Chalaza Journal of Animal Husbandry
Url: http://usnsj.id/index.php/CJAH
Email: chalaza.usnsj@gmail.com

Moringa (*Moringa oliefera*) Leaf Flour Addition on Water Content, Sensory Quality, Favorability Level, and Yield of Chicken Nuggets

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ARTICLE INFO

p-ISSN: 2548-5504
e-ISSN: 2548-3803
Vol. 7, No. 2, December 2022
URL: https://dx.doi.org/10.31327/chalaza.v7i2.1774

Abstract

Chicken nuggets are fast food products made from processed chicken meat that can be processed using the innovation of adding moringa leaf flour to overcome the lack of vegetable fiber. This study aims to determine the water content, organoleptic quality, level of favorability, and yield of chicken nuggets with the addition of moringa leaf flour. The materials used were broiler chicken thigh and breast, moringa flour, wheat flour, kitchen spices (garlic, and pepper), salt, and binder (eggs, cornstarch, and breadcrumbs). The method used was a completely randomized design (CRD) with 4 treatments and 4 replications. The treatments consisted of P0; without the addition of Moringa leaf flour (control), P1; Moringa leaf flour 3%, P2; Moringa leaf flour 5%, and P3; Moringa leaf flour 7%. The variables observed were water content, organoleptic, favorability level, and yield. Data were analyzed using ANOVA and Kruskal-Wallis nonparametric test. The results showed that the best level of addition of Moringa leaf flour was 7% (P3) with a percentage decrease in water content of 56.89% and the highest at the addition of 3% (P1) at 59.52%, while the organoleptic value and level of favorability for chicken nuggets with the best addition of moringa leaf flour was in treatment P1 (3%) with a brownish yellow color, a slightly distinctive smell of nuggets and a slightly specific taste of nuggets. Judging from the results of the study, processing with the addition of moringa leaf flour can reduce the water content of chicken nuggets but it will affect the organoleptic quality of the panelists' favorability for chicken nuggets if the addition of moringa leaf flour is above 3%.

Keywords: Moringa leaf flour, moisture content, organoleptic, yield, favorability level

A. Introduction

Livestock products provide good nutrition in meeting the nutritional needs of the community. Meat is one of the livestock products that can meet human nutritional needs. There are various choices for meat consumption, besides beef and mutton, chicken meat is also widely consumed by the community. Chicken meat is one of the foodstuffs with a high contribution of animal protein to meet the nutritional needs of the community. Chicken meat has good nutritional content because it contains protein is about 18% along with complete amino acids, niacin, and vitamin B6. In general, meat has perishable properties that can cause degenerative diseases, so processing is needed to create new products that can maintain the quality and nutritional value of meat. According to Pangestika et al. (2018), chicken meat is one of the perishable foodstuffs because it contains a lot of water. The water content in chicken meat is about 56%. One of the efforts that have been made to prevent damage to meat is processing.

Nugget is one of the processed meat products that is popular in today's society. Nuggets are very easy to prepare by simply frying them in hot oil for a few minutes, then serving them to eat. In addition to their very practical preparation, nuggets are also very popular with various groups ranging from children to adults. One of the well-known processed nuggets is chicken meat that named chicken nuggets.

One of the ingredients that can be added to overcome the shortcomings of fast food is the presence of vegetables. Therefore we need a food innovation with the addition of vegetables so that the need for fiber will be met. In the opinion of Hatuti (2015), several types of vegetables have been added to processed nuggets including spinach, broccoli, mushrooms, carrots, tomatoes, and others. One type of vegetable that has the potential to be added to processed nuggets is Moringa leaf (*Moringa oliefera* L). Moringa leaves are one of the plants that can be utilized. Moringa leaves are a good source of protein, calcium, iron, β-carotene (converted into vitamin A in the human body), vitamin C, and vitamin E. Purwati (2019), the content of Nutrients in Moringa is quite high so it is so important as a functional food that is beneficial for health and also overcomes malnutrition. According to Kurniawati *et al.* (2018) besides being able to be consumed in fresh form, Moringa can be processed into flour or powder which is useful as a fortificant to meet nutritional needs. In addition, use in the form of flour or powder will be easier to store and use at any time(Sauveur & Broin, 2013). Purba *et al.* (2019) stated that Moringa leaf flour has several hypotensive, anticancer, and antibacterial substances in the form of niacimicin and pterygospermin.

The manufacture of a new food ingredient required quality standardization, which includes chemical and organoleptic properties. Appearance is one of the most important characteristics of consumer purchasing decisions. The characteristics not only affect consumer decisions and satisfaction but are also indicators of product processing improvements(Yuangyai et al., 2013). In general, determining the quality of food ingredients depends on several factors including color, aroma, taste, and texture. The addition of moringa leaf flour is expected to increase the nutrient content, be accepted by the community, and have a good influence on the chemical quality, organoleptic chicken nuggets, and public acceptance.

B. Methodology

1. Time and Location Research

This research was conducted in 2022 at the Laboratory of Animal Products Processing Technology in the Animal Husbandry Study Program, Faculty of Marine Animal Husbandry and Fisheries, Universitas Nusa Cendana, Kupang, for one month. Starting from March 2022 to April 2022.

2. Research Material

The ingredients used are meat, Moringa leaf flour, wheat flour, breadcrumbs, garlic, pepper or pepper, salt, full cream milk, eggs, cooking oil, and ice cubes. The equipment used in this research is a food processor or blender, basin, stove, digital scale, aluminum foil, frying pan, steamer (5kg pot), baking sheet, cutting board, freezer, label paper, plastic gloves, and stationery.

3. Research Design

This study used an experimental method using a completely randomized design (CRD) with a total of 4 treatments and 4 replications. The arrangement of the treatment is as follows:
P0: Without the addition of Moringa leaf flour
P1: Addition of 3% Moringa leaf flour

P2: Addition of 5% Moringa leaf flour
P3: Addition of 7% Moringa leaf flour

4. Research Procedure

The stages of making chicken nuggets are as follows:

a) Broiler chicken as much as 9600g taken from the breast and thigh cut into small pieces.
b) The meat is mashed using a meat grinder or blender by adding ice cubes.
c) All the spices that have been prepared are then mixed into the smooth meat mixture.
d) The addition of Moringa leaf flour to the dough is as follows (P0) without the addition of Moringa leaf flour; (P1) as much as 3% addition of Moringa leaf flour; (P3) as much as 5% addition of Moringa leaf flour; and (P4) as much as 7% addition of Moringa leaf flour. Each container or pan will be labeled with paper.
e) All dough is steamed in each steamer for ±30 minutes, then cooled in the refrigerator for 30 minutes.
f) Nuggets in each replicate container are then sliced into rectangles with a size of 2×5cm. Each piece of nugget will be dipped in the egg yolk and breadcrumbs several times.
g) Fried chicken nuggets until golden yellow.

5. The Technique of Data Analysis

The water content test and yield test data will be processed using Analysis of Variance (ANOVA). If the effect is significant, a further Duncan test will be carried out to determine the difference between treatments (Gaspers, 1991). Meanwhile, non-parametric data from organoleptic and hedonic tests will be analyzed using Kruskal Wallis and if it has a significant effect it will be carried out with Mann Whitney to determine the difference between treatments. Data processing using SSPS version 23 software.

C. Findings and Discussion

Tests of water content, yield, organoleptic, and level of favorability from the results of the study obtained the following results:

1. Testing the Moisture Content of Chicken Nuggets

The data from the analysis of the water content in nuggets can be seen in Table 1. The difference in the water content contained in the ingredients can affect the water content in chicken nuggets. Determination of the water content in a food ingredient is also very dependent on the nature of the food ingredient. The water content of chicken nuggets showed that there was no difference at each level of the addition of moringa leaf flour with different amounts. Laksono *et al*. (2012) argue that high water content can lead to the proliferation of microbes (bacteria, molds, and yeasts) which can change the quality of nugget products.

Table 1. Average Moisture Content and Yield of Chicken Nuggets with the Addition of Different Moringa Leaf Flour

Parameter Test	Treatments				P-Value
	P0	P1	P2	P3	
Moisture Content	57,86±2,78	59,52±0,59	58,21±0,56	56,89±1,02	0,167
Yield	82,22±9,24^{b}	72,23±7,10^{a}	68,40±1,41^{a}	67,86±0,86^{a}	0,017

$^{a,b,c)}$**Different superscripts on the same line show significant differences(P<0.05)**

Based on Table 1, it can be explained that the water content value in on control usage of (P0) without the addition of moringa leaf flour was 57.86%, statistically not significantly different from the water content at the level of 3%, 5%, and 7% addition of Moringa leaf flour, namely by 59.52%, 58.21%, and 56.89%. However, the average value of water content in treatment P1 (3%) tended to be way up. The addition of Moringa leaf flour to an amount of 7% did not much affect the water content of chicken nuggets. This was because the higher percentage of dry matter used caused the water content of the nuggets to decrease.

Based on SNI 01-6683-2002 regarding chicken nuggets, the water content of moringa chicken nuggets in this study is still below the standard, which is a maximum of 60%. Thus, the water content produced by chicken nuggets with adding of Moringa leaf flour still meets the water content standards of chicken nuggets.

2. Chicken Nugget Yield Testing

Based on a statistical analysis of the yield of chicken nuggets showed that the addition of moringa leaf flour (0%, 3%, 5%, 7%) gave a value that had a significant effect (P<0.05) on chicken nuggets (Table 1). Chicken nuggets were different because they were influenced by the addition of moringa leaf flour in each treatment, namely P1 (3%) yielded 72.23% yield, P2 (5%) yielded 68.40% yield, and P3 (7%) yielded yield 67.86%. Research conducted (Ruchdiansyah et al., 2016), that the yields produced were different due to differences in adding moringa leaves in each treatment. The more the amount of Moringa leaf flour used, the smaller the yield percentage, meaning that the percentage of the main raw material that becomes the final product is getting smaller.

The insignificant yield of chicken nuggets can also be affected by water content and water holding capacity. WHC (Water Holding Capacity) or water holding capacity is the ability of meat to bind water which is influenced by protein in meat (Permadi et al., 2012).

3. Chicken Nuggets Organoleptic Quality Testing

The results showed that the good organoleptic quality of the color, taste, and aroma of chicken nuggets with the formulation of the addition of 3% Moringa leaf flour (P1) was the best. The organoleptic quality of chicken nuggets with the addition of moringa leaf flour is shown in Table 2.

Table 2. Average Organolepticof Chicken Nugget with Adding of Different Moringa Leaf Flour

Parameter	Treatment				
Test	P0	P1	P2	P3	P- Value
Color	4,92±0,28^{d}	3,20±0,88^{c}	2,82±1,08^{b}	2,13±1,14^{a}	0,000
Aroma	3,87±0,68^{c}	3,12±0,85^{b}	2,30±1,09^{a}	2,23±1,08^{a}	0,000
Taste	4,43±0,65^{c}	3,32±0,89^{b}	2,55±0,87^{a}	2,53±1,16^{a}	0,000

$^{(a,b,c,d)}$Different superscripts on the same line show very significant differences(P<0,01). Color: 5= golden-yellow, 4= slightly brownish yellow, 3= greenish yellow, 2= slightly green,1= dark green. Aroma: 5= Typical smell of nuggets, 4= the smell of nuggets, 3= slightly smell of nuggets, 2= Slightly smell of Moringa, 1= Smell of Moringa. Taste: 5= Strong nugget specific, 4= Slightly nugget specific, 3= Less specific for the nugget, 2= Slightly Moringa taste, 1= More. Treatment: P0= control, P1= Moringa leaf flour 3%, P2= Moringa leaf flour 5%, P3= Moringa leaf flour 7%

4. Effect of Treatment on Color

Color is a determining factor for the quality of a foodstuff because it appears visually first. Color has an important role in attractiveness, identification, and quality attributes(Sebayang & Siahaan, 2018).In general, color is a determining factor for the quality of a food product, because it appears visually first. Based on the average value of statistical analysis, the color score ranges from 2,13 (slightly green) – 4.92 (golden yellow). Based on the Kruskal Wallis test appear that the addition of Moringa leaf flour had a very significant effect (P<0.01) on chicken nuggets. The color difference in the nuggets can be influenced by the amount of addition of different Moringa leaf flour.

These results indicate that the most preferred color of chicken nuggets with the addition of Moringa flour is P1 (3%) which tends to be slightly brownish-yellow. This is because the majority of panelists like the color of the nugget which tends to be golden yellow and the brownish-yellow color of P1 is still acceptable to the panelists. Vice versa, the higher the amount of addition of Moringa leaf flour will cause a color change which tends to become dark green which affects the amount of acceptance of the panelists. The green shade of Moringa leaves is influenced by the content of chlorophyll with a high concentration of 6890 kg/mg dry matter (Hatuti, 2015). Chlorophyll is a substance found in leaves to produce a natural green color, so it is often also referred to as leaf green. Chlorophyll in Moringa leaves is not only a pigment that gives green color to leaves, chlorophyll also has health benefits. The benefits of chlorophyll are supported by the nutritional content in it which is believed to be able to lose weight, heal wounds, and prevent cancer. According to Kurniasih (2015), the chlorophyll content in Moringa leaves is 4 times more than in wheatgrass.

5. Effect of Treatment on Aroma

Aroma is one of the important factors in a food product. The food industry considers it very important to carry out an aroma test because it can quickly assess a product whether is liked or not (Nurlaila et al., 2018). Based on the average value of statistical analysis, the aroma

score ranges from 2.23 (slightly smells of Moringa) – 3.87 (smells of nuggets). The lowest aroma score was obtained from the usage of with the addition of 7% Moringa leaf flour (P3) of 2.23 (slightly smelled of Moringa) compared to the level of use of P1 and P2. Based on the Kruskal Wallis test appear that adding Moringa leaf flour with different amounts to chicken nuggets gave a very significant value (P<0.01) to the aroma of chicken nuggets. typical of nuggets, while the addition of 5% Moringa leaf flour produces nuggets with a slight Moringa smell, and the addition of 7% Moringa leaf flour produces nuggets with a Moringa aroma.

From these results, it could be stated that the higher the use of moringa leaf flour, the aroma of the nuggets produced becomes somewhat unpleasant. The aroma produced comes from the main raw materials, namely chicken meat and moringa leaf flour. Furthermore, the addition of Moringa leaf extract affects the aroma because Moringa leaves contain lip oxidase enzymes found in vegetables, where the lip oxidase enzyme will hydrolyze compounds that cause unpleasant odors (Ilona, A & Ismawati, 2015).

6. Effect of Treatment on Taste

Testing of sensory properties that is important in the assessment of a food product is taste. Taste is one of the factors that attract consumers to a food product. In general, consumers judge the quality of a food product from its taste. Based on the organoleptic test, the value for the adding of moringa leaf flour with the highest taste score was obtained from the treatment with the addition of 3% moringa leaf flour (P1) of 3.32, and the lowest taste score was obtained from treatment 4 (P3) by the adding of Moringa leaf flour 7 % of 2.58.

This shows that the higher the proportion of addition to the nuggets, the more dominant the taste of the Moringa leaves will be. This is in line with research directed by Hatuti (2015), where nuggets without the addition of Moringa leaves (control) had the highest score indicating that the taste of the nuggets was strong, while the use of Moringa leaves in both fresh and dried forms would reduce the specific taste of the nuggets. In their research, Nahak *et al*. (2021) reported that Moringa leaves contain tannin compounds that produce a distinctive taste in Moringa leaves. This is because tannins are anti-nutritional compounds that cause a bitter taste, thereby reducing the favorability of the panelists.

7. Hedonic Testing (Favourite)

The results of the average test scores for the panelists' favorability for chicken nuggets with different levels of addition of Moringa leaf flour are shown in Table 3.

Table 3. Average Favorability Level of Chicken Nuggets with Addition of Different Moringa Leaf Flour

Parameter Test	Treatment				
	P0	P1	P2	P3	P- Value
Color	4,68±0,57^{d}	3,98±0,65^{c}	3,75±0,65^{b}	3,48±0,89^{a}	0,000
Aroma	4,72±0,49^{d}	3,98±0,47^{c}	3,52±0,85^{b}	2,92±1,08^{a}	0,000
Taste	4,73±0,52^{d}	4,12±0,56^{c}	3,30±0,74^{b}	2,58±1,05^{a}	0,000

$^{(a,b,c,d)}$Different superscripts on the same line show very significant differences(P<0,01). The score of Hedonic Test: 5= like very much, 4= like, 3= like barely, 2= dislike, 1= more dislike

Table 3 shows that the overall treatment without the addition of Moringa leaf flour (control) was the most preferred by the panelists as to color, aroma, and taste. However, the formulation of the adding moringa leaf flour with the highest favorability score was obtained from treatment P1 (3%) on all parameters, while the lowest favorability score was obtained from treatment P3 with the addition of 7% Moringa leaf flour. Changes that occur in the level of favorability are visible in the mean value of all treatments P0, P1, P2, and P3. This occurs because of differences in the addition of moringa leaf flour for all treatments, where P0 (control), P1 (3%), P2 (5%), and P3 (7%).

Based on the hedonic test of color, taste, and aroma showed, therefore, panelists gave the highest score to the P1 treatment (3%), while the addition of 7% resulted in a decrease in the score of the panelists. This happened because the majority of the panelists tended to like nuggets with specific characteristics of nuggets and at the level of addition of 3% the taste, aroma, and color produced were close to the typical criteria of nuggets. Changes in the score for each treatment were also because the panelists were not familiar with processed foodstuffs

with the addition of Moringa leaf flour. In line with the study of Evivie *et al*. (2016), stated that adding different moringa leaf powders can affect panelists' acceptance.

D. Conclusion

Based on the results of the study, it could be concluded that the best chicken nugget product with the best level of addition of Moringa leaf flour is 3%.

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