A Review of Dried Surimi Concentrate: Producing and Evaluating Methods

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ABSTRACT

It is vital to produce and create a variety of processed fishing products based on the principles of correct handling and processing in order to boost people's purchasing power and widen distribution networks for fishery products and products. Development can be done on both finished products and products that can be processed further to become finished products. Making fish raw materials into intermediate products, such as surimi, is one strategy to create and utilize processed goods and underutilized fresh fishery products. Surimi is mashed meat that has undergone numerous cleaning and washing processes to remove the majority of the blood, odor, color, and fat. A number of variables, including the type of fish, level of freshness, fishing technique, fishing season, growth stage, and fish size, will affect the ability to produce surimi of high quality. The transition from frozen to dry surimi production will allow for a wide range of new uses for fish protein and increase its appeal as a food ingredient. When the folding test is completed with a high score, it is demonstrated that its capacity to create a gel when compared to raw surimi is still very good (AA). The myofibril protein concentration, the amount of sugar used as an anti-denaturant, the pH and ionic strength of the meat dispersion, as well as the temperature of the spray drying equipment, will all have an impact on how well spray dried surimi performs.

Keyword: *characteristics, fish, spray-dried, surimi, quality*

1. INTRODUCTION

Fishery products in Indonesia are generally still consumed fresh or processed traditionally, such as through salting or smoking. This has resulted in very limited distribution of fishery products, causing the consumption level of Indonesian fishery products to be limited. The rapid decline in the quality of fishery products and the lack of proper control of handling and processing fishery products will cause the distribution and consumption of fishery products to be increasingly limited. Distribution problems will result in the accumulation of fishery products in one place only during the harvest season or fishing season for certain types of fish, so that many fishery products are not utilized.

In order to increase people's consumption power and expand distribution networks for fishery products and products, it is necessary to provide and develop various processed fishery products based on the principles of proper handling and processing. Development can be carried out on finished products and intermediate products that can be further processed into final processed products. In addition, the diversification of processed products can also increase the nutritional value of the products consumed and reduce the dependence of the processors on fresh fish raw materials [1].

One way to develop and utilize processed products and fresh fishery products that are not utilized is by preparing the fish raw materials in the form of intermediate products, one of which is surimi. Surimi are myofibrillar proteins that have been stabilized and obtained from fish meat that has been separated from the bones, washed with

water and then mixed with cryoprotectant [2]. Surimi has potential as a source of protein consumed in addition to animal and vegetable protein [3].

In the form of surimi, fish meat is prepared to be easily used in various preparations with fish-based ingredients, as well as for fortification, easy to store, durable in a form similar to fresh fish meat and has specific properties required for various product developments, especially those that demand elasticity in the final product [1]. Products made from surimi are unique products with flavors that are similar to their natural flavors coupled with convenience, safety and versatility factors [2].

In addition to raw and frozen forms of surimi, lately there is also dried surimi which is used as a raw material for kamaboko and other surimi-based products. Dried protein offers numerous commercial advantages, such as lower shipping costs, easier storage, and ease of application in dry mixes (as in extruded snack products). Shifting of surimi production from frozen to dry form will be able to open many new applications for fish protein and will lead to wider acceptance as an ingredient in food composition [4]. This paper aims to provide a brief overview of the knowledge of how to make dry surimi and surimi and some characteristic evaluation.

2. SURIMI

2.1 General Definition

Surimi is mashed meat that is cleaned and washed repeatedly so that most of the blood, odor, pigment and fat are lost. Surimi was first developed in Japan traditionally since several hundred years ago and is usually used as a raw material for making surimi-based products, namely kamaboko. Surimi and its derivative products began to be popular in America in the early 1980s, at which time there was a shortage of King Crab and then a crab-like product developed but made with the basic ingredient of surimi called kanikama [1]. The various surimi-based products available today are based on Japanese processing technology and are the result of two breakthrough discoveries, namely the discovery of the use of cryoprotectants in surimi processing in 1960 and the discovery of artificial crab meat products derived from surimi [5].

There are several types of surimi made, the name surimi is raw surimi that does not go through the freezing process, is produced in limited quantities, to maintain freshness and is directly processed into the desired final product on the same day. Meanwhile, surimi through frozen storage is divided into two types, namely Mu-en surimi which is processed without the addition of salt and Ka-en surimi which is processed with the addition of salt to mashed meat [6]. According to [1], there are several advantages obtained from the use of surimi, namely:

a. Can be used directly for processing food products such as meatballs, sausages, kamaboko, burgers and others.
b. Odorless, free of bones and thorns, so that the processed products are easier for people of all ages to consume.
c. The supply and price are relatively stable because surimi can be stored for a long time and this facilitates the planning of processed production.
d. The cost of storage, distribution and transportation is cheaper, because surimi is the only useful part of the fish.
e. Save time and labor due to easier handling
f. Less waste disposal problems.

2.2 Surimi Ingredients

To produce surimi of good quality will depend on many factors such as the type of fish, freshness level, fishing method, fishing season, growth phase and fish size. After that, the handling of surimi raw materials must be carried out properly, starting from the ship to the surimi processing place, everything is done in a cold chain and with maintained environmental sanitation and hygiene.

Surimi which is made from white meat fish raw material, does not have mud odor, is not too fishy, contains low fat and has good gelling ability will give better results (surimi) [1],[2]. Basically, all types of fish can be used as raw materials in making surimi, it's just that certain treatments need to be done first. Fish raw materials to be used must be fresh because otherwise it will produce surimi with low gelling ability as a result of the decomposition of the proteins contained in fish. According to [6], if the fish used is not fresh, it will complicate the process of removing water after washing the mashed meat. According to

The raw material for red-fleshed fish will produce surimi which is darker and smells fishier, so it can only be used to make processed products whose color does not have to be white. Red meat fish contains more fat so that surimi and surimi products go rancid faster [1]. Red meat fish also has a higher connective tissue and fat content, Trimethyl Amin Oxide (TMAO) than white meat [6]. This will affect the ability of surimi gel formation.

Other ingredients needed in surimi processing are ice, salt, cryoprotectant (sorbitol, sucrose) and other materials to increase water holding capacity (polyphosphate). Ice is used to keep the fish meat cold (low temperature) in order to avoid or inhibit the decrease in the quality of the freshness of the fish meat. Salt is usually used when washing mashed fish meat with cold water. The addition of salt is intended to accelerate the reduction of water, the removal of mucus, blood and other impurities from the minced fish meat. The salt used should be clean, white and fine table salt as much as 0.2-0.3% of cold washing water [1].

2.3 Treatment for Fatty fish in Surimi Production

Most of the fish that contain high fat are red meat fish with a total catch of 40-50% in the world [7]. This high number of catches causes a desire to use this type of fish into a variety of products. Especially for the manufacture of surimi products, the fat content in fish will inhibit the formation of myofibril protein gel and can cause rancid and fishy aroma, which are important characteristics for surimi products. Thus, to utilize it, an effective method is needed to improve and develop the quality of the raw materials before they are processed into surimi. Eel, when viewed from the fat content, which is 11.66% [8] does not belong to the group of fish with high fat content but includes fish with medium fat content. Classification of fish based on fat content can be seen in Table 1.

Table 1. Fish groups based on fat and protein content

Groups	Fat Content	Protein Content
Low fat-high protein	< 5%	15-20%
Medium fat-high protein	5-15%	15-20%
High fat-low protein	>15%	<15%
Low fat-high protein	<5%	>20%
Low fat-low protein	<5%	<15%

Source: [9]

Pretreatment should be used to lower the fish's fat content in order to improve the quality of the surimi made from fatty fish. The initial treatment that can be done is by washing the crushed fish meat in an alkaline manner. The addition of base to surimi washing water results in a higher quality product than using plain water. In general, sodium bicarbonate (0.1%) and sodium pyrophosphate (0.05 - 0.1%) are added with several concentrations in the washing process. The gel formation process will increase after this treatment because the solubility of sarcoplasmic proteins will increase and there is a decrease in the level of denaturation due to the increase in the pH of the meat. It will also produce surimi with better color, remove more fat and have a better taste. To prevent oxidation of fats, antioxidants can be added to the washing water [7],[10].

[6] states the same thing that the important thing to note when making surimi from high-fat fish is to remove the fat from the meat and from the surface under the skin where there is a lot of fat. The washing process is also effective for removing fat. It is known that there is 80% fat content in fish meat and 60% can be removed by washing process. The washing method using sodium bicarbonate is proven to be more effective in removing fat and can make the *ashi* stronger.

2.4 Spray Dried Surimi

An important functional property of surimi is its ability to form an elastic gel when mixed with salt and heated. Fish protein is stabilized during frozen storage with the addition of cryoprotectant additives. This additive is also useful for protecting protein against denaturation caused by the drying process. Dried protein offers numerous commercial advantages, such as lower shipping costs, easier storage, and ease of application in dry mixes (as in extruded snack products). The shift in surimi production from frozen to dry form will open up many new applications for fish protein and will lead to wider acceptance as a food ingredient [4]. Surimi can be dried by spray drying method into surimi in the form of flour. The processing stages are:

a. Separate the head and clean the innards.
b. Separate the bones, skin, scales so that only the meat is produced
c. Crush the fish meat
d. Wash the mashed meat several times (cycles and washing times as needed) to separate the water-soluble proteins and other components of the myofibril proteins.
e. Add sugar as an anti-denaturing compound along with cold water.
f. Flow the mixture into a colloid mill.
g. Filter this dispersion to separate any remaining skin, scales or bone.

h. Dry the mixture by spray drying at an inlet air temperature of 150-180^{o}C, and an outlet air temperature of 50-80^{o}C. To enter the material into the drying chamber a special high-pressure pump is used due to the high viscosity of the protein dispersion of the material.

Surimi produced by this process is a white powder resembling wheat flour with an average particle size of 50 μm. The general composition of dry surimi can be seen in Table 2.

Table 2. General composition of spray dried surimi

Composition	Value (%)
Moisture	5
Protein	65
Fat	4
Carbohydrate	24
Ash	2

Source: [4]

The ability to form a gel from spray-dried surimi is reduced when compared to conventional frozen surimi, but its function as a starting material is wider. Its ability to form a gel when compared to raw surimi is still very good, it is proven when the folding test is carried out with a high score (AA). Several factors will affect the functionality of spray dried surimi such as myofibril protein concentration, sugar content as anti-denaturation, pH and ionic strength of meat dispersion and temperature of spray drying equipment [4].

3. CHARACTERISTICS, EVALUATION, PRODUCT IDENTIFICATION

3.1 Surimi Quality Characteristics

Appearance

The overall appearance of the product is very important because if a product is unattractive, potential consumers may never experience the taste and texture of the product. Appearance consists of color, size, shape and uniformity of the product [11]. Surimi with the best quality is surimi with the highest whiteness, cleanest and highest gel strength [12]. Observation of uniformity can provide an assessment of surimi products that still contain impurities, blood stains, or are exposed to microbial contamination.

Texture

Texture can be measured using the human senses or through a series of measurement procedures by mechanical devices such as a penetrometer [11]. The texture of the surimi produced will be closely related to its ability to form a gel from myofibril proteins. The characteristics of surimi are the white color, the taste is bland, the ability to form a gel, the capacity to form an emulsion, the ability to bind water. Depending on the type of fish used, the surimi process must be modified to meet the required quality of surimi [13]. Texture has the following characteristics:

a. A group of physical properties derived from the structure of the product
b. Closely related to the study of physical properties consisting of mechanical and rheological properties
c. Consists of a group of traits and not a single characteristic
d. Texture is felt by touch, usually in the mouth but other parts of the body such as the hands also play a role
e. Has nothing to do with the taste caused by chemicals such as taste and aroma.

Aroma and Flavor

The aroma of a product is detected when the compounds in it enter the nasal passages and are interpreted by the olfactory system. A good aroma of surimi is a fresh aroma specific to the type of fish. Meanwhile, flavor is defined as the impression received through the chemical compounds of the product in the mouth and includes aromatic compounds, basic tastes (salty, sweet, bitter and sour) and taste factors of chemical compounds such as hot spices, cold, biting, taste. metal and umami. Aroma and flavor are closely related [11].

3.2 Surimi Evaluation

Chemical Analysis

Testing on dried surimi is almost the same as testing on frozen surimi. The tests carried out are usually to check the nutritional content and quality of the surimi produced and must meet certain standards that have been set. To test the water content of surimi can be done with a simple method such as the oven method and carried out triplo. The pH test was carried out using a pH meter which was dipped in the homogenized water of surimi and carried out in duplicate. TVB (Total Volatile Base) test is carried out to determine the quality of products made from fresh fish but in dry form of surimi this is not necessary. Several common chemical analysis to evaluate surimi and surimi products are moisture, protein, fat, ash, carbohydrate and pH [14],[15],[16].

Microbiological Analysis

Microorganism testing will depend on what stage will be studied, for example if we want to know the microorganisms that grow during storage then we can perform tests to count aerobic microorganisms. It can also test the number of mesophilic bacteria in unfrozen surimi or psychrophilic bacteria in frozen surimi. The limit of microorganisms (bacteria) allowed per gram is 10^6 colonies/g for fresh fish products due to their chemical and organoleptic specifications. However, it is still acceptable up to 10^8 colonies/g [17]. According to [18], the microbiological testing for fishery products that are commonly carried out is calculating the total number of bacteria, testing the number of bacteria presumably, testing for Salmonella, Shigella and Vibrio.

Physical Analysis

Texture which is closely related to gel strength is an important factor in determining the quality of surimi. To test the texture mechanically, it is recommended to also perform an organoleptic test because the texture has characteristics that are difficult to measure. Measurements can be made with the Okada Gelometer instrument. Surimi gel strength in this case was assessed objectively by using tools such as Instron, Rheometer or Tensiometer. Gel strength was expressed in g/cm^2 [1]. The degree of whiteness of the resulting surimi was measured using a Hunter Whiteness equipped with a color meter. Impurities that enter the surimi need to be tested to ensure that the surimi produced is of good quality [6]. Some of the physical analyzes that are often carried out on surimi products include the visual contaminant test and the Hunter Whiteness Tester [19].

Organoleptic Test

Surimi organoleptic testing requires a group of trained panelists. Tests are usually carried out on appearance, color, odor and springiness or resilience. Appearance is usually tested by observing the level of cleanliness and brilliance of the surimi. While color testing is generally associated with the level / degree of white color of surimi. Sensory analysis which common performed on surimi and surimi-based products includes folding test, bite test, and hedonic test.

3.3 Filler and Non-Filler Materials

Filler material plays a role in shaping the texture of the final product. When a surimi hydrogel is formed as a result of the dispersion of the surimi polymer in water when salt is added and heated, a matrix is formed which traps water in a viscoelastic solid. In general, other ingredients will be trapped in the matrix formed and "fill" the gel. These trapped materials will affect the functional properties such as influencing the formation of a continuous surimi gel matrix during heating; modify the viscosity, mobility and other properties of the aqueous phase and affect the texture and final appearance [20].

Materials included in the filler category are usually sourced from carbohydrates (carrageenan, cellulose, starch) or protein additives that are not derived from meat (whey protein, soy, beef plasma, eggs, etc.). Non-filler materials usually function as flavoring and flavoring agents (spices, MSG) or food additives (developers, emulsifiers, binders, dyes, synthetic flavors) which do not directly affect the product structure. In the manufacture of these extruded snacks, the non-filler ingredients are included in the category of vegetable oil, water, monoglycerides, sugar, salt, milk powder.

4. CONCLUSIONS

Preparing fish raw materials into intermediate products, such as surimi, is one strategy to create and utilize processed goods and underutilized fresh fishery products. With flavors that are identical to their natural flavors and convenience, safety, and adaptability features, items manufactured from surimi are distinctive products. In addition to dried surimi, which is utilized as a raw material for kamaboko and other surimi-based goods, raw and frozen forms of surimi are also available these days. Numerous economic benefits of dried protein include reduced shipping

costs, simpler storage, and simplicity of use in dry mixtures. Surimi made with this method has an average particle size of 50 µm and is a white powder that resembles wheat flour. When compared to traditional frozen surimi, spray-dried surimi has a lower gel-forming capacity, but a wider range of applications as a starting material.

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