Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK), March 2023 Vol. 18 No. 1
E-ISSN : 2338 – 1620 | P-ISSN : 1978 – 0303 DOI : 10.21776/ub.jitek.2023.018.01.6

THE EFFECT OF THE ADDITION OF SKIM MILK POWDER TO BROILER LIVER NUGGETS ON PHYSICOCHEMICAL AND ORGANOLEPTIC QUALITY

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Submitted 11 February 2023; Accepted 21 March 2023

ABSTRACT

Chicken nuggets are a popular product among the public, but because of the relatively high price, not all people can consume them. The development of innovation in processed nugget products is increasingly diverse, such as using chicken liver added skim milk powder to improve nutritional quality, physical quality, and consumer preferences. The purpose of this research was to determine the effect of the addition of skim milk powder on broiler liver nuggets in terms of moisture content, water activity (Aw), and physical quality. The research method was a laboratory experiment with a completely randomized design (CRD) is P0 (0%), P1 (5%), P2 (7%), and P3 (10%) for differences adding skim milk powder and the data were analyzed using analysis of variance or ANOVA. The results showed that the addition of skim milk powder was not significantly different ($P>0.05$) on moisture content, water activity (Aw), texture, and physical quality of yield and color (L*, a*, b*), but had an effect on significantly ($P<0.05$) in organoleptic (color, taste, and odor) and some of the essential amino acids. The conclusion was that the addition of skim milk powder on 10% was used as a treatment best with moister content, water activity (Aw), and texture, than for physical quality, the best addition was 10% for yield, color, tasteMand color L* (brightness), a* (redness) b* (yellowness). As a reference for further research can compare other commodity types of the liver.

Keywords: *Chicken liver; skim milk powder; quality*

INTRODUCTION

The field of food technology has experienced developments that have resulted in changes in people's consumption patterns. People are more interested and choose to consume products that are ready to cook, namely products that undergo a processing process from beginning to end (packaging) so that when the product reaches consumers, the food product is ready to be cooked. According to Susanti *et al*. (2020), examples of ready-to-cook food products are nuggets, sausages, and others that can be cooked immediately and then ready for consumption.

Nugget is a ready-to-cook product that is processed through the restructured meat or restructured food technique. Meat restructuring is the processing of small, irregular meat, which is then attached and becomes a food product. The advantages of restructuring meat are increasing the selling value, and producing a better structure and texture of the product from the origin (Thohari *et al*., 2017). Nuggets on the market use raw materials such as chicken meat, beef nuggets, and fish nuggets, but not all people can consume these nuggets because they are relatively expensive. Chicken liver is a food product that contains high iron, which is 15.8 mg/100 grams (Fauziah *et al*. 2019). Chicken liver has the potential to be developed into a variety of innovative products that have economic value (Wijayanti *et al*. 2013). Therefore, broiler liver can be processed into nugget products that have economic value and consumer appeal for all circles of society while maintaining nutritional value and consumer acceptance.

The process of making nuggets requires a filler and a binder. The addition of fillers in restructured meat products serves to increase product weight by substituting some meat so that costs can be reduced and help increase product volume (Astriani *et al*., 2013). Tapioca flour is usually used as a filler. The filler material is a non-meat material that contains carbohydrates in the form of starch (amylopectin and amylose). Binders play an important role in the formation of the texture of broiler liver nuggets. The nugget processing process, namely mixing, steaming, and frying causes a certain amount of water to be released which affects the quality of the nuggets. Therefore, a binder is needed that functions to bind water during the nugget processing process (Sinta *et al*., 2019). According to Rosa *et al*. (2022), binders are non-meat materials that contain protein. Binder material derived from dairy products, namely milk powder.

The process of making nuggets requires an emulsifier for dough stability. The emulsifying agent in the dough is a protein that binds fat and water as an emulsion (Syafie and Djumadil, 2019). Therefore, it is necessary to add an ingredient containing protein for the emulsification process of broiler liver nuggets. Skim milk contains 35.6 grams of protein per 100 grams of powdered skim milk, higher than chicken liver which contains 27.5 grams of protein per 100 grams of chicken liver, so it is expected to maintain the stability of emulsification.

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How to cite:
Amertaningtyas, D., Evanuarini, H., Mutia, S. H., & Zahra, L. L. (2023). The Effect of The Addition of Skim Milk Powder to Broiler Liver Nuggets on Physicochemical and Organoleptic Quality. Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK), 18 (1), 50-63

Sinta *et al*. (2019) explained that the addition of 5% skims milk powder affected the organoleptic quality and the level of preference for broiler nuggets. Based on this description, this research is expected to increase public interest in processed chicken liver and to determine the effect of adding skim milk powder at different levels on the physicochemical quality, namely moisture content, water activity (Aw), texture, yield, the color with color reader, amino acid profile and organoleptic on chicken liver nuggets.

MATERIALS AND METHODS

Research Material

The research was carried out at the Laboratory of Animal Products Technology, Faculty of Animal Science, Universitas Brawijaya, and Laboratory of Food Quality and Safety Testing, Faculty of Agricultural Engineering, Universitas Brawijaya. Analysis of the amino acid profile with UPLC was carried out at PT. Saraswanti Indo Genetech Surabaya. The material observed was chicken liver nuggets with the addition of skim milk powder. in tapioca flour nugget products, and others. The equipment used is a meat grinder/blender, knives, cutting boards, pans, stoves, aluminum nuggets molds, basins, digital scales, stopwatches, and aluminum foil.

Research Method

The research method used was a Completely Randomized Design (CRD) experiment with 4 treatments and 4 replications. The treatments were P0 (without adding skim milk powder), P1 (adding skim milk powder 5%), P2 (adding skim milk powder 7%), and P3 (adding skim milk powder 10%).

Research Procedure

The manufacturing stage begins with washing the fresh broiler liver thoroughly in running water, then first steaming the broiler liver with a steamer at 90°C for 10 minutes. After steaming, the broiler liver is cooled first, then ground using a grinder until smooth, mixed with other ingredients such as tapioca flour, eggs, salt, pepper, mashed garlic, and water, then stirred until well mixed, then added skim milk powder according to with treatment (0%, 5%, 7%, and 10%) and stir again until well mixed. The dough is put into a mold lined with aluminum foil, then steamed for 45 minutes at 90°C. If the nuggets are cooked, then the next step is to cool the nuggets at room temperature and then slice them into 4 x 4 x 1 cm sizes. Broiler liver nuggets are coated with egg white, then rolled in breadcrumbs and half-cooked at 170°C for 2 – 4 seconds then stored in the freezer and deep-fried at 180°C for 2 – 3 minutes. The next stage is testing on the physicochemical quality, namely moisture content, water activity (Aw), texture, yield, the color with color reader (L*, a*, b*), amino acid profile, and organoleptic (color, taste, odor) on chicken liver nuggets.

Variable

Research variables include:

1. Moisture content using the oven method (gravimetric) according to Daniel, et al., (2014).
   The empty cup is weighed and the weight is recorded (a). A sample of 1-2 grams (x) is inserted. The crucibles and samples were dried in an oven at a temperature of 105°C, until the weight was constant. After drying the cup and its contents were cooled in a desiccator, the final weight was weighed and the moisture content was calculated using the formula:

$$\text{Moisture content (\%)} = \frac{(x-y)}{(y-a)} \times 100\%$$

Description :
- x = weight of the cup and sample before drying (g)
- y = weight of the cup and sample after drying (g)
- a = weight of empty cup (g)

2. Water activity using the Aw meter according to Nilatany, *et al*. (2014).
   The Aw meter was calibrated with saturated NaCl, put 1 g of sample was into the Aw meter measuring cup, then closed and locked. Then press the start button, when it is finished it will appear complete and the sample Aw value will appear on the screen.
3. Texture using a texture analyzer according to Untoro, *et al.* (2012).
   The probe is mounted on the sample to be measured and the distance between the object table and the probe is adjusted, the probe is allowed to calibrate first, then the sample is placed on the object table, pressed the start test button, the tool will carry out texture measurements by pressing the sample until the probe returns to its original shape, then the test results will be obtained in the form of numbers.
4. Yield testing (%) according to Kusumaningrum *et al*. (2013).
   The chicken liver nugget dough was weighed before being steamed, then fried the nugget dough that had been cut and covered with breadcrumbs until the nuggets were half cooked. Drain until cool, then weigh again the weight of the chicken liver nuggets that have been half-cooked. The value of the nugget yield is calculated by the formula:

$$\text{Yield (\%)} = \frac{\text{nuggets weight (gram)}}{\text{batter (gram)}} \times 100$$

5. Favorite organoleptic (Color, taste, and odor) according to Putri and Nita (2018)
   This organoleptic test was carried out by a hedonic test by giving a score with a set scale, to determine the level of preference for chicken liver nuggets. The range of values given is from the number 1 to 5. With the provision that a score of 1 indicates a strongly disliked score, a score of 2 indicates a dislike value, a score of 3 indicates a moderately favorable score, a 4 score indicates a liking value, and a score of 5 indicates a strongly liked value. The sample was given a random 3-digit number code then the panelists were asked to determine their level of preference. The panelists involved were 7 trained panelists.
6. Color testing with a* color reader according to Khoiriyah *et al*. (2019).
   The color reader is standardized by measuring the dL, da, and db values of a standard ceramic board with known values of L, a, and b. The sample was cut into two parts and placed in a petri dish with a white bottom or clear plastic. The sample is flattened until the entire surface of the cup is covered. Attached and slightly pressed the color reader on the surface of the sample. The values of dL, da, and db were measured using a color reader. The measurement of dL, da, and db values was carried out at three different points. The brightness level is obtained based on the formula:

   L* = Standar L + dL
   a* = Standar a + da
   b* = Standar b + db

   Description :
   L = color brightness, the value ranges from 0-100 which indicates the greater the value, the higher the brightness.
   a = redness, +a* (positive) values range

from 0 to +80 for red, and –a* (negative) values range from 0 to –80 for green.

b = yellowish, +b* (positive) values from 0 to +70 for yellow, and –b* (negative) values from 0 to -70 for blue.

7. Profile amino acid was analyzed using ultra-performance liquid chromatography (UPLC. ACQUITY UPLC-H Class). (Lumamuly, *et al*. 2019)
   The samples P3 (adding skim milk powder 10%) which were free of fat and water were hydrolyzed by acid and base to obtain free amino acid components, using 6 M H_2SO_4 and 6 M $Ba(OH)_2$. Acid hydrolysis using 1 g sample powder, refluxed using 6 mL H_2SO_4 6 M at 110° C for 12 hours, the solution was neutralized by adding 6 M $Ba(OH)_2$ until the pH was neutral. Then the solution was filtered and the filtrate was diluted in a 50 mL flask to the mark, put into a sample bottle, and analyzed using UPLC. Meanwhile, by alkaline hydrolysis, 1 g of sample powder was refluxed using 6 mL of 6 M $Ba(OH)_2$ at 110° C for 12 hours. The solution was neutralized by adding 6 M H_2SO_4 until the pH was neutral. The solution was filtered and the filtrate was diluted in a 50 mL flask to the mark. Then put it in a sample bottle and analyzed using UPLC.

Data Analysis

Based on Sudarwati *et al*. (2019), the data from the observation of yield, organoleptic, and color tests using a color reader obtained from the Completely Randomized Design (CRD) method with 4 treatments and 4 replications were analyzed using Analysis Of Variance (ANOVA) and if there were differences If it is real, it will be continued using the Duncan Multiple Distance Test (UJBD).

RESULTS AND DISCUSSION

The quality of chicken liver nuggets using skim milk powder is shown in Table 1 which shows that the variables that have no significant effect (P>0.05) on the Moisture content (%), Water Activity, Texture (N), and Yield (%).

Moisture content (%)

The results of the treatment of adding skim milk to chicken liver nuggets are explained in Table 1 where these results show a decrease in value as the higher the percentage of addition. The lower the value of the moisture content of the food, it can minimize the occurrence of changes in the nugget product, the average value of 40.99% of the research nugget product is the optimum value because this value is lower than other moisture content values. The resulting value of moisture content in chicken liver nuggets with the addition of powdered skimmed milk is still within the Indonesian national standard because it is less than the maximum value of the moisture content of nuggets contained in SNI No. 01-6683-2002 which is a maximum of 60%. High moisture content in food products can facilitate the growth of microbes that cause fast food spoilage.

Table 1. The average value of variable test moisture content, Aw, and texture tests on chicken liver nuggets with the addition of skim milk powder.

Treatment	Moisture content (%)	Water Activity	Texture (N)	Yield (%)
P0	43.87±2.62	0.949±0.004	12.92±2.13	160.49±12.73
P1	43.53±1.28	0.950±0.002	13.90±2.31	165.59±14.92
P2	42.38±1.13	0.945±0.007	17.22±0.81	163.21±15.05
P3	40.99±0.52	0.943±0.003	14.45±2.67	162.91±7.07

The study shows a low moisture content value which can be concluded that the addition of powdered skimmed milk has no significant effect (P>0.05). The results of this analysis that the product is chicken liver nuggets with lower moisture content are expected to slow down the growth of spoilage microbes which will be able to extend the shelf life of nuggets for a longer time.

The higher the percentage of addition of skim milk powder causing the moisture content to decrease, is due to the effect of the addition of skim milk powder on chicken liver nuggets. According to Safitri and Anggrayni (2019) the advantage of skimmed milk powder is that it can bind water due to the ability of skimmed milk powder to bind water so that the milk granules can become large, when heated the granules will break. This is called gelatinization in this gelatinization there is an increased viscosity because water has entered the milk granules and cannot move freely. In addition, the decrease in moisture content in chicken liver nuggets is also influenced by processing factors.

The moisture content in nuggets can be reduced during the steaming process and the addition of other ingredients because in the steaming process the interaction of starch and protein results in a decrease in the moisture content. This is by following the opinion of Mulyani *et al*. (2015) which states that the interaction mechanism of starch and protein can cause a decrease in moisture content because water cannot be completely bound. After all, hydrogen bonds should be used to bind water but are used for starch and protein interactions.

Water Activity (Aw)

The results of adding skim milk to chicken liver nuggets are explained in Table 1 that showed the higher the addition of skim milk powder can reduce the value of water activity (Aw) in nugget products with the statement of Leviana *et al*. (2017), the higher the value of water activity (Aw) of a food ingredient, the smaller the durability of the food ingredient, the research treatment has not can extend the shelf life of the product. The product of chicken liver nuggets with the addition of skim milk powder showed that the use of skim milk powder had no significant effect (P>0.05) on the water activity (Aw) of liver nuggets. Types of microbes that can damage chicken liver nuggets at this value are types of bacteria according to State *et al*. (2016) each microorganism has a minimum Aw value to grow well, for example in bacteria with Aw: 0,90; yeast Aw: 0.80-0.90 and molds with Aw: 0.60-0.70.

The decrease in the value of water activity in chicken liver nuggets was also influenced by a decrease in the value of moisture content in the chicken liver nuggets. According to Putra *et al*. (2015), if there is a change in the moisture content of the food, the Aw value of the food will also change. The value of water activity (Aw) can also be influenced by temperature and storage time because if food is not stored at the right temperature and time it will help accelerate the microorganism's growth. According to Heryani *et al*. (2020) Aw can be affected by temperature and storage time.

Textur (N)

Research has an effect on the texture of nugget products with different results, the addition of 7% skim milk powder produces a more chewy nugget texture, but when added with 10% skim milk powder there is a decrease in the elasticity of chicken liver nuggets.

The analysis showed that the addition of skim milk powder to chicken liver nuggets had no significant effect (P>0.05) on the texture of chicken liver nuggets. According to Sinta *et al*. (2019) in his research, the addition of 5% skimmed milk powder in chicken nuggets did not affect the texture and elasticity of the chicken meat nuggets, however, the addition of 10%

skimmed milk powder affected the panelists' preference for the texture and elasticity of chicken meat nuggets. Therefore, a change in the texture value is possible because skim milk powder can help improve the texture of the nuggets. The texture of chicken liver nuggets can be influenced by the texture of the chicken liver itself because chicken liver has a soft texture and crumbles easily making the resulting nuggets soft. According to Wijayanti *et al*. (2013) stated that the higher the substitution of broiler chicken liver, the more tender the nuggets produced, this is because the chicken liver does not have muscle fibers so it will be easily crushed and is soft but dense.

The texture of chicken liver nuggets can also be affected by the moisture content in the nuggets. According to Dengo *et al*. (2019), the texture test is also influenced by the moisture content in the basic ingredients in making nuggets. High moisture content can cause the texture of the nuggets to be smoother and not chewy (mushy).

Yield

Chicken liver nugget products with the addition of skim milk powder can increase the yield value, but the higher addition can reduce the yield value due to the decrease in moisture content which is influenced by water and protein binding capacity.

The increase in the percentage of skimmed milk powder was concluded to reduce the yield of chicken liver nuggets, but the yield value could be influenced by ingredients other than skim milk powder. According to Fauzanin *et al*. (2015), the yield value is influenced by the water-binding capacity of the materials used and processing processes such as steaming and frying. The results of the analysis that the addition of skim milk powder had no significant effect (P>0.05) on the yield of chicken liver nuggets showed the less water that comes out in the cooking process because it is retained by the protein, the higher the yield. According to Kusumaningrum *et al*. (2013) stated that the yield is influenced by the water-holding capacity and the swelling properties of the content of each flour used. The content of egg white contains a lot of water, where water is useful for providing watery properties and also increase yield.

Organoleptic Preference

The organoleptic quality of chicken liver nuggets using skim milk powder is shown in Table 2 which shows that the variables that have significant differences (p<0.05)

Table 2. The average value of the organoleptic test (color, taste, and odor) on broiler liver nuggets with the addition of skim milk powder

Treatments	Organoleptic		
	Color	Taste	Odor
P0	2.82 ±1.12^{a}	3,64±0,73^{a}	2.82 ±1.12^{a}
P1	3.21 ±1.26^{b}	3,93±0,77^{ab}	3.21 ±1.26^{b}
P2	3.04 ±1.17^{ab}	3,96±0,79^{ab}	3.04 ±1.17^{ab}
P3	2.57 ±1.10^{a}	3,61±0,63^{a}	2.57 ±1.10^{a}

Note: Superscript (a,b) in the same column shows a significant difference (P< 0.05)

Color

The organoleptic test of the preference for color parameters on liver nuggets with the addition of skim milk powder showed that the yield was at a neutral level, but the higher the percentage addition, the preference value decreased due to the darker the color of the nuggets. Comparable to the research of Sinta *et al*. (2019) on chicken nuggets with the addition of powdered skim

milk. Chicken nuggets with the addition of 5% skim milk powder were preferred by the panelists and had the highest average value of 3.87, while the addition of 15% skim milk powder had the lowest average value of 3.31, the more skim milk powder the value of the color had decreased.

The results of the analysis of variance showed that the effect of the addition of powdered skim milk gave a significant difference to chicken liver nuggets ($P<0.05$). The significant difference is suspected because the treatment given has a different color from the color of the nuggets in general, the addition of low skim milk powder produces a bright color while the addition of skim milk powder which is too much color produces bone white nuggets. This is due to the influence of the color properties of the binder used. Tapioca flour has a light or white color, while powdered skim milk is yellowish white, so the addition of different flours can affect the color of the nuggets produced. The final result of the nugget shows a yellow-to-brown color. The frying process affects the final color of the nuggets produced. This is in line with Amertaningtyas *et al*. (2021) suggesting that frying may cause the color of the nuggets to become slightly brown. This agrees with Rosa *et al*. (2022) color in a product, especially in food products, plays an important role in consumer acceptance of color changes caused by the frying process and the addition of breadcrumbs. The color of the nuggets becomes yellow-brown in each treatment due to the heating process that occurs when frying the nuggets, the color appears due to the Maillard reaction.

Taste

The effect of adding skim milk powder to liver nugget products on the taste parameters of the product is favored up to an addition of 7%, while the increase in treatment reduces the taste preferences of the nugget product. Judging from previous research by Sinta *et al*. (2019) chicken nugget products with the addition of powdered skim milk can increase the organoleptic value of the nugget taste, but in Sinta's research *et al*. (2019) the preference value of chicken nuggets with the addition of powdered skim milk is in the percentage of 5% with a value of 3.82, can be due to differences in the basic ingredients for making nuggets.

The results of the analysis of variance showed that the effect of the addition of powdered skim milk gave a significant difference to chicken liver nuggets ($P<0.05$). The significant difference is suspected because the treatment given has a different taste from the taste of nuggets in general and can be influenced by the spices added and the frying process that affects the taste of the nuggets. According to Amertaningtyas *et al*. (2021) stated that the components used in the manufacture of processed products are very concerned to create a good taste so that consumers like it. Frying affects the taste of nuggets due to changes in chemical composition during the frying process.

Odor

The odor parameter of the liver nugget product with the addition of skim powder implants can increase the average organoleptic aroma score with a preference value of like to neutral. The addition of skim milk powder up to 7% was able to reduce the characteristic odor of the chicken liver which was less favored by the panelists, but the addition of skim milk 10% decreased the organoleptic value because more and more addition of skim milk powder gave a strong odor. By following research by Sinta *et al*. (2019) that the organoleptic odor produced is influenced by the use of the basic ingredients of nuggets, namely broiler chicken with the addition of powdered milk. The scent is difficult to define objectively. Product evaluation of aroma and taste still depends on sensory testing by panelists (testing panel). The results of the analysis of variance showed that the effect of the

addition of powdered skim milk gave a significant difference to chicken liver nuggets (P<0.05). The odor produced comes from the main ingredients liver and other ingredients as well as from the added spices that produce a fragrant odor in the product. This agrees with Amertaningtyas *et al*. (2021) who stated that the odor of chicken liver nuggets and beef liver nuggets comes from the main ingredients of liver and spices as a flavor enhancer that produces a fragrant aroma in the product. The aroma produced in nugget products is derived from volatile components due to the heating process of the main ingredients and added spices so that the more components in the nuggets will give a more fragrant odor.

Color with *Color Reader* (L*, a*, b*)

The color measurement method used is the absolute color system measurement L*, a*, and b*. Color testing using the Color Reader CR-10 (Konica Minolta). The results of the analysis of variance showed that the addition of different skim milk powders had no significant effect (P>0.05) on the color of chicken liver nuggets. The average color value of chicken liver nuggets with the addition of powdered skim milk can be seen in Table 3.

Table 3. The Average Color Value of L*, a*, and b* on Chicken Liver Nugget with the Addition of Skim Milk Powder

Treatments	Color		
	Lightness (L*)	Redness (a*)	Yellowness (b*)
P0	40.38±0.40	14.08±0.61	20.48±1.25
P1	40.73±0.59	14.00±0.45	20.45±1.07
P2	40.35±0.71	13.70±0.29	19.68±1.25
P3	40.25±0.87	13.58±0.34	19.73±0.83

Color L*(*Lightness*)

The results of the analysis of variance showed that the color test of chicken liver nuggets with the addition of powdered skim milk did not have a significant effect on the brightness of L*. Based on Table 6, it can be seen that the average color value of L* (lightness) decreases with the addition of skim milk powder. The color value L* (lightness) indicates the brightness level of a product. The L* (lightness) color value range starts from 0 (dark) and 100 (lightness). The higher the L* color value, the higher the brightness of the nugget.

The addition of skim milk powder increased the degree of brightness (L*) when compared to the treatment without the addition of powdered skim milk, but along with the addition of skim milk powder the degree of brightness (L*) decreased. This can be caused by skim milk powder which has a yellowish-white color, while tapioca flour has a lighter or white color. By following Sinta *et al*. (2019) stating that tapioca flour has a light or white color, while skim milk powder is yellowish white so the addition of different flours can affect the color of the nuggets produced.

Chicken liver nuggets with the addition of powdered skim milk produce a color that tends to look dark, this is due to the main raw material, namely chicken liver which tends to be dark in color. This is by following Permatasari *et al*. (2020) in the manufacture of complementary foods (ASI) made from chicken liver and cowpea flour (*Vigna Unguiculata L*). The color of MPASI with more chicken liver balance shows a darker color, this is due to the content of chicken liver, namely minerals (Fe) and zinc (Ze) which can cause color changes. Agustia research *et al*. (2017) produced mocaf-garut biscuit products with chicken liver substitution, the color becomes darker

because chicken liver contains iron, and products fortified with the iron will have a dull color as a result of complex changes between iron and iron. polyphenols. The brown color of chicken liver nuggets is also influenced by tapioca flour as a binder and the color of bread flour as a coating or battering during the frying process.

In this study, tapioca flour was used as a filler for broiler liver nuggets with the addition of powdered skim milk, resulting in an average value of L*(lightness) color that was 40.25-40.73 higher than the research by Shah (2021) for liver nuggets. chicken with the addition of tapioca flour has an average value of color L*(lightness) of 24.2.

Color a* (*Redness*)

The results of the analysis of variance showed that the color test of chicken liver nuggets with the addition of powdered skim milk did not have a significant effect on the color a*(redness). Color a* is depicted in red or green, a positive a* color indicates red, while a* is negative for green. The color of chicken liver nuggets with the addition of powdered skim milk showed a reddish color which decreased along with the addition of powdered skim milk. The positive a* value in chicken liver nuggets shows a reddish color. The brown color produced by chicken liver nuggets can be caused by the frying process which causes the Maillard reaction. This is by following Pertiwi *et al*. (2021) who stated that the positive a* value in the nugget indicated the intensity of the red color. The decrease in the color of a* can be caused by damage to color pigments during the cooking process. Gumilar *et al*.) that color can change during cooking. This can be caused by the loss of some of the color pigments due to the release of cell fluid during cooking or processing so the color intensity decreases.

The brown color of the chicken liver nuggets and the increase in the redness value also occur due to the Maillard reaction during the frying process which causes the nuggets to turn brown. In this study, tapioca flour was used as a filler material for broiler liver nuggets with the addition of powdered skim milk, resulting in an average value of a* (redness) color of 14.08-13.58, higher than the research of Shah (2021) nuggets. chicken liver with the addition of tapioca flour has an average value of color a*(redness) of 0.59.

Color b*(*Yellowness*)

The results of the analysis of variance showed that the addition of skim milk powder had no significant effect (P>0.05) on the degree of yellowness (b*) of chicken liver nuggets. Yaam liver nuggets show a color that tends to be brown because it is influenced by the color of the basic ingredients of chicken liver and the processing process. The addition of more skim milk causes the color of b*(yellowness) to decrease, due to damage to the color pigment during the cooking process. The Maillard reaction also affects the color of b*(yellowness). The research of Kusuma *et al*. (2013) suggested that the increase in the yellowness value was due to the Maillard reaction during the frying process and also the presence of pigments in the flour used. The value of redness (a*) and the value of yellowness (b*) have comparable values. The effect of increasing the yellowness value is the same as the effect of the redness value, one of which is the Maillard reaction. Crackers with a high value of redness also have a high value of yellowness and vice versa, so visual colors can be produced. Shah's research (2021) showed that chicken liver nuggets with tapioca flour added an average value of color b*(yellowness) of 23.12 higher than broiler liver nuggets with the addition of powdered skim milk.

Amino Acids Profile.

The amino acid profile of the sample (mg/kg) shows in Table 4. Table 4 shows that the sample had some essential amino

acids such as phenylalanine, lysine, tyrosine, and threonine. Amertaningtyas, *et al* (2022) said that liver nuggets have the highest amino acid L-glutamic acid. 22358.79 mg/kg in steamed chicken liver and steamed 26188.21 mg/kg in steamed beef liver. The essential amino acid is threonine 12892.09; histidine 8182.07; lysine 13032.86; tyrosine 10733.85 and phenylalanine 16006.23. When compared with other research by Liputo *et al*. (2013) that Nike fish (*Awaous Melanocephalus*) nuggets with the addition of tempeh, the largest amino acids were lysine at 0.901% and lysine at 0.864%.

Table 4. Amino acids profile on adding skim milk powder 10% (P3) chicken liver nuggets.

No	Amino Acids	Unit (mg/kg)
1	L-Serine	4946.13
2	L-Glutamic Acid	21033.86
3	L-Phenylalanine	7182.91
4	L-Isoleucine	5146.39
5	L-Valine	6382.07
6	L-Alanine	5975.92
7	L-Arginine	7295.37
8	Glycine	5641.86
9	L-Lysine	6891.64
10	L-Aspartic Acid	9550.01
11	L-Leucine	9262.4
12	L-Tyrosine	3533.07
13	L-Proline	6182.4
14	L-Threonine	5959.71
15	L-Histidine	3300.54

CONCLUSION

Based on the results, it can be concluded that the study showed that the addition of skim milk powder to chicken liver nuggets did not affect the moisture content, water activity, texture, yield, and color with a color reader. Meanwhile, the organoleptic quality showed that the use of skim milk powder had significant differences in the color, taste, and odor of chicken liver nuggets. The essentials amino acid profiles such as are phenylalanine, lysine, tyrosine, threonine, and histidine.

ACKNOWLEDGMENT

Acknowledgments for the Brawijaya University Research and Community Service Institute through Dana Penerimaan Negara Bukan Pajak (PNBP) following the DIPA of Brawijaya University Number: DIPA-: 974.36/UN10.C10/PN/2022 on the Hibah Penelitian Pemula (HPP) scheme

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