

FISHERY AND AQUACULTURE

Level – III

Based on July 2022, Version- I Occupational Standard



Module Title: Process and utilize fish by-products

LG Code: AGR FAQ2 M07 LO (1-3) LG (24-26)

TTLM Cod: AGR FAQ2 TTLM 0523V1

May, 2023

Addis Ababa, Ethiopia

Contents

Introduction to the Module	3
LO #1- Prepare work area for processing and utilizing.....	4
Instruction sheet.....	4
Information sheet -1.....	6
Self-check 1	35
Written test	35
LO #2- Process fish byproduct	36
Instruction sheet.....	36
Information Sheet- 2	37
Self-check 2	55
Operation sheet 2	56
Lap Test	58
LO#3: Complete fish by product processing activities	59
Instruction sheet.....	59
Information sheet-3.....	60
Self-check 3	63
Lap test-3	65

Introduction to the Module

This module covers the knowledge, skills and attitude required to make fish by product in to valuable product. Processing fishing byproduct is the main concern this module. Among all the first learning out comes requires prepare work area for processing and utilizing. Under this learning outcome many important contents are illustrated, such as basic information identifying processing tools, equipment and materials, types of fish byproducts fish byproduct sources and so.

The second learning outcome is focused on Process fish byproduct to perform activities of Grinding large fish and byproducts, Cooking and heating fish byproducts, Pressing, drying press cake, Grinding, sifting and packing the dried meals Storage and transport of fish meals. and the final learning outcome summarizes about how to complete fish by product processing activities that includes Handling waste materials Handling material, tools and equipment Recording and documenting work outcomes.

Terminology

Fish: are diverse group of animals that live and breathe in water (any aquatic animal) (or cold-blooded), typically ectothermic covered with scales. All fish are vertebrates (animals with backbones) with gills for breathing. Most fish have fins for swimming, scales for protection, and a streamlined body for moving easily through the water.

byproduct: is the is product which we obtain from after processing the target production of our want. Thus are including fish scale, skin, bone, fin, gill and head of the fishes are byproduct.

Processing: making of fish byproduct in to valuable product though follow different serous step and techniques.

Hygienically: With care to keep free of germs. This will require rodent control and management, contamination of fish product and by product.

Occupational health and safety (OHS): actions to be taken to ensure safe operation and maintenance of machinery and equipment

Page 3 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
--------------	---	--------------------------------------	------------------------

A fishery is a unit, engaged in processing of byproduct, which is determined by an authority or other entity to be safe.

LG #24	LO #1- Prepare work area for processing and utilizing
Instruction sheet	
<p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none"> • Identifying processing tools, equipment and materials • Identifying types of fish byproducts • Identify Fish byproduct sources • Fish byproduct processing techniques and steps • Use of fish byproduct • Collecting fish byproducts • Occupational health and safety(OHS) procedures • Unsafe and inefficient aspects of the work area <p>This guide will also assist you to attain the learning outcomes stated in the cover page. specifically, upon completion of this learning guide, you will be able to:</p> <ul style="list-style-type: none"> • Identify process tools, equipment and materials • Identify types of fish byproducts • Identify fish byproduct sources • Identify fish byproduct processing techniques and steps • Use of fish byproduct • Collect fish byproducts • Occupational health and safety(OHS) procedures 	

- Unsafe and inefficient aspects of the work area

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet -1

1.1 Equipment, Tools and Utensils: Uses of Specifications

Biotechnology advances for by-products conversion into products of interest are numerous. In order to give maximum elements of understanding, it is essential to define the framework of this module to understand why and how we can use technological device for fish byproduct processing and bioconversion technologies are applicable. It is essential to look beyond the technical and technological advances on the subject and so to take into account the economic, social, political and environmental parameters, which govern all forms of approaches for fish by-products upgrading. Every equipment, tool and utensil that are purchased are accompanied with a manual containing specifications as to how they are used, manipulated or operated, cared for and stored to lengthen their serviceability. Specifications usually include the following:

1. Important safeguards or basic safety precautions to follow when using the device like a pressure cooker for instance.
2. Warning labels which serve as a reminder to the user to read and follow instructions on the proper use and operation of a certain device equipment or tool.
3. Dimensions, weights and capacities as in the case of cookers, boilers and steamers.
4. Instructions on caring for the equipment, tool or utensil.
5. Instructions on the correct usage of the device.

When using any equipment, tool or device it is important to read and understand the manufacturer's specifications in order to properly or accurately use or manipulate them and prevent any accident that may occur due to ignorance or lack of information pertaining to their correct usage. Being familiar with all information pertaining to food processing equipment results to systematic, orderly and accurate accomplishment of tasks.

Knowing the parts and functions of equipment, tools and utensils used in processing food ensures accurate or proper use, operation and care for them. It is very easy for a food processor

Page 6 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
--------------	---	--------------------------------------	------------------------

to manipulate a particular device if he knows all its parts and their respective functions. Proper maintenance for the parts of any tool, equipment and utensil can also be done if a processor is familiar with them.




Fish process of product and by product require some essential materials, tools, equipment and facilities which are used for varies purposes. Such equipment may be used for: Processes the fish product and by product.




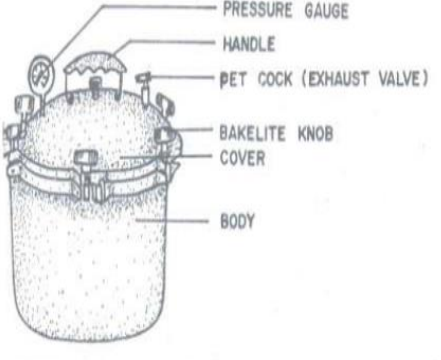
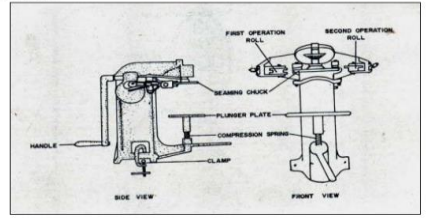
This information sheet provides you detail description on materials, tools, equipment and facilities which are used in a variety of categorized tasks in fish processing.

Fish processing require some essential equipment and facilities which are used for varied purposes. Such equipment may be used for grinding fish and making different fish products.

Important materials, tools and equipments in fish processing activities are listed and discussed as table below.

table 1. Types Material, tools and equipment

No	Name	Function	Figure/images
1.	Descaler	To remove the scale of the fish	<p>3. Descaler or scalers</p> <p>They are used in removing the scales of a fish.</p>  <p>Electric Fish Scalers</p>
2.	Nigh	Used to slatering fish	<p>2. Cutting Implements</p> <p>a. Knives</p>  <p>or cutting or slicing fish or meat; for scaling fish</p>
3.	Cuter	Cut the part of the fish	 <p>The whole fish is dumped with fish heads due to the incomplete cutting</p>

4.	Grinder	Used for grinding of fish	
5.	Wheel barrow	To transport the product and waste	
6.	Presser	Used to press fish byproduct	
7.	A pressure cooker	A pressure cooker is an important canning equipment used to process fish packed in a hermetically sealed container at a high controlled temperature and pressure for a certain period of time.	<p>The Pressure Cooker</p>  <p style="text-align: center;">PRESSURE COOKER</p>
8.	Caner	Used for packaging of fish by product	<p>The Can Sealer</p>  <p style="text-align: center;">The can sealer is an equipment used to seal tin cans with its first and second</p>

9.	slicer	Used to slicing fish by product	
10.	Screw conveyor	Used fish byproducts pushing to grinder machine	
11.	Plastic bucket	used in the food processing (fish, shrimp & meat) for storage & keeping product fresh.	
12.	Oil-water Separator Machine	Used for oil from fish byproduct	

13.	Cooking dish	Using for cooking as cook	
14.	crusher	Use for crush dried fish	
15.	Dryer machine	Used for quiqly dry the fish	<p>fish drying machine</p> 
16.	Pleete machine	Used for making mixed dish for fish meal	
17.	Sack	Used for fish byproduct collectng	
18.	19. Heat Transfer Oil System	Release the heat to separate the oil part of fish from other remaining	

1.2 Types of fish byproducts

There is a large quantity of very small fish landed as by-catch which do not find a ready market as fresh fish. Fish processing and filleting industries turn out large quantities of fisheries waste. All these are good sources of high quality protein, fat, mineral etc. The modern fish-processing industry in our country is nothing is doing. Although we have no exported dry fish product and byproduct. This phenomenal decrease in export of products and development in fish processing industry has been more or less based on a single commodity, prawns, which constitute about 10-20% of the total catch. However, this modern trend globally fish waste product can give different types of fish byproduct that are include:

1.2.1 Fishmeal

Fishmeal is a traditionally used livestock feed supplement. Fishmeal has high quality protein containing high levels of lysine, methionine and cysteine, three of the essential amino acids which the animal bodies cannot synthesize, and this makes it an unrivalled constituent of feed stuff. It is also a good source of B-group vitamins like cyanocobalamin (B12), chlorine, niacin, pantothenic acid and riboflavin. Fishmeal is rich in minerals like calcium, phosphorus, copper and iron and is also the source of some trace element.

1.2.2 Fish oils

Fish oil is of two types, the liver oil and the body oil. Fish liver oils were used for therapeutic purposes in the treatment of vitamin A and D deficiencies. Body oils have recently won much attention because of the content of polyunsaturated fatty acids (PUFA), particularly η 3 PUFA used in the control of heart ailments in humans.

- **Fish-liver oil**

The therapeutic values of fish-liver oil were discovered in 18th century, and fish liver oil became a common medicinal product. Both vitamin A and D are found in certain fish-liver oils. The most important fish-liver oils obtained are from cod, haddock and shark. Halibut and tuna livers are also rich sources of vitamin A and D. The weight of liver, fat content and presence of vitamins

Page 11 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

dependent on a number of factors like species, age, sex, nutritional status, stage of spawning and area from where it was caught.



Fig.1.1 Fish liver oil capsules



Fig.1.2 Fish body oil capsules

1.2.3. Fish Silage

When fish is available which cannot be used for direct consumption for several reasons, it is used for production of fish meal, which has got ready market as an animal-feed. If material is available at a place where there is no fish meal plant and no reasonable transport to the nearest plant, there may be severe restrictions on fish meal production because of fish odors, one has to look for alternate processes. When animal farms are very near to landing centers, it is worthwhile to go for silage production. Fish silage can be defined as a product made from whole fish or parts of fishes to which no other material has been added, other than an acid, and in which liquefaction of fish is brought about by enzymes already present in the fish. Fish silage can be made from whole fish or parts of fish by treating it with mineral acid (sulphuric acid) or organic acid (formic acid). Ensiling can also be achieved by lactic acid produced by fermentation of sugar using lactic acid bacteria or starter culture. As the source of sugar, molasses is added to the fish or fish offal. The product is a stable liquid with a malty odor, which has very good storage characteristics and contains all water present in the original material. It is a simple process and requires little capital equipment particularly if non-oily fishes are used. The use of oily fish usually requires oil

separation, for which temperature of the silage I raised to 70-900C and floating oil is separated by decantation or centrifugation.



Fig.1.3. Fish silage

Uses Fish silage is used as cattle feed. Either the whole mass or the decanted liquid portion can be used. When solid feed is desired, the silage is mixed with rice bran or other feed ingredients.

1.2.4. Fish protein concentrate (FPC)

Fish protein concentrate (FPC) is any stable fish preparation, intended for human consumption, in which protein is more concentrated than in original fish.

FAO defines following 3 types of FPC:

Type A: It is virtually odorless and tasteless powder having a maximum total fat content of 0.75%.

Type B: Powder having no specific limits as to odor of flavor, but definitely having a fishy flavor and a maximum fat content of 3%.

Type C: Normal fish meal produced under satisfactorily hygienic conditions.



Fig. 1.4. Fish Protein concentrate

Though FPC is intended for human consumption it is not relished for consumption as such. It is therefore incorporated as a protein supplement in human diet. 5%-10% level FPC in bread and biscuit is considered the acceptable limit.

1.2.5. Chitin

Chitin is the second most abundant organic compound on earth next only to cellulose. It is a white, hard, inelastic nitrogenous polysaccharide widely distributed in the exoskeleton of insects, crab, shrimp and lobster and also in the internal structures of other invertebrates, e.g. squid. Shrimp shell and head waste constitute the single largest source of chitin in India.



Fig. 1.5 the crabs shall

1.2.6. Prawn head meal and shell waste

Page 14 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

The head and shell of shrimp/ prawn and other crustacean form the major fishery waste where crustacean are abundant. In countries such as the USA, India, Thailand, Malaysia, Philippines, South Africa and Mexico, shrimp, crab and lobster turn out huge quantities of shell waste; the disposal of which presents a serious problem. This waste contains a good percentage of protein and chitin other than minerals. The protein can be extracted along with flavor-bearing compounds and converted into shrimp extract having potential use as a natural flavoring material.



Fig. 1.5 Preparation of shrimp extract

Prawn head and shell waste meant for extraction of protein and conversion to shrimp extract should be collected fresh and stored in ice to minimize spoilage. It is washed in potable water to remove all adhering dirt, and other extraneous matters. The protein is then extracted by boiling with 0.5% sodium-hydroxide solution in water. The boiled mass is filtered through appropriate sieve to separate residual shell. The filtrate is neutralized with Hydrochloric acid initially, and with acetic acid towards the end to a pH 6.8 to 7.0. The neutralized filtrate is concentrated by boiling in an open steam jacketed kettle to a semi-solid mass with moisture content of about 35 to 45%. The paste so prepared is generally known as shrimp extract. It contains on average 40% moisture, 40% partially hydrolyzed protein and 10% minerals. The yield is 20% of the fresh heads and shells.

1.2.7. Pet feed

Pet food is animal feed intended for consumption by pets. Typically sold in pet stores and supermarkets, it is usually specific to the type of animal, such as dog food or cat food. Most meat used for animals is a byproduct of the human food industry, and is not regarded as "human grade".

Page 15 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023



Fig. 1.7 pet feed

1.2.8. Glue

Fish glue is impure gelatin (collagen) prepared from fish heads, bones and skins. Fish glue is known for value added product from fish processing by-products as the adhesive agent. Fish wastes resulting from industrial fish processing operations often consists of offal, flesh, skin, bone, entrails, shell etc.

1.2.9. Cosmetics

new industrial processing techniques are being developed to obtain valuable protein, antioxidants and oils from fish waste that generate from byproducts and that can have used skin care products.

1.3 Fish byproduct sources

1.3.1 Post-harvest fish loss and fish wastes

Post-harvest fisheries losses are of great concern because they equate to a loss of valuable animal protein for consumers and lost income for fishers, processors and traders. Reducing losses is therefore an important development goal in the fisheries sector. Post-harvest fish losses are one source of fish byproduct. Post-harvest fish losses often caused by biochemical and microbiological spoilage changes that occur in fish after death. A live fish has natural defense mechanisms that help to prevent spoilage. However, once a fish dies, its defense mechanisms stop and enzymatic, oxidative and microbiological spoilage begins to cause quality deterioration.

Post-harvest fish losses are often caused by biochemical and microbiological spoilage changes that occur in fish after death. A live fish has natural defense mechanisms that help to prevent

spoilage. However, once a fish dies, its defense mechanisms stop and enzymatic, oxidative and microbiological spoilage begins to cause quality deterioration discarding of bycatch at sea because fish is too small or not valuable enough to land for sale; poor processing techniques damaging fish; animal predation and insect infestation; inadequate packaging and storage practices leading to damage of the end product; market dynamics, especially fluctuations in demand and supply of fish and fish products, affect price and therefore income.

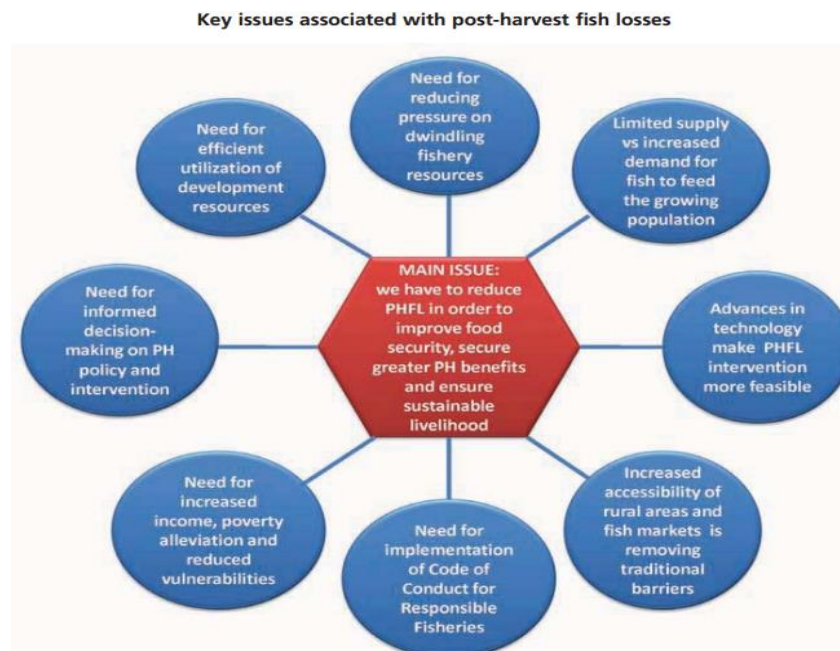


Fig. 1.8 issues associated with post-harvest fish losses

1.3.2 Fish processing factory wastes

During processing in industry some of harvested fish will use as source of fish byproduct due to some reason.

- **Physical loss**

Physical fish loss refers to fish that, after capture or landing, is not used. It is either thrown away accidentally, voluntary or as authorized. Physical loss can be caused by theft, by insects eating the fish, or by bird or animal predation.

- **Quality loss**

Quality loss refers to fish that has undergone changes owing to spoilage or physical damage and has suffered quality deterioration. Such fish is sold for a lower price than that which would have been achieved if the fish were of “best quality”. This is the most common PHFL in many areas.

The other is processing waste is obtained from as parts remaining after fillet and other parts removed for human consumption.

Major Processing Line Components: Heads, Viscera, frames, skins others such as tails, fins, scales, mince, blood, etc.

1.3.3 Fish market wastes

Market force loss is a loss caused by unexpected market demand and supply situations. These cause operators to sell their product at a price below expectations. The loss is the difference between the expected price and the actual price.

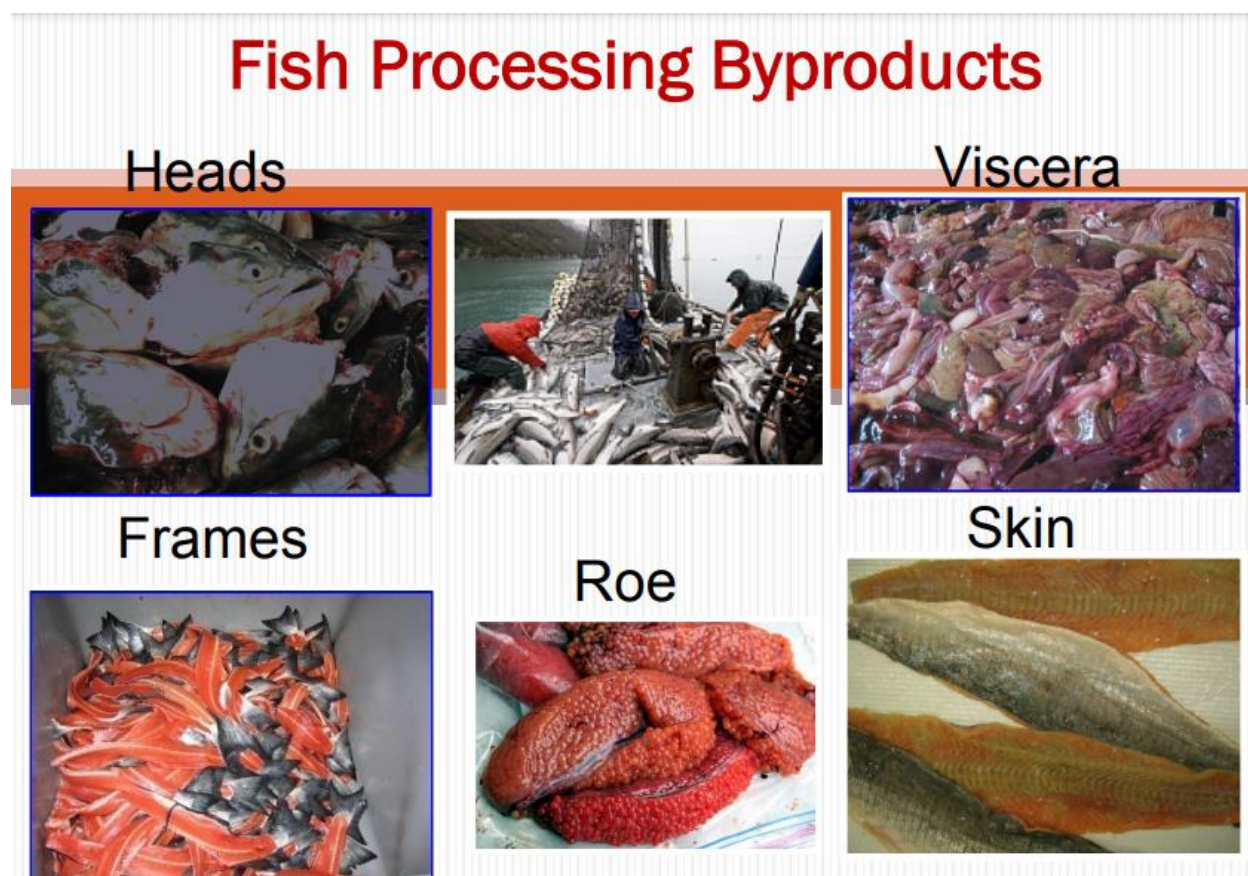


Fig. 1.9 different source fish by product

1.4 Fish byproduct processing techniques and steps

1.4.1 Manufacturing process fish meal

Fish meal is rich in all the essential amino acids, B- group vitamins and minerals particularly phosphorus and calcium. It is produced followed by techniques of: cooking, pressing, drying and grinding skeletal remains along with adhering protein aqueous tissues of fish from filleting and canning operations. Or by processing whole miscellaneous fish mainly caught along with prawns, which include Jew fish, sole, silver-bellies, ribbonfish and the like. The composition of fish meal differs considerably due to variations in raw materials used, processing methods and conditions employed. The main raw material for fish meal is abundant but sporadic catches of oil-sardine on the west-coast.

During recent years organized fish meal industry has showed sign of revival. In 1972 there were 7 such plants in the country with an installed capacity of 175 tons/day. About a dozen modern fish meal plants of wet-reduction type are now in operation at various fishing centers.

- **Raw materials**

High-fat like anchovies, sardines, herring, menhaden etc. are traditionally used as raw materials to manufacture fishmeal. Small by catch fish from shrimp trawling generally not marketable as fresh fish due to various reasons like very small size, bony nature, etc. also can be used. Juveniles of commercially important fish and waste from fish processing and filleting plants, cannery wastes, carcasses of fish like shark and other fish wastes are also used as raw material for fish meal and oil production. Traditional fish meal production in India was from sun-dried fish collected from various drying Centers all along the coast, and the product was chiefly used as manure. Better quality fish meal has been a prominent item of export from very beginning of this industry. The importance of improving quality for better use was felt, and the Ministry of Food and Agriculture has, as early as in 1959, laid down specifications regarding quality fish meal. Later the Bureau of Indian Standards (BIS) has brought out the specification for fish meal as livestock feed for facilitating proper quality control.

Page 19 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

Fish can be reduced to fish meal by 2 general processes: Dry-rendering and wet-rendering

- **Dry-rendering**

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

- **Wet-rendering**

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

The process requires elaborated equipment's and is normally a continuous one and therefore adaptable to reduction of large quantities of fish.



Fig.1.10 Fish Meal



Fig.1.1. Fish Meal Plant

General Fish byproduct processing step (Outline)

The fish meal and oil process is a separation process in which the content of water, oil, and solids of the fish are separated and the water removed by evaporation and drying.

The process has not been altered for a long period of time. Extensive development of the various equipment has been, and currently is, taking place in order to reduce energy consumption, increase product quality, and protect the environment. A modern fish meal line appears in the flow diagram in.

Step 1 is the cooking where the fish is heated and the protein coagulated in order to release the water and oil. Today the cooker is typically indirectly heated with steam and the flow controlled with respect to time and temperature.

Step 2 is mechanically dewatering the heated product using a strainer screw combined with a screw press. The press cake has a water content of approximately 50% and contains about 70% of the solids.

Step 3 is a separation of the oil from the press water using high speed decanters, where suspended solids are removed and now are called grax. This is followed by a centrifuge step where the oil is separated. The water is now called stick water and contains 6-10% soluble protein.

Step 4 is the concentration of the stick water from the centrifuge in an evaporator up to 40-50% solids. The evaporator is typically a “multi-effect” and can use steam, waste heat from the dryers, or electricity in the MVR (mechanical vapor recompression) evaporator.

Step 5 is the drying of the press cake mixed with grax from the decanter, and the soluble material from the evaporator, from approximately 55% to below 10% moisture. The drying process has the largest effect on the protein quality and several types of dryers are today being used. Direct fired rotary drum dryers are widely used in large volume plants and produce a fair average quality (FAQ) meal. Steam dryers are used in new installations and can be operated with minimum air intake securing optimal conditions for waste heat utilization and protection against pollution of the air. The steam dryer produces what is called steam-dried meal.

Page 21 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

- **Decanting**

decanters play – and will continue to play – a key role in separation processes for fish products, such as fish meal and fish oil. Among the decanter separation processes are the:

- Removal of oil and solids from fish press water or from whole fish to produce fish meal and fish oil.
- Removal of solids from fish products hydrolysate proteins for onward processing and concentration.
- Low-temperature extraction of proteins from fish meat (surimi) and or fish oil extraction for human consumption.

1.4.2 Oil extraction techniques

There are the different techniques

(1) By auto fermentation:

Fish livers are first chopped into small pieces and exposed to sun in earthen pots for several days, so that it undergoes decomposition. As it undergoes decomposition, the oil that is released is collected. This oil is crude and used for burning lamps in curing yards.

(2) By boiling:

Chopped livers are boiled with sufficient quantity of water. The released oil is then decanted off easily. Although this method is simple, the yield, however, is moderate as all the oil is not extracted from liver. This method is generally followed in small scale industries.

(3) By steaming:

Minced livers of fishes such as cod (which has high oil content) are steamed at a temperature of 85-90°C under a pressure of 2 kg/sq. cm. The liver cells disintegrate and the oil is collected from the top layer. This method is good for operation while on board of fishing vessels or trawlers, where steam is readily available.

(4) By chemical digestion:

Chemical digestion is done by the following three methods:

Page 22 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

Aqua acid digestion:

Aquacade is a patented mixture of sodium bicarbonate and paraldehyde. When fresh liver is mixed with it, it partly denatures the protein and yields a pulp. The pulp is stirred with warm water as it is passed through a series of tanks or cylinders. This gives rise to an emulsion of water and released oil. As soon as the emulsion breaks, the oil floats on the top from where it is collected. Alkali digestion:

Digestion of proteins in the liver with alkali has proved to be the most successful method. The livers of halibut, tuna and some sharks, which are relatively poor in oil but high in vitamin A potency, are processed in this manner. In this case, the oil is held strongly by proteins and is not totally released by steaming or boiling.

Minced liver is mixed with dilute caustic soda (1-2% by weight) or sodium bicarbonate (2-5% by weight). It is then steamed at 82-88°C with constant stirring. The pulp is then centrifuged and the super-natant oil is collected.

Enzyme-alkali digestion:

This chemical digestion is a modified version of the above, where alkali (sodium bicarbonate) is added after the chopped liver is treated with an enzyme (pepsin). As pepsin acts best in an acidic medium, HCl is added to the mixture.

At first the chopped liver is brought to pH level of 1.2 to 1.5 by the addition of HCl. Then commercial pepsin (0.5% by weight of the liver) is mixed with the pulp and digested at 43-49°C. The pH is then raised to about 9.0 by the addition of sodium bicarbonate and the temperature is increased to 80°C. After complete digestion, the oil that has gathered at the top is collected.

(5) By solvent extraction:

This is an advanced and expensive process although the yield is higher. This involves solvent extraction plant/equipment and solvents, like ethylene dichloride, solvent ether, chloroform, light petroleum, etc.

Page 23 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

In this method, at first the minced liver is dehydrated with the application of an anhydrous salt, generally sodium sulphate. When the moisture has been removed, the pulp thus formed is mixed with the solvent (preferably ethylene dichloride) and put to extraction process.

After distillation the oil is separated out. Any free fatty acid present in the liver is removed during refinement of the oil. The solvent extracted oil is darker in color and has a higher viscosity.

The Principal Method of Processing for separating oils

The bulk of the world's fish meal and oil is today manufactured by the wet pressing method. The main steps of the process are cooking for coagulation of the protein thereby liberating bound water and oil, separation by pressing of the coagulate yielding a solid phase (press cake) containing 60-80% of the oil-free dry matter (protein, bones) and oil, and a liquid phase (press liquor) containing water and the rest of the solids (oil, dissolved and suspended protein, vitamins and minerals). The main part of the sludge in the press liquor is removed by centrifugation in a decanter and the oil is subsequently removed by centrifuge. The stick water is concentrated in multi-effect evaporators and the concentrate is thoroughly mixed with the press cake, which is then dehydrated usually by two-stage drying. The dried material is milled and stored in bags or in bulk. The oil is stored in tanks.

Procedure of extraction oil

- Large fish are hashed while smaller fish (for example, those less than 40 cm long) are fed directly at a constant rate by the feeding machine to the indirect steam cooker.
- The coagulated mass is pre-strained in a strainer conveyor or in a vibrating screen, before entering the twin screw press.
- The products from the press (press cake and press liquor) are treated as follows.
- The press cake is disintegrated in the tearing machine to facilitate mixing with stick water concentrate and drying in an indirect steam dryer or a direct flame dryer.

- The meal passes through a vibrating screen furnished with a magnet to remove extraneous matter like pieces of wood and metal (for example, fish hooks) before entering the hammer mill.
- The ground meal is automatically weighed out in bags by the scales the bags are closed (e.g., by sewing) and conveyed to the store. Alternatively, the meal is stored in a holding and blending silo before bagging, pelleting or storing in bulk.

In the following sections we shall take a closer look at the various unit operations of the process.

Centrifugal methods

In these systems, the separation of the coagulated fish pulp is based on centrifugation instead of pressing. The below stated are center fugal procedure:

- In one of these systems (Centrifish, DeLaval pat, Sweden), the fish is cooked in an indirect apparatus heated by flue gases,
- and the coagulated material separated into an oil-stick water phase, containing some suspended sludge, and a solid phase in a decanter centrifuge.
- The liquid phase from the decanter is separated into oil, stick water and sludge by means of self-cleaning centrifuges.
- The solids are dehydrated in an indirect tube dryer heated by flue gases.

The compact arrangement, which does not require a steam boiler, has made this system attractive for installation on board the ship. Without evaporation, however, about 20% to 30% of the solids is lost with the stick water. Because of the relatively low installation costs and minimum operation attendance, packaged fishmeal plants are also of interest for stationary operation.

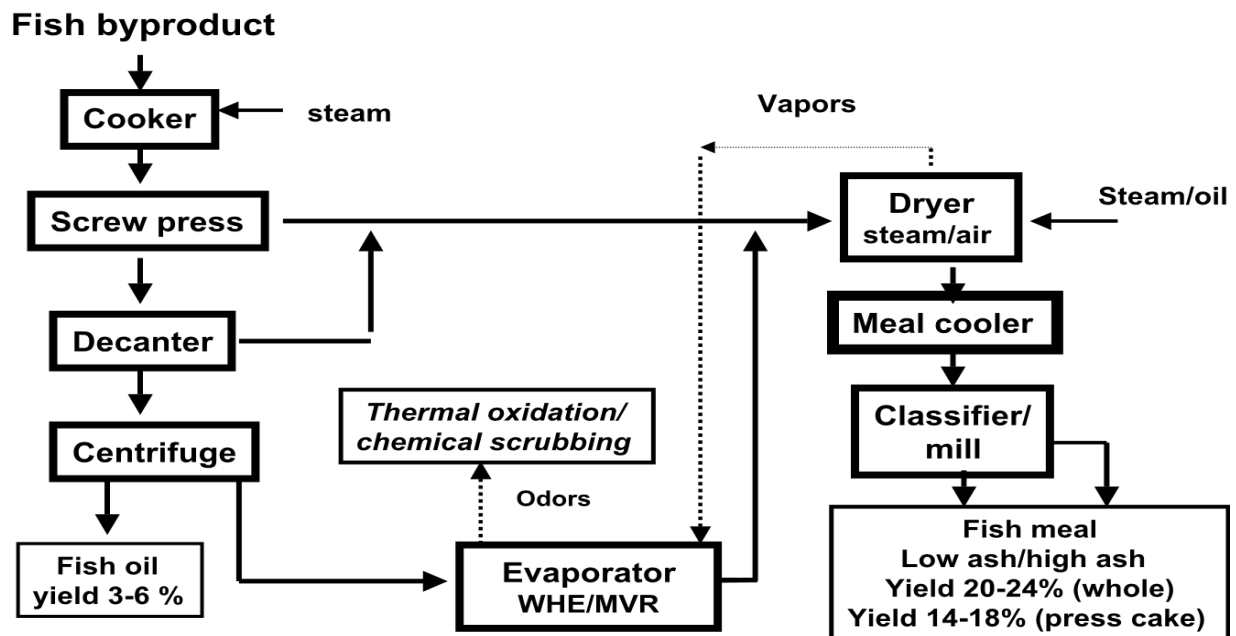


Fig.13 General steps fish byproduct processing

1.5 Use of fish byproduct

Fish by product is have great important thus are include listed below:

- Human Supplements, Biochemical, Proteins and Oils
- Human Foods and Ingredients
- Industrial Ingredients
- Pet Food Ingredients for different animals like dog and cats.
- Aquaculture Ingredients
- Pig and Chicken Feed Ingredients
- Fertilizers
- Fuels

Plastics are usually made from petroleum products and do not decompose in the environment, but researchers have for the first time produced fish waste in environmentally friendly plastic fisheries.

Fish waste is used as organic fertilizer, nutrients for agricultural purposes or as a renewable source. Fish waste has been proven to be an organic fertilizer and nutrient for both agricultural uses; and soil strengthening is useful.

Bioactive peptides derived from fish waste can be used as anti-hypertensive, antioxidants, anticoagulants, and antimicrobial compounds in functional foods or food and pharmaceuticals according to their therapeutic potential in the treatment or prevention of diseases.

The best way to produce high value-added products from these low-value raw materials is to use protease enzymes to produce hydrolyzed protein.

The main purpose of hydrolysis of fish waste is to achieve maximum recycling of available components while maintaining their high quality.

One of the determining and important factors in enzymatic hydrolysis using commercial enzymes is the choice of protease enzyme. In protein hydrolysis, conditions such as pH, temperature, hydrolysis time and enzymatic activity affect enzyme performance.

According to research, hydrolyzed proteins have shown significant ability to inhibit hydroxyl radicals and linoleic acid peroxidation.

According to the results, radical scavenging activity of hydrolyzed protein increased by 40% with increasing degree of hydrolysis.

1.6 Collecting fish byproducts

The main source of fish byproduct is head, fine, skin, scales should collect timely because if that not collect it will have spoiled though virus, fungal and bacterial.

Sack is one equipment that used for collection.

That spoiled fish byproduct will contaminate the environment as well as the fisherman and its processor.

During collecting fish byproduct, we should category based on the source type and as its purpose required.

1.7 Occupational health and safety(OHS) procedures

Page 27 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

Occupational Health and Safety Occupational health and safety issues that occur during the operational phase of fish processing projects primarily include the following:

- a) Physical hazards
- b) Biological hazards
- c) Lifting, carrying, and repetitive work injuries
- d) Exposure to chemicals
- e) Exposure to heat and cold
- c) Confined space
- a) Exposure to noise and vibrations

a) Physical hazards

Causes of accidents in fish processing operations include falls caused by slippery floors and stairs; equipment safety issues associated with filleting knives and other sharp tools; and cuts from sharp edges on process equipment(e.g.stainless steel basins). In addition to general recommendations included in the General EHS Guidelines, the following are sector- specific recommendations for accident prevention: Provide workers with training in the proper use and maintenance of cutting equipment (including the use of machine safety devices, handling/storageand upkeepof knives, and emergency shutoff procedures) and personal protective equipment (e.g. metallic gloves and leather aprons for cutting activities, and protective footwear with rubber soles) ;

Design the plant so that different activities and the flow of processes do not cross. In addition, clearly demarcate transport corridors and working areas; ensure that handrails are provided on platforms, ladders, and stairs; and use non- slip floor surfacing;Use completely enclosed conveyer belts to protect hands and fingers.

b) Biological hazards

Workers involved in manual gutting, skinning, and general handling of fish and shellfish may develop infections and or allergic reactionsresulting from exposure to th e fish itself, or

Page 28 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

bacteria on the fish. Water spraying processes may result in the formation of aerosols with bacteria that can be inhaled. In addition to general recommendations included in the General

EHS Guidelines, the following are sector -specific recommendations to prevent exposure to bacteria: Consider work rotation strategies to reduce occupational exposure to allergens ;

Wear gloves to protect hands from exposure to products, especially when working with seafood that is known to create allergic reactions (e.g. scallops and shrimp).

Provide food- approved shielding hand creams; Avoid aerosol-generating activities (e.g. use of compressed air or high- pressure water for cleaning). Where these

activities cannot be avoided, provide proper ventilation of enclosed or semi- enclosed areas to reduce or eliminate exposure to aerosols, in addition to adequate distances between workers and aerosol- generating activities; Ensure physical segregation of work and personal facilities to maintain worker personal hygiene.

c) Lifting, Carrying, and Repetitive Work

Fish processing activities may include a variety of situations in which workers can be exposed to lifting, carrying, repetitive work, and work posture injuries. Many of the manual operations

in less mechanized fish processing plants include lifting heavy boxes of raw materials.

Repetitive strain injuries may result from manual filleting and trimming operations. Poor

working postures may result from the design of the workspace, furniture, machinery, and tools.

Recommended prevention and control measures for these activities are discussed in the General EHS Guidelines.

d) Chemicals

Exposure to chemicals (including gases and vapors) includes handling chemicals such as chlorine, lye, and acids that are related to cleaning operations and disinfection in process areas.

In fish smoking facilities, workers could be exposed to smoke particles that contain potential or confirmed carcinogens such as polycyclic aromatic hydrocarbons (PAHs).

Recommendations to prevent and control exposure to chemicals are presented in the General EHS Guidelines.

Page 29 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

Additional, industry- specific recommendations include:

Avoid locating smoking kilns in the same rooms as processing workers. Chimney exhaust systems should ensure that smoke is not entering the processing factory.

Respiratory protection should be used when cleaning smoke ovens; Ensure that employees handling concentrated lye, acid, and chlorine wear protective clothing and eyewear.

e) Heat and Cold

Exposure to extreme heat and cold is common because fish processing is often conducted in air-conditioned plants under low temperature, even in tropical locations. Improper work clothes in combination with stationary work locations can result, or be an additional factor, in respiratory and musculo skeletal ailments.

Recommendations for the management of exposure to heat and cold include the following:

Set the temperature in air- conditioned processing facilities, where stationary manual work is conducted, at a level that is appropriate according to temperature stress management procedures as noted in the General EHS Guidelines. Products awaiting the next processing step can be kept chilled without lowering the ambient temperature through proper use of ice, slush -ice, or waterice mixtures;

Equip cold stores and chill stores with strip curtains to avoid extensive drafts when doors are open. Ensure freezers can be opened from the inside;

Design air- conditioning systems for processing facilities in conjunction with strip curtain placement to minimize d rafts; Provide protective clothing in cold environments (e.g.refrigerated storage rooms). Process workers should always be equipped with proper working garments, including dry boots;

Reduce movement of processing workers between different temperature zones (e.g. when packing frozen products).

f) Confined Space

Page 30 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

Occupational health and safety impacts associated with confined spaces in fish processing operations (e.g. storage areas, boat holds) are common to most industries, and their prevention and control are discussed in the General EHS Guidelines.

g) Noise and Vibrations

Noise and vibration exposure may result from proximity to noisy machinery (e.g. compressors, automatic packing machinery, condensers, ventilation units, and pressurized air). Recommendations for noise management are discussed in the General EHS Guidelines.

1.8 Unsafe and inefficient aspects of the work area

1.8.1 Workplace hazards and high risk work





The health problems among fish processing workers have been attributed mainly to safety risks (mechanical and electrical accidents); excessive noise levels and low temperatures; bacterial and parasitic infections; bio aerosols containing seafood allergens, microorganisms, and toxins; and poor ergonomic practices and workplace organization. These commonly result in fatal or non-fatal injuries and occupational diseases such as frostbite and aggravation of Raynaud's phenomenon; noise induced hearing loss; skin infection and sepsis; allergic respiratory diseases (rhino conjunctivitis, asthma, extrinsic allergic alveoli are) and skin conditions (urticarial, contact dermatitis); musculoskeletal cumulative trauma disorders; and stress related health problems. The reported prevalence of occupational asthma associated with fish processing is 2–8%, and occupational protein contact dermatitis (PCD) and urticarial is 3–11%.






Musculoskeletal disorders of the neck and shoulders occur in 31–35% of the workforce, with younger untrained or unskilled women being more adversely affected.


There is personal protective equipment that used for protecting the fish by product processor in the work area. Those are listed in below table:

Page 31 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

Table: 2 Types of PPE that can be used

No.	Types of PPE to fishery	Description	Figure
1	Eyes goggles	Chemical or metal splash, dust, projectiles, gas and vapor, radiation Safety spectacles, goggles, face screens, face shields, and visors Make sure the eye protection chosen has the right combination of impact/dust/ splash/molten metal eye protection for the task and fits the user properly.	
2	Head and neck (Helmet)	Impact from falling or flying objects, risk of head bumping, hair getting tangled in machinery, chemical drips or splash, climate or temperature Industrial safety helmets, bump caps, hairnets and fire fighters' helmets.	
3	Ear noise	a combination of sound level and duration of exposure, very high-level sounds are a hazard even with short duration Earplugs, earmuffs, semi-insert/canal caps	
4	Hands glove	Abrasion, temperature extremes, cuts and punctures, impact, chemicals, electric shock, radiation, biological agents and prolonged immersion in water Gloves, gloves with a cuff, gauntlets and sleeving that covers part or all of the	

		arm	
5	boots	Wet, hot and cold conditions, electrostatic build-up, slipping, cuts and punctures, falling objects, heavy loads, metal and chemical splash, vehicles Safety boots and shoes with protective toecaps and penetration-resistant, mid-sole wellington boots and specific footwear, e.g. foundry boots and chainsaw boots .	
6	Safety shoes	Protecting workers leg from sharp martials cutting	
7	Respirator	oxygen-deficient atmospheres, dusts, gases and vapors	
8	Whole body suits	Heat, chemical or metal splash, spray from pressure leaks or spray guns, contaminated dust, impact or penetration, excessive wear or entanglement of own clothing Conventional or disposable overalls, boiler suits, aprons, chemical suits.	
9	aprons	Used of stay with clean cloth	

10	Sun screen	Protect from sun light.	
----	------------	-------------------------	---

Self-check 1	Written test
---------------------	---------------------

Name..... ID..... Date.....

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part I: Say True or False for Questions based on statements.

1. About 45 to 60 percent of all fish, including head, tail, fins, skin, scales, viscera and spine, are waste products.
2. A homogenizer can be used to finely mix small samples of seafood products.
- 3 Fishmeal is used livestock feed supplement.

Part II. Fill in the black space

1. _____ is a separation process in which the content of water, oil, and solids of the fish are separated and the water removed by evaporation and drying.
2. _____ is part of fish that available which cannot be used for direct consumption for several reasons.

Part III. Short Answer Questions

1. What are the source of fish By-Products?
2. List at least five use of fish byproduct.
3. Write at least 3 mainly used tools equipment & materials necessary for fish byproduct processing.

LG 25 LO #2- Process fish byproduct

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Grinding large fish and byproducts
- Cooking and heating fish byproducts
- Pressing
- Drying press cake
- Grinding, sifting and packing the dried meals
- Storage and transport of fish meals

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Grind large fish and byproducts
- Cook and heating fish byproducts
- Press
- Dry press cake
- Grinding, sifting and packing the dried meals
- Storage and transport of fish meals

Learning Instructions:

- Read the specific objectives of this Learning Guide.
- Follow the instructions described below.
- Read the information written in the information Sheets
- Accomplish the Self-checks

- Perform Operation Sheets
- Do the “LAP test”

Information Sheet- 2

2.1. Grinding large fish and byproducts

Chopping into smaller pieces some fish can be ground whole (e.g. silversides, *Menidia menidia*). However, for more effective blending, it is best to chop the fish up before attempting to grind. This is best done with fish that are not completely thawed.

The first step in the production process is to grind the product. If volumes are small, this can be done with a manual meat grinder. For bigger volumes an electric grinder will be needed. It is important the grinder produces particles that are small enough to enable the preservative (the acid) enter into the heart of the particle.

Grinding procedures:

- Collect fish by product
- Clean fish byproduct
- Chop the fish byproduct until the size of fish be coming 100g – 300g.
- Calibrate and start the grinder
- Grind the fish byproduct to maximum particle size should be less than 1mm.

2.2. Cooking and heating fish byproducts

2.2.1 Cooking

Fish is an excellent protein to serve because there are many ways that you can cook it, but not all methods of cooking will work every type of fish. For example, some types of fish are too tick to cook under a broiler, and some types of fish are too delicate to deep fry though heating. Here, we will break down different things to consider when deciding how to fish cook to use for each cooking methods.

Page 37 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

Procedure of cooking fish byproduct:

- Adjust the hot pellet using a temperature of 85°C to 90°C.
- Add fish byproduct to cooking dish
- Wait for 15 to 20 min

Fish is first typically cooked to coagulate protein and allow some oil to be released, In addition, micro-organisms are killed by this process. Clean conveyors, holds and storage pits, short storage time and reduced temperatures minimize micro-organisms and the spoilage they may cause. The lower temperatures also reduce fish enzyme activity (autolysis), another form of spoilage. Cooked fish then passes into a screw press where liquor is pressed out and the solids (press-cake) go to the drier.

The liquor is **decanted** to remove further solids. It is then **centrifuged** to spin off oil and separate out an aqueous phase (stick water). The stick water passes through **evaporators** to reduce its volume (concentrate). This concentrated liquor (called stick water because it tends to be viscous and sticky) is returned to the **press cake** entering the drier.

Cooking is an exacting operation in production and is sometimes difficult to control. Production of cooked material which can be readily pressed is dependent on the quality of the raw material and on the process conditions.

A precise time-temperature program for this process can therefore not be set up and, as mentioned above, a process of trial and error is generally required when fish of unknown history is processed.

The most common practice of cooking good raw material, however, is to heat to 95°-100 °C within. Most manufacturers operate cookers to ensure rapid heating of the mass to a temperature of about 95° C. The proof of good cooking is good press ability of the mass which leads to proper removal of press liquor and, in particular for fatty fish species, efficient recovery of oil, giving a meal with low fat content which is a criterion of quality.

The process must be controlled to ensure sufficient cooking, but overcooking must be avoided as this results in problems with pressing and the presence of large amounts of suspended particles in the stick water, which makes evaporation difficult.

The capacity of a heat exchanger, such as an indirect steam cooker, is proportional to the area of the heating surfaces and to the temperature difference between the two sides of the wall.

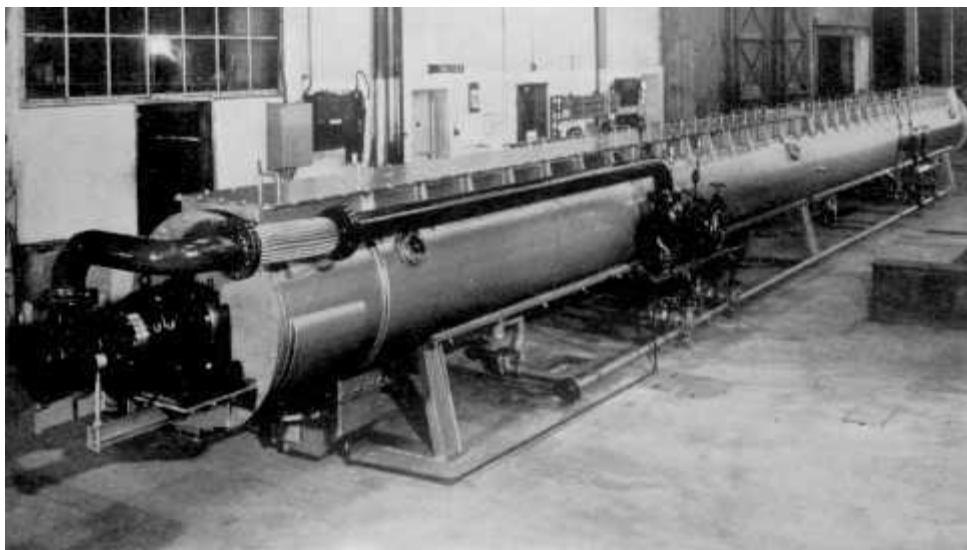


Fig. 2.1 Cooker machine

Furthermore, the capacity is influenced by the resistance to heat transfer largely caused by the existence of films and coatings on the heating surfaces. An important way of reducing the tendency to scaling, caused by coagulation of protein on the hot walls, is to use moderate steam temperatures, especially in the early stages of heating. Another measure is, of course, to introduce and enforce good routines for effective cleaning at regular intervals.

Pre-straining

One result of the heating process is that the oil and a major part of the water is released and to a large extent may be removed from the solids by simple draining. Removal of more liquid is achieved by subsequent treatment of the solid part in presses or centrifuges, or in a combination of the two.

Page 39 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

To facilitate the functioning of the press, the liquid liberated in the cooker is drained from the coagulated fish pulp in a strainer conveyor or in a vibrating or rotary strainer. Figure shows a strainer conveyor set at an incline between the cooker and the press. It is designed on the same principle as that of a screw conveyor except that the lower end (that closer to the cooker) is fitted with an easily replaceable strainer in the shape of a half cylinder. Strainers with different sizes of perforations may be required for various types of fish. Figure shows a vibrating strainer. The fundamental principle here is that the cooked material is conveyed to a strainer which is kept vibrating by an electric motor. The liquid phase passes through the strainer holes whereas the solid phase is vibrated along the surface of the strainer to an outlet.

2.2.2 Heat Processing

Heat processing is the most important operation in canning process. In heat processing/ the product is subjected to heat at a high temperature (say 110°C or above) to sufficient length of time to cause destruction of all pathogenic organisms and inactivate or destroy the micro-organisms causing. Among the pathogenic bacteria, *Clostridium botulinum* is the most important, since it is able to grow in sealed cans under vacuum if it present and lead to the development of a potentially lethal toxin. In general, proper thermal processing prevents spoilage, helps to retain most of the organoleptic qualities and assures consumer safety.

The temperature and duration of heat processing depend on the type and nature of microorganism and heat penetration characteristic of the food.

When micro-organisms are subjected to heating in steam, it is observed that 90% of the population is destroyed at equal intervals of time at a particular temperature. This time to reduce the bacterial population by 90% is known as the 'D' value or the decimal reduction time at that temperature. The 'D' value is in fact, a measure of the heat resistance of the micro-organisms. Safety from botulism, is assured by giving a process equivalent to 12 decimal reductions (12D) in the population of *Cl. botulinum*. This is made more reliable and reasonable by assuming an initial *Clostridium botulinum* spore level of 1 organism per gram of the food material by reducing the spore level to 10⁻¹².

In the case of non-pathogenic spore, a comparatively higher initial spore level and final spore survival is accepted on grounds that health risk and spoilage is not so severe as compared to that of *Cl. botulinum*. If a very low spore survival in the case of non-pathogenic thermophilic organisms such as 10-12 is considered, it will require heat processing for longer periods leading to unfavorable situations, like loss of quality, increase in energy consumption, decrease in production output etc. Hence a compromise on heat processing time for obtaining safety from *Clostridium botulinum* and non-spoilage due to thermophilic non-pathogenic organisms is an acceptable practice. The sterility condition arrived on this concept is known as commercial sterility. In relation to canned foods, FAO/WHO Codex Alimentarius Commission (1983), defines commercial sterility as the condition achieved by the application of heat, sufficient alone, or in combination with other appropriate treatments, to render the food free from micro-organisms capable of growing in the food at normal, non- refrigerated conditions at which the food is likely to be held during distribution and storage.

The **cans** are stacked in crates and placed in retorts for heat processing. Before closing the lid of the retort, air from the retort is completely flushed out by flushing with steam. The air vent is then closed and steam is admitted in to the retort in such a way that the temperature and pressure is raised slowly till the required temperature and pressure is attained. Heat processing is carried out at the designated temperature, pressure and duration till the heat processing value designated as F0 is attained. F0 value is the heat processing time at 121°C (250°F). In practice, the lethal rates of all temperatures above 90°C is integrated in terms of heating at 120°C and the total lethal rates of the heating process is expressed as equivalent to heating at 121°C. When the heat processing is over steam is released slowly till the pressure is brought down to zero. Aluminum cans and flexible pouches require super imposed pressure cooling for preventing bursting while steam pressure is released. The cans are taken out and transferred to cooling tanks immediately after heat processing.

2.3. Pressing

The purpose of pressing is to squeeze out as much liquid as possible from the solid phase after the initial heating process. Pressing improves the oil yield. Both continuous single-and twin-screw presses are used in the fish meal industry today. The screw in the single-screw press is

Page 41 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

designed with a taper and exerts an increasing pressure on the fish pulp by reducing the volume as it progresses through the press.

To ensure free drainage of liquid in the press, the material should be porous; that is, there should be many open channels in its mass for the passage of liquid.

The procedures of pressing:

- Adjust and check the presser machine.
- Cooked material from small and autolyzed fish will, as a rule, contain large quantities of fine particles (sludge) that tend to clog up these channels.
- Start pressing the presser after adding the cooked fish byproduct.

In such cases, the porosity of the **press cake** may be improved by increasing the diameter of the holes of the pre-strainer. A greater part of the fines will then follow the liquid phase and not hamper the function of the press. To take advantage of this measure, the capacity of the decanters (desludging centrifuges) should be sufficient to handle the increased volume of sludge in the liquid.

This is important not only to improve the oil yield and the quality of the meal, but also to reduce the moisture content of the press cake as far as possible, thereby reducing the fuel consumption of the dryers and increasing their capacity.

Two types of continuous press are used in the fishmeal industry; these are provided with either one or two screws. Both work on the principle of helical screw conveyors rotating in a tightly fitting cage, which is provided with perforations for the drainage of press liquid. The screws are made with a taper, thus ensuring that the volume between the flights is gradually reduced. This means that the material, during passage along the press, is subjected to increasing pressures and, as a consequence, additional amounts of liquid are expressed.

The performance of the press is largely determined by the profile and the compression ratio of the screws, that is, the ratio between the flight volumes of the inlet and outlet flights. Whether standard screws based on fish of average mature and quality, or screws with a special profile and

compression ration should be used, is a question for careful consideration and discussion with the press manufacturer.

Occasionally difficulties are experienced, particularly when processing soft and autolyzed fish. The press "slips", meaning that the screws rotate in the material without conveying it forward. This problem may be minimized by incorporating special devices in the single screw press; but the most efficient measure is to use two screws mounted side by side and rotating them in opposite directions.

For this reason, the twin screw press has become the most commonly used type of press. Modern presses are very efficient dewatering devices, yielding press cakes with moisture contents as low as 50%.

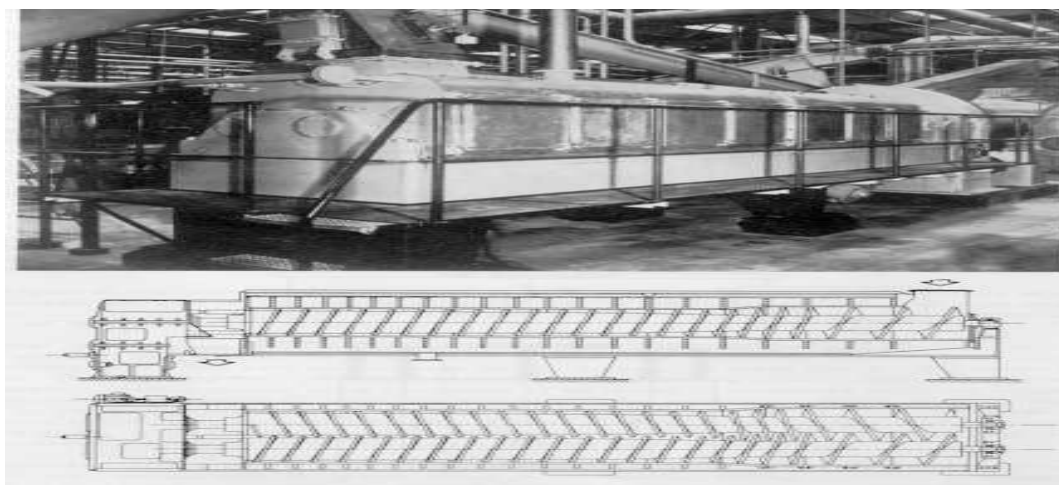


Fig. 2.2 Twin screw press

The performance of the press may be regulated in two ways: one may adjust the level of cooked material in the hopper above the press, a high level resulting in higher pressure and consequently a more complete filling of the inlet screw flights; the other factor is the rate of revolution of the screws; increased speed means greater throughput and a shorter pressing time. How to adjust these two factors to obtain optimum performance is largely a matter of experience and skill?

Good performance of the press depends upon relatively tight fitting of the screw flights to the surrounding strainer plates. If the distance between the flight tops and the screens becomes too

Page 43 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

wide, for instance after long wear and tear, both the efficiency and the capacity will suffer; rebuilding and readjustment of the screw flights are then necessary. Another factor that needs continuous surveillance is the performance of the strainer plates. Regular inspection and cleaning is necessary to ensure that the holes are open and allow free escape of liquid. As pointed out earlier, temperature is a factor of great importance for the whole cooking and pressing operation. Basic information today indicates that moderate temperatures are preferable from the standpoint of release of oil and denaturation of protein. On the other side, high temperatures reduce the viscosity of the oil and tend to facilitate the flow from the solid phase. With the equipment we just have described, we must again rely on experimental data to establish optimum conditions for a particular raw material.

Processing problems may be encountered under two entirely different conditions.

One relates to completely fresh fish that tends to retain more oil and water than desirable. For the time being, there is no solution to this problem except by resorting to one of the two equally deplorable measures; either by reducing the speed of the press and thereby the capacity of the whole plant. Or by storing the fish for a day or two before processing, thus leading to deterioration of quality.

The other situation occurs with soft and autolyzed fish. As mentioned in the introduction to this section, the answer to this problem is to bleed off in the pre-strainer more liquid and fines to be handled by the decanters. Some processors will often resort to the use of coagulating agents like formaldehyde, which help to solidify the material and improve the performance of the press. This, practice, however, should be restricted as far as possible because formaldehyde reacts with the essential amino acid lysine, and thereby reduces the nutritional quality of the protein. Calcium chloride (CaCl_2) has also been used as a hardener, but this practice was abandoned because it raised the chloride content of the meal to unacceptable levels, particularly in cases where stick water is incorporated and whole meal produced.

2.3.1 Centrifugation

To separate solids from liquid by centrifugation is a standard operation in many industries including the fishmeal and oil industry. With the development of centrifuges that can handle materials with high contents of solids and at high rates of through put, it now possible to use

Page 44 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
----------------------	--	--	--------------------------------

decanter instead of presses to separate the solids from the liquid in cooked fish. The advantages are several.

- First, it presents a simplification of the process.
- Secondly, centrifugation is a better known and more controllable unit operation than pressing and filtration.
- Thirdly, centrifugation is a much quicker process than pressing and significantly reduces the heat load on the material, a factor of importance for the manufacture of special products.
- Perhaps the most important advantage is the ability of the centrifuge to process soft and very fluid material where the press would fail completely.
- Better hygiene and simpler procedures for washing operations are further features on the plus side.

On the negative side one should note that the centrifuge will discharge the solids with a higher moisture content than the press. This means increased fuel consumption for the drying operation. Furthermore, the centrifuge tends to produce more emulsions and fines, causing problems in the subsequent separation of oil, water and sludge in the liquid phase.

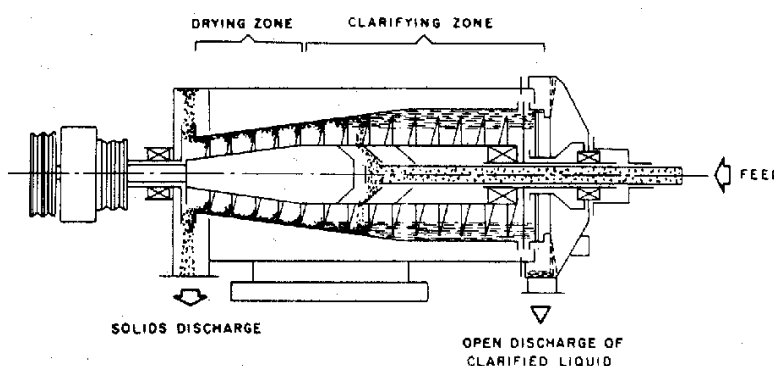


Fig. 1.1 Decanter

3.2.2 Decanter

Although the use of decaners for the separation of solids and liquid in cooked fish material for the time being appears relatively unimportant, centrifugation is an interesting area where we may

Page 45 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

expect new developments. Combinations of press, strainer and centrifuge in various ways also open interesting possibilities which should prove worthwhile investigating.

3.2.2 Separation of press liquor

The liquor coming from the press and the pre-strainer consists of water and varying amounts of oil and dry matter. The oil content is related to the proportion of oil in the fish. The content of dry matter, occurring both in dissolved and suspended (finely dispersed) forms, varies with the size and quality of the fish and with the extent of mechanical handling prior to processing.

The quantity of press liquor will also vary with the nature and quality of the raw material, and increases particularly with advancing autolysis of the fish. Under average conditions one may estimate the volume of press liquor at about 70% of the raw material while the remaining 30% makes up the press cake.

The separation of the three fractions of the press liquor, sludge, oil and water, is based on their different specific gravities. If press liquor is left for some time in a tank, it will settle out in three layers: sludge at the bottom, water in between and oil at the top. In the early days of fish oil production, this method of settling under the influence of gravity alone was standard procedure. It had many drawbacks such as poor yield, impure fractions and, above all, it was extremely slow. With centrifugation we get several thousand times greater forces at our disposal, and the separation process may now be accomplished in seconds when compared with the hours required for the settling method.

An important prerequisite for efficient separation is high temperature, implying that the press liquor should be reheated to 90°-95°C before entering the centrifuges. This applies to sludge removal as well as to separation of oil and water.

The suspended solids are first to be removed. This is done in a horizontal centrifuge, a so-called decanter or dislodge. It consists of a partly cylindrical and partly conical rotor drum (bowl) and, inside this, a screw conveyor of the same shape. The press liquor is fed into the rotor where, by centrifugal force, it is thrown toward the bowl's periphery. The denser solids are rapidly precipitated along the inside rotor surface. The screw conveyor rotates with the bowl, but at a rate some 30 to 50 rpm faster than the speed of rotation of the drum; the deposited solids are thus

scraped off continuously. Before being discharged, they are lifted out of the liquid phase and pass through a drying or dewatering zone.

The performance of the decanter may be controlled in two ways. It is possible to adjust the thickness of the liquid layer (a thick layer represents a longer zone and allows more time for clarification of the liquid) and, associated with this, there will be a correspondingly shorter zone of sludge and less time for dewatering the solids. The reverse will, of course, be the case with a thin liquid layer. The other regulating parameter is the speed of the screw conveyor relative to that of the bowl. The higher the content of solids in the liquid the faster the conveyor should rotate in relation to the bowl in order to remove the precipitate. In addition to these parameters one may naturally influence performance by regulating the feed. Optimum conditions are dependent both on quantity and nature, specially particle size, of the solids in the liquid. Decanters are available in various sizes.

For smaller plants, the investment in a decanter may not be economically justified. In such cases a vibrating strainer, although less efficient, may be a cheaper but entirely satisfactory solution.

Separation of stick water from oil takes place in vertical disc centrifuges, either of the nozzle type, which discharge the stick water and remaining sludge continuously, or of the self-cleaning type, which is often preferred. In the latter, the stick water is continuously discharged, whereas the sludge is collected in the bowl and periodically ejected according to a timed program which depends on the quantity and the nature of the sludge. The stick water with a dry matter content of 6-9% is concentrated in evaporators. The sludge in most cases can be pumped to the press cake.

The main component of the bowl is a stack of conical discs lying on top of each other at distances of 0.5 to 2 mm apart. The discs have a number of distribution holes to provide passages for the liquid from the bottom of the disc stack. The decanter liquid is fed from a control tube. The oil moves along the discs toward the center and discharges through the holes in the nut. The stick water moves toward the periphery and discharges behind the separating plate through the regulation ring. This is inter-changeable to adjust the separation. The sludge separates along the

bowl periphery and is discharged through the bowl slot into the frame chute at regular intervals. Centrifuges are available with rates of throughput ranging from 500 to 25 000 liters/h.

3.2.3 Oil polishing

Oil polishing, carried out in special separators, is the final refining step done at the factory before the oil is pumped into storage. Polishing is facilitated by using hot water, which extracts impurities from the oil and thus ensures stability during storage.

The efficiency of separation depends upon both design and mode of operation of the centrifuges. The speed of separation depends upon the motility of the particles and upon the centrifugal force of the separator. Motility depends upon material properties, such as viscosity and specific gravity, which in turn depend upon temperature. Accordingly, good temperature control is required; the temperature of the feed should be maintained at about 95°C, but not less than 90°C. The centrifugal force is proportional to the angular velocity squared and to the radius of the centrifuge bowl, while the stress on the material of construction is proportional to the angular velocity squared and to the square of the radius. Centrifuges are designed to operate at high speeds and are, therefore, generally constructed with small radii. Centrifuges operating at about 5 000 rpm, yielding a centrifugal force of 5 000 x g (natural gravity), are generally used in the fishmeal industry.

3.2.4 Evaporation

When decanters and separators have removed the major part of oil and suspended solids from the press liquid, we are left with the so-called stick water. For all practical purposes, one may estimate the amount of stick water at about 65% of the raw material. Besides water, stick water will contain the following components:

- dissolved protein
- undissolved (suspended) protein
- residual oil
- minerals
- vitamins
- amines/ammonia

During evaporation, solids are deposited on the hot surfaces impeding heat transfer and blocking the tubes. So it needs some process blow to treat waste

Page 48 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

- These deposits **must be removed regularly**, generally during shut-down periods (for example at weekends). Such removal necessitates chemical and mechanical treatments.
- Chemical treatment should be carried out when required, usually once a week.
- Mild steel evaporators may be cleaned with about **14% caustic soda solutions**, recirculated at about 80°C for 5 h and left standing overnight.
- The apparatus is then emptied and thoroughly rinsed with water before the factory resumes normal operation.
- Mechanical scale removal in mild steel evaporators may be necessary several times a year.
- The weekly cleaning of stainless steel evaporators is usually done with stronger cleansing agents. Two hours' treatment with caustic soda will dissolve protein deposits, and a subsequent one hour's treatment with 5% nitric acid at 60°C will remove more firmly bound material. M
- mechanical cleaning of stainless steel evaporators should be avoided if possible but, if it should prove necessary, it should be carried out with great care to avoid scratches or other damage to the surface, which would result in loss of an important property of stainless steel, that is its smoothness.
- The smoother the surface the less firmly does the scale adhere to the surface. Monthly cleaning (caustic soda) on the steam side of the evaporators is also advisable. To prevent corrosion and facilitate cleaning, stainless steel tubes are recommended.

The commonly used evaporators operate with vertical tubes partly filled with boiling liquid, gradually giving off water vapor while moving upward in the tubes and into the chamber, separating liquid and vapors. The volume of liquid is quite large and it takes, therefore, a long time before the desired concentration has been reached, and concentrate starts flowing to the dryers. This time lag between pressing and concentrating is particularly undesirable and causes problems in factories with the intermittent supplies of raw material. In such cases, the falling film evaporator becomes of special interest because it operates with a short holding time and small liquid volume. Here the stick water enters at the top of the tubes, which are heated from the outside by steam or hot gases. On its way down, water evaporates and the liquid becomes more

and more concentrated, and finally ends up at the bottom as concentrate. The falling film evaporator also offers advantages in connection with energy saving systems using vapor recompression. So far, it has found limited use in the fish-meal industry largely because it requires special skill and attention from the operator. Because of its many advantages, however, the falling film evaporator is definitely a new alternative to consider for future plants.

2.4. Drying press cake

The bulk of the world's fish meal and oil is today manufactured by the wet pressing method. The main steps of the process are cooking for coagulation of the protein thereby liberating bound water and oil, separation by pressing of the coagulate yielding a solid phase (press cake) containing 60-80% of the oil-free dry matter (protein, bones) and oil, and a liquid phase (press liquor) containing water and the rest of the solids (oil, dissolved and suspended protein, vitamins and minerals).

- The main part of the sludge in the press liquor is removed by centrifugation in a decanter and the oil is subsequently removed by centrifuge.
- The stick water is concentrated in multi-effect evaporators and the concentrate is thoroughly mixed with the press cake, which is then dehydrated usually by two-stage drying. The dried material is milled and stored in bags or in bulk.

The oil is stored in tanks Large fish are hashed while smaller fish (for example, those less than 40 cm long) are fed directly at a constant rate by the feeding machine to the indirect steam cooker.

The coagulated mass is pre-strained in a strainer conveyor, or in a vibrating screen, before entering the twin screw press.

The products from the press (press cake and press liquor) are treated as follows.

- The press cake is disintegrated in the tearing machine (wet mill) to facilitate mixing with stick water concentrate and drying in an indirect steam dryer or a direct flame dryer.
- The meal passes through a vibrating screen furnished with a magnet to remove extraneous matter like pieces of wood and metal (for example, fish hooks) before entering the hammer mill.

- The ground meal is automatically weighed out in bags by the scales (K), the bags are closed (e.g., by sewing) and conveyed to the store.
- Alternatively, the meal is stored in a holding and blending silo before bagging, pelleting or storing in bulk.

2.5. Grinding, sifting and packing the dried meals

2.5.1 Grinding

Before milling, the meal should pass another vibrating sieve and magnet to remove extraneous matter, like pieces of wood, cloth, fish hooks, and nails, which might still be present. The purpose of milling is to facilitate uniform incorporation in feeds. A properly milled meal has an attractive appearance and is readily mixed into feed rations which require homogeneous blending.

Different users require fish meal of different particle sizes. The ideal in milling is to produce small particles averaging around 40 mesh Tyler screen and of as even a size as possible. In practice, however, there is a great variation in particle size, ranging from 10 mesh to over 100 mesh.

Most purchasing specifications require the fish meal to pass through a 10 mesh screen, otherwise it is too coarse for uniform incorporation.

Production of excessive fines (particles below 150 mesh) should be avoided, for example by screening before milling and passing only the oversize particles through the mill. Large amounts of fines are undesirable for several reasons. They cause dusting when handled, sift through woven bags resulting in loss of weight and in pollution, cause compacting of bulk meal and tend to clog the nostrils of chickens eating the feed.

2.5.2 Sifting

The dried fish meals need to grind finally to break down any lumps and particles of bones and other parts of fish, in order to packaging the meal in to bags or storing it in silos for bulk delivery, for transport to the farm of animal. After first cycle grind the fish byproduct should take place sifting due to separate grinded part from un grinded the un grinded part needed to regrinding to facilitate easily packaging.

Page 51 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

2.5.3 Packaging and Labeling of processed product

Some of the listed bellows are the point we should not forget during packaging operation to minimize the risk of contamination and spoilage.

- Packaging of dried fish and squids should be carried out when the products have cooled down to room temperature.
- Packaging material should be clean, sound, durable, sufficient for its intended use, and of food-grade quality.
- Only packaging material and labels complying with the specifications of the processors should be accepted into the processing facility.
- Labels that are to be used in direct contact with the fish and squids should be made of a non-absorbent material and the ink or dye used on that label should be approved by the authorized agency.
- Packaging should be properly stored, considering the temperature and humidity of the storage area.
- A systematic stock rotation plan should be developed and maintained to avoid out of date materials.
- Packaging should be properly protected and segregated to prevent cross contamination.
- The packaged products should meet appropriate standards for labeling and weights.

Packaging of still warm products can result to sweating of products inside the packaging, particularly when packed in plastic bags.

Storage and transport of fish meals

There are different techniques which used to store the fish byproduct:

Addition of antioxidant

Reactive fish meals are "stabilized" by means of antioxidant immediately after manufacture, and may be stored in bulk or shipped as soon as they are cooled. The amount of antioxidant required for avoiding undue heating depends on the degree of reactivity of the oil (lipid unsaturation), and varies with fish species. Considerable excesses of ethoxyquin are, however, added for safety.

Page 52 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

Very careful control is necessary because of the small amount of antioxidant that is added to the fish meal and the need for even dispersion.

For this reason, the antioxidant is added to the meal in the screw conveyor leading from the dryer to the mill so that mixing can occur end route.

Automatic controls are available for the addition of the antioxidant, complete with alarm bells and other devices to warn the factory personnel if anything is amiss, to avoid any fish meal being bagged without having been adequately treated.

For ethoxyquin dosage it is essential to install proper automatic control and all fish meal passing the dozer after the sounding of the alarm must be diverted. until the correct dosage has been re-established, and passed through the dosing system again.

In some factories the antioxidant is mixed with a constant amount of stick water concentrate and this solution is then added to the press cake in the screw conveyor to the dryer.

The effectiveness of the antioxidant is similar, whether added before or after drying. It must be stressed that stabilized meal retains a small trace of reactivity and is not completely stable. Nevertheless, the oil quality (energy value) is retained during prolonged storage; and, far more importantly, so is the protein quality of the meal, which otherwise could decrease through reaction with oxidized fish oil.

Pelletizing

Pelletized fish meal, mainly produced by large manufacturers, facilitates bulk storage and transport. The flow properties are improved and dusting is reduced. Pellets do not represent any essential space saving compared with bulk stored meal; nor are oxidation and spontaneous heating retarded by pelletizing. The bulk density of pellets is the same as that of fish meal (generally 600 to 700 kg/m³). During handling, however, some of the pellets break and the broken pieces and meal formed in this way occupy the spaces between the pellets and thus increase the bulk density. Pellet diameters vary between 8 mm and 12 mm. Pelleting machines of 120 hp are capable of turning out about 5 t of pellets or more per hour.

Generally fish meal is not readily spoiled by bacterial action because of its low water content, and it has a very small bulk compared to the fish from which it is made; indeed, these are two of the main reasons for making fish meal.

Page 53 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

- It can transport with different car if the product dry, but unless it need cool truck.
- There is no need to refrigerate the meal in storage can store at room of temprature. Fish meal is usually stored and transported either in sacks made of paper, hessian or plastics, or in bulk. Fish meal in bulk is sometimes pelletized to make mechanical handling easier, since it does not flow readily as a powder.
- Fish oil present in the stored meal can react with oxygen in the atmosphere; the heat generated may damage the meal nutritionally and, on occasion, cause the meal to catch fire. Fortunately this is now a rather rare occurrence, due to the widespread use of antioxidants. Not all fish oils are equally reactive; some oily meals seem to require antioxidant treatment; whilst others do not.
- The most commonly used antioxidant is ethoxyquin; the amount used varies but is normally in the range 200-1000 mg/kg. Sacks of newly made oily meal are frequently stored in ventilated stacks, particularly in hot climates. White fish meal, with a low oil content, does not require antioxidant treatment.
- Fish meal is best kept in dry place protected from rodents and birds. Spoilage is normally very slight even after excessively long periods of storage; fish meal will keep for several years without detectable change in its nutritional value.
- Fish meal made from fatty fish, however, will show a gradual decrease in fat content, as measured by extraction with ether, unless antioxidants are present; this is because the fats slowly oxidize during storage and become relatively insoluble in common organic solvents. Oxidized fat is less valuable nutritionally because the animal cannot utilize it for its energy needs. The risk of taint to the animal flesh is much reduced, however, once the fats are oxidized.
- Protection against contamination during the manufacture of meal has been mentioned; protection during storage is equally important. The floors, walls and handling equipment in the store must be kept clean, and screens over doors and windows help to keep out birds and rodents that may be carriers of Salmonella organisms. Foot dips are sometimes provided to prevent workers carrying harmful bacteria into the store. The

risk of contamination is generally much higher when handling meal in bulk, particularly during loading and unloading of transport.

Monitoring of air temperatures inside the cargo hold should be also carried out during transportation by using a recording thermometer.

Self-check 2	Written test
---------------------	---------------------

Name.....ID..... Date.....

Directions: Answer all the questions listed below

Test I: Choose the best answer

1. _____ is the first step in the production process fish byproduct.

- a. Caning
- b. Grinding
- c. cooking
- d. pressing

2. which condition is mandatory for transporting fish byproduct.

- A. Freezing B. Canning C. Drying D. all

3. Packaging material should be _____?

Page 55 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

A. clean B. sound C. durable D. sufficient for its intended use, and of food-grade quality
E. All

2. ----- is fish byproduct stored in a low-temperature environment

- A. curing
- B. freezing
- C. heating
- D. waste disposal

Operation sheet 2

2.1 Make grinding fish byproduct

a) materials and equipments

- PPE
- Grider
- Fish byproduct
- Cleanner
- Choper

b) procedures

- Wear PPE
- Clean the fish byproduct and grinder
- Chek and adjust the grinder
- Chope the large size fish byproduct
- Grind and handl for the next processing steps

2.2 Applying cooking fish byproduct

a) materials and equipments

- PPE

Page 56 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

- Steam cooking machine
- Grinded fish byproduct
- Decanter

b) procedures

- Wear PPE
- Chek and adjust the steam cooker
- Cooking with 90 dgree to 120 dgree celcius temprature and handl for the next processing steps

2.3 Apply pressing fish byproduct

a) materials and equepments

- PPE
- presser
- cooked fish byproduct
- Cleanner
- decanter

b) procedures

- Wear PPE
- Press fish byproduct
- Chek and adjust make on the presser
- Decant the pressed fish byproduct
- Handl for the next processing steps

2.4 Appy packaging fish byproduct

a) materials and equepments

- PPE
- Fish oil, fish meal and other
- Cleanner

- Canner

b) procedures

- Wear PPE
- Clean which the caning material
- Chek and adjust the canner mechine
- Making can
- Handl for the next processing steps of storing and transporting

Lap Test

Name..... ID.....date-----

Time started: _____ Time finished: _____

Instructions: Show necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task 1: grind the fish product.

Task 2: cook the fish product

Task 3: press the cooked fish by-product

Task 4: can the final fish by-product result

LG#26	LO#3: Complete fish by product processing activities
Instruction sheet	
<p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none"> • Handling waste materials • Handling material, tools and equipment 	
<p>This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:</p> <ul style="list-style-type: none"> • Handling waste materials • Handling material, tools and equipment • Recording and documenting work outcomes 	
Learning Instructions:	
<p>7. Read the specific objectives of this Learning Guide.</p> <p>8. Follow the instructions described below.</p> <p>9. Read the information written in the information Sheets</p> <p>10. Accomplish the Self-checks</p> <p>11. Perform Operation Sheets</p> <p>12. Do the “LAP test</p>	

Information sheet-3

3.1. Handling waste materials

Industrial Process debris fish and wastewater

Process Wastewater Treatment Techniques for treating industrial process wastewater in this sector include grease traps, skimmers or oil water separators for separation of floatable solids; flow and load equalization; sedimentation for suspended solids reduction using clarifiers or settling ponds ; biological treatment, typically anaerobic (if high in organic content) followed by aerobic treatment, for reduction of soluble organic matter (BOD); biological nutrient removal for reduction in nitrogen and phosphorus; chlorination of effluent when disinfection is required; dewatering and disposal of residuals; in some instances composting or land application of wastewater treatment residuals of acceptable quality may be possible. Additional engineering controls may be required to contain and neutralize nuisance odors.

Fish processing requires large amounts of water, primarily for washing and cleaning purposes, but also as media for storage and refrigeration of fish products before and during processing.

In addition, water is an important lubricant and transport medium in the various handling and processing steps of bulk fish processing. Fish processing wastewater has a high organic content, and subsequently a high biochemical oxygen demand (BOD), because of the presence of blood, tissue, and dissolved protein. It also typically has a high content of nitrogen (especially if blood is present) and phosphorus.

Any waste products from processing must be disposed of in a manner which does not harm the environment, either the water or land. Processing waste should be kept in an enclosed place to prevent entry of flies, rats and other pests. The waste should be quickly disposed of properly. Filleting, salting, and other processing activities should be done in a separate area.

The waste should be quickly disposed of properly. Filleting, salting, and other processing activities should be done in a separate area.

Page 60 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

3.2. Handling material, tools and equipment

The processing area, equipment and utensils must be kept clean and in good condition. In addition, fresh fish and equipment used for processing fish should not come into contact with processed products as this can contaminate the processed products with bacteria which may cause food poisoning. Pesticides or insecticides must never be used on fish during processing, on equipment used for processing, or on final products as these chemicals are harmful to the consumers and the workers.

Detergents and disinfectants may also be present with water after application during facility cleaning activities of equipment. A range of chemicals is typically used for cleaning, including acid, alkaline, and neutral detergents, as well as disinfectants. The disinfectants commonly used include chlorine compounds, hydrogen peroxide, and formaldehyde. Other compounds also may be used for select activities (e.g. disinfection of fishmeal processing equipment).

- Finished products must be cleaned and handled the material which that used in fish processing a careful manner.
- After all of this cleaning activities the tools must be stored in dry area.
- During transferring one place to other we should limit our self from direct contact to the equipment.
- Not carry many equipment's in once with hand because it may be lead fail to ground and will destroy.

3.3. Recording and documenting work outcomes

a) General requirements, all records required by this part shall include:

- (1) The name and location of the processor or importer;
- (2) The date and time of the activity that the record reflects;
- (3) The signature or initials of the person performing the operation; and

Page 61 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

(4) Where appropriate, the identity of the product and the production code, if any. Processing and other information shall be entered on records at the time that it is observed.

(b) Record retention.

(1) All records required by this part shall be retained at the processing facility or importer's place of business in the United States for at least 1 year after the date they were prepared in the case of refrigerated products and for at least 2 years after the date they were prepared in the case of frozen, preserved, or shelf-stable products.

(2) Records that relate to the general adequacy of equipment or processes being used by a processor, including the results of scientific studies and evaluations, shall be retained at the processing facility or the importer's place of business in the United States for at least 2 years after their applicability to the product being produced at the facility.

(3) If the processing facility is closed for a prolonged period between seasonal packs, or if record storage capacity is limited on a processing vessel or at a remote processing site, the records may be transferred to some other reasonably accessible location at the end of the seasonal pack but shall be immediately returned for official review upon demand.

(c) Official review. All records required by this part and all plans and procedures required by this part shall be available for official review and copying at reasonable times.

(d) Public disclosure.

(e) Records maintained on computers. The maintenance of records on computers is acceptable, provided that appropriate controls are implemented to ensure the integrity of the electronic data and signatures.

Self-check 3	Written test
--------------	--------------

Name..... ID..... Date.....

Directions: Answer all the questions listed below.

Test: I, give short answer

1. list cleaning methods of tolls and equipment.
2. how we can dispose the fish byproduct.

Operation sheet 3

- **Techniques of transporting live fish**

A. Materials required

- Polythene Bags
- Globs

B. Procedures/step

- Making and using plastic bags:
- Cut the plastic bag material to the dimensions shown.
- Cut the plastic bag
- Fold one end.
- Melt and fuse the tied end
- Transport the fish

Lap test-3	Performance Test
-------------------	-------------------------

Name.....

ID.....

Date.....

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1hrs minute. The project is expected from each student to do it.

Task- 1 Conduct fish byproduct waste transport.

Reference materials

Books

AbebeGetahun, 2013. Fisheries and Aquaculture (Biol. 4062).

Agents in Uganda January 2020.

Aquaculture Training Manual for Extension, January, 2020

Asare A. 2017 .Development Action Association.Manual on Improved PostHarvest Fish Processing.

Department of Fisheries Post-Harvest Technologies and Quality Control (DFPTQ), Fisheries Administration (FiA), Cambodia (2012

FAO, 2003.Guidelines For Handling And Preservation Of Fresh Fish For Further Processing In Vietnam

Francesco Cardia, 2015. Aquaculture operations in floating HDPE cages A field handbook.

Ministry of Agriculture, 2011.Fish harvesting and post-harvest handling, Uganda

Steven T. Summerfelt *, John Davidson, Grover Wilson, Thomas Waldrop (2008).Advances in fish harvest technologies for circular tanks

Web Address

<http://youtube.com/watch?v=2XogN7ORAM4>

Page 66 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I May, 2023
---------------	---	--------------------------------------	------------------------

[http://youtube.com/watch?v=E17njNcDSe0,](http://youtube.com/watch?v=E17njNcDSe0)

<http://youtube.com/watch?v=ujV6MdyuOp0>

<http://youtube.com/watch?v=UP3gwGauWrg>

https://commercialvehicle.in/wp-content/uploads/2017/01/IMG_5489-copy.jpg

[https://www.123rf.com/photo_120638669_female-fish-farm-worker-fishing-with-net-sturgeon-at-reservoir.html \(access](https://www.123rf.com/photo_120638669_female-fish-farm-worker-fishing-with-net-sturgeon-at-reservoir.html)

<https://www.afma.gov.au/fisheries-management/methods-and-gear/traps>

[https://www.alibaba.com/product-detail/Insulated-Plastic-Fish-Tub-Plastic-Insulated_60651873103.html?spm=a2700.7724857.0.0.1596188aI0KhOS#8.](https://www.alibaba.com/product-detail/Insulated-Plastic-Fish-Tub-Plastic-Insulated_60651873103.html?spm=a2700.7724857.0.0.1596188aI0KhOS#8)

<https://www.amazon.com/Waterproof->

[https://www.fao.org/3/e7171e/E7171E07.htm \(access date 17/2023\)](https://www.fao.org/3/e7171e/E7171E07.htm)

https://www.fao.org/fishery/docs/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e16.htm

<https://www.floridagofishing.com/fishing-beach-seining.html>

<https://www.instructables.com/>

<https://www.instructables.com/Running-a-Gill-Net-to-Collect-Fish-Samples/>

<https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/longlines>

<https://www.outdoorlife.com/story/gear/best-life-vest/>

<https://www.researchgate.net>

<https://www.shutterstock.com/image-photo/people-cut-red-fish-on-table-591966566>

KNOWLEDGEMENT

Ministry of Labor and Skills wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

Page 68 of 69	Ministry of labor and Skills Author/Copyright	Fishery and Aquaculture level III	Version I
			May, 2023

The experts who developed the learning guide

S.N	Name	Qualification	Educational Level	College	Phone number	E-mail
1	Temesgen Tadesse	Human nutrition	A	Asosa ATVET	0911593623	<u>Temesgen9393@gmail.com</u>
2	Alemayehu Tolera	Animal production	A	Bako APTC	0994132626	<u>toleraalex@gmail.com</u>
3	Addise Desta	Animal Production	A	W/SAVET	0913270120	<u>addiserahel2701@gmail.com</u>
4	Gashaw Assefie	Animal Science	A	Agarfa ATVET	0914068274	<u>lakomelzajournalist@gmail.com</u>
5	Mezgabu Abate	Biotechnology	A	Woreta TVET	0937705931	<u>Mezgebuabate16@gmail.com</u>
6	Elias Tekle	Animal Production	A	Alage ATVET	0913352348	Eliastekle39@gmail.com