

REVIEW ARTICLE, VARIETY OF TRADITIONAL FISH PROCESSING IN INDONESIA

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ABSTRACT

The process of processing and preserving fish is one of the important parts of the fishing industry chain. The purpose of this article is to find out the various kinds of traditional fish processing carried out in Indonesia. Based on reviews from various articles, information was obtained that the variety of traditional fish processing and preservation carried out in Indonesia is drying, salting, smoking, harvesting and fermentation.

Keywords: Fish, Processing, Traditional

Introduction

Fish is a food ingredient that contains high-quality protein because it contains essential amino acids needed by the body, in addition, its biological value reaches 90%, with little binding tissue so that it is easily digested. (Rahmawati 2012). The weakness of fish as a food ingredient is that it is easy to experience a process of deterioration of quality and spoilage. Thus, it needs preservation and fast processing to be used as much as possible as a food ingredient for humans (Imbir *et al.* 2015).

The process of processing and preserving fish is one of the important parts of the fishing industry chain. Without these two processes, the increase in fish production that has been achieved so far will be in vain, because not all fishery products can be utilized by consumers in good condition. (Tuyu *et al.* 2014).

The variety of traditional fish processing carried out in Indonesia aims to reduce the water content in the fish body and provide natural chemical compounds so as not to provide an opportunity for bacteria to multiply. The variety of processing carried out includes salting, drying, salting, smoking and fermentation. (Imbir *et al.* 2015). This review article aims to explain the various varieties of traditional fish processing carried out in Indonesia.

Fish is a food ingredient that contains high protein and contains essential amino acids needed by the body, in addition, its biological value reaches 90%, with little binding tissue so that it is easily digested. (Afdholi *et al.* 2017). The most important thing is that it is much cheaper compared to other sources of protein. Fish can also be used as a medicinal material – medicine, animal feed, and others. Its chemical content, size, and nutritional value depends on its type, age of sex, degree of maturity, and conditions in which it lives. In to make good use of fish, it is necessary to know the characteristics it has, for example, the structure of the body of the fish, the ratio of body size and weight, physical and chemical properties, proteins, fats, vitamins and other compounds it contains. (Rahmawati 2012). Fishery products are natural resources that have great benefits for human life. These benefits include as a source of energy, helping the growth and maintenance of the body, strengthening the body's resistance, as well as facilitating physiological processes in the body. (Rahmawati 2012).

According to Rahmawati (2012) The advantages of fishery products compared to other animal products are as follows:

- 1) A fairly high protein content (20%) in the body of fish is composed of acids - amino acids that are patterned close to the pattern of need for amino acids in the human body.
- 2) Fish meat is easily digested by the body because it contains a small amount of binding weave (tendons).
- 3) Fish meat contains acids – unsaturated fatty acids with very low cholesterol levels needed by the human body.
- 4) In addition, fish meat contains several minerals such as K, Cl, P, S, Mg, Ca, Fe, Ma, Zn, F, Ar, Cu, and Y, as well as vitamins A and D in sufficient quantities to meet human needs.

Fish also have some drawbacks according to Rahmawati (2012), that is:

- 1) The high water content (80%), the pH of the fish body is close to neutral, and the fish meat that is very easily digested by autolysis enzymes causes the meat to be very soft, thus becoming a good medium for the growth of putrefactive bacteria.
- 2) The content of unsaturated fatty acids causes fish meat to easily undergo an oxidation process, causing a rancid odor.

The process of decay in fish is caused by the activity of enzymes, microorganisms, and oxidation in the body of the fish by changes such as the thump of bad smell, stiffened meat, faded eyes, and the presence of mucus on the gills and outer body. The shortcomings contained in fish can hinder the marketing efforts of fishery products, not infrequently causing big losses, especially when fish products are abundant. Therefore, a processing process is needed to add value, both in terms of nutrition, taste, the smell of shape/texture, and durability.

Fish Processing

Fish is a food that is easily damaged (decomposed), in just about 8 hours since the fish is caught and landed, there will be a process of change that leads to damage so that fish and other fishery products can be utilized as much as possible, it is necessary to maintain their condition (Reo 2013). Processing is one way to defend fish from the process of decay, so that it can be stored for a long time until it is time to be used as a consumption material (Reo 2013). sebgainya. Efforts in carrying out processing can be done in various ways. For example, freshly caught fish can be retained freshness by cooling or freezing, or it can also be processed into semi-finished products such as in the manufacture of Pemindangan fish and so on. The efforts made in fish processing are carried out traditionally by utilizing natural processes. A natural factor that is widely used is the heat of sunlight. Through the road of drying the fish under the scorching sun, the water content in the fish meat will be reduced so that the fish becomes dry and durable. There are many other natural factors that can be used for fish processing. Since science and technology developed rapidly as it is today, the business in fish processing has also grown with the increasing number of mechanical equipment used in the processing process. So that with fairly modern equipment, the processing process becomes faster (Rahmawati 2012). Fish are caught not

Table 1. Utilization of Fish parts

Fish Section	Main Elements	Can Be Made Into	Use
Meat	Main proteins, fats, extract ingredients	Various foodstuffs	Human Food
Eggs (roe, milt)	Proteins, Fats	Various materials then	Human Food
Head	Proteins, fats, calcium phosphates	Fish meal, fish oil	Fodder
Bones, fins	Calcium phosphate, nitrogen-containing materials	Fish meal	Fodder
Skin	Collagen	Raw materials for adhesives and leather	Technical
Scale	Collagen, Guanine	Adhesive	Technical
Bubble swimming	Collagen	Adhesive	Technical
Liver	Nitrogen-containing materials, fats, vitamins A, D, B	Manufacture of vitamins, human food, pet food	Treatment, human food and animal food
Digestive apparatus	Nitrogen-containing materials, fats, enzymes	Fish meal, fat and enzymes	Animal food, technical ingredients

only to be used for the meat part, but can be used as fodder, medicine, and used as technical materials (Rahmawati 2012).

Traditional processing includes a number of various processing techniques that aim to preserve fish by reducing water content through drying and adding salt and or adding chemicals that can affect changes that cause the desired taste. Traditional processed fish or cured fish is a product that is processed simply and is

generally carried out on a household industrial scale. The types of preparations that include traditional processed products are 44 dried or dried salted fish, Pemindangan fish, smoked fish and fermented products, namely soy sauce, peda, shrimp paste and the like (Naiu *et al.* 2018).

Fish Processing by Drying

Drying fish without being salted (fresh) or salted is the simplest and cheapest way of preserving fish compared to other ways of preserving fish. Drying is defined as a method of removing part of the water from a material up to a moisture content level equivalent to the value of water activity (A_w) that is safe from microbiological damage (Naiu *et al.* 2018). In drying there are 2 (two) processes, namely: a) The process of transferring heat to evaporate the liquid in the material with the help of drying air. b) The process of mass transfer, where the water or moisture of the material passes from the inside of the material to the surface, then from the surface to the drying air flow. Drying is a way of preserving fish by reducing the moisture content of the fish body as much as possible. The body of the fish contains 56-80% of water, if this water content is reduced, then the metabolism of bacteria will be disturbed and eventually die. At a moisture content of 40% the bacteria are already inactive, even some die, but the spores are still alive. These spores will grow and reactivate if the moisture content increases. Therefore, the fish are usually salted in advance before drying.

The purpose of drying fish is:

- 1) preserve fish by lowering the moisture content in it,
- 2) reduce the volume and weight of the fish handled so that the cost of hooking and storage decreases,
- 3) increase convenience in use (in some specific types of products drying is combined with instantiation).

The drying speed is determined by the following factors: a. Airspeed, b. Air temperature, c. Air humidity, d. The size and thickness of the fish, e. The direction of air flow towards fish, f. Physical and chemical properties of fish (shape, size, composition and moisture content), and g. Characteristics of the dryer. The basic principle of the drying process is the evaporation of water due to the difference in water content between the air and the goods to be dried. One of the factors that can speed up the drying process is wind (air flowing). When the air is still, the moisture content around the dried product is more saturated so that the drying process is slower. The drying method is twofold, namely the natural drying method and the artificial/mechanical drying method.

Natural Drying



Figure 1. Natural Drying of Fish

The natural drying process is a drying process that is carried out using wind and sunlight media. In the drying of nature, fish are dried in the sun on shelves that are installed obliquely ($\pm 15^\circ\text{C}$) towards the arrival of the wind and placed in an open place so that they are exposed to sunlight and direct gusts of wind (Budiman 2004). The advantage of natural drying is that the process is very simple, inexpensive and does not require special equipment so it is easy for everyone to do. In the natural drying process, the wind serves to transfer moisture released from the fish, from the top of the fish to another place so that evaporation takes place faster.

In the absence of air movement, for example, if the drying is in a closed place (in the absence of gusts of wind), drying will run slowly (Budiman 2004).

In addition to wind blowing, natural drying is also influenced by the intensity of sunlight during drying, the higher the intensity, the faster the drying process will take place and vice versa. Therefore, the natural drying process is often hampered during the rainy season because the intensity of sunlight is very lacking. Due to the slow drying, the process of decay is likely to remain ongoing during the drying process. The degree of dryness of the fish is measured by pressing on the body of the fish using the thumb and forefinger of the hand, the pressure of the fingers will not cause marks. In addition, another way is to fold the body of the fish, where the dried fish will not break if the body is folded (Budiman 2004).

Artificial Drying

Artificial drying is a drying process without the use of sunlight. This process can be done mechanically or using certain materials. The advantages of mechanical drying include temperature, humidity, and wind speed can be regulated. In addition, sanitation and hygiene are easier to control. Artificial drying has not been popular because the cost of mechanical tools or materials used is relatively more expensive when compared to natural drying (Naiu *et al.* 2018).

On mechanical drying, the fish are arranged on the shelves of storage in a closed room equipped with several ventilation holes. Into the room, heat generated from the electric heating element is blown. The heat is blown with a fan or blower so that it flows towards the fish shelves. The wind that carries moisture from the body of the fish will come out of the ventilation holes. Mechanical dryers include: ovens, cabinet-type dryers, tunnel dryers, cold dryers, infrared dryers, and vacuum freeze drying devices. According to Naiu *et al.* (2018), Mechanical drying has several advantages, including:

- 1) The height of temperature, humidity and air speed are easily regulated.
- 2) Sanitation and hygiene are easier to control.
- 3) Does not require a spacious place.
- 4) Drying time becomes more regular (not affected by the presence of a rainy season).

The process of drying fish is as follows: the salted fish is removed from the container, then the fish is washed and cleaned of dirt as well as the remnants of salt attached to the body. Put the fish in a natural drying or artificial/mechanical drying place. Further dried, the drying time is affected by the type of drying used as well as the size of the dried fish. After drying, the fish are sorted by their quality and well packed to avoid damage during storage.

Fish Processing by Salting

Salting, which is also often referred to as salting, is one of the preservation methods whose products are the easiest to find in all parts of Indonesia. In the salting process, preservation is carried out by reducing the water content in the fish's body and in the body of bacteria so that bacteria cannot live and develop anymore. Salting technology is usually not used as a single preservation method, but is still continued with other preservation processes such as drying or boiling. This follow-up process will produce three kinds of different salted fish products, namely: wet salted fish, dried salted fish and boiled salted fish (Pemindangan fish). In principle, salting is a way of preserving fish by using salt as a preservative medium (Naiu *et al.* 2018).

The type of salt used is table salt in the form of crystals and solutions. Through salting, the activity of microorganisms, especially bacteria, will be inhibited, so that fish become durable and can be stored for a longer period of time. During the salting process, a process of salt penetration into the body of the fish occurs. On the contrary, the fluid in the body of the fish will come out due to the difference in concentration. After there is an equation of salt concentration between the fish's body and its environment, then at that time there is a thickening of the remaining body fluids and the clumping of proteins (denaturation) as well as the tightening of fish body cells so that the nature of the meat changes (Naiu *et al.* 2018).

The mechanism of how to preserve fish with salt is as follows:



Figure 2. Fish Salting

- 1) Salt absorbs water from the body of fish through the process of osmosis. The water content in the body of the fish is reduced. Lack of water in the body of fish as a medium for the growth of bacteria causes metabolic processes in the body of bacteria to be disturbed.
- 2) Salt also absorbs water from the body of bacteria so that bacteria will undergo plasmolysis (separation of plasma nuclei) so that bacteria will die.

The speed of the process of absorbing salt into the fish's body is influenced by several factors as follows:

- 1) Freshness of the body of the fish. The fresher the fish, the slower the process of absorbing salt into the fish's body.
- 2) Fat content. Fat will block the entry of salt into the body of fish, so that fish with a high fat content will experience slow salt absorption.
- 3) The thickness of the meat of the fish. The thicker the fish meat, the slower the salting process.
- 4) The smoothness of salt crystals. Fine salt will dissolve faster and seep into the body of the fish. But too fast absorption will result in the surface of the meat quickly hardening (salt burn) and this will inhibit the release of water content from the inside of the fish's body.
- 5) Temperature. The higher the temperature of the solution, the smaller the viscosity of the saline solution so that the absorption process will be easier.

Salting methods can be grouped into three types, namely:

- 1) The dry salting method is a salting method that uses salt crystals mixed with fish. Dry salting is carried out by sprinkling crystalline salts on neatly arranged layers of fish. Each layer of fish is interspersed with a layer of salt. In this salting process, the fish's body fluids will be absorbed by the salt crystals which causes the salt crystals to melt so that a concentrated salt solution is formed.
- 2) In the wet salting method, salt is used in the form of a solution (30-35% means that 1 liter of water there is 30-35 grams of salt). The fish to be salted is put in a container that has been filled with a concentrated saline solution. The top of the container is closed and ballasted so that all the fish are submerged. The duration of soaking depends on the desired thickness and degree of saltiness. Saline solution will suck the liquid and salt ions enter the body of the fish.
- 3) This salting method is almost the same as dry salting, which is to use crystal salt, but not to use a storage container. The salting process is carried out directly on the deck of the ship / floor or can also be done in a container in the form of a basket that is not waterproof, where the fish is mixed with salt crystals. The disadvantage of this method is that more salt is required and the salting process takes place very slowly.

Fish Processing by Smoking

Smoking is the process of processing or preserving fish using smoked media as a preservative medium which is the residue of burning wood, coconut shells, sawdust, or rice husks. Fish processing by smoking is quite popular in Indonesia. This method can be found in various regions, but there are not as many salting or drying products. Fumigation can delay the process of deterioration of fish quality, but in the not too distant future, unlike salted fish or dried fish. The term smoking is defined for the absorption of various chemical compounds derived from wood smoke into fish, accompanied by half drying and usually preceded by a salting process. So, the term smoke curing covers the entire process that starts from the preparation stage of the raw material to the last fumigation resulting in a change in the color, flavor and texture of the fish (Naiu *et al.* 2018).

The purpose of fumigation in fish is three things. First, process the fish so that it is ready for direct consumption. Second, it gives a distinctive taste to be preferred by consumers. Third, it provides durability through heating, drying and chemical reactions of smoke with fish meat tissue during the fumigation process. In principle, the fumigation technique is the process of drawing water by various compounds from smoke. Smoke is formed due to incomplete combustion, that is, combustion with a limited amount of oxygen. The durability of smoke is very limited, that is, it depends on the length and thickness of the smoke. In order for the fish to last longer, fumigation should be combined with other means of preservation, for example storage at low temperatures (Naiu *et al.* 2018).

The success rate of the fish smoking process depends on the following factors (Naiu *et al.* 2018):

- 1) Quality and volume of smoke The quality and volume of smoke produced depends on the type of wood used. The type of wood used in the fumigation process should be a hard (non-resinous) type of wood or coconut shell. In addition to being hard, the wood used should not be flammable and can produce large amounts of smoke and a long time. Fish farmers in Indonesia usually use turi wood in the fumigation process. This type of wood is easy to obtain and contains a lot of phenol elements and organic acids. This type of wood is good for the fumigation process because these two elements can produce smoked fish products with a distinctive taste and color.
- 2) Temperature and humidity of the fumigation chamber

The room in which the fumigation process is located should have a low temperature and humidity of the air. With a low smoking temperature, the smoke produced is lighter so that the volume of smoke attached to the fish's body is more abundant and evenly distributed. In addition, with low air humidity, it also causes the liquid contained in the fish's body to be more volatile.

3) Air circulation in the fumigation chamber

Air circulation in the fumigation chamber must be good to guarantee the temperature and humidity of the air in a constant state during the fumigation process. In addition, the flow of smoke will spread evenly and continuously so that the smoke attached to the fish is abundant and evenly distributed.

Fish Processing by Harvesting

Harvesting is one of the traditional ways of processing and preserving fish that has long been used by the people of our country. Actually, salting is also a series of salting processes followed by a boiling or steaming process. The number of harvesting products is still smaller when compared to salting and drying products. The low number of harvesting products is due to several problems that are often faced, namely (Budiman 2004):

- 1) Harvesting fish has a lower endurance when compared to salted fish.
- 2) Most of the farming business is only carried out on a small scale (home industry), and the technology carried out is obtained for generations
- 3) Sanitation and hygiene are poorly observed, especially by household industry. So that the quality and durability of Pemindangan fish are not good.

The types of fish that are often used as raw materials for Pemindangan fish include: milkfish (*Chanos-chanos*), cobs (*Ethynus affinis*), skipjack (*Katsuwonus pelamis*), kites (*Decapterus ruselli*), bloated (*Rastrelliger canagurta*), carp (*Ciprynus carpio*), tilapia (*Tilapia mosambica*) and others (Budiman 2004).

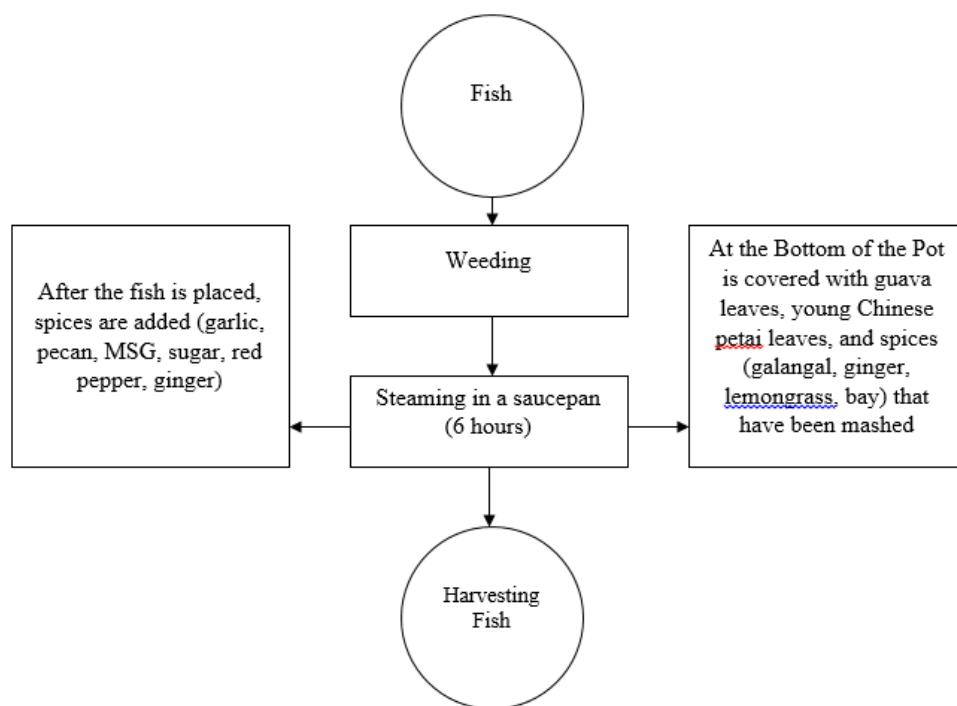


Figure 3. Fish Processing Process by farming

Each region has its own characteristics in making Pemindangan fish. This difference lies in the container, the type of fish and the way it is processed. However, in general, the process of harvesting is not much different, which is a combination of salting and boiling. In Indonesia, there are several types of Pemindangan fish, including (Budiman 2004):

- 1) Bawean farming is a type of processing with the method of flying kite fish and milkfish. the used container is made of earth. The base is given a woven bamboo base or banana leaves / dried bamboo. The boiling process is carried out in two stages: the first stage is boiling for 2 –6 hours and the second stage for 0.5 – 1 hour. The second stage of boiling is carried out after the first

boiled water is removed and a small amount of saline is added. After the boiling process is complete, the container (kendil) is wrapped in teak leaves or cement paper so that the container does not break easily. If stored at an appropriate ambient temperature, this Farming fish can last up to + 3 months.

- 2) Muncar farming is a type of farming by arranging fish on loho (bamboo trays / nyiru), then loho is put into a container (belanga). In each belanga there can be 5-15 loho, in each loho there are 1-2 layers of fish. The type of fish used is usually lemuru fish. Fish are cleaned and soaked in saline solution for 1 – 2 hours. Then the fish are arranged in loho while draining. After drying, arrange the loho in a belanga that is already filled with water. On the base of the belanga, a filter (support) is installed so that the loho is not submerged in water. The steaming process lasts for 1 – 3 hours. Once the fish is cooked, turn off the heat and let the container (belanga) remain on top of the furnace for the cooling stage for one night. Good fishing fish is shiny, yellowish, dense, not too salty and tastes savory.

The process of making a new style of farming is used by besek as a container where fish are arranged. The base and sides of the besek are given a base with straw or dried plantain leaves. The processed fish is usually whitefish. The fish are neatly arranged on the besek and each layer of fish is covered with crystal salt. Leave for 1–3 hours, then boil the fish in a belanga filled with boiling salt solution for 1–2 hours. After that remove the besek from inside the drain belanga and

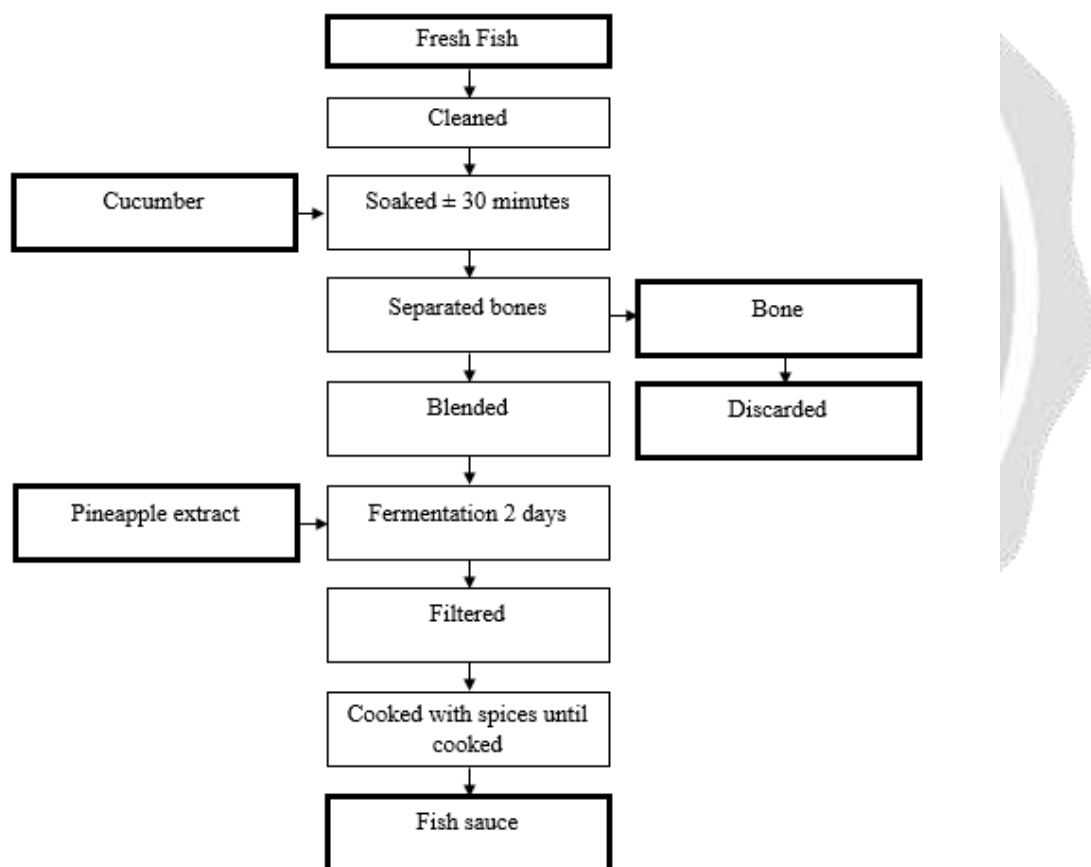


Figure 4. The Process of Making Fish Sauce

cool. The resulting product is denser, cleaner and more durable when compared to other means.

Fish Processing by Fermentation

Fermentation is a way of processing through the process of utilizing the decomposition of compounds from complex protein materials. These complex proteins are found in the body of fish which are converted into simpler compounds with the help of enzymes derived from the body of fish or microorganisms and take place under a controlled state (Naiu *et al.* 2018)

The method of fermentation can basically only be divided into two, namely:

- 1) A fermentation process that allows the occurrence of decomposition or transformation that will later be able to produce a product with a completely different (changing) shape and properties from its initial state. For example, in the processing of shrimp paste, fish sauce and peda fish.
- 2) The fermentation process that produces compounds, in fact, will have the ability or durability in the processed product, for example in the manufacture of peda fish.

The fermentation process that occurs in fish is a process of biological or semibiological decomposition of complex compounds, especially proteins, into simpler compounds under a controlled state. During the fermentation process, fish protein will be hydrolyzed into amino acids and peptides, then amino acids will decompose further into other components that play a role in the formation of the taste of the product. The process of fermentation of fish which is a biological or semibiological process in principle can be distinguished over four groups, namely as follows (Naiu *et al.* 2018):

- 1) Fermentation uses high salt content, for example in the manufacture of peda, fish sauce, shrimp paste and bekasem.
- 2) Fermentation uses organic acids, for example in the manufacture of fish silage by adding propionic and formic acids.
- 3) Fermentation uses mineral acids, for example in the manufacture of fish silage using strong acids.
- 4) Fermentation uses bacteria, for example in the manufacture of bekasem and chao anchovies.

Conclusion

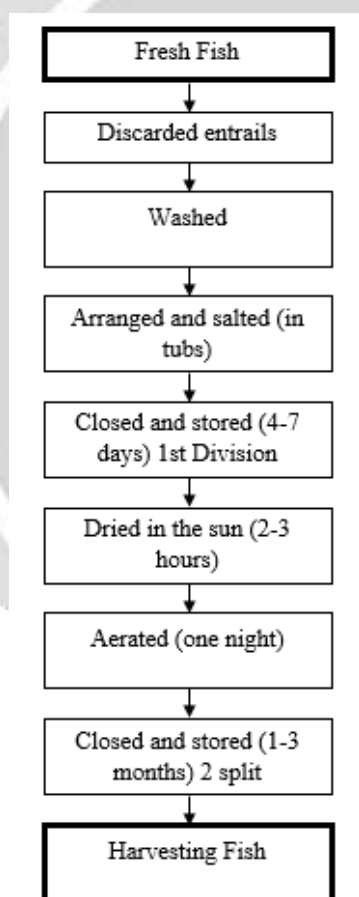


Figure 5. Peda Fish Making Process

Based on reviews from various articles, information was obtained that the variety of traditional fish processing and preservation carried out in Indonesia is drying, salting, smoking, harvesting and fermentation.

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