The Effect of Washing Cycle on the Yield of Tilapia (*Oreochromis niloticus*) Surimi

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ABSTRACT

Surimi is a prepared form of fish meat that can be used to readily add flavor and fortification to a range of dishes with fish-based ingredients. It has specialized qualities required for a variety of product innovations, especially those that necessitate flexibility in the end product, and is also made to be easy to store and durable in a form comparable to fresh fish meat. Knowing the qualities of proteins, the effects of washing, adding salt, adding chemicals like cryoprotectants, and the impacts of storage on the product are all important to manufacture high-quality surimi. In order to make surimi, the mashed flesh must first be cleaned. This process enables the surimi to keep its gel-forming capacity, giving surimi-based goods an elastic texture. This study seeks to give a general overview of how the number of washing cycles affects the yield production of surimi prepared from tilapia as its raw material.

Keyword: *fish, surimi, tilapia, washing cycle, yield percentage*

1. INTRODUCTION

Developing 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 fish meat that has been removed from the bones, rinsed in water, and combined with a cryoprotectant to stabilize the myofibrillar proteins [1]. Surimi has the potential to be used as a source of protein in addition to animal and plant sources [2].

Fish meat is prepared in the form of surimi to be easily used in a variety of preparations with fish-based ingredients, as well as for fortification. It is also made to be simple to store, durable in a form similar to fresh fish meat, and it has specific properties needed for a variety of product developments, particularly those that demand elasticity in the finished product [3]. When combined with convenience, safety, and adaptability characteristics, items created from surimi are distinctive goods with flavors that are similar to their natural flavors [1].

Surimi is meat that has been ground or minced and repeatedly cleansed and rinsed to remove the majority of the blood, odor, pigment, and fat. The historic usage of surimi as a raw material for the production of kamaboko and other surimi-based foods dates back several hundred years in Japan [3]. To produce high-quality surimi, it is necessary to have knowledge of fresh fish raw materials, protein properties, the effects of washing, adding salt, adding additives like cryoprotectants, and the effects of storage on the product. Then, if we want to sell the finished goods, we can create products that are processed to final specifications and still meet consumer requests. The washing process of mashed meat is an important step in making surimi. This step allows the surimi made to maintain its gel-forming ability, which will give an elastic texture to surimi-based products.

The raw material used as raw material for making surimi in this study is freshwater fish of the black tilapia type. The most widely cultivated black tilapia in Indonesia, especially West Java, is the GIFT tilapia. Tilapia GIFT is a new variety resulting from a cross between several varieties of tilapia developed in various countries. The name GIFT from Tilapia GIFT comes from the abbreviation of Genetic Improvement of Farmed Tilapias. This variety entered Indonesia in 1994 in the form of the 4^{th} generation and in 1997 the 6^{th} generation through the Freshwater Research Institute (Ministry of Marine Affairs and Fisheries, 2001). GIFT tilapia has a thicker meat than local tilapia and therefore will facilitate the process of separating the meat (filet) in making surimi. This study aims to provide an overview regarding the effect of washing cycle number on the surimi's yield made from tilapia as its raw material.

2. MATERIAL AND METHOD

2.1 Materials and Instruments

The instruments used to make surimi include: cutting boards, knives, basins/plastic containers, *blacu* or calico cloth, MK-62JNR Meat Grinder (National), Food Processor (National), measuring cups, plastic sealers. Meanwhile, the ingredients used in this research on surimi are: Tilapia, salt, ice cubes, ice water. sucrose, sorbitol, tripolyphosphate

2.2 Method and Parameters

Surimi Making Procedure

The raw material used in this research is fresh black tilapia (*Oreochromis niloticus*). Surimi is made in a cold chain to avoid further damage so that the gel's ability to form is maintained. The stages of making surimi and treatments, starting from the preparation of raw materials, are as follows:

1) Weighing whole tilapia to be used as raw material for making surimi using a digital scale.
2) Gutting tilapia by removing the scales, gills and entrails using a knife.
3) Separate the tilapia meat by filleting it with a knife to separate it from the bones and thorns. The skin is separated by slicing with a knife, and the thorns that are still left in the flesh are separated manually by hand. The fillet of tilapia meat is then put into a basin of ice.
4) Weigh the resulting tilapia meat filet using a digital scale.
5) Mash the tilapia filet using a meat grinder after previously sliced into small cubes to make it easier to put in the grinder.
6) Weigh the resulting mashed meat using a digital scale.
7) Divide the mashed meat into 3 washing parts, namely mashed meat which has been washed once (A), twice (B) and three times (C). At each washing, weighing is carried out to calculate the yield
8) Wash the mashed meat using cold water with the water temperature kept below 5^{o}C by stirring the mashed meat in cold water for 10 minutes. The amount of water used is 3 times the weight of mashed meat used (w/v) or the ratio is 3:1.
9) Adding salt in the last washing step is 0.3% of the weight of the washed mashed meat.
10) Remove the water on the mashed meat that has been washed by squeezing it by hand using a calico filter cloth.
11) Weigh the mashed meat that has undergone a process of washing and removing water (surimi) using a digital scale.

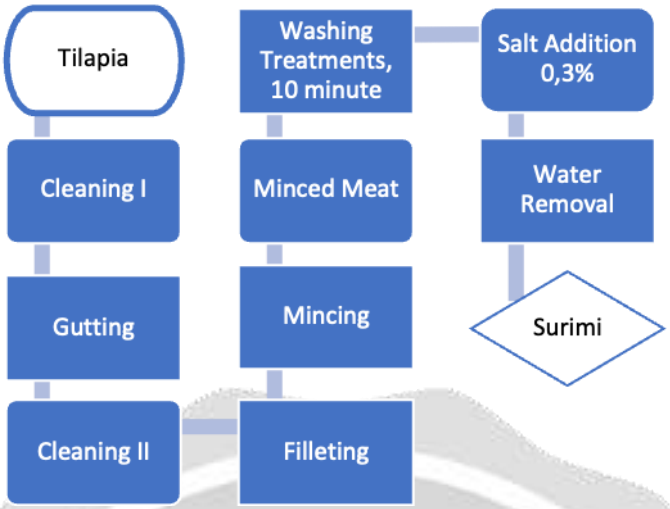

Figure 1. Surimi Making Process Flowchart

2.3 Analysis Procedure

Yield

Meat yield was calculated from whole tilapia which was weighed as initial weight (a). Then the meat was taken but without further washing which was weighed as the final weight (b). The yield of tilapia meat is calculated by the formula:

Fillet yield (%) = b / a x 100%

Description:
a = initial weight of whole tilapia
b = weight of meat without washing

Surimi yield was calculated from whole tilapia in each treatment which was weighed as initial weight (a). Then the meat is taken and the washing process is carried out so that it becomes surimi, which is then weighed as the final weight (c). The yield of tilapia surimi can be calculated by the formula:

Surimi yield (%) = c / a x 100%

Description:
a = initial weight of whole tilapia
c = final weight of surimi

3. RESULT AND DISCUSSION

3.1 Tilapia (*Oreochromis niloticus*)

The cultivation of tilapia *Oreochromis niloticus* (Nile tilapia) can be traced to about 4000 years ago in the civilization of the ancient Egyptians. Meanwhile, significant developments in the world distribution of tilapia occurred during the 1940s and 1950s. Tilapia from Japan was introduced to Thailand in 1965 and from Thailand was sent to the Philippines. In 1971 tilapia was introduced in Brazil and then brought to the United States in 1971. In 1978 tilapia was introduced in China which later became the country with the highest tilapia production and consistently produced more than half of world production in 1992 to 2003 or around 806,000 tons in 2003, in comparison Indonesia in the same year produced 72,000 tons of tilapia [4] The classification of tilapia according to [5] is:

Phylum : Chordata
Sub phylum : Vertebrates

Class	: Osteichthyes
Sub Class	: Acanthoptherigii
Order	: Percomorphii
Sub Order	: Percoidea
Family	: Cichlidae
Genus	: Oreochromis
Species	: *Oreochromis niloticus* L.

The most common characteristic of tilapia is that there are six dark vertical stripes on the tail fin, where such lines are also found on the dorsal and anal fins [5]. In 1987 ICLARM (International Center for Living Aquatic Resources Management) succeeded in developing a new superior variety of tilapia called tilapia GIFT. This GIFT tilapia is the result of a cross between several varieties of tilapia that exist in several countries in the world [6].

Tilapia GIFT is the result of a cross between several types of fish belonging to the Cichilidae family, which has a posture and body color similar to that of black (local) tilapia. When still in the seed phase, the two types of fish are almost indistinguishable from each other, only in the developmental phase of adult fish will be seen. Local tilapia grows slower than GIFT tilapia. Nila GIFT has a relatively ideal body posture. The ratio of length to height is about 2:1 and appears larger. Nila GIFT has a slightly whitish black body color. The underside of the gill cover (operculum) is white. Stenoid-shaped scales are large and neatly arranged. The head is relatively small so that the eyes appear prominent and large. The lateral line is cut off in the middle of the body. The dorsal and pelvic fins have weak rays and sharp paper like thorns [7].

3.2 Tilapia Surimi Yield

Yield needs to be calculated to find out how much part can be consumed from a material. The yield of tilapia was calculated based on the ratio of the final weight to the weight of the whole fish. The total weight of all tilapia used in this study is 4935 g, then after gutting and filleting the weight becomes 1358 g. After being filet, the fish meat is then ground into pulverized meat weighing 1336 g. The results of the yield calculation can be seen in Tables 1 and 2.

Table 1. Yield of tilapia meat

Results	Yield Value (%)
Fillet Yield	27,52
Minced Meat Yield	27,07

The amount of yield produced is still not too far from the yield of tilapia in general. [8] stated that tilapia is a good raw material for kamaboko (surimi-based product). The taste, flavor and gel strength of tilapia kamaboko is excellent. Even so, the yield of mashed meat is only 25% of its total body weight.

Table 2. Surimi yield after washing cycle

Washing Frequency	Washing Cycle	Yield (%)
1 cycle	-	65,25
2 cycle	I	66,28
	II	64,90
3 cycle	I	95,60
	II	85,60
	III	57,80

After the minced tilapia meat is washed 1 to 3 times and the water is removed, to determine the ratio of the resulting weight, the yield is then calculated by weighing the mashed meat after each washing, the results are then compared with the weight of the initial mashed meat. For washing one and two times, the yields produced were not too much different (65.25% for one wash and 66.28% and 64.90% for washing twice), only a slight decrease was caused by some of the mashed meat containing sarcoplasmic protein. dissolved in the washing water while some remains on the squeezing cloth.

In the minced meat that was washed three times there was a huge difference (95.60% for the first washing; 85.60% for the second washing; 57.80% for the third washing), this is because during the first and second pressing process, the water that comes out not too much, hence that the weight calculated on the scales (minced meat and water) is still large.

The water removal process will take place gradually better as the percentage of salt concentration in the washing water increases. Therefore, it is common to add a mixture of 0.1 – 0.3% NaCl and/or $CaCl_2$ salts to the final wash water. However, special attention must be paid because too much salt content in the washing water will cause dissolution of myofibrillar proteins which in turn will result in increased loss of myofibrillar proteins. The remaining salt will also increase the possibility of protein denaturation during frozen storage [1].

The yield produced will vary in number depending on the type, size, season and the type of equipment used. To obtain the maximum yield, the process of making filets and separating meat must be carried out carefully. The process of making fish meat fillets will affect the quality and quantity of the mashed meat produced. The position of the cut near the head of the fish is very important, if it is too far in front, the gills and heart will be left behind and the quality of the product will decrease, but if it is too far behind, the yield will decrease [9].

The washing time carried out in this study is 10 minutes/cycle. According to [10], a long washing time did not increase the amount of sarcoplasmic protein lost when the comparison condition was reached, while the addition of a washing cycle would remove the remaining sarcoplasmic protein from the mashed meat continuously, and would cause the yield to decrease.

The decrease in yield can be caused by the dissolution of sarcoplasmic proteins and the separation of connective tissue proteins during the separation of meat. Sarcoplasmic proteins that are still present in surimi will be coagulated by heat and stick to myofibril proteins when surimi is heated. This event inhibits the process of gel formation in the manufacture of fish cake. Stroma is a protein that forms connective tissue and cannot be extracted by water, alkaline solutions, acids and neutral salts. The components of the stroma are collagen and elastin. If the connective tissue containing a large percentage of collagen is heated for a long time, the collagen will turn into water-soluble gelatin [8].

[1] also argue that the use of an increased water ratio for washing usually results in more protein loss and increased waste disposal. It is estimated that up to 50% of the total amount of protein is lost during the washing stage. Most sarcoplasmic proteins are moderately water soluble and can be removed during the initial washing steps. Subsequent washing removes the sarcoplasmic protein along with a small amount of myofibril protein. Consequently, once the sarcoplasmic proteins have been completely removed, further leaching results in the loss of myofibrillar proteins. Myosin content (MHC), water binding ability, and whiteness of mashed meat will decrease when using a low water/meat ratio.

The freshness of tilapia also affects the yield of surimi produced. According to [1], the highest amount of yield and protein content, minimal amount of loss during processing, and good gelling ability will be related to surimi processed from tilapia filet which is still in the pre-rigor phase. Surimi with one washing cycle has been chosen as the best treatment. This can be seen from the yield and organoleptic score of kamaboko which will be explained in the next sub-chapter.

4. CONCLUSIONS

Knowledge of fresh fish raw materials, protein characteristics, the effects of washing, adding salt, adding chemicals such cryoprotectants, and the impacts of storage on the product are prerequisites for producing high-quality surimi. A critical step in the preparation of surimi is washing the minced meat. This process enables the surimi to keep its capacity to gel immediately, giving surimi-based products an elastic texture. To determine how much part can be made from a material, yield must be calculated. Based on the proportion of the end weight to the weight of the whole fish, the yield of tilapia was estimated. The type, size, season, and type of equipment employed will all have an impact on the yield that is produced. Making filets and separating the meat must be done carefully to achieve the highest yield. The type and amount of minced meat produced will depend on how fish meat fillets are made.

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