics: *Vibrio parahaemolyticus* is a Gram negative, non-spore forming rodes. They are motile, facultatively anaerobic, halophilic and exhibit pleomorphism. Slightly curved, coccoid and swollen forms are also observed. Its optimum growth temperature is 30-35^0C. They are very heat sensitive and they cannot grow beyond 44^0c.

Primary habitat: This is of marine origin and can be found in seawater, sediments, planktons, fin fishes and shell fishes of coastal and estuarine origin. It is not reported from deep ocean since it cannot withstand deep ocean hydrostatic pressure.

Diseases and symptoms: In man *V.parahaemolyticus* causes either diarrhoea, occasionally dysentery or gastroenteritis. The infection is limited for only a few days with little evidence of spreading from one person to another.

Control measures: The natural reservoirs of *V.parahaemolyticus* is sea, estuaries and animals harvested from there. Preventing contamination of raw material is impossible. So much effort should be taken to prevent contamination of the finished products. Time and temperature control is very essential to control its rapid multiplication. *V.parahaemolyticus* is sensitive to heat, disinfectants, low pH. None of these other than heat would inactivate *V.parahaemolyticus* to a safer level. The most important means of controlling infection in human being lies in simple hygienic measures to prevent multiplication and cross contamination. Freezing is the most important method of preventing multiplication of *V.parahaemolyticus* in seafood.

Food poisoning would not occur if seafood is heated to 100^0C before consumption.

Clostridium botulinum

Characteristics: ***Clostridium botulinum*** is an anaerobic, Gram positive, spore forming, rod shaped bacterium. When it grows in food, it produces a toxin. This toxin is elaborated into food from bacterial cell.It is an exotoxin. Chemically it is a protein and when we ingest the food containing this toxin we get food poisoning. This food poisoning is called 'botulism'. Botulism toxin is a neurotoxin.

Primary habitat: This anaerobic bacterium is usually present in soil, aquaculture farm sediments and sea bottom.During unfavourable conditions *C. botulinum* produce spores which cannot be destroyed by heat treatment. Under favourable anaerobic conditions, the spores grow and produce toxin which is heat labile.

Symptoms of botulism

Symptoms begin usually within 12-36 hours after ingestion. Nausea and vomiting are the initial symptoms. In some cases, gastrointestinal disturbances follow. Thirst, diplopia (double vision), difficulty to swallow and difficulty to speak may follow. They may further be followed by breathing difficulty which may further lead to death. There is no satisfactory treatment for botulism. Once the disease is recognised as botulism, the only available remedy is to administer antitoxin injection.

Control measures: *Clostridium botulinum* is usually present in fish obtained either by capture or by aquaculture. Bottom feeding fishes, crustaceans and molluscs usually have highest level of contamination with *Clostridium botulinum.* Intestinal tract of these species is the main reservoir of this bacterium. So the incidence is

markedly reduced by gutting the fish. The source of botulism poisoning is usually the preserved food such as meat and meat products, canned vegetables and fish, salted and smoked fish and surimi. The spores of *Clostridium botulinum* are heat resistant. If food is contaminated with the spores, they survive heat treatment. These spores can germinate and produce toxins under favourable conditions. But the toxin is heat labile (destroyed at 80^0C in 30 to 40 minutes and at 100^0C in 10 minutes.). Hence boiling the canned food for 10 to 15 minutes prior to eating can prevent hazards due to botulism.\

Shigella

Characteristics: Shigella are Gram negative, rod shaped, non motile, non-spore forming, facultatively anaerobes growing within a temperature range of 10 – 40^0C.The optimum growth temperature is 37^0C.

Primary habitat: Man is the only known natural host for Shigella. The organism is transmitted directly from hand to mouth through contaminated fingers, contaminated food, water and ice, food handlers who are carriers of this organism, through flies and contaminated contact surfaces.

Diseases and symptoms: Shigella is often associated with intestinal diseases like bacillary dysentery. It is characterised by the passage of loose motion mixed with blood and mucous.

Control measures: As the infection due to shigella is exclusively from human sources. The measures like good personal hygeine, hygienic food handling practices, time and temperature control, restricting known carriers from food handling and use of properly chlorinated water and ice are followed to prevent or control this organism.

Microbial limits

Particulars	Raw products	Cooked Products
TPC	$5x10^5$/gram	$1x10^5$/gram
Faecal coliforms	20/gram	Nil
Staphylococcus aureus	100/gram	100/gram
Salmonella	Absent/25 gram	Absent/25 gram
V.cholerae	Absent/25 gram	Absent/25 gram

Practicals

Identification and observation of different bacteria.

Identification and operation of various equipments used in seafood industry.

Assessment Activities

Field visit report and OJT report.

Class test and Seminar

TE Questions

1. _____is a faecal indicator bacteria.
2. Select a bacteria found in the nasal cavity of man from the list below.
   (*E.Coli, Staphylococcus aureus, Clostridium, Vibrio cholerae*)
3. Describe the sampling methods for Bacteriological analysis
4. Select the exact colony character of bacterium given in column A from column B.

A	B
Staphylococcus aureus	• Brown colonies with metallic sheen
	• Red colonies with or without black centres
	• Small black shiny colonies surrounded by an area of clear zone

3 Briefly describe the method of enumeration of TPC

Unit No. 3.4
Hygiene and Sanitation in fish processing plants

Introduction

This unit highlights the need for factory hygiene, personal hygiene and chlorination schedule in processing plants. SSOPs and GMPs followed in Indian sea food industry are also dealt here. In the early stages the quality of products processed and exported by our sea food industry was heterogeneous in nature due to the lack of quality standards. This unit highlights the quality aspects like GMP which includes factory hygiene, personal hygiene, SSOP and chlorination schedule to be followed in seafood processing plant.

Learning Outcomes

The learner :

- Practises personal hygiene.
- Explains factory hygiene.
- Evaluates the quality of raw material in a processing plant.
- Practises online processing.
- Records temperature maintenance during processing.
- Experiments on freezing and packing related to production and process control.
- Experiments on packing and storage of frozen foods.
- Explains shipment of processed material.
- Lists key points on SSOP.
- Sketches chlorination chart.
- Estimates available chlorine in process water
- Practises cleaning schedule in a processing plant

GOOD MANUFACTURING PRACTICES (GMP)

Protection of consumers against food borne diseases and maintenance of manufacture's reputation mainly depend on the levels of sanitation in the seafood exporting unit. Seafood processing units handle highly perishable commodity which need utmost care and hygiene. Elevated temperature, poor sanitary conditions of the factory premises and inadequate hygiene of the workers will speed up the spoilage. Any amount of money spent in the factory will result in only diminishing returns

unless well organised programme of sanitation is prepared and implemented. GMP (Good Manufacturing Practices)is one such programme in which a series of preventive measures and permanent controls are undertaken during food production to ensure safe end product. The GMP regulations are as follows.

1. Personnels

Disease control : Any person who, by medical examination or supervisory observation, is shown to have, or appears to have, an illness, infected wounds, or any other abnormal source of microbial contamination shall be excluded from any operations.

Cleanliness: All the workers are to be provided with clean outer garments and boots/foot wears to wear before entering into the working area. They have to clean their nails by brushing, washing hands thoroughly with the soap solution provided at all entry points and disinfecting in the hand dip (20ppm chlorinated water) before starting work. Remove all the unsecured jewellery which may directly come in contact with food or food handling surfaces while in operations.Proper training is given to workers of all sections. Proper man power is also to be allotted in each section.

2. Building and facilities

Building:

The building should be a strong permanent structure with smooth surface to facilitate easy cleaning of dust particles adhering to it. The roof of the building is to be made of concrete. Separate and adequate change room facilities are to be provided for the male and female workers of pre-processing and processing section. A raised platform is to be provided in the receiving section for unloading the material from the trucks. Separate Chill rooms are to be provided for the storing of raw materials and processed materials. Separate sections for pre-processing, sorting, grading and processing are needed with sufficient spaces to avoid any cross contamination. Separate areas are to be provided for the washing of pre-processing utensils. Freezing, packing and storing facilities are to be provided in such a way as to facilitate the flow of work in a unilateral direction. Floors are to be easily washable with desired slopes towards the drainage line to avoid any stagnation of water. All walls in the area should be cemented and polished or fitted with glazed tiles up to a height of 6 feet from the floor to facilitate easy cleaning. The floor-wall joint shall be curved to facilitate easy cleaning.

All the doors are to be tight fitting and self closing type. Sufficient number of toilets with all facilities are to be provided. Toilets do not directly open into the pre processing

and processing area.At the entry to the fish handling area, adequate number of wash basins may be fitted to wash and disinfect workers' hands before entering the hall. There shall be foot dip filled with germicides at the entry to the hall and workers shall be instructed to enter the hall only through the foot-dip. There shall be sufficient lights and ventilation in the hall.All doors of the processing unit opening to outside shall be fitted with automatically working air curtains. Proper waste disposal facility is to be provided. Adequate facilities are to be provided for microbiological and organoleptic analysis of the product.

Floor : The floor inside the compound is to be concreted and maintained to avoid any contamination due to dust and stagnation of water.

Adequate drainage is provided in such a way as to prevent the entry and breeding of pests. Effluent Treatment Plant and its floor shall have proper slope so that the water on the floor runs into the drain.The drainage openings shall be closed with grills of proper size to prevent entry of rodents.

Other facilities: There shall be plentiful supply of potable water in the fish handling hall. Ice shall be stored on raised platform in separate insulation room.

1. Production and process control

a. Raw material purchase and receiving to the unit.

Purchase only very fresh material landed in clean and neat landing centres. Purchase only well iced material (Temperature of the material below +4ºC). After purchasing, the materials are re-iced immediately with sufficient quantity of ice, layer by layer (1:1 proportion) in good and clean containers for transporting to the factory by insulated trucks. Material is unloaded to the raised platform, from there to the raw material receiving area through chute.

b. Pre-processing

In the pre-processing centre after de-icing, the material is washed with chilled water distributed to the peeling/ pre-processing table where peeling, beheading, removal of entrails/gutting & cleaning, filleting etc. are carried out. Pre- processed material is iced and shifted to the processing area for further processing.

c. Processing

After de-icing and washing the materials are graded and sorted, according to the requirements of the buyers. Weighing, setting in trays, adding glaze and arranging in the trolleys for shifting it to the freezer room or loading in to the plate freezer are done.

d. Freezing

i) **Plate Freezing:** The freezer will be pre-cooled at +5°C and thereafter the processed material is loaded into the plate freezers. The plate freezer will freeze the product at –40°C in 90 minutes, for attaining the core temperature of the products at -18°C.

ii) **Blast Freezing:** Here the trolleys in which the trays containing materials are loaded in to the pre-cooled blast freezer and it is operated until the temperature inside reaches up to –40°C. This procedure will take around 4 to 5 hours

e. Packing of the frozen products

Packing of both block frozen and blast frozen products are carried out in the packing area. In the master cartons details such as Name of the product, Manufacture's address, Approval number of the Establishment, Type of packing, Brand, etc. are printed.

f. Storage of the Product

After packing in the master cartons the same is stacked in a cold store where the temperature is maintained at –18° C or below.

g. Inspections for quality assurance

All processing units should be equipped with an in-house laboratory to monitor plant sanitation and to have an in-process check on the product.

SANITATION STANDARD OPERATING PROCEDURES (SSOPs)

The sanitary procedures followed have to be clearly expressed by the seafood factory. The areas covered are sanitary aspects of water, food contact surfaces including equipments, machinery, utensils and employees, cross contamination with potable and non-potable water, materials at different stages, ice, pest control measures, sanitising and toilet facilities, protection from adulterants, storage of toxic chemicals and employees health. The areas where daily sanitation monitoring needed should be identified. Eight key sanitation conditions are explained below.

1. *Safety of the water and ice that come in contact with food or food contact surfaces, or used in the manufacture of ice should be ensured. Testing of water is carried out once in a year, and once in 4months at EIC approved laboratory for the parameters as per the EEC Directive.*

    - TPC at 37°C, 22°C; faecal coliforms and *Vibrio cholerae* are tested fortnightly.

- Water tanks are cleaned fortnightly or as when needed, as per the cleaning procedure.
- The roof of the concrete water tanks are sealed so that there is no chance for any external contamination due to bird droppings, dust, rodents etc.

2. *Condition and cleanliness of food contact surfaces, including utensils, gloves and outer garments*.

   All the equipments that come in contact with food are made of good grade plastic, stainless steel /Aluminum alloy and GI

3. *Prevention of cross contamination from sanitary objects to food, food packaging material, other food contact surfaces, including utensils, gloves and other outer garments and from raw material to final product.*

The following precautionary practices are exercised to prevent cross contamination:

- The lay out of the plant is in such a way that the raw material received is in the one end and the finished product handling is in the opposite end.
- There are separate sections for pre-processing and processing
- There are separate change rooms for male and female workers of pre-processing and processing with all facilities.
- Separate facilities and utensils are provided for each sections like raw material receiving, pre-processing, processing etc. and they are distinctly marked by different colours.
- There are separate washing areas for utensils of pre-processing and processing.

4. *Maintenance of hand washing & sanitizing and toilet facilities*.

Hand washing facilities are provided at the entrance of pre-processing and processing sections, entrance of toilets and bath rooms. Foot operated taps for potable water, sink, soap solution, soap filling cans and single use towels are provided. Basins containing 20 ppm chlorinated water is kept before the main working areas for sanitizing the hands by dipping for a contact time of one minute.Toilet facilities are provided in the rest rooms and change rooms as well.

5. Protection from adulterants

   Protection of food, food contact surfaces from adulteration with lubricants, fuel, pesticides, cleaning compounds, sanitizing agents, and other chemical,

physical and biological contaminants. These are properly labelled and stored in a separate chamber and also have separate entrance for storage.

6. *Proper labeling, storage and use of toxic compounds*.

7. *Control of employee health conditions.*

   Before appointment of workers, the health conditions are assessed by a medical practitioner. Those who have good health or those who are free from any contagious diseases are appointed for the work inside the factory. Periodic health check-ups are conducted and health card showing history of each worker is maintained in a prescribed format.

8. *Exclusion of pests from the plant.*

   Pests are excluded by providing air curtains and fly catchers at all entry points. Rodent traps are placed to prevent the entry of rodents**.**

Chlorination

In plant chlorination has become popular in seafood processing industry for process control and maintenance of good manufacturing practices. In processing plants sodium hypochlorites are used as main source of chlorine. It can be directly added to the water to be chlorinated. Chlorinated water is used for cleaning processing hall, utensils, processing tables, walls and floors, crates, and all other contact surfces. Process water as well as water used for glazing is chlorinated to disinfect. Some of the chlorine added combines with organic matters. The chlorine remaining after satisfying the demand of water will be available for germicidal action. The level of chlorine required in water during the various stages of processing seafood are given below.

CHLORINATION CHART

Process water	:	Below 2 ppm
Ice	:	Below 2ppm
Glaze water	:	Below 2 ppm
Hand Dip	:	20ppm
Foot dip	:	50 ppm
Utensil	:	50 ppm
Floor	:	150 ppm

Cleaning Schedule: All food contact surfaces including utensils and equipments are cleaned before start and end of work as and when required as per the cleaning procedure.

- Clean the food contact surfaces with water and thoroughly scrub using brush for removing slime and solid particles, and wash with potable water.
- Scrub with alkaline liquids detergent –Teepol and Wash with potable water.
- Apply disinfectant, chlorine water of desired level for a contact time of 15 minutes.
- Final wash with potable water.

Practicals

1. Visit to fish processing plant, learn and practise
    - Personal hygiene
    - Factory hygiene
    - Processing operation

Estimation available chlorine

Chlorinated water is used for manufacturing ice, as process water and glaze water and for cleaning various contact surfaces in the processing hall. Definite specifications are there for available chlorine in water used for different operations. Some of the chlorine combines with organic matters. The remaining chlorine available for the bactericidal and bacteriostatic property is of great importance in fish processing industry. It can be determined titrimetrically by employing $Na_2S_2O_2$ or As_2O_2 and colorimetrically by O- toludine method.

Estimation of chlorine by thiosulphate titration

Principle: This method is based on the following reaction

$$CI_2 + Na_2S_4O_3 = Na_2S_4O_6 + NaCI$$

When potassium iodide is used in the reaction, the CI_2 liberates an equivalent amount of I_2 from KI. The end point is indicated by the discharge of blue colour using starch indicator. If the available chlorine content is less than 15- 20 ppm, 1000 ml water is used for estimation.

Reagents required

Sodium thiosulphate 0.025 N

Dissolve 25gm of $Na_2S_2O_3.5H_2O$ in 1L to get 0.1N $Na_2S_2O_3$, standardize against

0.1 N $K_2Cr_2O_7$. Dilute it.

Glacial acetic acid

Potassium iodide

Starch Indicator

Procedure

Pipette 20 ml water sample in to a 250 ml conical flask.Add 2 g of Kl and 5 ml of glacial acetic acid. Titrate it with std. 0.025N sodium thiosulphate till a light yellow colour is obtained. Then add 1 ml starch indicator and continue titration till complete disappearance of blue colour. Note down the volume of thiosulphate used.

Calculation

Available CI_2 in water (mg/L)

$$= \frac{V \times N \times 35.5 \times 1000}{\text{Vol. of water sample}}$$

V = Volume of thiosulphate consumed in titration

N = Normality of thiosulphate used in titration

35.5 =Equivalent weight of chlorine

Assessment Activities

Handling of apparatus in lab while titration

Calculation of available chlorine

Preparation of questionnaire on personal hygiene and factory hygiene

Summarize the cleaning procedure followed in processing plants

TE questions

1. Expand the following

   GMP, SSOP

2. Match the following

2ppm	Hand wash
20ppm	Floor washing
50ppm	Utensil washing
100ppm	Ice and processing water

3. Briefly explain personal hygiene

5. Describe 8 points of SSOP

Unit No. 3.5

QUALITY STANDARDS FOR FISH AND FISHERY PRODUCTS

Introduction

Food standards have been introduced on a national and international level to protect the consumer's health and ensure fair practices in food trade. The formulation of standards for fish and fish products became necessary to attain a minimum standards of cleanliness and hygiene in fish handling, processing and exporting. Quality requirements of different countries are also highlighted here. In order to assure the quality of sea foods various inspection systems are in use. The guideline by these inspection agencies ensures that marine products are safe to consume and are produced under hygienic conditions. This unit highlights the various aspects of inspection systems in India and abroad.

Learning Outcomes

The learner :

- Lists national and international standards in sea food industry.
- Evaluates various inspection systems.
- Works with HACCP in Sea food industry.
- Maintains various records in processing plants like Hazard analysis work sheet, HACCP plan form, Tunnel freezer register, Plate freezer registers, Consolidated daily production register, Daily sanitation check list, Check list for personal hygiene, Chlorination register, Register for analytical report, Raw material evaluation register, Register for pre-processing summary and Register for processing.

National Standards

Government of India through an act of parliament passed a legislation on the Export (quality control & inspection) Act in 1963. Based on this act an Export Inspection Council (EIC) was set up on January 1964 to conduct quality control and pre shipment inspection. The EIC is assisted by Export Inspection Agency (EIA) established by the Government under section of the act. Five such EIA were established, one each at Mumbai, Kochi, Kolkatta, Delhi and Chennai.

From 1969 various inspection schemes of fish and fishery products were handed over to EIA by CIFT. Today all types of marine products are subjected to compulsory

quality control and pre-shipment inspection before export. It has become mandatory that a certificate of inspection accompanies all consignments.

Bureau of Indian standards (BIS): The system was initially known as Indian Standards Institution (ISI). BIS published specifications for fish and fishery products. The main objective is to formulate qualifying standards for various products including fishery products and its components are as follows.

- To check physical specification of product such as weight, size etc.
- To check chemical parameters of the product and its composition such as food additives, ingredients etc.
- To check microbial parameters and avoid contamination of the product.

BIS Specification for Frozen Fish

Raw material	Fresh & clean
Signs of spoilage	Nil
Freezing temperature	Less than – 40° C
Freezing time	Less than 2 hours
Organoleptic quality	Superior
TPC	Below 5 lakhs

The Food Safety and Standards Authority of India (FSSAI)

It has been established under Food Safety and Standards Act, 2006 which consolidates various acts and orders that have hitherto handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.

International standards

Codex Alimentarius Commission

It is an international organization for the formulation of food standards to use globally. The aim is to protect consumer's health and ensuring their trade practice. Those standards are used by member countries to formulate their own standards. The codex documents include proficiency in respect of good hygiene, contaminants and food additives, labelling, presentation and sample selection.

ISO 9000

It is an international organization for standardization, established in 1946 with headquarters at Geneva, Switzerland. The purpose of ISO is to promote the development of standardization globally to facilitate international exchange of goods and services. ISO 9001, 9002, and 9003 are models for quality assurance in organization . ISO 9004 provides detailed elements to consider when designing or revising a quality management system. Companies can register their quality management system to only ISO 9001, 9002, 9003. ISO 9000 is the short cut name for the overall series of the 5 documents and the name for the first one in the series.

USFDA

It is enforced by US Government for the safety of general public. It is intended to ensure that food is pure, wholesome, safe and produced under hygienic conditions. The requirements under USFDA are name and address of the manufacturer, net weight, common name of food, ingredients in food, source of raw material, nutritional label, production code indicating date of production and food additives.

EU Standards

It is prescribed by the countries of European Union. Microbial standards, heavy metal standards and drug residual content prescribed in European standard make it unique from other quality standards.

USFDA, EU and Japanese Standards for fish and fishery products

Particulars	Raw products	Cooked Products
TPC	$5x10^5$/gram	$1x10^5$/gram
Faecal coliforms	20/gram	Nil
Staphylococcus aureus	100/gram	100/gram
Salmonella	Absent/25 gram	Absent/25 gram
V.cholerae	Absent/25 gram	Absent/25 gram

Various Inspection Systems

Consignment wise Inspection

It is the simplest form of inspection. Here the owner of the exporting unit submits an export request for inspection after his consignment is ready for export. EIA performs

inspection of the product by drawing random sampling. If the sample meets the requirements and standards specified, a certificate of worthiness will be issued to the consignment or otherwise it is rejected.

Drawbacks of the system are:

- The rejection of the consignment cause heavy loss to the processor.
- Leads to dislocation of shipping schedule.

Quality Control and Inspection in Approved units (QCIA)

According to this, each processing unit should fulfil certain minimum requirements related to surroundings, construction, lay out, ceiling, floor, fly proofing, vermin and animal control, ventilation, lighting, working table, utensils, machinery, cold storage and warehousing, water and ice, sanitary facilities, sewage and waste disposal, toilet facilities, personal health & hygiene and transportation facilities.

The unit decided to operate under this system will have to get an approval from the competent authority before starting the processing. On request a panel of experts visit the plant and approval will be accorded.

Continuous inspection at different stages of processing is followed. The quality of water and ice, sanitary and hygienic condition of the plant and maintenance of documents will also be monitored regularly. Certificate of inspection is issued by EIA based on end product inspection. It ensures high quality product and losses can be minimized since the defects are rectified at the production line itself.

In Process Quality Control (IPQC)

To get approval under this system the processing plant meets certain additional requirements over those in QCIA that includes competent and qualified personnel to supervise pre- processing operations, to conduct organoleptic evaluation and bacterial analysis of the product and laboratory with all equipments and chemicals. Inspection and monitoring at various stages of the processing are conducted by the personnel of the unit. Based on declaration of the technologist regarding the export worthiness of the consignment, EIA issues certificate of export.

Self certification Scheme

A unit performed under IPQC for a stipulated period without any problem and with out any rejections are eligible for self certification. This system is extended to processors who fulfil:

- All infrastructural facilities.
- Strict quality control system in the plant.
- Regular auditing of the quality system
- Established reputation.

The technologist of the plant performs the end product inspection and processors are permitted to certify the export worthiness of their product.

European Union Approval

European Union countries banned import of Indian seafood due to report of certain pathogens in it during 1997. Government of India took up the matter and as a result of bilateral negotiations a new system of approval to sea food processing plant was introduced. The unit which wishes to export fish and fishery products to European Union has to give a request to EIA. The preliminary panel, IDP (Inter Departmental Panel) will inspect the plant. If it is approved by IDP a second high power panel, SAT (Supervisory Audit Team) will carry out inspection. SAT will give recommendation to EIC and EIC will approve the plant for exporting to EU.

Hazard Analysis Critical Control Point (HACCP)

Hazard Analysis Critical Control Point (HACCP)concept was proposed by USFDA has been taken as a standard process control system for assuring food safety by international bodies**.** This concept offers possibilities to secure the safe production of food**.** It helps the processors to perform the analysis and control the process to prevent known hazards that are likely to occur. It is a preventive strategy, based on thorough analysis of the prevailing conditions in the processing factory. It is a study related to the prevention of contamination and growth of micro organisms in all stages of food chain. Through this system, the hazards that may occur at different stages of processing are identified and prevent it or reduce it to an acceptable or safer level by the implementation of Good Manufacturing Practices, Good Hygienic Practices, Sanitation Standard Operating Procedures etc.

Hazard: A hazard is a biological, chemical, physical or economical factors with potential to cause an adverse effect on health and wealth.

Biological hazard: This includes pathogenic bacteria, viruses and parasites. These hazards can come from raw materials or from food processing steps.

Physical hazard: It includes any physical substances like sand, stones, glass pieces, insects etc. Decomposition, adulteration and economic fraud also come under physical hazard.

Chemical Hazard: Naturally occurring chemical hazards including histamine poisoning, ciguatoxin, PSP, DSP, ASP, unintentionally added chemicals like pesticides, fungicides, intentionally added chemicals like antibiotics in aquaculture, sulphites used to prevent melanosis in shrimp etc.

Control point: Control point is any step in a manufacturing process of a product at which a biological, physical or chemical hazard can be controlled.

Critical Control point: Critical Control point is any step in a manufacturing process of a product which if not controlled properly may result in the occurrence of a risk so that the products are unwholesome or cause of economic fraud.

Principles of HACCP:

- Conduct a hazard analysis, identify, list the hazards and specify the control measures.
- Identify the CCPs in the process.
- Establish the conditions necessary to control hazards at each CCP.
- Establish monitoring system to ensure control of CCPs
- Establish corrective action or preventive measures to be taken while monitoring, indicates that a particular CCP is moving out of control.
- Establish verification procedure which include supplementary tests together with a review which confirms HACCP is working properly.
- Establish a documentation system.

Practicals

Preparation of Hazard analysis Work sheet and Plan form for the given Product. Give a product with its flow chart and prepare Work sheet and Plan form for that particular product.

Hazard Analysis Worksheet

Firm name

Firm address

Product Description

Method of Storage & Distribution

Intended use & Consumer

Ingredient/ Processing Steps	Identify potential hazards introduced, controlled or enhanced in this step	Are any potential food-safety hazards significant (Yes/ No)	Justify your decision for column 3	What preventive measures can be applied to prevent the significant hazard	Is this step a critical control point
	Biological				
	Chemical				
	Physical				
	Biological				
	Chemical				
	Physical				

HACCP Plan Form

Firm name

Firm address

Product Description

Method of Storage & Distribution

Intended use & Consumer

Critical Control Point	Significant Hazard (s)	Critical Limits for each preventive measures	Monitoring				Corrective Action (s)	Records	Verification
			What	How	Frequency	Who			

Signature of company Official

Date

Example

Product Description	:	Frozen Cuttle Fish Whole cleaned Block Frozen 5 x 4 Kg pack
Method of Distribution	:	Frozen store at – 18° C
Intended use & Consumer	:	General Public

FLOW CHART

Receiving

↓

De-icing & Washing

↓

Sorting & Grading

↓

Weighing

↓

Setting in trays

→ Q/C Inspection

↓

Freezing

↓

Packing in master cartons

↓

Cold storage

↓

→ Q/C Inspection

Shipment

HAZARD ANALYSIS WORKSHEET

Product Description : Frozen Cuttle Fish Whole cleaned
Block Frozen 5 x 4 Kg pack

Method of Distribution : Frozen store at - 18o C

Intended use & Consumer : General Public

Ingredient/ Processing steps	Identify potential hazards introduced, controlled or enhanced in this step	Are any potential food safety hazards significant? (Y/N)	Justify decision for column 3	What preventive measures can be applied for this significant hazard ?	Is this step a critical control point (Y/N)
Raw material receiving	Biological – Bacterial pathogens	Y	Raw sea food can be a source of pathogens	Controlled by GMP & SSOP	Y
	Chemical - None	Y			
	Physical – Soil, Metal pieces, glass pieces	Y	Injurious to health	Controlled by SOP	
De-icing and washing	Biological – Bacterial pathogen growth	N	Controlled by SOP,SSOP		N
	Chemical - None				
	Physical – None				
Sorting & Grading	Biological – Bacterial pathogen growth	N	Controlled by SOP,SSOP		N
	Chemical - None				
	Physical – None				

Weighing	Biological – Bacterial pathogen growth	N	Controlled by SOP, SSOP		N
	Chemical - None				
	Physical – None				
Setting in trays	Biological – Bacterial pathogen growth	N	Controlled by SOP, SSOP		N
	Chemical - None				
	Physical – None				
Freezing	Biological – Bacterial pathogen growth	N	Controlled by SOP, SSOP		N
	Chemical - None				
	Physical – None				
Packing	Biological – Bacterial pathogen growth	N	Not likely to occur because the product is frozen		N
	Chemical - None				
	Physical – None				
Cold storage	Biological – Bacterial pathogen growth	N	Not likely to occur because the product is frozen		N
	Chemical - None				
	Physical – None				
Shipment	Biological – Bacterial pathogen growth	N	Not likely to occur because the product is frozen		N
	Chemical - None				
	Physical – None				

HACCP Plan Form

Product Description : Frozen Cuttle Fish Whole cleaned
Block Frozen 5 x 4 Kg pack

Method of Distribution : Frozen store at - 18^0 C

Intended use & Consumer : General Public

Critical Control Point	Significant Hazard (s)	Critical Limits for each preventive measures	Monitoring	Corrective Action (s)	Records	Verification			
			What	How	Frequency	Who			
Raw Material Receiving	Pathogen	Raw material temperature should be $+4^o$ C or below Freezing with in **6 hrs.**	Raw material temperature Arrival Time Quantity of ice	Temp. monitoring by digital thermometer Using clock Visual observation	For every 50 Kg of Raw material Continuous visual observation	Q/C in charge Supervisor	If the raw material temp. is above 5^o C the material will be rejected If there is no sufficient quantity of ice more ice will be added	Raw material evaluation register Monitoring records	Review of raw material evaluation sheet Review of end product test report (microbiological) Review of calibration reports

Signature of company Official Date

3.5.4 Various Registers used for Documentation

Processing Register: This register contains the total quantity of raw material purchased with variety, quantity received, quantity packed, filled weight, count when packed as well as bacterial condition of the raw material.

Consolidated Production Register: This contains the data of total quantity produced grade-wise, quantity shipped and the balance available at any time.

Packing register:This indicates the exact number of cartons produced each day, the cartons certified and balance to be certified.

Inspection register:These contain the details of organoleptic and bacteriological analysis of each day's production and details of analysis of sanitary samples.

Register for non-conventional packs: This include stocks of all non-conventional packs stored in the cold storage.

FREEZER LOG

Date:

Sl

Load No.	Item	Time of loading	Time			Temp		Time of unloading	Core temp.	Signature
			1st	2nd	3rd	4th	5th			

Date:

Shift:

Plate Freezer

Load No.	Item	Time of loading	Time		Temp	Time of unloading	Core temp.	Signature
			30min.	60min.	90min			

CONSOLIDATED DAILY PRODUCTION REGISTER

Type of Product…… Type of Pack……..……..Date……

Code……..

Grade								Total No. of slabs	Signature of Technologist	Remarks / Signature of EIA Officer
Previous stock										
Production										
Total										
Less despatched										
Balance										

DAILY SANITATION CHECKLIST

SANITATION CONDITION	Time						CORRECTIVE ACTION
A. PREMISES							
1. No unwanted materials in the surroundings							
2. No stagnant water							
B. RECEIVING SECTION							
1. Is the floor & wall clean							
2. Are the doors clean							
3. Rodent and fly proofing adequate							
4. Free from dust and insects							
5. Air curtain and chute door working							
C. PRE- PROCESSING							
1. Is the floor and wall clean							
2. Rodent and fly proofing adequate							
3. Drainage clean							
4. Waste disposal adequate							
5. Are all the taps functioning							
6. Utensils are properly arranged.							
D. PROCESSING SECTION							
1. No unwanted materials							
2. All taps functioning							
3. Drainage clean							
4. Floor and wall clean							
5. Utensils are properly arranged							
E. ICE STORE							
1. Ice tub clean							
F. CHEMICAL STORE							
1. Dry and wet chemicals stored separately and labelled.							
G. PACKING SECTION							
1. The packing materials are properly arranged							
2. All utensils clean.							
3. Taps working.							
H. ANTE ROOM							
1. The floor and wall clean							
I. COLD STORE							
1. Thermograph working properly							
2. The digital display functioning							
J. CHANGE ROOMS							
1. Change rooms clean.							
2. Gum boots Properly kept							
K. TOILETS							
1. Are toilets kept clean and flushes working							
L. MACHINE ROOM							
1. Machine room kept clean and arranged							

CHECK LIST FOR PERSONNEL HYGIENE

Date:

Shift:

	Shift I	Shift II	Remarks
General health condition			
Condition of uniform			
Mouth cover properly worn			
Head gear properly worn			
Nails trimmed			
Condition of hands			
No ornaments/flowers			
Gum boots are clean			
Overall appearance			
Monitored by			

CHLORINATION REGISTER

Chlorine level in ppm

Time	Foot Dip ppm	Hand dip ppm	In line Water ppm	Ice ppm	Water For			Dip Water ppm	Glaze Water ppm	Remarks
					Floor Washing ppm	Table / Equipment ppm	Utensils, Tray, Scalesppm			

Date

Signature of Supervisor

REGISTER FOR ANALYTICAL REPORT

Name of the Fishery product
Type of Product
No. of Cartons
No. of samples drawn code:

ORGANOLEPTIC ANALYSIS

Sl. No.										
Type of packing										
Declared Size/ Grade										
Species										
Drained Wt./pack Wt.										
Count Per Lb/ Kg or Wt. per piece										
General appearance										
General odour										
Dehydration										
Discolouration										
Deterioration										
Black spot on shell or meat										
Broken /damaged/bruised pieces										
Legs, veins, loose shells etc.										
Non uniformity of size										
Foreign vegetable matter										
Objectionable Foreign matter										
Texture										
Total deductions/ Percentage										
Overall rating										
BACTERIOLOGICAL ANALYSIS										
T.P.C. at 37° C/g										
E.Coli at 37° C/g										
Staphylococcus at 37° C/g										
Salmonella + / -										
Vibrio Cholerae + / -										

Decision : Remarks : Place :

RAW MATERIAL EVALUATION REGISTER

Date :

Source :

Type :

Species :

Quantity :

Day code :

Vehicle No :

Name & address of supplier	Receiving Time	Temperature of the Material	Appearance Rating	Odour	De-hydration	Dis-colouration	Decom position	Quantity Accepted	Corrective Action	CCP monitoring	Remark	Signature of Production Supervisor	Reviewed by signature of QCT

REGISTER FOR PRE- PROCESSING SUMMARY

Lot No.	Receiving Time	Species	Temperature	Pre-Processing		Quantity of Raw Material	Quantity of Pre-processed Material	Quantity of Waste material	Yield %	Signature of Supervisor	Signature of QCT
				Starting Time	Finishing Time						

REGISTER OF PROCESSING

Date …….

Lot No.	Type of product	Species of the material	Qty. in Kgs	Time in	No. of samples tested	Size grade of the samples & No. of pieces While packing	Filled weight observed grade wise	Organoleptic quality	Organoleptic quality if not satisfactory		Remarks	Signature of the Technologist of the unit/ EIA Officer
									Nature of defects	Action		

Practicals (detailing)

1. Chart preparation on physical, biological and chemical hazards.
2. Visit to processing plant and collect specimen copy of various records maintained in processing plants.

Assessment activities

Participation in practicals

- Unit test

TE questions

1. Find the odd man out

   USFDA FSSAI Codex Alimentarius ISO 9000

2. Expand the following

   HACCP EIC BIS CCP FSSAI

3. Match the following

Sl. No.	A	B
1	Physical Hazard	Heavy metals
2	Chemical Hazards	Pathogenic bacteria
3	Biological Hazard	Metal and glass Pieces

4. Prepare an article on the quality standards of fish and other sea foods
5. List the seven principles of HACCP
6. List any five registers used in sea food processing plant
7. Describe Hazard and CCP

EXTENDED ACTIVITY

Seminar on Contamination , Spoilage, Preservation and Processing of Fish and other Sea foods

PTC can be made service oriented by water quality analysis of adjacent water bodies for TPC and E.coli; Checking quality of ice from nearby ice plants.

LIST OF PRACTICALS

1. Draw the structure of a bacterial cell
2. Chart preparation on the different growth phase of bacteria
3. Preparation of stock buffer
4. Preparation of working buffer
5. Enumeration of TPC of Fishery products
6. Identification & Operation of lab equipments like Autoclave, Hot air oven, Incubator, Colony counter, water bath, water still, BOD incubator
7. Chart preparation and exhibition on GMP and SSOP
8. Preparation of chlorination chart of a processing plant.
9. Estimation of available chlorine
10. Calculation of the amount of chlorine to chlorinate water as per required concentration
11. Writing sample records and registers maintained in processing plants
12. Chart preparation on physical, biological and chemical hazards

OVERVIEW OF MODULE 4

Ready to eat, cooked fishery based products have now been popularised among consumers in India. It can be produced with out much investment and sophisticated technology. Production of fishery based products can be included in the rural development programmes. Encouraging the production and marketing of fishery based products through cottage industries can create self employment opportunities at village level. This will enhance living standards of the rural poor of India.

Hence this module highlights the importance of fish and other sea foods by familiarizing and developing skills in the production of various fish based products and other sea foods.

ABOUT THE UNITS

UNIT 4.1 Value Added Fishery Products

Introduction

At present consumers prefer value added fishery products than traditional raw fish. This value added fishery products can be prepared not only from value fishes but

also from cheaply available trash fishes. Many value added fish products like fish cutlets, fish wafers, fish sausage etc. can be prepared from fishes without much investment and mechanical support. The learners develop skills in the preparation, storage, and distribution of value added products under hygienic conditions through practicals, field visits, PTC and OJT activities mentioned in this unit.

Learning Outcomes

The learner :

- Prepares fish marinades
- Prepares fish /clam/prawn pickle
- Prepares fish /clam/ prawn cutlet
- Prepares Fish wafers
- Prepares Fish sausage
- Prepares Fish Ball
- Prepares Fish Finger
- Prepares Fish momos
- Describes the preparation of Fish Protein Concentrate
- Prepares Fish soup powder
- Prepares Dried Prawn pulp
- Describes the preparation of Masmin flakes

Concepts (detailing)

FISH MARINADES

Marinades are fish or fish portions processed by treatment with edible acid and salt and put up in brine or oil. Development of micro organisms are generally delayed in acid medium having concentration of 1-2%. Salt extracts water out of the fish tissue and cause the proteins to coagulate.

Types of Marinades

On the basis of process employed, the marinades are classified into Cooked marinades and Fried marinades.

Cooked marinades

Fish or fish portions are treated with edible acids and salt and are heat treated. The combined effect of heat and acid gives the preservative effect.

Fried marinades

In the Fried marinades the fish after pre treatment with acid and salt is baked or fried in the oil with or without breading and is covered with acetic acid or sauces. The higher temperature of frying kills most of the bacteria in fish flesh.

Assessment activity

Group discussion

Class test

Preparation of a project report for starting a small scale fish pickle unit

Practical

PREPARATION OF COOKED MARINADES

Raw material – Good quality Raw material

↓

Washing

↓

Dressing – Gilling, beheading and filleting

↓

Blanching – Blanching in 2% acetic acid and 6-8% salt at 85^0C for 10 -15 min

↓

Adding spices – Coriander, cloves, pepper and bay leaves are added to final pack

↓

Packing – Pack in a medium of 2% acetic acid and 3% salt

↓

Sealing

PREPARATION OF FRIED MARINADES

Raw material – Good quality raw material

↓

Washing – To remove dirt, sand, etc.

↓

Weighing

↓

Dressing – Gilling, beheading and filleting

↓

Brining – 5 % salt solution for 10 min

↓

Frying – Deep fry at temperature 1600 C - 1800 for 5-12 min

↓

Adding spices like coriander, cloves, pepper and bay leaves to the final pack.

↓

Pack in a medium of 2% acetic acid and 3% salt

FISH CUTLET

This product is prepared from minced fish meat. Fish cutlet is a highly acceptable consumer product. They can be flash fried and kept stored up to 6 months.

Preparation of fish cutlets

Cook the fish and separate the meat. Cook the potatoes, peel, mash and add the cooked fish mince, salt, turmeric powder, kashmiri chilly powder, pepper powder, masala and fried chopped onion, ginger and curry leaves. Mix them well. Mould the mixture into round shape and dip in batter and rolled over bread crumps. This is flash fried in vegetable oil maintained at 160-170^{0}c for 5 seconds. They are then packed in consumer packets and kept stored at -20^0 c. Cutlets are deep fried prior to consuming. Storage life is 6 months at -20^{0}c.

Assessment activity

- Calculation of the economics of fish cutlet.
- Marketability of fish cutlet.

Practical

Preparation of fish /prawn/clam cutlet

FISH WAFERS

Fish Wafers

Dried, ready-to-fry and ready-to-serve wafers, with carbohydrate as main base and incorporating salt and several other ingredients with or without spices are very popular in most parts of the country. Cheaper varieties of fishes like thread fin breams, sciaenids, cat fish etc. can be used for the preparation of this product.

Practical activity

Preparation of fish wafers

The dressed and cleaned fishes are cooked in water for 30 minutes. It is then cooled and edible meat alone is separated. Homogenize the processed fish meat with 1 litre of water for 10 minutes in a mechanical grinding machine. Add corn flour, tapioca starch, salt and water; blend the whole mass for one hour. Spread the homogenised mass uniformly in aluminium trays in a thin layer of 1-2 mm thickness and cook in steam for 3-5 mins. Cool to room temperature. Cut the cooked material into desired shapes and dry under sun or preferably in artificial dryer (at 45° C to 50° C) to a moisture content below 10%.Pack suitable lots of the dried product in sealed polythene bags or glass bottles and store it in a cool and dry place till marketing. The product can be stored in good condition for two years. Permitted food colours can be incorporated, if needed, at the time of mixing the other ingredients with the processed fish meat in order to get desired colour. Generally, this type of product is used as side dish after frying in oil.

FISH SAUSAGE

Sausages are prepared from the mince of low value fishes along with ingredients like

starch, sugar, salt, spices, fat. These are packed in natural casings, synthetic non-edible and edible casings. Normally the sausages are stored at refrigerated temperatures for two weeks, and for more than six months in frozen storage. Heat processed sausages can be stored at room temperatures for a period of six months.

The main ingredient is surimi or ground fish meat. The surimi is mixed with salt (3-4%), sugar (2-3%), sodium glutamate (0.3%) starch, and soya protein in a silent cutter. At the end of mixing, lard or shortening (5-10%), polyphosphate (0.2-0.3%) and flavorings are added and the minced meat is placed in a casing tube made from vinylidine chloride. Stuffing is done by an automatic screw stuffer. The casing tube is closed by metal rings. The tube is heated in hot water at 85-90°C for 40-60 min. After heating, it is cooled down slowly to avoid shrinking of the tube and then stored at refrigerated temperature

Assessment activity

Prepare a write up on Fish sausage

FISH BALLS

There are several varieties of fish which do not command a ready market as fresh fish, but are comparable to many table fish in nutritive value. One of the ways of ensuring effective utilisation of such fish is to process ready-to-serve or ready-to-cook value added products, for which there already exists great demand from within the country as also from abroad. Fish ball is one such product prepared using fish mince and starch.

Practical activity

Fish ball preparation

Mix fish mince with 1 % salt and 5% corn starch (if required, spices like garlic, ginger etc. can be added). Prepare balls of 2-3 cm in diameter. The balls are battered and breaded. Pack the balls preferably in thermoformed trays as such or after flash frying in hot vegetable oil. Preserve by freezing and store at -18^{0}c.

Assessment activity

Prepare a write up on fish balls

FISH FINGERS

Fish fingers, also known as fish sticks is a processed food made using a white fish, which has been battered or breaded. They are commonly available in the frozen food section of supermarkets. They can be baked in the oven,

grilled, shallow fried, or deep-fried. The fish used may be either fillets cut to shape or minced/ground fish reformed to shape. Those made entirely from fillets are generally regarded as the higher quality products and will typically have a prominent sign on the box stating that the fish is 100% fillet. Minced fish is more commonly used in store brand economy products. They may have either batter or breadcrumbs around the outside as casing, although the coating is normally breadcrumbs. In addition to white fish, fish fingers are sometimes made with salmon.

Practical activity

Preparation of fish fingers

Fish is washed in chilled water. It is weighed and meat is separated to a size of 1 x 1 x 5 cm. It is again washed in chilled water, soaking with 3% salt and lemon juice for 1 hr. Drain for 10 minutes, Pierce thin bamboo needle or stick from coconut leaves. Then batter (prepared by mixing egg, corn flour, wheat flour, Bengal gram, dal powder, salt ginger, garlic, kashmiri chilly power etc.) is prepared. It is breaded and quickly frozen for storage. Fry in oil before serving.

Assessment activity

Prepare a write up on Fish fingers

FISH MOMOS

Momos is a broad classification for a dish that consists of small pieces of dough (made from a variety of starch sources), often wrapped around a filling. The dough can be based on bread, flour, or potatoes, and filled with fish, They may be cooked by boiling, frying, simmering, or steaming. It can be consued as such or with gravy / sauce, or in soups or stews.

Practical activity

Prepare fish momos

Ingredients

1. Flour (Maida)	-	2 cup
2. Salt	-	¼ tea spoon
3. Water	-	as needed

Combine flour and salt in a large bowl. Add little water knead well for 5 to 6 mins. to make nice soft dough. Cover the dough with a damp cloth. Cover the bowl with a lid and keep aside for 10 min. or until use.

For stuffing

1. Fish (Tuna,Seer fish,etc.) -500g
2. Onion -1 (finely chopped)
3. Ginger paste -1 tsp.
4. Garlic Paste -1 tsp
5. Chopped spring onion - 4
6. Pepper powder- ½ tsp
7. Lime juice -1 tbsp.
8. Salt to taste

Instructions

- Knead dough with maida, salt and water. The dough should not be sticky but right for rolling out
- For the filling de-vein and mash the fish, add all the other ingredients and mix well
- Divide the dough into small balls. Using dry flour roll each ball into a thin circle (as thin as possible)
- Place a small amount of stuffing in the centre of the circle
- Start pleating from one side and join in the centre. Prepare all the momos, cover with wet cloth and keep aside until use.
- Grease steamer pan with oil, arrange the momos in the pan (keep space between them). Steam till the outer cover becomes transparent (for about 10-12 min). It depends on the thickness of the outer cover
- Serve hot with tartar sauce or tomato ketchup.

Assessment activity

Prepare a write up on Fish momos

FISH PROTEIN CONCENTRATE

Fish Protein Concentrate (FPC) is a food grade powder product designated primarily for human consumption. FPC is a colourless, odourless powder product with medium level of protein (50-70%) and contains some level of fat/oil (1-20%) in the powder

form as well; prepared from fresh fish of almost any kind or size.

Preparation of FPC

Fresh fish is selected for the preparation of FPC. The raw material is washed well in chilled water and weighed. The fish is beheaded, de-skinned and gut is removed. The edible meat is picked and minced well and minced meat is suspended in water in the ratio 1:1. Add glacial acetic acid at the ratio of 5% of the weight of minced fish. It is heated at 70-80^0 C for 30 min. on a water bath. The mixture is filtered and the left over is pressed to make press cake. The press cake is extracted with ethanol which removes colour and moisture. This is again filtered and pressed in a cotton cloth. The pressed cake is dried under sun or mechanically in a drier. The dried material is powdered and packed properly. The packed material is stored at room temperature.

Assessment activity

Prepare a write up on FPC

FISH SOUP POWDER

White flesh of many low value fish like threadfin bream, Sciaenids, perches, etc. can be used to prepare fish soup powder. This product has high consumer acceptability and is now produced by several manufacturers.

Practical activity

Preparation of Fish Soup Powder

The fresh fish is de-skinned and de-boned after cooking. The fried onion is added to this meat and ground to a fine paste. Then coriander powder, cassava starch, sugar, pepper powder, garlic, ascorbic acid, carboxy methyl cellulose and mono sodium glutamate are ground to a fine paste. Mix with ground paste. Spread to a thin layer, dry under vaccum, pulverise and sieve. Mix with milk powder and pack in laminated pouches.

Assessment activity

Practical work on Fish soup powder.

DRIED PRAWN PULP

Usually small sized thelly prawns are used for making dried prawn pulp. Prawn is cooked in salt water until it turns pink in colour. Dry in sunlight. Beating in gunny bags. Winnowing to separate shell. The pulp is collected and packed properly.

Practical activity

Preparation of Dried prawn pulp

MASMIN FLAKES

An innovative value added product is prepared by smoking and drying tuna meat. Minced tuna meat is mixed with salt and liquid smoke, made into a paste and stuffed inside a stainless steel mould, after which blocks are cooked and dried till the moisture reaches below 15%. Using a flaking machine, masmin flakes are produced and dried again to get the product moisture content below 10%. Flakes are then packed in polyester/polythene laminated pouches and stored at room temperature. Masmin flakes prepared by improved method has superior biochemical qualities compared to traditional masmin. The lower moisture of masmin flakes assures higher shelf life. Nutritional profiles such as protein content and lysine content are high. It shows higher levels of PUFA especially EPA, DHA and can play a vital role in attracting consumer health consciousness to this product.

TE QUESTIONS

1. Name the 2 types of Marinades
2. Name the preservation method in which the anaerobic fermentation in brine or immersion in vinegar is practised
3. Given below are some fishery value added products. Select the breaded product
   a. fish pickle
   b. fish sausage
   c. fish momos
   d. fish cutlet
4. Lakshdweep is famous for this product

   It is a smoked product.

   It is made from Tuna fish.

   Name the product.
5. Name the fishery value added product for which natural or artificial casing is necessary for the preparation.
6. You are asked to prepare fish pickle in the practical examination. Write the procedure to prepare it.

UNIT 4.2
Fishery Byproducts

Introduction

Fish offal and trash fishes are the major sources for the production of fish byproducts. Fish flesh on an average contains 15-20% protein. Some species of fish contain very high amounts of body oil. Few species of fish like shark, cod etc. are good sources of liver oil. Fish processing and filleting industries turn out large quantities of fishery waste. All these are good sources of high quality protein, fat, minerals etc. and are used to produce different fishery byproducts.

The traditional fishery byproducts are fish meal, fish body and liver oils, fish maws/ isinglass etc. Fish protein concentrate, pearl essence, fish skin leather etc. are some other byproducts generally processed out of fish and fish waste. Chitin and chitosan processed out of shrimp, crab and other crustacean shell waste are byproducts of high economic value. Biochemical and pharmaceutical products like bile salts, insulin, glucosamine etc. are byproducts of great significance. A brief account of some of the important fishery byproducts is given below.

Learning Outcomes

The learner :

- Prepares chitin & chitosan
- Prepares shrimp extract
- Prepares Fish meal
- Prepares Fish body oil
- Describes the preparation of Pearl essence
- Describes the preparation of Isinglass
- Prepares Fish silage

Chitin and Chitosan

Chitin is the second most abundant biopolymer on earth next only to cellulose. It is a white, hard, inelastic nitrogenous polysaccharide extensively used for several purposes. In India, the single largest source of chitin is the shrimp shell waste. Chitin is produced from the shell waste by deproteinisation and demineralization. Chitosan

is produced by the deacetylation of chitin. Chitosan has several industrial and medicinal uses.

Chitosan is used

- growth promoter in animals and birds, used as an ingredient in their feed.
- clarifying agent of fruit juices
- purification of drinking water
- treatment of waste water and sewage effluents
- sizing agent in textiles and paper
- pharmaceutical and cosmetic industry

Practicals

Preparation of chitin and chitosan

Chitin is prepared from shrimp or crab shell waste which involves two important steps, demineralisation of the waste using a mineral acid followed by deproteinsation of the demineralised mass using a dilute solution of caustic soda. The shell waste is stirred well with dilute hydrochloric acid (1.2N) until it becomes soft. Demineralisation may take upto 1-2 hours for completion and is indicated by stoppage of effervescence. The liquid is decanted and the mass is washed with water until free of acid. Then the residue is boiled in 5% NaOH for 30 minutes. Drain the solution and wash the residue till free of alkali. Filter off the liquid and dry under sun or using mechanical drier.

Chitosan is prepared by the deactylation of chitin with 60% NaOH or KOH in 1:1 ratio for 90 minutes at 95-100^{o}C. The alkali is drained off and the residue is washed repeatedly using water until it is free from alkali. The residue is then dried in sun or in a mechanical drier. It is then packed in polythene bags.

Assessment activities

Quiz

Draw chart for preparation of chitin

Shrimp extract

Large quantities of prawn waste are thrown away as waste. The high percentage of protein present in this waste can be isolated for human consumption or as animal feed.

Practicals

Preparation of shrimp extract

Prawn waste is washed to remove dirt, sand, etc. Then it is boiled with 3% NaOH for 30 minutes. It is then filtered and the filtrate is neutralized with acetic acid. The filtrate is concentrated to obtain semi solid mass. It is packed in polythene bags and stored in frozen condition.

Assessment activities

Quiz

Port folio

Report on shrimp extract preparation

Fish meal

Fish meal is a commercial product made from fish offal and trash fish. It is a brown powder or cake with high nutrient. Constituents of meal vary depending on the type of raw material and the process used. Protein is generally around 65%. Moisture, fat and ash content vary at 6-10%, 5-10% and 12-33% respectively. Fish meal is also an important source for minerals such as calcium, phosphorus, copper, zinc, manganese, iodine and selenium. Hence fish meal is considered to be a valuable constituent of fish and poultry feeds.

Practicals

Preparation

Fish meal is prepared mainly by two processes – wet rendering and dry rendering.

Wet rendering is normally applied to fatty fish where it is boiled with water to render the bones and meat portions soft. The aqueous portion decanted and the solid portion is pressed in a canvas bag with screw press to remove further quantity of water and oil. The filtrate and pressed out liquid together is called stick-water. The whole liquid is then centrifuged to remove oil. The pressed cake is dried and then pulverized in a grinder and sieved to get uniform size. Pack in polythene pouches. In wet rendering some of the soluble nutrients like proteins, minerals and vitamins are lost in the stick water. Most of the fat content is expelled out along with stick water in the wet rendering.

Dry rendering is the process employed to lean fish where it is dried in the sun to moisture levels of about 10% . It is then pulverized and packed. All nutrients are

retained in the dry rendering. In dry rendering fat is retained in the final product, it gets easily oxidized and rancid, adversely affecting its quality and shelf life.

Assessment activities

Quiz

Draw flow chart for preparation of fish meal by wet rendering method.

Port folio

Report on fish meal preparation

Field visit report

Fish body oil

Body oil is extracted from fatty fishes like Oil sardine. Fish body oil is also obtained as a byproduct of fish meal production.

Uses

- Preparation of factice, an artificial rubber filling compound from sardine oil
- Fat liquoring in the leather industry
- Tempering of steel
- Batching of jute
- Manufacture of insecticidal soap
- Protective coat on wooden fishing crafts

Practicals

Preparation of fish body oil

The raw material is washed, cooked with equal quantity of water for 30 minutes with occasional stirring till oil floats on the surface. The oil that floats on the surface is collected. It is then boiled again for another half an hour with occasional stirring and allowed to settle. The upper layer of the oil is decanted and water is kept separately. The cooked mass is then pressed in a cloth bag using a screw press. The press liquor and the liquid portion already decanted and kept earlier are mixed and common salt is added and stirred. This helps quick separation of oil. The oil is then heated on a water bath to remove adhering water and stored in air tight containers.

Assessment activities

Draw chart for preparation of fish body oil

Quiz

Pearl essence

Guanine is deposited in the epidermal layer and on the scales of most of the pelagic fishes. Since those crystalline guanine are suspended in a suitable solvent the product is called pearl essence. The scales are soaked in gasoline to separate pearl essence from protein and water. The pearl essence is transferred into gasoline where it floats to the surface. The separated pearl essence is then filtered to obtain the fine particles of pearl essence.

Uses

- Artificial pearl
- Shiny coatings in ash trays, fishing rods, book covers, textiles, jewellery boxes, umbrella handles and electric light switches.

Assessment activities

Quiz

Isinglass / Fish maws

Dried air bladders (swim bladders) of catfish, carps, eels, polynemids, sciaenids, sea bass, etc. is called Fish maws. They are rich in collagen and used as delicacy in Chinese soups. The bladders are first removed from the selected fish and blood and adhering fat materials are scraped off. They are then cut open and washed thoroughly in running water. Then the outer black membrane is removed by scraping. Subsequently the bladders are cut into pieces and are dried in an artificial drier or in sun and stored in suitable containers. Isinglass, so prepared is used for clarifying beverages like wine, beer and vinegar. Isinglass also reduces 2 to 0.05% of the suspended solids in beer and increases filtration rate from 3000 to 11,000 liters. It can also be used as an adhesive base and in confectionery product, Indian ink and as an efficient adhesive for glass, pottery and leather. Products with less than 8% moisture content are however, preferred for industrial purposes.

Assessment activities

Quiz

Fish silage

Fish silage is a liquid product made from trash fish or fish offal that are liquefied by the action of enzymes in the fish in the presence of an added acid. The enzymes breakdown fish protein into smaller soluble units and the acid helps to speed up their

activity while preventing bacterial spoilage. Formic, propionic, sulphuric and phosphoric acids are used. Normally about 3-4% of acid is added so that the pH remains at or below 4.0.

Practicals

Preparation of fish silage

Fish or offal is ground and mixed well with 3.5% by weight of formic acid of 85% concentration using a mechanical mixer. The quantity of acid used must be sufficient to bring down the pH of the mixture to 4. Periodic agitation will assist the process of liquefaction of protein that may take 1-2 weeks depending upon the freshness and oil content of fish.

Uses

Fish silage is used as cattle feed.

Assessment activities

Seminar on fishery byproducts

Unit test

Quiz

Port folio

Report on fish silage

TE questions

1. Name the two methods employed for preparation of fish meal.
2. Given below are the uses of a fishery byproduct. Name the byproduct.
   - preparation of factice, an artificial rubber filling compound
   - coating on wooden fishing crafts
3. Varun prepared a fishery byproduct from the scales of sardines, mackerels, carps, mullets and ribbon fishes. Identify it.
4. In a pre- processing plant large quantities of prawn shell waste is available. Can you use this for making any fishery byproduct?. If yes, name the product and describe the method of preparation.
5. What is used for the preparation of isin glass?

UNIT 4.3
MISCELLANEOUS AQUATIC PRODUCTS

Introduction

Though aquatic products are largely based on fish related products, plant origin products also contribute substantial proportion to the aquatic products. Sea weeds are the major plant items from sea and they have higher content of important minerals like calcium and iron than fruits. It has important role in the food consumption of people. This unit highlights the important plant and animal based aquatic products and their usage. Some aquatic products like Ambergris has importance in perfume industry.

Learning Outcomes

The learner :

- Explains the source and importance of Algin
- Explains the source and importance of Agar agar
- Explains the source and importance of Carrageenan
- Explains the source and importance of Beche-de-mer
- Explains the source and importance of Ambergris

Detailing of Unit

Algin

Brown algae

Algin, also called alginic acid or alginate, is a polysaccharide distributed widely in the cell walls of brown algae; binds with water to form a viscous gum. Its colour ranges from white to yellowish-brown. It is sold in filamentous, granular or powdered forms. Alginates are refined from brown seaweeds. A wide variety of brown seaweeds of the phylum *Phaeophyceae* are harvested throughout the world to be converted into the raw material commonly known as sodium alginate.

Uses

Sodium alginate has a wide use across a wide variety of industries including food, textile printing and pharmaceutical. Dental impression material utilizes alginate as its means of gelling. Alginate is both food and skin safe.

- Manufacture of paper and textiles, water proofing and fireproofing fabrics.
- In food industry as a thickening agent for drinks, ice cream and cosmetics and as a gelling agent for jellies.
- In pharmaceutical preparations, such as Gaviscon, in which it combines with bicarbonate to inhibit reflux.
- Sodium alginate is used as an impression-making material in dentistry.
- Sodium alginate is used in reactive dye printing and as a thickener for reactive dyes in textile screen-printing. Alginates do not react with these dyes and wash out easily, unlike starch-based thickeners.
- Calcium alginate is used in different types of medical products including skin wound dressings to promote healing and can be removed with less pain than conventional dressings.

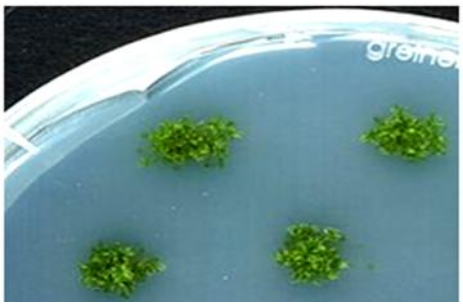
Preparation

Seaweed is broken into pieces and stirred with a hot solution of an alkali, usually sodium carbonate, for about two hours. The alginate dissolves as sodium alginate to give a very thick slurry. This slurry also contains the part of the seaweed that does not dissolve, mainly cellulose. This insoluble residue is filtered. The goal of the extraction process is to obtain dry, powdered, sodium alginate. The calcium and magnesium salts do not dissolve in water; the sodium salt does.

Agar agar

Agar is a gel forming substance soluble in hot water. It is a complex mixture of polysaccharides obtained from the cell wall of certain species of red algae. It is mainly a mixture of two polysaccharides – Agarose and Agaropectin. The major source of agar is agar yielding red algae like Gracilaria, Gelidium and Pterocladia. The characteristics of agar includes the gelling power in aqueous environment. (It gives gels without flavour) and it withstands thermal treatment above 100^{o} C.

Agar plates for microbial culture

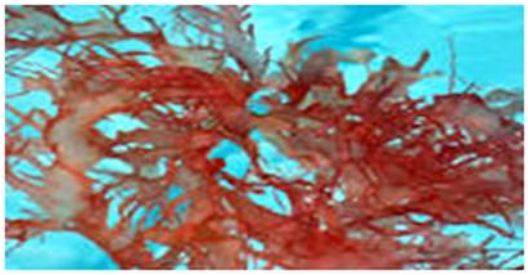


Plant Tissue culture in agar

Uses

- Thickening and gelling agent
- In bakery, it is used to cover cakes as in icing
- In bacteriology, it is used for the preparation of culture media
- In confectionery, it is used to prepare jellies
- It is used as plant tissue culture medium

Carrageenan



Red algae

Carrageenan or **carrageenin** is a polysaccharide extracted from red edible seaweeds. They are widely used in the food industry, for their gelling, thickening, and stabilizing properties. Their main application is in dairy and meat products, due to their strong binding to food proteins.

Gelatinous extracts of the seaweed, *Chondrus crispus* (Irish Moss) is used as food additives, an alternative to gelatin in some applications or may be used to replace gelatin in confectionery.

Preparation

The seaweed is dried, ground and washed thoroughly. After treatment with hot alkali solution (e.g., 5–8% potassium hydroxide), the cellulose is removed from the carrageenan by centrifugation and filtration. The resulting carrageenan solution is then concentrated by evaporation. It is dried and ground to specification.

Uses

- Desserts, ice cream, cream, milkshakes, yogurts, salad dressings, sweetened condensed milks
- Sauces: used to increase viscosity
- Beer: clarifier to remove haze-causing proteins

- Pâtés and processed meats (e.g., ham): substitute for fat, increase water retention, and increase volume.
- Toothpaste: stabilizer to prevent constituents separating
- Fruit Gushers: ingredient in the encapsulated gel
- Fire fighting foam: thickener to cause foam to become sticky
- Shampoo and cosmetic creams: thickener
- Air freshener gels
- Marbling: the ancient art of paper and fabric marbling uses a carrageenan mixture on which paints or inks float; the paper or fabric is then laid on it, absorbing the colours
- Shoe polish: gel to increase viscosity
- Biotechnology: gel to immobilize cells/enzymes
- Pharmaceuticals: used as an inactive excipient in pills/ tablets
- Soy milk and other plant milks: used to thicken, in an attempt to emulate the consistency of whole milk
- Diet sodas: to enhance texture and suspend flavours
- Pet food
- Personal lubricants
- Vegetarian hot dogs

Beche-de-mer

The food product prepared from Sea cucumbers **(** marine animals of the Phylum **Echinodermata**, Class **Holothuroidea,** Genus *Holothuria***)** is called **Beche-de-mer.** They are used in fresh or dried form in various cuisines. In some cultural contexts the sea cucumber is thought to have medicinal value.

Fresh sea cucumber

Dried sea cucumber

Ambergris

Ambergris is a compound excreted from the intestine of sperm whales and found floating on sea surface and on coastal areas. It has a peculiar musk odour and used in blending large number of exotic perfumes. Ambergris is often spotted in tropical and sub tropical sea shores of many countries like Australia, Newzealand, India and Bahamas.

Ambergris is now considered as a morbid material from the intestinal tract of sperm whale. It comes from the stomach of dead whales. When sperm whale feeds on cuttle fish, due to some injury or unknown reason ambergris is formed in the intestine. This is based on the observation that often small fragments of cuttle fish are found in the ambergris when collected freshly.

A good quality ambergris is soft, waxy and gray in color and is found to have concentric layered structure resembling that of onion. It is mainly used in perfumery as tincture and essence for fixing delicate odours.

TE Questions

1. Write short notes on agar agar
2. State the uses of algin.
3. Beche-de-mer is prepared from ——————————.
4. Name the product obtained from sperm whale which is used in perfume industry.
5. Find the odd man out.

   Laminaria, Macrocystis, Ascophyllum, Gelidium, Staphylococcus

UNIT 4.4
PACKAGING OF FISHERY PRODUCTS

Introduction

Packaging is an important part of production, storage and distribution of any product. It facilitates the easier and safer transport of the product and protects it from contamination and loss, damage or degradation etc. It also provides an opportunity to the buyer to identify the product and of course persuades the buyer to purchase the product. This unit helps to get basic idea of packaging material and packing methods. Packaging may be defined as the means of ensuring the safe delivery of a product to the end consumer in sound condition at the minimum overall cost. Food packaging is an external means of preservation of food during storage , transportation and distribution. They should facilitate storage, effective chilling, internal and long distance transport, easy determination of quantities and display in whole sale and retail markets. Packaging materials protect the product from contamination or loss. The printing on the exterior of the package helps to identify the brand and attract the buyer's attention.

Learning Outcomes

The learner :

- Identifies packing materials like Glass containers, Metal cans, Types of paper packages, Cellophane, LDPE, HDPE, Aluminium foil and Retort pouch
- Practises packing of Frozen Material like IQF products, Block frozen Products.
- Practises packing methods like, packing on stand pouch, packing in polythene covers.
- Categorises the packing of various value added fishery products and by products.
- Classifies the packaging of canned fish and fish pickle
- Evaluates modern packing methods like MAP, CAP, Vacuum packing.

Packing materials

Glass containers

Glass containers are one of the important materials for food packaging. It is strong, rigid, chemically inert and can be moulded in to variety of size and shape. It is an excellent barrier to solids, liquids, gases and gives protection against flavour and

odour contamination. The main disadvantage is that it is fragile in nature.

Metal cans

It is mainly used for heat sterilized products. Different types of metal containers like standard tin plate, light weight tin plate and tin free steel etc. are available in the market. Metal cans have superior strength and can fill products easily. The main disadvantages are weight, difficulty in reclosing and disposal.

Paper

Considerable quantity of packaged foods are stored and distributed in packages made out of paper or paper based products. Because of its low cost, easy availability and versatility it retains first position in packaging materials. It is permeable to gases and moisture and loses its strength when wet. Ordinary paper is not oil resistant but can be made resistant by mechanical process during manufacture. The different types of papers used in packaging of seafood are listed below.

- **Kraft paper** : This is a strong paper and is used for the manufacture of corrugated fibre board box.
- **Parchment paper** : The surface of parchment paper is more intact than kraft paper and it has greater oil resistance and wet strength properties
- **Grease proof paper** : It is resistant to oil and fat but this property is lost when the paper becomes wet. It is used for wrapping fish, meat and diary products.
- **Paper board** : Thick paper is called paper board. Paper boards are used for carton making.

Cellophane

It is produced from highly purified cellulose. Uncoated cellophane is flexible, strong, transparent, grease proof, hygroscopic and permeable to water vapour. When both sides of the film are coated with moisture resistant lacquers, permeability to vapour and other gases is greatly reduced. Polythene coated cellophane is available. It has low permeability to odours so that the aroma is retained in the package itself.

Low Density Polyethylene – LDPE

Most widely used packaging material as it posses qualities such as transparency, water-vapour impermeability, heat stability, chemical inertness and low cost of production. It resists temperature between – 40 to 85^{o} C. It is made by the polymerisation ethylene (natural state is gas) under high pressure and temperature. The density of the finished product is low and it is called low density polyethylene.

High Density Polyethylene – HDPE

It is produced by low pressure process. The density of the finished product is high. HDPE is stronger, thicker and less flexible than LDPE and has lower permeability to gases and moisture. It can withstand temperature up to 121° C.

Aluminium foil

Aluminium foil is a solid sheet rolled to a thickness less than 0.006 inches. It has properties like reflectivity, thermal conductivity, light weight, corrosion resistance, grease and oil resistance, tastelessness, odourlessness, heat and flame resistance. Aluminium foil free from defects is a perfect barrier of moisture and oxygen. It is the cheapest material to use for the said properties. Foils of thickness 8 to 10 micron are used for food packing.

Retort pouch

Retort pouch is a type of flexible packaging material for canned products. It can withstand thermal processing. It is made of three materials, an outer layer of polyester for strength, a middle layer of aluminium foil as barrier for moisture, light and gas and an inner layer poly propylene as the heat seal and food contact material. The pouch is thinner than cans and takes less time to reach sterilization temperature . It can be easily opened by cutting with scissors . The main disadvantage of pouch packing could be that they are not robust like cans and special packaging system is required for transportation.

Assessment activity

Collection and Exhibition of different types of packaging materials

Assignment on packing materials

Packaging of frozen Fish

In India Sea food industry has emerged as one of the major export oriented industry. India exports ninety varieties of seafood products to various countries all over the world. Of these, frozen products dominates the trade. Frozen shrimp, Frozen fish, Cuttlefish and Squids are important marine products exported from India. A suitable frozen fish package must be able to meet the following requirements.

- Reduction in moisture loss, oxidation and change of odour and flavour.
- Retention of volatile flavours
- Flexibility to fit the contour of the food.
- Resistance to puncture,brittleness and deterioration at low temperature.
- Ease of filling.

The conventional system of processing shrimps is to in plate freezers as blocks of 2 kg and 4 kg. The material for packing comprises LDPE/HDPE films, duplex carton and corrugated fibre board box. The problems with this packaging system are their low mechanical strength and tendency to get wet due to deposit of moisture.

Shrimps are frozen as blocks of 2 kg each in duplex board cartons lined with low density polyethylene (LDPE) and 10 such cartons are packed in master cartons made of 5 ply or 7 ply corrugated fibre board box. Fishes, cuttlefish and squid products are frozen as 2 kg or 4 kg blocks. 10 or 5 such blocks are packed in master cartons made of 5 ply or 7 ply corrugated fibre board box lined with low density polyethylene (LDPE).

IQF products are filled in a primary container (plastic mono film, co - extruded film or laminated pouches) of capacity varying from 200 gm to 4 kg. After weighing the primary pack is closed by heat sealing and further packed in master cartons for storage and transportation. If and when duplex carton is used , it will be desirable to use laminated plastic film on the inner side of the carton (The most effective film is 10 micron poly propylene).

Practical Activity

Preparation and packaging of 2 kg block frozen shrimp and fish

Assessment activity

Evaluate the personal skill of learners on packaging of various frozen fishery products.

Packaging of dried Fishery products

Baskets with braided coconut or palmyra leaves are the containers exclusively used for packing this product both for export and internal distribution.An overwrap with gunny fabrics is given as reinforcement in the case of products meant for export and those which have to be transported over long distance inside the country.

But now the bulk of packaging material in use are waxed corrugated cartons, dead wood or plywood boxes and high density polyethylene (HDPE is impervious to microbial and insect attack). The commonly used packaging material for consumer pack of dry fish are low density polyethylene or poly propylene.

Practical Activity

Preparation and packaging of dried fishery products such as dried anchovy and dried shrimp

Assesment activity

Packaging of dried fishery products

Packaging of value added fishery products and byproducts

As the sea food industry in India started diversifying into the production of various value added fishery products, packing of these products become necessary. Processing technologies have been developed for preparing fish ready to cook and ready to serve and value added products from many varieties of cheaper fish which has less demand in the fresh fish market. The most important such products are battered and breaded shrimp, Squid rings, stuffed squid, fish fingers, fish cutlet and fish momos etc. The thermoformed trays produced from food grade PVC and poly styrene are suitable for packaging value added fishery products. These thermoformed trays are usually sealed with polyester based film and are useful in self service system.

Practical Activity

Preparation and packaging of value added Fishery products such as fish sausage,fish cutlet and fish momos

Assessment activity

Packaging of value added Fishery products

Packaging of canned fish and fish pickle

An ideal canned fish package should be hermetically sealable, thermally conductive, inexpensive and without affecting the odour, colour, texture or food value of the content. Sulphur resistant lacquered cans are generally used for food products. Tin plate cans and aluminium cans are also become popular. Today bulk of the canned fish in the world is being packed in aluminium cans as it does not produce dark sulphur stains.

The traditional material for packing of pickled products is glass bottles because of its rigidity, inertness, non toxicity, durability and non permeability to gases and moisture. But recently flexible packaging materials based on polyester laminated with LDPE – HDPE co- extruded film are in use. In this flexible packaging materials pickle can be kept for a period of 7 to 8 months at ambient temperature .These materials do not have any bad effect on the product and can be fabricated as stand up packs with all details printed. So this material can replace the glass containers and the cost is also found to be less than that of glass containers.

Practicals

Preparation and packaging of fish pickle

Assessment activity

Packaging of fish pickle

Modern Packaging Methods

Vacuum Packing

Vacuum Packing is a method of packaging that removes air from the package prior to sealing. This method involves manually or automatically placed items in a plastic film package, removing air from inside and sealing the package. Shrink film is used to have a tight fit to the contents.

Modified Atmosphere Packaging (MAP)

The high ambient temperature of tropical countries favours rapid multiplication of microbes and thereby accelerates spoilage. Presently ice and mechanical refrigeration are the common methods to retard microbial and enzymatic spoilage. Modified Atmosphere packaging (MAP) is a technologically viable method developed as a supplement to ice and mechanical refrigeration to reduce the loss and extend the storage life of fresh sea food products.

In MAP air is replaced with different gas mixtures to regulate / retard microbial activity and discard discolouration of the product. The gases normally employed are carbon dioxide, mixtures of carbon dioxide and oxygen, carbon dioxide and nitrogen, oxygen and nitrogen. Packaging materials generally employed for this purpose are flexible films of nylon, PVC moulded trays and low density polyethylene.

Controlled Atmosphere Packaging (CAP)

A controlled atmosphere is an agricultural storage method; an atmosphere in which oxygen, carbon dioxide and nitrogen concentrations as well as temperature and humidity are regulated. CAP is usually employed in the storage of fruits where the respiration rate is retarded so that they do not mature as quickly, which helps to maintain crispness and flavour. During this time, the starch also slowly changes to sugar, so that the fruits coming out of CAP has that “just-picked” taste.

TE Questions

1. List out different packaging materials used for the packaging of fishery products
2. Expand the following
   HDPE, LDPE, PVC
3. State the difference between kraft paper and parchment paper
4. Match the following

a. Glass container		i	Fish and meat
b. Metal cans		ii	Fish pickle
c. Grease proof paper		iii	Canned foods

5. Prepare an article about the advantages of Retort pouch over metal can

EXTENDED ACTIVITY

Project proposal preparation for a small scale fishery value added product unit.

Seminar on Prospectus of Battered and Breaded products in Indian market.

LIST OF PRACTICALS

1. Preparation of fish /clam/prawn pickle
2. Evaluate the economics in preparation of fish /clam/prawn pickle
3. Preparation of fish /clam/prawn cutlet
4. Evaluate the economics in preparation of fish /clam/prawn cutlet
5. Preparation of fish wafers
6. Preparation of Fish sausage
7. Preparation of Fish Finger
8. Preparation of Fish momos
9. Preparation of fish wafers
10. Preparation of chitin & chitosan
11. Preparation of fish meal
12. Preparation of Fish body oil
13. Preparation of Fish Silage
14. Exhibition on packing materials like Glass containers, Metal cans, Types of paper packages, Cellophane, LDPE, HDPE, Aluminium foil and Retort pouch.

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