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THE PHYSICOCHEMICAL AND ORGANOLEPTIC QUALITY OF LIVER NUGGETS WITH CORN FLOUR AND SAGO FLOUR

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ABSTRACT

The study aims to determine the effect of using corn flour and sago flour on chicken liver nuggets and beef liver nuggets in terms of physicochemical and organoleptic quality. The materials used in the study were chicken liver, beef liver, sago flour, corn flour, chicken eggs, salt, garlic, pepper, and breadcrumbs. The research method used was a laboratory experiment with a nested Randomized Block Design (RBD) with 4 treatments and 5 replications. The treatment was distinguished by several codes including CC: chicken liver+corn flour, CS: chicken liver+sago flour, BC: beef liver+corn flour, and BS: beef liver + sago flour. The variables analyzed were water content, water activity (Aw), carbohydrates, texture, and organoleptic tests. The results showed that liver nuggets had a very significant effect ($P<0.01$) on water content, texture, smell, and taste values in the organoleptic test but had no effect on water activity (Aw) and color values in the organoleptic test. The average value of moisture content is 2.18-2.64%, Aw is 0.95-0.96, the texture is 98.70-126.30 N, carbohydrates is 37.95-37.74%, the color value is 3.50- 3.54, aroma value 3.58-3.96 and taste value 3.75-3.88. The conclusion is the use of flour types has an effect on the physicochemical and organoleptic quality of liver nuggets.

Keywords*:* By-product; restructured meat; processed liver

INTRODUCTION

Nuggets are processed food products that use restructured meat technology or are well-known as a meat processing technique that utilizes low-quality meat (Ageng et al., 2014). The aim of making nuggets is to re-glue the relatively small and irregular pieces of meat into a better meat product and increase the added value of the meat. Badan Standarisasi Nasional (BSN) (2014) on SNI 01-6683-2014 defines nuggets are processed meat products that have been printed, cooked, and made from a mixture of ground beef which is coated with or without the addition of other food ingredients and food additives. permitted. The use of meat in the manufacture of nuggets can be replaced or mixed with the liver so that it becomes a new product, namely liver nuggets. This is so that the price is cheaper and can be consumed by all circles of society more broadly while maintaining nutritional value and consumer acceptance.

Chicken liver is an organ that is classified as waste or by-product but has advantages over livers sourced from other livestock because the price is cheaper and easier to find on the market (Malichati and Adi, 2018). The nutritional content of beef liver is also quite high, in general, for every 100 g of beef liver, it contains 136 kcal of energy, 19.8g protein, and 4.2g fat, not much different from the nutritional content for every 100g of beef, namely 19.0g protein, 2.5g (Gumilar and Primary 2017). However currently, the processing of chicken and beef liver itself is still lacking in diversity and the utilization of its potential is not optimal. Broiler chicken liver is an internal organ that is an example of a by-product of slaughtering chickens. Broiler chicken liver has a great possibility to be reprocessed into a product that has a higher economic value. The main vitamins that are abundant in the chicken liver are vitamin A, vitamin B complex, especially vitamin B12, and folic acid and iron (Fe) (Yuliana et al., 2013). Beef liver contains 6.6 mg/100 g iron and 19.7 g/100 g protein which play a role in increasing the absorption of non-heme iron, forming red blood cells, and maintaining blood osmotic pressure (Agustia, et al 2017).

The binder in the liver nugget contains higher protein than the filler. The use of binding agents in the manufacture of liver nuggets serves to increase water-holding capacity and emulsify fat. In making liver nuggets using corn flour and sago flour. Previous research conducted by Yuliana, et al (2013) namely the substitution of chicken liver in chicken nuggets can affect the physical and chemical nuggets. Tapioca flour is made from cassava (Manihot esculenta) (Ageng et al., 2014), sago flour from sago tree trunks (Metroxylon sago Rottb), and wheat flour from wheat (Triticum spp) (Wahyuningtias et al., 2014). In Indonesia, sago flour and corn flour are flours made from easily available local ingredients. According to Ernawati, et al (2018), the nutritional content of sago flour per 100 grams is 381 calories (Cal), 0.3 g protein, 0.2 g fat, 91.3 g carbohydrates, while corn flour has 362 calories (cal) respectively.), 8.1g protein, 3.6g fat, and 76.9g carbohydrates. Therefore, this research was conducted to find out the differences in the types and the best formulas for fillers in chicken liver and beef liver nuggets, in terms of fat, cholesterol, iron, protein, and amino acid levels. Based on this, as an effort to diversify nugget products, it is necessary to conduct research on differences in the utilization of corn flour

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and sago flour on the physicochemical and organoleptic qualities of liver nuggets, both chicken liver and beef liver on water content, water activity (Aw), carbohydrates, texture, and organoleptic tests.

MATERIALS AND METHODS

Time and location of research

This research was conducted at the Animal Product Technology Laboratory, Faculty of Animal Science Brawijaya University, Malang.

Research materials and methods

The materials used in this study were fresh broiler chicken liver, fresh beef liver, Hawaiian brand corn flour, and Irasa brand sago flour. Other ingredients consist of bread flour and other spices such as garlic, sugar, salt, ground pepper, chicken eggs, and cooking oil.

The equipment used in the manufacture and processing of liver nuggets: nugget molds measuring 20 x 8.5 cm, aluminum foil, gas stove, boiler, frying pan, container, spoon, knife, Philip brand blender, Camry Digital digital scale EK3561, stopwatch, oven and texture analyzer Universal Testing Machine (Zwick/Z 0.5) and Tesco Aw meter.

Making process

The materials used are chicken liver, beef liver, wheat flour, and tapioca flour. The research procedure for making nuggets uses a modified reference by Yuliana, et al., (2013) starting with cleaned chicken and beef liver, steamed for ± 15 minutes at a temperature of ± 100°C then ground. Chicken liver and beef liver have been finely mixed with various kinds of spices according to a predetermined composition. Corn flour and sago flour is added to the dough according to the composition. The dough is then placed into a rectangular aluminum mold with a size of 20 x 8.5 cm which has been coated with aluminum foil and steamed until cooked for ± 45 minutes at 100^{o}C. After that, it is cooled, cut to size, and coated with wet flour and panir flour, then the nuggets are fried for 2 to 3 minutes until they are golden brown. Samples are ready to be analyzed according to variables.

Variable Test

Moisture content (%) according to AOAC (2005)

The moisture content test was carried out by the dry oven heating method with a temperature of 100-105°C, namely by evaporating the water contained in the material by heating. The material is heated until it has a constant weight. Constant weight indicates that the state of the water in the material has completely evaporated, and only the dry weight of the material itself remains as follows:

1. Grind the ingredients using a mortar and pestle
2. Heat the porcelain crucible in the oven at 105°C for 5 minutes and cool in the desiccator for 15 minutes.
3. Weigh the empty porcelain crucible
4. Weigh as much as 2 grams of sample into the porcelain
5. Heat the porcelain containing the sample for 1.5 hours at a temperature of 105°C
6. Cool in a desiccator for 15 minutes and weigh
7. Reheat porcelain for 10 minutes at 105°C and cool for 5 minutes in a desiccator, then weigh and record
8. Repeat the eighth step until the weight is constant or at least three times.
9. Wash the crushed cup using alcohol
10. Put the crushed cup into the oven for 10 minutes and cool it in the desiccator for 5 minutes
11. Weigh the empty weight of the crushed cup using a digital balance
12. Calculate the results of the test with the formula for calculating the water content (%) as follows:

$$\frac{initial\ weight - heating\ average\ weight\ (1\ \&\ 2)}{liver\ nugget\ sample\ weight}\ X\ 100\%$$

Water activity (Aw) according to AOAC (2005)

The Aw calculation is carried out with an Aw meter that has been calibrated first in NaCl solution and then pays attention to the temperature for the correction factor. The water activity test procedure is as follows:

1. Prepare tools and materials
2. Calibrate the Aw meter by adding NaCl liquid
3. Closed the Aw meter is left for up to 3 minutes until it reaches the reading scale of 0.9
4. Open the Aw meter and then clean the sample area
5. Insert the sample and the tool is closed for up to 5 minutes
6. Read and record the Aw scale and pay attention to the temperature scale for the correction factor

Water activity in the material is formulated by the following equation:

$$Aw = \frac{P}{P0}\ x\ \frac{ERH}{100}$$

Description :
Aw = water activity
P = humidity partial vapor pressure in the material
P0 = saturation pressure of pure steam
ERH = Equilibrium Relative Humidity

Texture (N) according to Untoro (2012).

The texture test is one of the tests of physical properties in the form of hardness or tenderness of the liver nugget which is analyzed using the Texture Profile Analysis tool and produces a value with units of N in the form of force (pull or pressure). The texture testing procedure is as follows:

1. Prepare tools and materials then cut the sample into cube size
2. Ensure that the Texture analyzer cable is connected to the computer monitor that is already turned on
3. Open the Texture ProLite program, open it, click on the define new test section and fill in the trigger point, test speed, target value, and probe type sections. Ensured the value on the monitor is 0 (zero)
4. Install the probe on the sample to be measured and then adjust the distance between the object table and the probe
5. Let the probe calibrate first and then the sample is placed on the object table.
6. Press the Run Test or Start Test button on the computer to carry out texture measurements by piercing the sample until the probe returns to its original shape.
7. Obtained test results in the form of values (numbers) that can be printed with a printer.
8. Record the test results (N).

Carbohydrates according to AOAC (2005)

Carbohydrate content was determined using a different method, namely by calculating the moisture content, ash content, protein content, and fat content. Calculated using the equation: % Carbohydrate content = 100 % - (moisture content + ash content + fat content + protein content).

Organoleptic test according to Soekarto 1981 and Setyaningsih, et al. (2010).

Organoleptic quality testing is done by testing how far the panelists like different nuggets including color, taste, and aroma. Panelists involved in the organoleptic test in this study were 10 people with trained panelist qualifications. Trained panelists are panelists who have been given an

explanation to recognize certain characteristics, the number of trained panelists is generally 5 to 10 people. (Soekarto, 1981). Panelists were asked to write down their responses and impressions of the color, taste, and aroma of the presented nugget samples.

Data analysis

The research method used was a laboratory experimental method using a Completely Randomized Design (RBD) Nested Pattern (Nested Experiment Design) with 4 treatments and 5 replications. The CC treatment used chicken liver + corn flour, CS used chicken liver + sago flour, BC used beef liver + corn flour, and BS used beef liver + sago flour. The test results data that has been obtained, is then tabulated using Microsoft Excel software. The data obtained, especially chemical data were analyzed using Analysis of Variance (ANOVA) and if there were differences between the treatments then it was continued with Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Utilization or use of corn flour and sago flour in chicken liver and beef liver nuggets had a very significant effect (P<0.01) on water content, texture, aroma, and taste values in organoleptic tests but had no effect on water activity (Aw) and color values organoleptic test, as shown in Table 1 and Table 2. The average value of water content is 2.18-2.64%, Aw 0.95-0.96, texture 98.70-126.30 N, Carbohydrate 37, 95-37.74%, the color value was 3.50-3.54, aroma value 3.58-3.96 and taste value 3.75-3.88.

Table 1. Value of water content (%), water activity (Aw), texture (N), and carbohydrates (%) chicken liver nuggets and beef liver nuggets treated with corn flour and sago flour

Variabel	Liver type	Flour Type		Liver Type Average
		Corn flour (C)	Sago Flour (S)	
1. Water Content (%)	Chicken liver (C)	2.72±1.15	2.55±1.15	2.64±1.04[a]
	Beef liver (B)	2.01±0.58	2.35±1.00	2.18±0.05[b]
	Flour Type Average	2.20±1.18[y]	2.45±1.03[x]	
2. Water activity (Aw)	Chicken liver (C)	0.94± 0.02	0.96± 0.02	0.95± 0.01
	Beef liver (B)	0.95± 0.01	0.96± 0.01	0.96± 0.01
	Flour Type Average	0.95± 0.01	0.96± 0.01	
3. Textur (N)	Chicken liver (C)	17.43±2.12	15.47±3.29	16.45±2.70 [b]
	Beef liver (B)	18.07±3.06	24.03±5.88	21.05±5.31[a]
	Flour Type Average	17.75±2.38[y]	19.75±6.34[x]	
4. Carbohydrates (%)	Chicken liver (C)	39.52±1.15	36.38±0.25	37.95±2.01
	Beef liver (B)	40.95±1.15	34.53±5.29	37.74±4.91
	Flour Type Average	40.24±1.30[x]	35.46±3.57[xy]	

Note: Different letter notations (a,b) in the row and (x and y) in the same column indicate a very significant (P <0.01) or significant (P<0.05) difference.

Water content

The results showed that the use of liver and flour types had a very significant effect (p <0.01) on the water content of the liver nuggets produced. The highest water content in chicken liver nuggets is possible because the texture of steamed chicken liver as a raw material for the dough is wetter than steamed beef liver. Agustia, et al (2017) explained that the type of liver used can affect the final result of the water content of a product. The water content in liver nuggets meets the criteria for nugget quality requirements in SNI (6683: 2014), namely a maximum nugget water content of 60%.

The use of fresh broiler chicken liver and fresh beef liver affects the water content. The chicken liver used had a higher water content value of 8.5% compared to the beef liver type of 5.91%. This is comparable to the results of research conducted by Agustia, et al (2017) that the type of liver used can

affect the final result of the water content of a product. The water content in the chicken liver is 75.68% higher than the water content in the beef liver which is 67.27%. Corn flour and sago flour are used as fillers for nuggets. For chicken liver and beef liver, the use of wheat flour and tapioca flour did not have a significant effect. The use of this type of chicken liver with wheat flour produces a higher water content than tapioca flour. Pradipta and Putri (2014) stated that the water content in wheat flour is due to the presence of amylose which easily absorbs water and amylopectin which retains water when it is absorbed. Testing the value of water content can affect the final taste and texture of food products. Khotimah, et al (2018) stated that water content affects the final result because if the water content is high it will result in microbial growth so that the food will be easily damaged and can cause a softer texture and the surface in the middle is more watery.

Water Activity (Aw)

The Aw value of chicken liver nuggets was 0.95, beef liver nuggets were 0.96 and on the addition of corn flour it was 0.95 and the addition of sago flour was 0.96. A good Aw value in foodstuffs has a range of numbers from (0 to 1) if it exceeds the specified range, it can be said that the product has been damaged. The use of corn flour and sago flour in nugget products doesn't affect Aw, because the water content in liver nuggets is not much different from wheat flour and tapioca flour. This is comparable to the opinion of Leviana and Paramitha (2017) that microbial activity in food is closely related to water content and water activity (Aw), so these two factors can affect the product's shelf life.

The high or low value of water activity will affect the shelf life and quality of food ingredients. The greater the value of water activity, the lower the shelf life of the food, and vice versa, the smaller the value of water activity, the longer the shelf life of the food. The range of water activity values is 0 to 1, therefore microorganisms have a minimum Aw so they can grow well, such as bacteria at Aw 0.90; yeast at Aw 0.8 to 0.9; mold at Aw 0.6 to 0.7 (Belitz et al., 2009).

Texture

The results of the analysis explained that the texture value (N) of the liver nuggets for each treatment was different. The texture value of the liver nuggets had a very significant effect ($P<0.01$). The texture value of chicken liver nuggets was 16.45 and that of the beef liver was higher at 21.05, and the texture value using corn flour was 17.75 N and sago flour was 19.75. This is possible because of the different characteristics of corn flour and sago flour. Ernawati, et al (2018), the nutritional content of sago flour per 100 grams is 381 calories (Cal), 0.3 g protein, 0.2 g fat, 91.3 g carbohydrates, while corn flour successively 362 calories (cal), 8.1g protein, 3.6g fat, and 76.9g carbohydrates.

Good liver nugget texture can be seen in two kinds, namely the outer texture and the inner texture. The outer texture of a good liver nugget is crunchy because of the breadcrumbs that have been glued to the surface of the nugget. Panir flour gives a crunchy texture on the outside after frying and changes the shape of the nuggets to be neater in shape and size, while the inner texture of a good nugget is soft, soft, and easy to consume so that the cooked nuggets are not hard when bitten but not too soft. and compact dough. The texture of liver nuggets can also change depending on the processing process, especially in the process of breaking the heart shape (restructured). Laksmi, et al (2012) stated that grinding or size Reduction functions to increase the surface area, resulting in protein extraction. Protein extraction serves to hold the pieces together as they cook, which can affect the texture. Steaming and cooking can also increase or decrease the tenderness of food.

Carbohydrate.

The results showed that the use of the type of liver and the type of flour had a very significant effect ($P<0.01$) on the

carbohydrate content of the resulting liver nuggets with carbohydrate values ranging from 35.46 – 40.24%. Corn flour and sago flour which are used as fillers are sources of carbohydrates. According to the USDA (2014), the carbohydrate content contained in wheat flour (100g) is 0.76% while the carbohydrate content contained in tapioca flour (100g) is 0.22%. Flour is a complex carbohydrate consisting of a long chain of sugars so the addition of flour will meet the needs of carbohydrates in a balanced way and will help maintain a healthy body and maintain the body's cell regeneration needs. Badan Standarisasi Nasional (2002) defines chicken nuggets as processed chicken products that are molded, cooked, and made from a mixture of ground chicken meat which is coated with or without the addition of other food ingredients and permitted food additives. The requirement for carbohydrate content in nuggets is a maximum of 25%. This treatment of chicken and beef liver nuggets using wheat flour and tapioca meets the quality requirements for nuggets.

Organoleptic Test

Statistical analysis data on the organoleptic quality of color, taste, and aroma of chicken liver nuggets and beef liver nuggets with the addition of corn flour and sago flour are presented in Table 2. Based on the results of statistical analysis, showed that the color organoleptic test had no effect ($p>0.05$) but had an effect very significant ($P<0.01$) on aroma and taste.

Table 2. Average organoleptic test values for color, aroma, and taste of chicken liver nuggets and beef liver nuggets with the addition of corn flour and sago flour.

Variabel	Liver type	Flour Type		Liver Type Average
		Corn flour (C)	Sago Flour (S)	
1. Color value	Chicken liver (C)	3.50±0.50	3.50±0.25	3.50±0.83
	Beef liver (B)	3.42±0.38	3.67±0.29	3.54±0.83
	Flour Type Average	3.46±0.25	3.52±0.25	
2. Smell value	Chicken liver (C)	3.92±0.38	3.25±0.25	3.58±0.47 [b]
	Beef liver (B)	4.00±0.25	3.92±0.14	3.96±0.69 [a]
	Flour Type Average	3.96±0.19 [x]	3.58±0.17 [y]	
3. Taste value	Chicken liver (C)	4.08±0.29	3.42±0.14	3.75±0.74
	Beef liver (B)	3.75±0.25	4.00±0.25	3.88±0.74
	Flour Type Average	3.92±0.14 [x]	3.71±0.25 [y]	

Note: Different letter notations (a,b) in the row and (x and y) in the same column indicate a very significant ($P<0.01$) or significant ($P<0.05$) difference.

The color of corn flour and sago flour is not much different, namely a slightly yellowish white color so during the process after frying, the color produced by the liver nuggets is also not much different, namely a slightly brownish color. The frying process may cause the nuggets to turn slightly brown. Bintoro (2008) states that the color of processed meat can be obtained from the influence of processing methods and added ingredients. The color organoleptic test is very important to do because it is the first element that is seen by the human senses before other elements, namely taste, and aroma, besides that color can attract consumer attention and can improve consumer taste. Kusumaningrum (2013) states that physically the color factor is very important in determining the quality of a food ingredient.

Taste is an element that is considered after color. The taste of a processed product is highly considered by consumers. The composition used in the manufacture of processed products is given great attention to creating a good taste so that consumers like it. The taste according to Erawati (2001) is a very important parameter in determining the level of consumer acceptance of a food product. Good taste can support the product so that the product can be accepted by consumers. Frying time also affects the taste of the nuggets due to changes in chemical composition during the frying process

The aroma of the nuggets produced is different, for both chicken liver nuggets and beef liver nuggets. Nugraha (2019) stated that the aroma produced in nugget products comes from volatile components due to the heating process of the main ingredients and spices added so that the more constituent components in the nuggets will give a more fragrant aroma. Sulistiawati (2014) states that aroma is a collection of compounds that cause synergism or antagonism effects because these compounds can change their properties when reacting with other compounds.

CONCLUSION

Based on the results of this study, it can be concluded that the use of flour types has an effect on the physicochemical and organoleptic quality of the liver nuggets, but does not differ in the color value in the organoleptic test. The average value of moisture content is 2.18-2.64%, Aw is 0.95-0.96, the texture is 98.70-126.30 N, carbohydrates is 37.95-37.74%, the color value is 3.50- 3.54, aroma value 3.58-3.96 and taste value 3.75-3.88.

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