FRESH FISH PACKAGING (A REVIEW)

Iis Rostini[1], Rusky Intan Pratama[1]

[1] *Staff at Laboratory of Fisheries Processing Product, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia*

ABSTRACT

Fresh fish are fish that have the same characteristics as live fish, both in appearance, smell, taste and texture. Fish packaging is needed to help prevent or reduce the occurrence of physical, chemical, microbiological and organoleptic damage. Packaging plays an important role in preserving food, including fish. Fresh fish packaging requirements must be able to reduce fat oxidation, can reduce dehydration, can reduce damage by microbes, can reduce drip and can prevent the permeation of odor-causing compounds. The principle of fresh fish packaging is to inhibit enzyme activity, prevent chemical reactions, and prevent the development of bacteria. The types of fresh fish packaging materials consist of plastic, stainless steel, paper, and edible packaging. The packaging method generally uses a vacuum system. Types of fish that are commonly packaged in fresh conditions include tuna, tuna, salmon, mackerel, and some fresh fish such as snakehead fish, goldfish, tilapia and milkfish. There are several differences in fresh fish packaging techniques depending on the type of fish and its purpose.

Keyword: - *Packaging, Fresh fish, Types of packaging, Packaging techniques*

1. INTRODUCTION

Fish that are good for consumption are fish that are still fresh. Fresh fish are fish that have not undergone any preservative treatment except for chilling. Handling of fresh fish is meant as all the work done on fresh fish from when it is caught until it is received by consumers [1]. Fish that is chilled to about 0oC can extend the freshness (shelf life) of fish up to 12-18 days from the time the fish is caught and dies, depending on the type of fish, how to handle it and the conditions of cooling.

Packaging plays an important role in preserving food, including fish. According to [2], packaging is the activity of designing and producing a container or wrapper as a product. The existence of packaging can help prevent or reduce the occurrence of damages. The damage that occurs can occur spontaneously but often occurs due to external environmental influences and the influence of the packaging used to limit food ingredients to the surrounding environment to prevent or inhibit the spoilage process for the time needed. Packaging materials and packaging methods vary widely, for example cellulose plastic, rubber, glass, wood, aluminum and stainless steel. According to [3] with several forms of fish or marine animals, several forms of packaging are needed.

Fresh fish packaging requirements must be able to reduce fat oxidation, can reduce dehydration, can reduce damage by microbes, can reduce drip and can prevent the permeation of odor-causing compounds. Therefore there is a need for further learning about the packaging of fresh fish. The purpose of this study was to determine the principles of fresh fish packaging, types of fresh fish packaging materials, common types of fish packaged in fresh condition and packaging techniques.

2. DEFINITION OF FRESH FISH

Fresh fish are fish that have the same characteristics as live fish, both in appearance, smell, taste and texture. In other words, fresh fish are fish that have just been caught and have not undergone further preservation or processing,

and fish that have not undergone physical or chemical changes or which still have the same characteristics when caught [4].

Fresh fish can be obtained through good handling and sanitation, the longer the fish is left after being caught without good handling, the faster the freshness of the fish will decrease. According to [4], the factors that determine the quality of fresh fish are influenced by, among others, fishing methods, fishing ports, and various other factors, starting from canning, packing, transportation and processing.

Fresh fish has a high water content, so excessive water loss will affect the texture, flavor and color changes of the fresh fish. Storage conditions that are not good or the use of packaging that cannot block the entry of oxygen will cause fish to suffer damage.

Therefore, to help prevent or reduce the occurrence of damages it is necessary to have fish packaging. Packaging plays an important role in preserving food. There are several requirements for packaging fresh fish, namely:

1) Can reduce fat oxidation,
2) Can reduce dehydration,
3) Can reduce damage by microbes,
4) Can reduce drip,
5) Can prevent the permeation of odor-causing compounds.

3. FRESH FISH PACKAGING PRINCIPLES

According to [5], food spoilage can be caused by two things, namely damage by the natural nature of the product which takes place spontaneously and secondly, damage due to environmental influences. Therefore it is necessary for packaging to limit food ingredients to the environment to prevent or delay the spoilage process so that food has a longer shelf life for consumption.

The most important properties of the packaging include gas and water vapor permeability and the surface area of the package. Packaging with good gas inhibition and a smaller surface area results in a longer product shelf life [6].

Several principles in fresh fish packaging according [7], namely:

a. Inhibiting enzyme activity, namely by reducing the temperature in the form of cooling or freezing and using inhibitors (enzyme inhibitors).
b. Prevent chemical reactions by lowering the temperature and using antioxidants and avoiding the presence of a catalyst.
c. Prevent the growth of bacteria by lowering the temperature (chilling or freezing), increasing the temperature (thermal processing), using inhibitors (NaCl, vinegar, sorbic acid, benzoic acid, propionic acid, nitric & nitric salts, phosphates, ascorbic acid, sugar, antibiotics, and antioxidants), prevent bacterial contamination and maintain sanitation.

The principle of packing fresh fish during transportation is that transportation must quickly reach the destination or place of sale or market.

4. TYPES OF FRESH FISH PACKAGING MATERIALS

a. Plastic Packaging

Plastics are organic polymers of various structures, chemical compositions and physical properties. Packaging made of plastic can be in the form of films (thin layers), bags or other forms. What is meant by film here is a sheet of plastic that has a thickness of 0.10 inches or even thinner. Materials that can be used to make plastics are cellulose, polyethylene, propylene polyamide, polyester, polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), rubber hydro chloride (pliofilm) and so on.

The following describes briefly several types of plastic commonly used in fresh fish packaging.

a. Polyethylene

Polyethylene (PE) is made by means of polymerization and ethylene gas which is a by-product of the oil or coal industry. There are two kinds of polyethylene, namely Low Density Polyethylene (LDPE) and High Density Polyethylene (HDPE). LDPE is a material that is strong, somewhat translucent, flexible and has a slightly greasy surface feel. Its protection power against water vapor is relatively high, but it is not good for other gases such as oxygen. It is easily converted into a very light film which is widely used for pre-packing fresh frozen products, which is particularly suitable for hot gluing purposes. LDPE is widely made into bags and printed into various forms of packaging, especially for low temperature purposes.

HDPE has properties that are harder, less translucent and less greasy. This plastic has better resistance to oil and grease, higher soft point. One of the advantages of using PEDT is that it can withstand sterilization conditions with hot steam.

b. Polypropylene

Polypropylene is another member of the olefin group in the form of a bidirectionally stretched film, known as opp (Oriented Polypropylene). The film is stretched in both directions perpendicular to the suitable temperature. The resulting film is glossy and clearer, more resistant to impact and more difficult to penetrate by moisture and oxygen. The most widespread use in the food industry is to wrap snacks and biscuits as a substitute for cellulose-derived materials.

c. Polyvinyl Chloride (PVC)

PVC is hard, stiff but clear and shiny, very difficult to penetrate water and low gas permeability. Therefore, this polymer is good enough for packaging for drinks containing carbon dioxide, mineral water and cooking oil. The addition of plasticisers (usually aromatic esters) can soften the resulting film and make it more flexible but the tensile strength at break is low, depending on the amount of plasticiser added.

This material is also widely produced in the form of films that have been oriented biaxially to make shrink films for meat and cheese. The resistance to oil and grease is quite good, the presence of chlorine makes this plastic difficult to burn.

b. Stainless Steel Packaging

Materials in contact with food must be clean and sterile. The surfaces of food processing equipment must be easily cleaned at each time of processing. Many of the cleaning agents are corrosive, therefore corrosive resistant materials are required. Stainless steel as the name implies has several desirable properties and can withstand attack by detergents, hypochlorite sterilizing solutions, acids and alkalis.

c. Paper Packaging

Paper as a packaging material is widely used and will maintain its position for a long time because it is cheap, easy to obtain and widely used.

The packaging properties of paper vary greatly depending on the manufacturing process and the additional treatment given. The strength and mechanical properties of paper depend on the mechanical treatment of the cellulose fibers and on the application of fillers and binders. The physico-chemical properties of paper, such as permeability to liquids, vapors and gases, can be modified by laminating. Paper can be used as a flexible packaging material or as a material for forming rigid paper containers [8].

d. Vacuum Packaging

Vacuum packaging is a packaging method by removing air from the packaging and the packaging is tightly closed to create a vacuum condition inside the packaging. Vacuum packaging is widely used in the food industry because of its effectiveness in suppressing oxidation reactions that occur in products at a relatively low cost (cheap). Vacuum packaging is commonly used in frozen products and heat-treated products. Vacuum packaging is also effective in suppressing the growth of certain spoilage bacteria. According to [9] in vacuum packaging the growth of existing aerobic spoilage bacteria will be inhibited by the anaerobic environmental conditions of vacuum packaging. According to [10] argues that changes in the atmosphere and changes in surface Eh suppress the growth of aerobic psychotropic spoilage bacteria. These conditions support the growth of facultative anaerobic organisms such as lactic acid bacteria which slow down the decay process.

e. Edible Packaging

Edible packaging can be grouped into two parts, namely those that function as an edible coating and those that are in the form of sheets (edible film). Edible coating is a thin layer of material that is formed directly by dipping, spraying, or panning to the surface of a food product with the intention of protecting and increasing the added value of the product [11]. Edible coatings produce a passive modified atmosphere condition, which can affect various changes in fresh products and minimally processed foodstuffs in several respects such as antioxidant properties, firmness colors, sensory qualities, inhibiting microbial growth, volatile components resulting from anaerobic processes [12].

Edible film is a thin layer made of edible material, formed on top of food components that functions as a mass transfer barrier (eg moisture, oxygen, fat and solutes) and/or as a carrier for food ingredients or additives and/or to improve food handling [13]. Edible film must have the same properties as packaging film such as plastic.

5. COMMON TYPES OF FISH PACKAGED IN FRESH CONDITION

Fresh fish can be obtained through good handling and sanitation, the longer the fish is left after being caught without good handling, the faster the freshness of the fish will decrease. The following are the types of seawater fish that are packed in fresh conditions, namely:

a. Tuna (*Thunnus* sp.)
Tuna (*Thunnu*s sp.) belongs to the fast-swimming fish group, having pink to dark red flesh. This fish has high commercial value and is important. There are many benefits contained in the body of tuna. Tuna is usually packaged in the form of loins, steaks, and so on. This is intended to make it easier for consumers to process the fish and produce quality products that are safe for consumption. Tuna fish is packaged using polypropylene plastic packaging for pocket products and polyethylene plastic for loin, ground meat and tail products.

b. Mackerel Tuna (*Euthynnus affinis*)
Tuna is one of the favorite prey for fishermen. Tuna is known as "kawakawa", little tuna, mackerel tuna or false albacore. This fish has a habit of clustering with various other types of fish such as tuna. Tuna is sold in the form of fresh fish, frozen fish and canned. Also in various processed fish: dried, salted, smoked, or boiled. The meat is of good quality when fresh, but will quickly deteriorate if not handled properly.

c. Salmon (*Oncorhynchus masou*)
Salmon is a fish that has a high nutritional content. This fish is also special because it eats small fish that eat seaweed where it is this seaweed that encourages omega 3 which is effective in preventing blood clots, lowering cholesterol, and protecting brain cells from aging diseases. Salmon is usually packaged in filet form or in whole form. This form is to make it easier for consumers to process the fish and produce quality products that are safe for consumption. Salmon is packaged using polypropylene plastic packaging that is safe for food.

d. Spanish mackerel (*Scomberomorus commersoni*)
Spanish mackerel has a relationship with tuna, because they are still relatives. In the wild, mackerel often swim in schools and sometimes close to the beach, depending on the food available in the sea. In general, this fish is sold fresh or frozen, but in developed countries it is marketed in the form of fillets (fish meat without scales and bones) and cut into steaks.

Apart from the types of marine fish above, there are many other marine fish that are commonly packaged fresh, such as Giant trevally (*Caranx ignobilis*), Grouper (*Epinephelus* sp.), Snapper (*Lutnajus* sp.), Long jawed mackerel (*Rastrelliger* sp.), Rabbitfish (*Siganus* sp.) and others.

Types of freshwater fish that are commonly packaged in fresh conditions, including snakehead fish or snakehead (*Channa striata*). Snakehead is a fish that is rich in albumin protein. This albumin is needed by the body for cell development, the formation of new cell tissue, as the transportation of drugs and so on. Snakehead fish can be packaged fresh. Usually packaged in a form such as filet or in the form of ground meat (minced fish). Apart from the snakehead fish, there are also other freshwater fish, namely goldfish, tilapia, pomfret, catfish and milkfish.

Handling of fresh fish is an important part of the fishery industry chain. Whether fresh fish is good or bad will affect the quality of fish as food ingredients or as raw materials for further processing. The aim of fish handling is to try to

keep the freshness of the fish after being caught as long as possible. In addition, it aims to keep fish production fresh after it reaches consumers.

Handling fresh fish on board is an important first step. Matters that need to be considered in handling fresh fish on board include the following.

a. Fish weeding or dressing
Weeding is done based on body size. For small fish whose bodies are easily damaged, such as lemuru or mackerel, there is no need to weed them. In addition, it also depends on the follow-up processing and market demand. If packaged in cans, the fish is filleted or frozen, but no need to be gutted.

b. Washing with running water
Washing aims to free fish from adhering dirt and the opportunity for putrefactive bacteria to arise.

c. Transfer of fish in holds
In this case, try not to let the fish fall off the deck so as not to injure the fish's skin. Wounds on the skin of the fish will speed up the decomposition process.

6. FRESH FISH PACKAGING TECHNIQUES

6.1 Fresh Tuna Packaging Techniques

a. Stages of receiving raw materials
Tuna fish is put into the raw material receiving room to check the quality, organoleptic, and temperature. Temperature checks are carried out to maintain the central body temperature of the fish not more than 4°C. This is intended to prevent an increase in histamine levels. Generally, the raw material received is tuna, which has a temperature of around 1-2 °C.

b. Washing
The process of washing fish is done using cold water. The temperature of the water used for the washing process is around 1°C. Washing water contains chlorine. Washing the tuna aims to remove and clean dirt, blood, mucus, and foreign objects that stick to the tuna so that it can reduce the number of microbes. According to [7], water made of ice or cold water used for washing without any treatment does not have any inhibitory effect on psychrophilic bacteria. Chlorine administration can reduce the number and types of psychrophilic bacteria. Good chlorine application is achieved if the residual content is between 2-7 ppm while the chlorine requirement is between 0.25-0.75 ppm.

c. 1st weighing
The weighing process is carried out to determine the weight of the tuna. Weighing of tuna is carried out one by one using a special sitting scale and then recorded in a fish weighing report book.

d. Cutting
Cutting tuna begins with removing the head. This cut is done carefully and follows the line of the gill cover (operculum). The heads, bones and fins of the cut fish are collected in a special tank for head, bone and fin waste.

The process of cutting tuna into loin requires special skills and is largely determined by the ability of the workforce. The formation of the loin must be absolutely neat and leave no bone residue in the meat. The formed loin should be free of bones and dark meat. According to [14], dark tuna meat has high levels of metmyoglobin as a result of oxidation. Efforts that can be made to protect tuna meat are by:

1) Maintain the integrity of the fish body
2) Reducing the effort to cut the fish body
3) Cover the body of the fish or pieces of fish meat with crushed ice
4) Wrap fish in oxygen impermeable packing material.

e. Loin formation

Loin formation is done manually by workers by cutting the fish meat starting from the tail towards the head until the meat on both sides of the fish is separated from the backbone. Fish meat is split into two parts from head to tail and each part is cut into two parts so that each fish gets four loins.

f. Skin removal (skinless)

The tuna that has been formed into loin is then skinless. Disposal of leather is done manually by workers using a knife in the processing room. The fish is removed from the skin so that nothing remains on the meat.

g. Black meat removal (trimming)

The trimming process is the process of separating the black meat. When trimming is done, it is also checked whether there is any remaining skin and bone. If there is any remaining skin or bone, it must be removed. The black meat in the fish is removed carefully until it is not left and does not touch other meat. The percentage of black meat in tuna is about 6-7% of the total weight.

h. 2nd weighing

Tuna fish are weighed one by one to determine the weight so that the number of fillets per species is known. When weighing, the grade is sorted according to company regulations. Quality sorting is carried out organoleptic, including observations of appearance, meat color, smell, and elasticity. Sorting is also done to distinguish the type of loin to be processed further.

i. Cooling

Packaged fish were stored in a chill room at -4°C to 0°C for 2 days. Chilling aims to keep and maintain the loin fresh and the temperature remains cold.

j. Primary packaging

After the product is removed from the cooling chamber, it is then smeared using a sponge or foam so that microbes do not grow. After that, just put it in the plastic. For loin, tail and ground meat products, polyethylene (PE) plastic is used. The plastic is primary packaging because it is directly related to production. The plastic is then labeled according to the product.

k. Vacuum packing

Products that have been wrapped neatly using plastic are vacuumed using a vacuum sealer so that the products are in a vacuum condition because the plastic is firmly attached and the air inside has been removed. If a leaky product is found, it must be re-wrapped and re-polished to avoid contamination from dirt and bacteria either directly or indirectly on the loin product.

l. Freezing

Products that have been packaged in plastic and vacuumed are arranged in long pans, then transported to the freezer room and placed on shelves. The freezer used is an Air Blast Freezer (ABF). Air Blast Freezer is a room or room or tunnel with cold air in it which is circulated with the help of a fan or fan. Air Blast Freezer is very practical to use because it can be used to freeze products of different sizes and types at the same time [1].

m. Checking and weighing

Products that have been frozen are removed from the long pan to be checked one by one and weighed before packaging.

n. Secondary packaging and labeling

The packaging process uses sacks for loin type end products with a capacity of 25-30 kg. Then the sack is tied using a rope. Each sack usually contains 5-7 frozen loin depending on the size of the frozen loin product. Each package is given a label that includes information about the product which can help make it easier for consumers to identify the product. After experiencing the packing process, these products are stored in cold storage.

o. Frozen storage

Packaged frozen tuna products are stored in cold storage at -18 to -20 °C. Product storage is packed and neatly arranged according to the processing time. Products that can be stored for up to 18 months. The storage and dispensing system is carried out using a First in First out (FIFO) system.

6.2 Fresh Fish Packaging Techniques through Air Force Facilities [15]

Packaging of fresh fish by air requires several conditions and techniques that need to be carried out and considered, along with an explanation.

a. Packaging Engineering
   1) Fish and ice are put into a plastic bag in layers with the arrangement of ice, fish, ice, fish, ice, and so on, the top and bottom layers are ice.
   2) Wet ice can be wrapped or unwrapped in a plastic bag.
   3) Plastic bags containing fish and ice are tied.
   4) Plastic bags that have been tied, put into a styrofoam box, then covered with a styrofoam lid and then put together using duct tape.
   5) When packing tuna and mackerel, bags filled with wet ice are placed in the gills, stomach and tail of the fish,
   6) When using dry ice, put it on the head and tail of the fish. When using dry ice packs the wrapper must be clean.
   7) For the arrangement of tuna and mackerel in styrofoam boxes can be layered (one level).
   8) Weight of the box: styrofoam measuring (750 x 420) mm and the contents weighing a maximum of 35 kg. The styrofoam box measures (1200 x 420) mm and the weight of the box is 80 kg. Styrofoam measuring (1500 X 500 X 400) mm the weight of the box and maximum content of 110kg.
   9) The next box is tied using strapping bands on all sides.
   10) The closed box is weighed and labeled.

b. Marking conditions
   Each package must be properly and easily readable labeled in accordance with applicable regulations, which provides information including:
   1) Product type;
   2) Net weight of product;
   3) Origin airport and destination airport;
   4) If there are several other additional ingredients, a description of the ingredients must be given;
   5) The name and address of the company, as well as the country where the product is packed;
   6) Date, month, year when the product was shipped (flighted).

7. CONCLUSION

Based on the results of the discussion on the packaging of fresh fish, the conclusions are drawn:

a. Fresh fish packaging plays an important role in preserving food, to help prevent or reduce spoilage.
b. The principles of fresh fish packaging include inhibiting enzyme activity, preventing chemical reactions, and preventing the development of bacteria.
c. The types of fresh fish packaging materials consist of plastic, stainless steel, paper, and edible packaging. The packaging method generally uses a vacuum system.
d. Types of fish that are commonly packaged in fresh conditions include tuna, tuna, salmon, mackerel, and some fresh fish such as snakehead fish, goldfish, tilapia and milkfish.
e. There are some differences in fresh fish packaging techniques depending on the fish and the transport.

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