Maintaining the Chemical Value and Organoleptic Properties of Pempek with the Frequency of Ice Water Washing Method

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Abstract. Pempek is a very famous food in the city of Palembang, Indonesia. Fish as the main ingredient of pempek can be washed after grinding with ice water in a certain frequency to increase the strength of the gel, remove most of the components that are soluble in water, blood, cause odor, and can improve the quality of color and taste. Mackerel sand fish is one of the main ingredients of pempek which can be made blending or crushed washed/with ice water ratio of 1:3 (material: water) according to treatment four treatments for 10 minutes for each washing process with the Non Factorial Randomized Design Methodology method. Statistically it was found that the washing frequency had a very significant effect on the fat content and water content and had a significant effect on the color and taste. The results showed the F4 frequency treatment that the level of color preference (score 4.40) and taste (score 4.05) and fat content was 0.38% lower and the moisture content was 58.08% higher. Making Pempek Lenjer with the frequency of washing Surimi with ice water produced by Pempek which is not fishy, and with the color and taste that is preferred.

Keywords: Frequency of Washing, Ice Water, Chemical, Organoleptic, Pempek

1. Background

Pempek has become a typical food by the people of Palembang, South Sumatra, Indonesia. and Pempek has been known since the days of the Sriwijaya Kingdom until now. The current Pempek has several forms, namely a large long lenjeran, a small short lenjeran, submarine, adaan, otak-otak, curly pempek and pastel [1]; [2]. Pempek has a special color, which depends on the type of constituent material. [22] stated that pempek is a processed product of fish meat in the form of a type of hagmogen protein gel, white in color, elastic and elastic in texture. Pempek consists of several ingredients or mixtures. [12] pempek is made from several mixtures of several basic ingredients such as fish meat (filet), tapioca flour, water, salt, and spices as an enhancer of taste. This mixture of ingredients is also called a dough, so that the mixture can be made from various forms of pempek and can be cooked by boiling, steaming, frying, or roasting. The cooked Pempek can be served with cuko pempek as a complement.

Fish that can be used to make pempek are good quality fish. There are several types of fish that can be used such as Belida fish (Notopterus chitala), Putak fish (Notopterus notopterus) and Cork fish (Channa striata). But, this type of Fish has a fairly high prices. Pempek from Belida fish, Putak fish, and Cork fish can be replaced with other cheaper sea fish such as Parang-Parang fish (Chirocentrus dorab), Red Snapper fish (Lutjanus argentimaculatus) and Mackerel Sand fish (Scomberomorus...
so it can obtained Pempek with a low production costs. Pempek produced from the type of sea fish produces the same color and taste of pempek as pempek from raw materials of cork fish [5].

Pempek, which is made from marine fish, will have a more fishy aroma and a darker color (white color is rather dull or grayish white) when compared to pempek made from raw cork fish. Pempek from cork fish does not smell fishy and is white. Sand mackerel which is included in the group of fish with high fat content is rapidly decayed due to fat oxidation. [15] mackerel fish has a protein content of 21.50%, fat of 2.60% and minera 11.50%. [9] states that fish that have more than 2% fat content include fish that have high fat content. This high fat content causes mackerel fish to experience rapid quality changes, especially which will cause decay resulting from the oxidation process causing a rancid odor. Mackerel sand can be processed into surimi before it is used as a mixture of pempek, so it does not smell fishy or rancid so that it can be used as a mixture of pempek and various other food products such as meatballs, noodles, sausage, burgers, cakes, and crackers.

Fish that will be made into surimi should be white fleshed fish, not smelly or stinky, and have the ability to form a gel so that the surimi texture will be elastic. Good quality fish are fresh fish [3]. Surimi fish can be classified into three types, namely white, dark, and medium surimi. White Surimi can be produced from fish with low fat content and a high level of gel strength such as cork fish and tilapia fish. Dark Surimi is produced from high-fat fish such as sardine and mackerel. Medium-colored surimi is produced from fish containing high olatile and hemoglobin, such as tuna, mackerel sand and catfish [20].

Washing fish meat with ice water before grinding / dozing is one way that can be done to increase gel strength [14]. Surimi as an ingredient in food products such as pempek can be washed with ice water first, in order to reduce or eliminate fishy odor. [5] the washing process in surimi acts to eliminate most of the components that are soluble in water, blood (pigment), the cause of fishy odor. [19] washing of surimi with ice water can reduce sarcoplasmic protein and blood from fish meat moss, so that it can eliminate fishy odor and cause a non-fishy aroma derived from volatile miofibrillar amino acids. [18] stated that three times washing of tilapia meat will produce surimi with the color, aroma and level of elasticity that favored by panelists.

The washing process uses a large amount of water is a critical stage for removing sarcoplasmic protein, blood, fat and other nitrogen components from fish pulp [16]. The number of cycles and washing volume varied with the type of fish, freshness of the fish, type of washing device and desired quality of fish meat [10]. [23] and [8] the washing frequency produced 3 times that of African catfish meat with the best gel quality characteristics with a ratio of the volume of water and fish used was 1 part of fish and 4 parts of ice water. Water used in the washing process of African catfish meat is done using cold water with a temperature of -5 ± 2°C. [2] states that from the results of the research on the frequency of washing treatment of sandy fish surimi as much as 4 times obtained the level of preference for aroma is very like and the level of elasticity is higher than other treatments. The aim of this study was to determine the effects of the frequency of washing the fish mackerel surimi with ice water on fat contents, water contents, colours and Taste of Pempek Lenjer.

2. Methods

The experimental design used in this study was a randomized block design arranged in a nonfactorial manner with the treatment of edoni is the frequency of washing ice water with five treatment levels and repeated four times. The treatment of the frequency of washing ice water is F0 = No washing, F1 = Washing once, F2 = Washing twice, F3 = Washing three times, F4 = Washing four times and continuing with further testing is a Real Honest Difference Test (BNJ Test) for fat content and moisture content data. Parameters observed in this study are fat levels measurement, water contents measurement, colours and tastes measurement.

2.1 Fat Levels Measurement

The determination of fat content was carried out by means of the Soxhlet method [4]. Here's how fat analysis works:
1. The smoothed sample is weighed 2g mixed with 8g of sand that has been dispersed and put into the Soxhlet tube in the thimble. Pour the ice water through the condenser.
2. The extraction tube is installed on a Soxlet distillation device with sufficient petroleum ether solvent for 4 hours. After the residue in the extraction tube is stirred, the extraction is continued again for 2 hours with the same solvent.
3. Petroleum ether which contains fat extract is transferred into a clean weighing bottle and the weight that is already known evaporated with a water bath until it is slightly thick. Drying is continued in the oven 100ºC until the weight is constant.
4. The weight of the residue in the weighing bottle is stated as fat weight.
5. Fat Levels Calculation (%) = \( \frac{(B-A)}{w} \) x 100%
   Remarks : 
   A = Weight of thimble bottle + sample after oven
   B = Weight of thimble bottle + sample before oven
   W = sample weight before extraction

2.2 Water Contents Measurement

The water content is determined using the drying / oven method (Thermogravimetry). This method is used for all food stuffs except products containing volatile compounds or volatile materials at 100ºC heat. The principle of this method is to dry the sample in a 100º-105ºC until the weight is constant and the initial and final weight difference is calculated as the water content [4]. The following steps of the water content analysis works:
1. The clean porcelain cup is dried in a drying oven at 105ºC for 1 hour with the lid removed.
2. Then the porcelain cup is taken using clamping pliers and cooled in a desiccator with the lid removed for 1 hour.
3. After being cooled, the porcelain cup is weighed closed.
4. Weighed the sample ± 2 grams using a porcelain dish and dried it in a drying oven at 105ºC for 8 hours or until the weight remained constant with the lid removed.
5. Using a clamp pliers, the porcelain cup is closed, then cooled in the desiccator for 30 minutes with the lid removed. After the cold, the porcelain cup was closed again and weighed. Water content is calculated by the formula:
   \[ \text{Water content} \text{(\%)} = \frac{(B-A)(C-A)}{(B-A)} \times 100\% \]
   Remarks : 
   A = The weight of the empty porcelain cup
   B = Weight of porcelain cup + sample before heating
   C = Porcelain cup weight + sample after heating

2.3 Colours and Tastes Measurement

A hedonic test is a test of preference (colour, aroma, and taste) used to evaluate acceptability or preference for the test sample. Edonic tests were conducted to determine the level of preference of the panelists for the examples presented. In this test, the panelists used were 20 people, then the panelists were given a form that assessed the examples presented. Examples tested were given a three-digit code and given a value according to their respective levels of preference Each observation of pempek lenjer sand mackerel which is rated between 1 and 5, with the highest value shows the highest degree of preference [17]. The panelists' favorite levels are as follows: Strongly Like score 5, Like score 4, Rather Like score 3, Don't Like score 2, and Strongly Dislike score 1. Each observation of pempek lenjer is rated between 1 to 5 or stretched according to the range the desired scale [21] with the highest value indicating the highest degree of preference (Setyaningsih et al., 2010). Data analysis was performed by Friedman test.

3. Results and Discussions

Fat content and moisture content were carried out by statistical analysis with F test as in Table 1 which shows that fat content and moisture content had a very significant effect on pempek lenjer. Parameters
of color, aroma, and taste have been analyzed statistically by Friedman test as in Table 2 which shows that colour, aroma, and flavor have a significant effects on the resulting pempek lenjer.

**Table 1.** The results of diversity analysis (F test) parameters of fat content and water content of Pempek

| Parameters  | F-count | F-table | F-count : F-table Result | Coefficient of Diversity (KK) |
|-------------|---------|---------|--------------------------|-------------------------------|
| Fat Levels  | 470,14  | 3,26    | 5,41 **                   | 6,55%                         |
| Water Levels| 11297,14| 3,26    | 5,41 **                   | 0,16%                         |

Note: ** as the effect is very real

**Table 2.** The Friedman test results in hedonic tests of colour, aroma, and taste of pempek.

| Parameters | T-critic | F-table (0,05=1,70) |
|------------|----------|---------------------|
| Colours    | 12,82    | *                   |
| Taste      | 5,56     | *                   |

Note: * as the effect is real

### 3.1 Fat Levels

Pempek lenjer fat levels value with the treatment of the frequency of washing fish mackerel sand with ice water and statistical analysis was carried out by BNJ test as shown in Figure 1. The F4 treatment from the BNJ test results in Picture 1 was significantly different from the treatments of F1 and F2, but not significantly different from treatment F3. The highest fat content was found in treatment F0 (without washing) with an average value of 1.89% and the lowest fat content in treatment F4 (washing four times) with an average value of 0.38%. Different frequency of washing will affect the fat levels produced in the pempek lenjer sand mackerel fish. One of the fats in animals (including fish) are in muscle tissue and blood. The meat dozing process before the washing process will facilitate the release of fat from muscle tissue and blood during the washing process with ice water. The amount of fat that will dissolve together with the release of blood from muscle tissue increases when the washing process increases in frequency. The fat content in the pempek fish mackerel sand produced will decrease with increasing frequency of washing on crushed meat sand mackerel fish.

Fats or lipids in the fish body are found in the liver, brain, spinal tissue, muscle tissue, skin and blood tissue. The washing process is a critical stage in making surimi. Washing with large amounts of water serves to remove sarcoplasmic protein, blood, fat and other nitrogen components from fish pulp [16]. The treatment of F0 without washing the pulverized meat of sand mackerel fish has the highest fat content on the produced pempek lenjer. Without the washing process with ice water, fat in fish can be lost in low amounts through the first washing process that aims to remove blood after the weeding process. It means that the amount of fat contained in the blood dissolved in water is lower than the treatment with the washing process and this will increase the fat content in the resulting Pempek lenjer. [15] stated in every 100g of mackerel meat contains 2.60g of fatty nutrients in every 100g of fresh sand mackerel fish.
Figure 1. Treatment of the frequency of washing sand mackerel with ice water against the fat levels of pempek lenjer

Note: The numbers followed by different letters mean significantly different from the BNJ test $\alpha = 5\%$ dan $\alpha = 1\%$

3.2 Water Contents

Pempek lenjer’s water content with the frequency of washing the fish mackerel sand with ice water is analyzed statistically with BNJ test as in Figure 2. Treatment F4 was very significantly different with treatment F3, F2, F1 and F0. The highest water content was found in treatment F4 (washing four times) with an average value of 58.08% and the lowest water content in treatment F0 (without washing) with an average value of 47.14%. Fish have miofibrillar proteins that are insoluble in water. The existence of a washing process that increases in frequency causes an increase in the amount of sarcoplasmic protein which is dissolved in the washing process. The dissolution of sarcoplasmic proteins can increase the levels of miofibrillar proteins that can bind to water. The presence of more than one washing frequency also causes more water molecules to be bound by miofibril proteins, so that the water content in the F4 treatment is more in the pempek lenjer produced compared to other treatments. Miofibrillar proteins are slightly soluble in water at neutral pH and dissolve in strong saline solutions. Miofibrillar protein is a protein that forms miofibril which consists of structural proteins (actin, myosin and actomiosin) and regulatory proteins (troponin, tropomyosin and actinin) and is the largest part of fish protein which is around 66-77% of total fish protein. Miofibrils play a role in water binding, clumping and gel formation in processed fish meat. [13] stated that the increase in water content during the washing process might be due to the hydration process by the myofibril protein.
3.3 Colours and Taste in Organoleptic Tests

The color value of Pempek Lenjer with the treatment of the frequency of washing sand mackerel with ice water was carried out statistical analysis with the Conover test obtained by the T-Criticism value of 12.82 as shown in table 2. T value - Criticism is greater (> ) than F-value Table 0.05 at free degree (4.76), amounting to 1.70, meaning the washing frequency treatment has a significant effect on the color of pempek lenjer sand mackerel and F4 treatment significantly different from treatment F3, F2, F1 and F0.

The highest level of preference for the color of pempek lenjer sand mackerel fish is shown in Figure 3 which in treatment F4 (washing four times) produced a pure white color on the pempek produced with an average value of 4.40 (preferred criteria for panelists). Different frequency of washing will affect the color produced on pempek lenjer sand mackerel fish. Fish have sarcoplasmic proteins that are soluble in water and which cause redness in fish meat. The existence of a washing process that increases in frequency causes an increase in the amount of sarcoplasmic protein which is dissolved in the washing process. The reduced amount of sarcoplasmic protein can increase the color of pulverized or surimi meat to be whiter and this can increase the value of the panelist's preference for the color of pempek lenjer fish mackerel sand on treatment F4.
The taste value of Pempek Lenjer with the treatment of the frequency of washing of mackerel sand with ice water was carried out statistical analysis with the Conover test obtained by the T-Criticism value of 5.56. T value - Criticism is greater (> ) than F-value Table 0.05 at free degree (4.76), 1.70 means that washing frequency treatment has a significant effect on the taste of pempek lenjer fish mackerel sand and F4 treatment is different is not real with treatments F3 and F2, but significantly different from treatments F1 and F0. The highest level of preference for the taste of pempek lenjer mackerel sand is found in treatment F4 (four times washing) which produces a taste similar to the typical taste of pempek cork fish with an average value of 4.05 (panelists' preferred criteria) and lowest preference level in treatment F0 (without washing) which produces a distinctive taste of Pempek sea fish with an average value of 3.05 (rather preferred criteria by panelists). Carbohydrates, fats and proteins have an important role in determining the characteristics of food ingredients, such as taste, color, texture and others. The savory taste of a product is determined by the amount of fat, carbohydrate and protein content [24]. Foodstuffs during the processing process will break down carbohydrates, proteins, fats and minerals, so the flavor will be better. The taste of food can be derived from food itself also comes from substances that are added from the outside during the process, so that it can cause a sharp taste or vice versa to be reduced.

4. **Conclusions**

The frequency of washing (F) mackerel sand with ice water has a very significant effect on fat content and pempek lenjer water content and has a significant effect on the color and taste of pempek lenjer. Pempek lenjer mackerel sand done by washing ice water 4 times (F4) has a lower fat content and has a higher water content, and has a higher organoleptic test score with the criteria of pempek lenjer sand mackerel fish is more preferred color and the taste by panelists. The treatment of washing with F4 ice water can reduce or eliminate fishy aroma.
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