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Physicochemical Characteristics of Catfish (*Clarias sp*) Sausage with Addition of Moringa Leaf Flour (*Moringa oleifera*)

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Abstract. Sausage is a processed food product that is generally made of meat, fat, filler, water, binder, and salt. Catfish is a source of animal protein that has advantages compared to other animal products, namely catfish which is rich in lysine, and leucine. Moringa leaf flour is Moringa leaves that are given drying, and milling treatment to facilitate processing into various food products and as a fortification material with high nutrition. This study aims to determine the effect of differences in concentration of catfish: tapioca flour with the addition of Moringa leaf flour on the physicochemical properties of catfish sausage. The results obtained in the study that the difference in the concentration of catfish: tapioca flour and the addition of Moringa leaf flour affect the analysis of water content 58%; fat content 13%; ash content 1.85%; protein content 18.09%; color parameter L* 47,26-66,48; color parameter a* (-4.43)-5.40; color parameter b* 14.25-26.71.

Keywords: ***Catfish, Moringa Leaf Flour, Sausage, Tapioca Flour***

1. Introduction

Indonesia is a country that has various nutritional problems. Lack of Protein Energy is due to the low level of energy and protein consumption in the daily diet, furthermore, it is not sufficient for the recommended needs [1]. The prevention of PEM is to increase the consumption of foods that are high in vitamins and protein found in plant and animal food sources [2]. Catfish is a source of animal protein that has advantages compared to other animal products, namely catfish which is rich in lysine and leucine. Sources of animal protein are found in catfish and sources of vegetable protein can be found in fruits and vegetables [3]. Moringa leaves are one type of vegetable as a source of vegetable protein produced from the Moringa plant. Moringa leaves have been widely researched on their usefulness and nutritional content of Moringa leaves. Moringa leaves are known to be rich in nutrients contained in them, namely protein, iron, phosphorus, calcium, potassium, zinc, vitamins A, B, C, D, E, K, biotin, and folic acid [4]. Sausage is one of the processed foods that are widely known and favored by the public. Sausages in Indonesia are readily available, made from processed meats such as chicken and beef. Sausage is a processed product of mashed meat mixed with herbs and spices, then put in a wrapper or cashing. Fish sausage is an innovation that is processed from fish meat that is right for consumption because fish sausage is a food of high nutritional value and a type of ready-to-eat food. This study aims

to determine the effect of differences in concentration of catfish: tapioca flour with the addition of Moringa leaf flour on the physicochemical properties of catfish sausage.

2. Materials and Methods

2.1. Material

The ingredients for the manufacturing process are catfish obtained from the Rejomulyo fish market in Semarang with the criteria of 4 months of age for catfish, fine pepper, tapioca flour, Sodium Tripolyphosphate (STPP), granulated sugar, Moringa leaves, ginger, nutmeg, skim milk, garlic, cooking oil, fine salt, ice water. The analytical materials used were concentrated H_2SO_4, NaOH, 0.1 N HCl, aquadest, methyl red, Kjeldhal tablets, and Hexan.

2.2. Method

The design used in this study used a completely randomized design method. This study uses a factorial design method with 2 factors. The first factor was the concentration of Moringa Leaf Flour (0%, 1%, 2%, 3 %). On the other hand, the second factor is the concentration of Catfish Meat: the concentration of Tapioca Flour (70%:30%, 75%:25%, 80%:20%) used.

2.3. Making Moringa Leaf Flour

To make Moringa leaf flour, first, Moringa leaves are sorted to get fresh Moringa leaves that are still green and separated from the twigs. Washing is done using running water to remove dirt on the surface of the leaves that can damage the quality of Moringa leaf flour. Drain the Moringa leaves after washing to speed up the drying process. Drying of Moringa leaves using a cabinet dryer for 4 hours at 50 o C and grinding of dried Moringa leaves using a blender which is then sifted using a 60 mesh sieve to produce fine Moringa leaf powder according to flour standards.

2.4. Sausage Making

Making a catfish sausage with the addition of Moringa leaf flour, the first is the preparation of catfish. Wash the catfish, then wash the spines and skin of the catfish to get the catfish meat. Grinding catfish with ice for 10 minutes followed by mixing catfish with additional ingredients for 20 minutes and ice water to prevent the dough temperature from being low during grinding so that the stability of the emulsion can be maintained. Printing is done by packaging using a plastic sleeve. Boiling is carried out according to the procedure with a time of 20 minutes.

2.5. Physicochemical Characteristic Test

The observed physio-chemical characteristics of crackers were water content, ash content, and protein content. The method employed in this work was Colour test chomatometer [5].

2.6. Data analysis

Data analysis was carried out using univariate analysis, if a difference was found, it would be continued with the DMRT test with a 95% confidence level. Data analysis was carried out using SPSS version 21 software.

3. Results and Discussion

3.1. Color Analysis (L, a* and b*)*

The results of color analysis showed that there was a significant difference ($p < 0.05$) between the concentration of catfish meat: tapioca flour and moringa leaf flour on the values of L*, a* and b* of catfish meatballs. Color analysis results are presented in Table 1.

Table 1. Catfish Sausage Color Analysis Results

Sample/ *sample*	Color *Value*		
	L*	a*	b*
X1Y1	65.20±1.46 ^{abD}	5.16±0.09 ^{bD}	14.25±0.05 ^{abA}
X1Y2	65.73±0.27 ^{bD}	5.4±0.16 ^{aD}	15.59±0.50 ^{bA}
X1Y3	66.48±0.86 ^{aD}	4.87±0.04 ^{cD}	14.46±0.05 ^{aA}
X2Y1	57.41±0.53 ^{abC}	-1.78±0.03 ^{bC}	25.31±0.17 ^{abB}
X2Y2	58.21±0.89 ^{bC}	-1.95±0.44 ^{aC}	24.86±0.81 ^{bB}
X2Y3	57.43±1.52 ^{aC}	-1.72±0.45 ^{cC}	25.03±0.64 ^{aB}
X3Y1	52.17±0.80 ^{abB}	-2.76±0.18 ^{bB}	26.50±0.21 ^{abBC}
X3Y2	55.50±2.16 ^{bB}	-3.1±0.14 ^{aB}	25.76±0.55 ^{bBC}
X3Y3	47.99±1.12 ^{aB}	-1.33±0.10 ^{cB}	24.53±0.40 ^{abc}
X4Y1	47.61±0.58 ^{abA}	-3.30±0.13 ^{bA}	25.38±0.58 ^{abC}
X4Y2	47.41±0.80 ^{bA}	-4.43±0.19 ^{aA}	26.71±0.35 ^{bC}
X4Y3	47.26±0.43 ^{aA}	-2.39±0.75 ^{cA}	25.82±0.28 ^{aC}

Color is a component that has a very important role in determining the acceptability and quality of food ingredients. The degree of color parameter L* represents brightness with a value of 0 indicating black and a value of 100 producing white. The value of L* color in catfish sausage in the control treatment or without the addition of Moringa leaf flour resulted in the highest value compared to catfish sausage which was given the addition of Moringa leaf flour. This is because the process of boiling catfish sausage with the addition of Moringa leaf flour can cause the green color of the chlorophyll of Moringa leaf flour to turn darker than before boiling sausages [6]

The degree of color value a* represents the chromaticity of the mixture of red and green. The color value +a* (positive) has a value scale of 0 to +100 indicating red color and the color value -a* (negative) has a value scale from 0 to (-80) indicating green color. The color parameter a* with the addition of Moringa leaf flour produces a greenish color. The use of Moringa leaf flour as an addition to the catfish sausage dough causes a decrease in the value of the -a* color to greenish. This is due to the damage to chlorophyll in Moringa leaf flour during the boiling process of catfish sausage [7].

The degree of color value b* represents the chromaticity of the blue-yellow color mixture. The color value +b* (positive) has a value scale of 0 to +70 indicating yellow color and the color value -b* (negative) has a value scale of 0 to (-70) indicating blue color. The color parameter b* with the addition of Moringa leaf flour produces yellow and blue colors. The use of Moringa leaf flour as an addition to the catfish sausage dough produces a yellowish color which can be seen from the graph of the +b* color analysis to greenish. The results of the analysis in the control treatment resulted in a lower b* color value compared to sausages that were given the addition of Moringa leaf flour. There is a change in color after adding Moringa leaf flour and heating during boiling which causes damage to chlorophyll [8].

3.2. Water content

The results of the water content analysis showed that there was a significant difference ($p< 0.05$) between the concentrations of catfish meat: tapioca flour and Moringa leaf flour on the water content of catfish sausage. The results of the analysis of water content are presented in Figure 1. Moisture content is a very important parameter in fish sausage products because it tends to spoil quickly. Based on the quality requirements of SNI (Indonesian National Standard), the water content of fish sausage is a maximum of 68%. The results of the water content of the catfish sausage sample in (Figure 1) obtained the results of water content of catfish sausage with a value of 51%-58%. Differences in the concentration of catfish and tapioca flour affect the water content of sausages. This is because the higher the

concentration of catfish used in making sausages, the higher the ability to bind water. The results of the higher water content with the lower concentration of tapioca flour used [3].

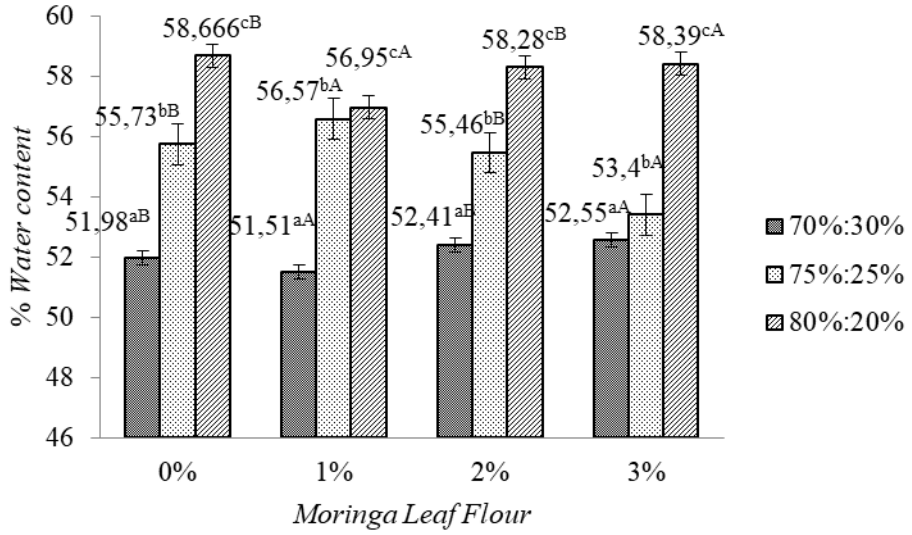

Figure 1. Water Content

3.3. Ash Content

The results of the ash content analysis showed that there was a significant difference ($p < 0.05$) between the concentrations of catfish meat: tapioca flour and Moringa leaf flour on the water content of catfish sausage. The results of the analysis of water content are presented in Figure 2. Ash content or inorganic substances are known as mineral elements, caused by the combustion process. The combustion process will burn out organic materials and the remaining unburned inorganic materials are called ash. ash content of catfish sausage with the same letter notation showed results that were not significantly different at 0.05 significance using the Univariate Test with Duncan. Based on SNI quality requirements, the maximum ash content of fish sausage is 2.5 %. The results of the analysis of the ash content of catfish sausage with the addition of Moringa leaf flour (Figure 2) obtained the results of the ash content of the catfish sausage sample with a percentage of 1.03%-1.85%. According to [8], ash content in food products is a negative substance produced from the residue of the combustion process of organic matter in food products. The higher the concentration of fish used, the higher the ash content. The addition of Moringa leaf flour in sausage dough is higher, the higher the ash content produced in catfish sausage.

3.4. Protein Content

The results of the analysis of protein content showed that there was a significant difference ($p < 0.05$) between the concentrations of catfish meat: tapioca flour and Moringa leaf flour on the water content of catfish sausage. The results of the analysis of water content are presented in Figure 3. Content of catfish sausage with the same letter notation showed results that were not significantly different at 0.05 significance using the Univariate Test with Duncan. Protein is a substance contained in the food that is very important for the body. Protein is a complex compound consisting of amino acids bound by peptide bonds with elements of Hydrogen (H), Oxygen (O), Carbon (C), and Nitrogen (N). Proteins function as regulatory substances and building blocks. Based on SNI quality requirements, the protein content of fish sausage is at least 9,0 %. The results of the analysis of the protein content of catfish sausage with the addition of Moringa leaf flour (Figure 3) showed the protein content of the catfish sausage sample with a value of 10.05%-18.09%. The protein content of catfish sausage with the addition of Moringa leaf flour, the higher the concentration of catfish and Moringa leaf flour used in making catfish sausage

with the addition of Moringa leaf flour, the higher the value of the protein content of the sausage, it is the same as low and high protein as seen from the high water content in the product is lost from the ingredients. The higher the value of the protein produced if the water loss is high.

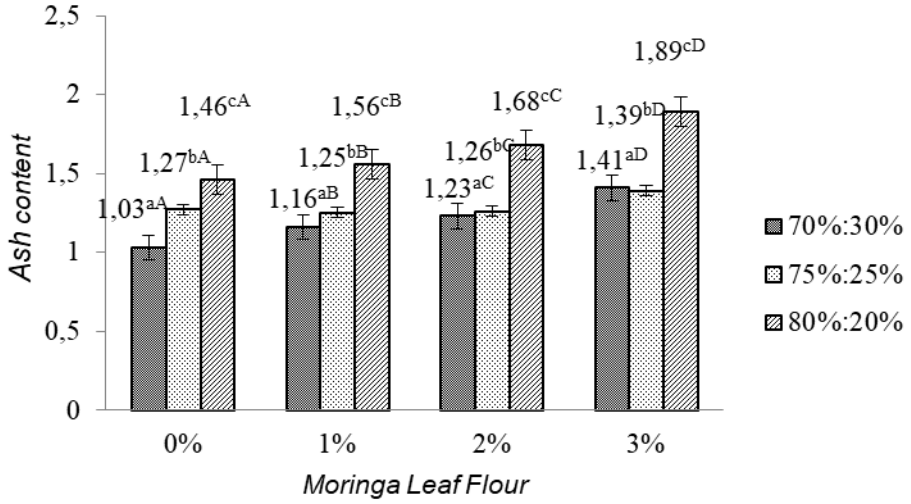

Figure 2. Ash Content

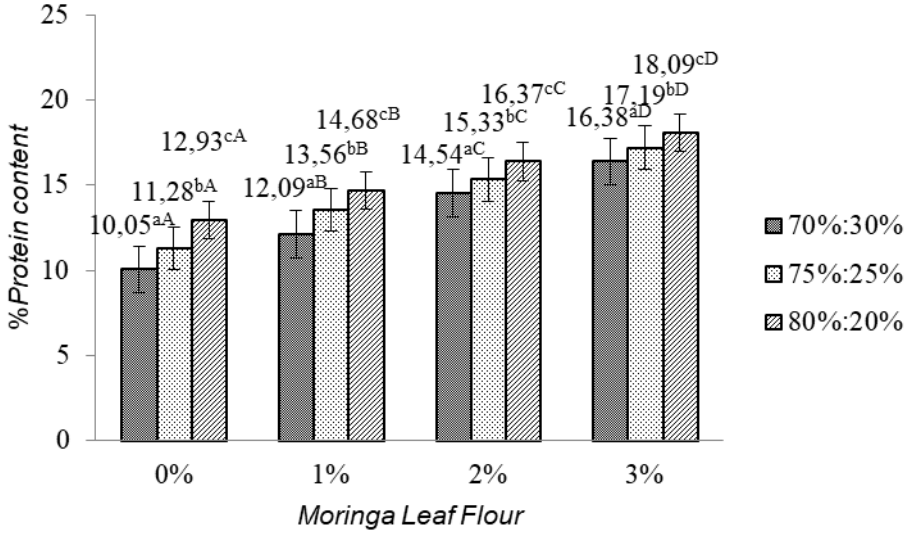

Figure 3. Protein Content

4. Conclusions

Differences in concentration of catfish meat: tapioca flour and Moringa leaf flour have an effect on the physical and chemical properties of catfish sausage. The chemical properties of catfish sausage increased the results of the analysis in the treatment of 80% catfish and 20% tapioca flour with the best results being 58.66% water content, 1.85% ash content, 18.09% protein content. The physical properties of L* color with the best results were 66.48 in the treatment of 80% catfish and 20% tapioca flour. Treatment of 75% catfish and 25% tapioca flour on color a* 5,40 and color b* 26,71. Chemical properties obtained the best results at a concentration of 3% Moringa leaf flour on water content, fat content, carbohydrates

and ash content and protein content. Physical properties obtained the best results at 0% concentration of Moringa leaf flour Color L* 66,48 %, Color a* 5,4%.

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