

The Proportion of Moringa and Cassava Leaves on the Chemical and Sensory Properties of Chicken Nuggets

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The Proportion of Moringa and Cassava Leaves on the Chemical and Sensory Properties of Chicken Nuggets

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Abstract. Several types of chicken meat products that have high protein content. Chicken meat can be used as a processed nugget product which is a healthy food product, for example with the addition of natural ingredients derived from moringa leaves and cassava which have good nutritional content for humans. From the proximate analysis of Moringa and cassava leaves are rich in nutrients that are good for humans. The purpose of this study was to determine and identify the chemical parameters of chicken nugget products enriched by Moringa (*Moringa poleifera*) and cassava leaves (*Manihot utilissima*). By using sensory evaluation methods and effectiveness tests. Then the chemical parameters by conducting laboratory analysis. From the results of the study, the best sensory evaluation of the nugget product is the proportion of cassava and Moringa leaves by 50: 50%, with a yield value of 0.68. Chemical analysis shows that the best treatment is also in the ratio of 50: 50%. Chemical parameters such as protein 10.16%, Vitamin C 181.80 mg, Calcium 112.30 mg, crude fiber 9.40%. The addition of moringa and cassava leaves affects chemical parameters (protein, crude fiber, calcium) in chicken nuggets.

Keywords: Moringa, cassava leaves, chicken meat, nugget, sensory, chemical properties.

1. Introduction

Chicken nuggets are food products that are in demand all over the world. Nugget products usually made from chicken meat and even fortified with vegetables that contain many proteins. This product usually half-cooked before being packed. The purpose of a half-cooked frying pan is to get a good product sensory and not excessive decomposition occurs if stored in freezing conditions [1]. The selection of chicken as the base material for making nugget is a lot of protein contains about 18% as well as having a complete source of acid – amino acids [2].

Children usually prefer crispy nugget products and are not from vegetable fermentation. It normally took a long time to introduce a variety of food or vegetables to children because the vegetable texture and taste even aroma are considered as not being appealing to them. Much effort is done so that a product can be filled with various types of vegetables that are generally children do not like. As processed to be made in the form of flour so that the adequacy of nutrients remains adequate [3].

One of the leaves that have a functional food source includes moringa leaves and cassava leaves. Both leaves are easy to obtain and possess the nutritional components and energy sources needed by the human body especially for children's growth and development [3]. Moringa leaves have been identified

to contain biochemical compounds that are beneficial to the health of the body, including compounds of vitamins, flavonoids, alkaloids, tannins, oxalic acid, saponins and phylic acid [4][5]. In the world of medicine or pharmacy moringa leaves are beneficial to protect the liver and kidneys from various diseases [5] and high blood pressure [6].

In addition to the moringa leaves, the leaves that have a high source of protein are cassava leaves. However, so far its utilization is wasted as a waste. Cassava leaves are one of the leaves that serve as vegetables and have a lot of minerals and vitamins that serve for the growth and health of the human body [7]. In addition, cassava leaves also contain protein composition of 25.23%, Vitamins (A, B1, and C), calcium, calories, phosphorus, fat, carbohydrate and iron [8].

The potential of moringa leaves and cassava leaves are very easy to obtain and many contain

important nutrients. But generally, people do not like to consume the leaves and is discarded as waste, or just as greening plants. While many benefits are obtained from both vegetable materials. Especially for children who do not like vegetables. The manufacture of innovative products from moringa leaves and cassava leaves have an important role to be utilized optimally. The fortification nugget of moringa leaves and cassava leaves is an innovative product that has a function as a foodstuff both for children and adults.

2. Research Methods

2.1. Materials and Equipment

H₃BO₃ 3%, NaOH 10%, H₂SO₄ concentrated, H₂SO₄ 0.3 N, HCl, alcohol. Kjeldahl tubes, measuring tubes, Iod solution, Oven, reaction tube, an exicator, filter paper, erlenmeyer, vacuum pump, sintered glass, heater, distillation tool.

2.2. Research Design

This research uses the group's random design with two factors. The first factor is the concentration of moringa leaves consisting of 3 levels of 40%, 50%, and 60%. The second factor is the concentration of cassava leaves consisting of 3 levels of 40%, 50%, and 60%. In the design formed 9 combinations that each combination is repeated 3 times.

2.3. Protein Assay

The sample weighed as much as 0.5 to 3.0 g and then inserted into the Kjeldahl flask and deconstruct by using 20 ml of concentrated sulfuric acid by heating until there was a clear coloured solution. The solution to the destruction was diluted and distilled by 10 ml of NaOH 10%. Destilat inserted (accommodated) in 25 ml solution H₃BO₃ 3%. The H₃BO₃ solution is assigned to a standard solution of HCl using red metal as an indicator. The titration results of this total nitrogen can be known. Sample protein levels are calculated by multiplying the total nitrogen and correction factors.

$$\text{Nitrogen content (\%)} = \frac{\text{ml titran} \times \text{NHCl} \times \text{fk} \times 14}{\text{sample weight}} \times 100\%$$

$$\text{Protein content (\%)} = \text{Total Nitrogen} \times 6.25$$

2.4. Crude Fiber Assay

The sample weighed as much as 2 g into the closed test tube, then added 30 ml H₂SO₄ 0.3 N and passed it into boiling water for 30 minutes. Add 15 ml NaOH 1.5 N then It was extracted for 30 minutes. Filter into sintered glass No 1 while in suction with a vacuum pump and then washed in succession with 50 cc of hot water, 50 cc H₂SO₄ 0.3 N and 50 cc alcohol. After that, it is dried in an oven for 8 hours or left overnight and cooled in an exicator for half an hour then weighed (a gram). And than grying in the electric furnace for 3 hours at 500 °C temperature and let it cool slightly then inserted into the exicator for half an hour then weighed (b grams).

$$\text{Fiber content} = \frac{a - b}{\text{sample weight}} \times 100\%$$

2.5. Vitamin C Assay

A total of 10 g of diluted samples in the Erlenmeyer 100 ml to achieve an impressions mark. The filtrate was shaken and filtered and then as many as 25 ml of the substrate was mined with 0.01 N iod using 1% kanji indicator. Vitamin C content can be calculated by this formula, where V is 0.01 N of iod volume used, P is Dilution factor and A is sample weight

$$\text{Vitamin C content} = \frac{P \times V \times 0.88 \text{ mg}}{A} \times 100\%$$

2.6. Calcium Assay

The sample solution that has been made is taken 1 mL and diluted with equates on a measuring flask 200 mL to the boundary mark. The calcium levels in the sample solution are determined by measuring the absorption with the atomic absorption spectrophotometer. Calcium metal is measured at a wavelength of 422.7 nm. The measurement results of the standard solution series made the calibration curve for calcium. While Ca mineral content in the sample nugget is obtained by using the following equation:

$$\text{Ca content} = \frac{\text{sample volume (L)} \times \text{sample concentration} \left(\frac{\text{mg}}{\text{L}}\right)}{\text{sample weight (g)}}$$

2.7. Sensory Evaluation

This sensory analysis is a qualitative analysis utilizing the score. These sensory analysis activities use untrained panelists. The number of panelists used was 30 people. The panelist was asked to assess the product organoleptically. The parameters tested by the panelist in the nugget product are colour, flavor, aroma and elasticity/texture. The hedonic test in sensory evaluation uses a numerical scale of 1-7, from the very dislikes to the stirred likes. Analysis of sensory evaluation data using an effective test method to determine the best treatment.

2.8. Statistical Analysis

Statistical analysis is done on chemical parameters. All experiments wererepeated in each group of their treatment and the repetition was three times. The Data obtained is analyzed using Anova, which is continued with the Duncan test, where P-value is ≤ 0.05 expressed significantly [9] [10] [11] [12].

3. 1

Crude Fiber Assay

fiber content in fortification nuggets increased. The more addition of the moringa leaves, so it can increase the fiber content of the nugget, it seen in the addition of 60% moringa leaves provide the highest crude fiber value of 8.33% and the addition of the leaves of moringa 40% provide the lowest crude fiber content value of 6.96%.

Table 1. Crude fiber content of Nugget (leaves of moringa and cassava leaves.)

Code	Treatment	Crude Fiber content (%)	Duncan 5%
K ₁	moringa leaves 40%	6,96 ^a	
K ₂	moringa leaves 50%	7,83 ^b	0.91
K ₃	moringa leaves 60%	8,33 ^b	
S ₁	cassava leaves 40%	6,77 ^a	0.57

S₂ cassava leaves 50%

7,88^b

The increase of crude fiber in the fortified nugget of cassava leaves and moringa leaves allegedly due to its crude fiber on cassava and moringa leaves. Moringa leaves have a protein content of 0.9 g [13], so when it added to the chicken nuggets there must be an increase in its protein content. The increase of crude fiber levels in this fortified chicken nuggets is expected to add the nutritional value that is in the chicken nuggets that previously very low of fiber content so that the chicken nugget has an increasingly good nutrient content. The increase in the level of fibers in the fortified nugget signifies an increase in product status capable of the metabolism of the human body.

The increased crude fiber levels in chicken nuggets added cassava leaves at each concentration are suspected to occur due to the crude fiber content of high cassava leaves. The presence of fiber on cassava leaves could be potentially increased fiber levels in the resulting nuggets. The higher concentration of cassava leaves used, hence the increase in the crude fiber of the resulting nuggets. It is seen in the crude fiber results of each treatment.

5 **Table 2.** Results of print analysis of crude fiber content of nugget

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.970 ^a	10	2.597	4.129	.006
Intercept	1609.002	1	1609.002	2558.125	.000
Cassava leave	13.810	2	6.905	10.978	.001
Klor leave	8.171	2	4.086	6.496	.009
Cassava*moringa	2.969	4	.742	1.180	.357
Group	1.020	2	.510	.811	.462
Error	10.064	16	.629		
Total	1645.036	27			
Corrected Total	36.034	26			

Based on the results of various print analyses, the addition of cassava leaves and moringa leaves produced distinct values. While the interaction between the addition of cassava leaves and moringa leaves has no real effect on the crude fiber content of nuggets with a yield of 0.357. This is due to the higher addition of cassava leaves and added moringa leaves, the resulting crude fiber is also increasingly higher.

The addition of cassava leaves can increase fiber content in fortification nugget products. The same reason is that inside cassava leaves there are also several fibers although still high in the moringa leaf fibers. The increase in the fortification fiber of cassava leaves and moringa leaves can provide several elements in the product. It means a complement that initially only limited to proteins and carbohydrates from chickens. Since the fibers in cassava leaves and Moringa can raise several fiber elements in the nugget. Crude fiber is a food residue due to the treatment of boiling acid or alkaline pans. The cassava fibers consist of cellulose in the presence of slight lignin and pentose. This crude fiber is also composed of fibers that can not be digested. This crude fiber has no nutritional value or nutrients but has a vital value in the metabolic process of the human body in facilitating the digestion of the human body (peristaltic process).

The fiber levels found in this fortification nugget are influenced by fiber in cassava and moringa leaves. The higher the addition of the moringa and cassava leaves on the nuggets of the higher the crude fiber found in the nuggets. The difference in crude fiber levels in the nugget at each treatment is due to each leaf proportion has different levels and due to processing influence. Crude fiber is a chemical substance that is resistant to the acidic and alkaline atmosphere. Crude fiber is largely composed of cellulose which is not easily soluble. This substance is also a type of polysaccharides (complex

carbohydrates). These fibers are classified as food chemicals that have long chain structures that are difficult to digest by enzyme compounds and are difficult to digest by human digestion. But some fibers are capable of being digested by the human intestine because of bacteria in the intestines. Fibers are grouped over water-soluble fibers that are capable of forming in the form of gels in the human gastrointestinal tract by absorbing water and being able to improve the texture and volume of feces. This soluble fiber is a non-structural component of the plant. The other fibers are water-insoluble fibers that are a structural component of the plant. The composition of fiber insoluble in water is generally more dominant than the presence of water-soluble fibers.

3.1.2. Protein

Protein is a vital nutrient needed by the human body to establish a metabolism. Protein needs can be derived from vegetable and animal materials. The results of the fortification nuggets showed that the addition of cassava leaves has a role in the addition of a number of proteins in nuggets. As shown in the following table.

Table 3. Average protein level of nugget

Code	Treatment	Protein Level	Duncan 5%
S ₁	Cassava leave 40%	7.788 ^a	
S ₂	Cassava leave 50%	8.177 ^b	1.09
S ₃	Cassava leave 60%	9.316 ^c	
K1	Moringa leave 40%	8,069 ^a	
K2	Moringa leave 50%	8,293 ^a	0.16
K3	Moringa leave 60%	8,918 ^b	

In the table shows, more addition of cassava leaves then the level of protein nugget becomes increasingly higher, instead of less the addition of cassava leaves then the lower protein levels in the nugget. Increased protein levels in chicken nuggets added cassava leaves at each concentration are suspected to occur because the protein levels in each of the raw materials used already have high protein content such as in chicken meat about 19% [2]. In the table shows more moringa leaves, the protein level of the nugget becomes increasingly higher. The less addition of moringa leaves then the lower protein levels in the nugget. The moringa leaves have a protein content of 18.7% [14]. So when added to the chicken nuggets there is an increase in protein content.

Table 4. Results of printing analysis of Nugget Protein levels

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16.507 ^a	10	1.651	12.076	.000
Intercept	1917.235	1	1917.235	14025.699	.000
Cassava leave	11.347	2	5.674	41.506	.000
Moringa leave	3.483	2	1.741	12.739	.000
Cassava * Moringa	.994	4	.249	1.819	.175
Group	.682	2	.341	2.496	.114
Error	2.187	16	.137		
Total	1935.929	27			
Corrected Total	18.694	26			

Based on the results of the printing analysis, it is indicated that the addition of cassava leaves and moringa leaves are distinct, while the interaction between the addition of cassava leaves and moringa

leaves has no noticeable effect on the results of 0.175. This is because the higher the number of cassava leaves and moringa leaves the more it will give effect to the increase in protein levels of nugget. Based on research conducted by [15], showed that the leaf formulations of moringa 70% give the highest value of protein levels on the manufacture of the tofu nuggets.

Protein compounds or nutrients have an important role in metabolic and life processes. This Protein is formed over the organic compounds of carbon, hydrogen, oxygen, and Nitrogen that the arrangement is almost the same as the group of fats and carbohydrates. Protein compounds also contain metallic elements such as Fe and Cu. Digestion of proteins will undergo breakdown into other basic chemical units of amino acids. Acids – amino bind to each other and relate to forming a band called the Peptide (CHON) bond. On a single protein molecule, it consists of 12 – 18 types of amino acids that number to reach hundreds of amino acids.

3.1.3. Vitamin C

Vitamin C in the fortification of cassava leaves and moringa has 175.8-181.9 mg levels. Lowest vitamin C levels are found in cassava leaf fortification 40% and moringa 40%. Moringa leaves and cassava leaves have high levels of vitamin C. Cassava leaves have a vitamin C rate of about 275 mg/100 g and the leaves of the vitamin C levels are approximately 220 mg/100 g [13]. The addition of cassava and moringa leaves can provide several increases in vitamin C in fortification nuggets. Because the chicken nuggets have no element of vitamin C, which originally only elements of carbohydrates and proteins.

Table 5. Average of Vitamin C levels in nuggets

Treatment	Replication			Average of Vitamin C (mg)	Duncan 5%
	1	2	3		
S1K1	175.84	175.99	175.82	175.8 ^a	
S1K2	178.01	178.14	177.5	177.8 ^b	
S1K3	178.97	179.02	178.83	178.9 ^c	
S2K1	179.32	179.4	179.32	179.3 ^c	
S2K2	179.91	179.85	179.93	179.9 ^d	1.05
S2K3	180.27	180.31	180.32	180.3 ^d	
S3K1	180.22	180.24	180.17	180.2 ^d	
S3K2	180.78	180.66	180.56	180.7 ^e	
S3K3	181.98	181.91	181.88	180.9 ^f	

The chicken nuggets also carry vitamin C, so when the leaves are added, cassava and moringa leaves that high in vitamin C, into the chicken nuggets it increased the content of vitamin C in the nugget [14]. Vitamin C can overcome free radicals that damage cell tissues namely as an antioxidant substance. In addition, vitamin C can protect the body as a numb system. Various diseases that can be caused by vitamin C deficiency are a canker, lethargic, have less weight and so on.

Table 6. Results of a print analysis of Vitamin C Nugget levels

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	73.720 ^a	10	7.372	541.781	.000
Intercept	869.462.168	1	869.462.168	63.898.413.861	.000
Cassava leave	53.074	2	26.537	1.950.245	.000

Moringa leave	16.392	2	8.196	602.350	.000
Cassava *	4.165	4	1.041	76.519	.000
Moringa					
Group	.089	2	.045	3.274	.064
Error	.218	16	.014		
Total	869.536.105	27			
Corrected Total	73.938	26			

2 Based on the results of the printing analysis of the variety of each of the addition cassava leaves and different moringa leaves. While the interaction between the addition of cassava leaves and different moringa leaves is evident in the results of 0.000. This is because the level of vitamin C in the nugget is also influenced by vitamin C levels of cassava leaves and moringa leaves. Similarly, the research conducted [16], that more and more moringa leaves in the Making of Meatballs, the higher also vitamin C content. The highest vitamin C levels gained from the addition of moringa leaves with a concentration of 70%. Vitamin c is widely found in fruits and vegetables such as those in cassava leaves and moringa leaves.

3.1.4. Calcium

The rate of calcium nuggets fortification of cassava leaves and moringa ranges from 101.76 -12.38 mg. The lowest calcium levels of cassava leaf fortification 40% with Moringa leaves 40%. Increased calcium levels are suspected because in cassava leaves and moringa already have compounds or elements of calcium. So that the element of calcium that is naturally present in cassava leaves and Moringa can give a number of calcium that is in the chicken nuggets is fortified.

Calcium element (Ca) is a macronutrient that is needed by the human body and is a group of mineral paint. The majority of these minerals (Ca) as much as 99% are on the bones and teeth. While the remaining 1% there is in the body fluid in the form of blood serum. The calcium level in cassava leaves is 165mg/100g which is very good for preventing bone diseases such as rheumatism and uratse acid with a high calcium-containing 440 mg/100 g [13] equivalent to calcium in 4 glasses of cow's milk, therefore the higher the addition of cassava leaves into the chicken nuggets, the higher also the calcium content [17].

Table 7. Average of calcium in nugget

Treatment	Replication			Calcium average (mg)	Duncan 5%
	1	2	3		
S1K1	101.56	101.49	102.22	101.76 ^a	
S1K2	102.02	101.98	102.68	102.23 ^a	
S1K3	104.25	103.88	103.76	103.96 ^b	
S2K1	104.08	104.14	103.74	103.99 ^b	
S2K2	105.77	105.94	104.88	105.53 ^c	1.50
S2K3	107.66	107.57	106.05	107.09 ^d	
S3K1	107.55	107.58	106.92	107.35 ^d	
S3K2	108.13	108.28	107.65	108.02 ^e	
S3K3	112.39	112.32	112.19	112.30 ^f	

This element of Ca has a role in the process of storing the body's metabolism in the form of glycogen. It is also utilized for development and growth processes. Humans have varying needs depending on their age or gender and activities. As the age grows, the amount of calcium needed by the body is greater. The element of calcium that is consumed in small quantities and less will cause a disease called bone impairment or osteoporosis

Table 8. Results of print analysis of calcium nugget levels

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	265.328 ^a	10	26.533	146.110	.000
Intercept	302.298.112	1	302.298.112	1.664.688.107	.000
Cassava leave	197.177	2	98.589	542.905	.000
Moringa leave	57.660	2	28.830	158.761	.000
Cassava * moringa	9.745	4	2.436	13.416	.000
Group	.745	2	.373	2.053	.161
Error	2.906	16	.182		
Total	302.566.346	27			
Corrected Total	268.234	26			

Based on the results of the printing analysis, it is indicated that the addition of cassava leaves and moringa leaves are distinct. Meanwhile, the interaction of cassava leaves and moringa leaves are distinct from the results of 0.000. This is due to calcium levels in the nugget is also influenced by the calcium level of cassava leaves and high moringa leaves. This results following the research [16] indicates that the addition of moringa leaves 60% gives the highest value of calcium in meatballs.

Calcium is a macronutrient that is needed by the body and minerals that are important to humans, 99% of the calcium in the human body is found in bones and teeth. As much as 1% of calcium is found in body fluids such as blood serum. Calcium is instrumental in the glycogen storage process. Calcium has many vital functions in the body. Calcium benefits are instrumental in the process of growth and development. Calcium needs in humans vary according to their age. With increasing age, the increasing needs of the calciums. Calcium deficiency can cause growth disorders and osteoporosis [18].

3.2. Evaluation Sensory Results

3.2.1. Colour

The results of the favorite analysis of cassava leaves colour and moringa leaves can be seen in Figure 1. It shows that the concentration of the addition of cassava leaves and different moringa leaves gives a favorite value to the nugget colour ranging from 3.08 to 6.17 which means that the colour of the nugget is somewhat dissimilar to the likes of panelists.

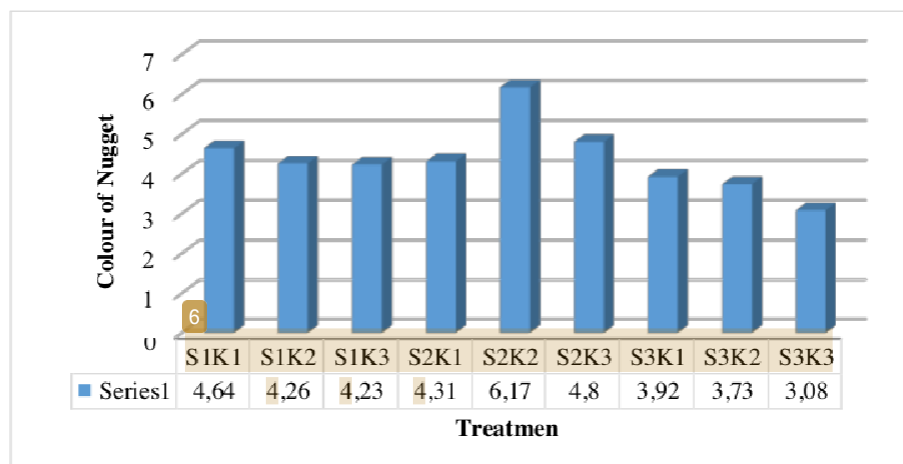


Figure 1. Colour of Nugget

Colour is the quality attribute that was first graded in the receipt of a meal. Colour is a trait of material that is considered derived from the spread of the beam spectrum, besides the colour is not a substance or object but a sensation of a person because of the stimulation of a file of radiation energy that falls into the sense of the eye or retinal eyes. Determining the quality of foodstuff generally depends on several factors, one such factor visually is colour, because the colour is the most determining factor to attract a food product.

Table 9. Organoleptic test Results Colour of Nugget parameters

Diversity sources	Average \pm deviation standard	significant
S Factor	1,60 \pm 0,817	
K Factor	1,57 \pm 0,817	0,000**
Colour	2,83 \pm 1,134	

** Very real

The table of analysis results of organoleptic test colours, the nugget shows that there is a very noticeable difference between the addition of cassava leaves and the addition of moringa leaves shown with a significant value of $0.000 < 0.05$. The colour difference in chicken nuggets is caused by the addition of cassava leaves that are dark green in reddish [19] and the green moringa leaves. Both types of leaves, of course, have chlorophyll content that can make the colour of the nugget into the greenish inside, while the nugget is generally yellow and it is white.

3.2.2. Aroma

Foodstuffs are also one of the charms for a food product. Foodstuffs can produce aromas because the foodstuffs contain volatile compounds. A volatile compound is a volatile compound that can cause a distinctive aroma. The aroma of foodstuffs can be an assessment of the quality and agility of the food for consumption, occurring in the middle of a food product signifying that the food is not worth consuming.

The results of the favorite test to the smell of cassava leaves and moringa leaves that can be seen in fig 2 indicate that the addition of cassava leaves and different moringa leaves give a favorite value to the nugget ranging from 3.51 – 5.12 which means the scent of nugget judged somewhat dislike to somewhat like by the panelist. Histogram aroma of the nugget can be seen in the following fig.

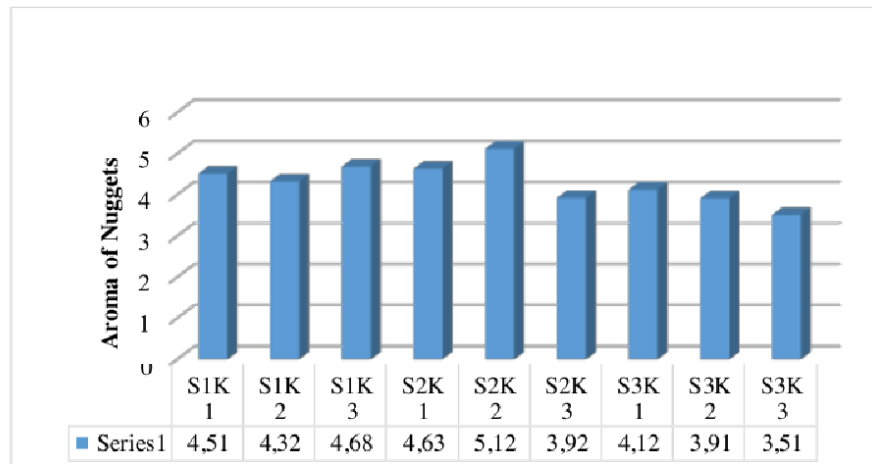


Figure 2. Aroma of nuggets

Table 10. Organoleptic test Result Aroma parameters

Diversity sources	Average ± Deviation standar	significant
S Factor	1.56 ± 0,817	
K Factor	1.56 ± 0,817	0,000**
Aroma	2.88 ± 0,910	

** : very real

Table results analysis of organoleptic test parameters aroma nugget that there is a very noticeable difference between the addition of cassava leaves and the addition of moringa leaves shown with a significant value of $0.000 \leq 0.05$. The difference in the smell of chicken nuggets occurs due to the addition of two types of leaves into the chicken nuggets, for its moringa leaves make the nugget produced to have a distinctive aroma because in the leaves have a scent of bad smells [13].

3.2.3. Taste

Taste is one of the consumer's appeals to a food product. Most consumers assess the quality of food products from the taste, the more delicious a food product, the more favored by consumers. The taste produced by a food product is derived from the ingredients used in the manufacturing process, namely raw materials and food additives. Your favorite test results to the sense of nugget that can be seen in **Figure 3.** showed that adding cassava leaves and different moringa leaves give the favorite taste value ranging from 4.02 – 6.38 which means that the nugget is rated neutral until the panelist likes it. The histogram flavor nugget cassava leaves and moringa leaves can be seen on the following.

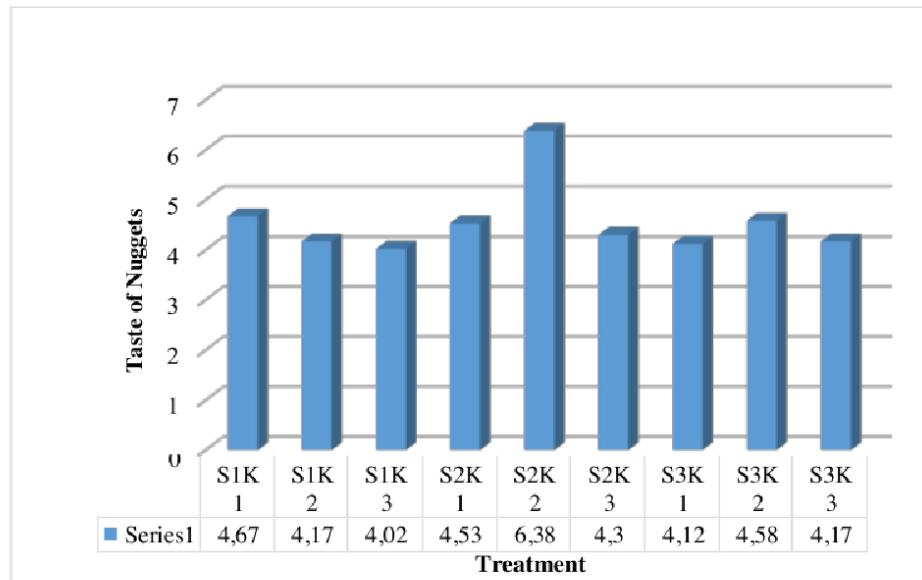


Figure 3. Taste of nuggets

The histogram above shows on the addition of cassava leaves 50% and the leaves of moringa 50% in chicken nugget produce a sense of nugget that is liked by panelist. And at the concentration treatment of cassava leaves 40% and the moringa leaves 60% produce a sense of nugget that is neutral by panelists

Table 11. Organoleptic test result taste parameters

Diversity sources	Average \pm deviation standar	Significant
S Factor	1.53 \pm 0.817	
K Factor	1.54 \pm 0.817	0,000**
Taste	2.94 \pm 1.040	

(**) = very real

The table of analysis results of the organoleptic test of nugget parameters shows that there is a very noticeable difference between the addition of cassava leaves and the leaf moringa shown with a significant value of $0.000 < 0.05$. Differences occur due to the addition of moringa leaves that have a distinctive scent of langu so that when added to the chicken nuggets will be a curtain as well Nuggets scent [13]. The higher the concentration of moringa leaves added then panelist less like because of the bad aroma.

3.2.4. Product smoothness

The favorite test results against the smoothness of the Nuggets seen in appendix 14 indicate that the addition of cassava leaves and different moringa leaves provide a favorite value for the elasticity of the Nuggets ranging from 0.03 – 5.6 which means Nugget's elasticity Rated very dislikes to somewhat like by the panelist. Histogram elasticity of cassava leaves and moringa leaves can be seen in the following image.

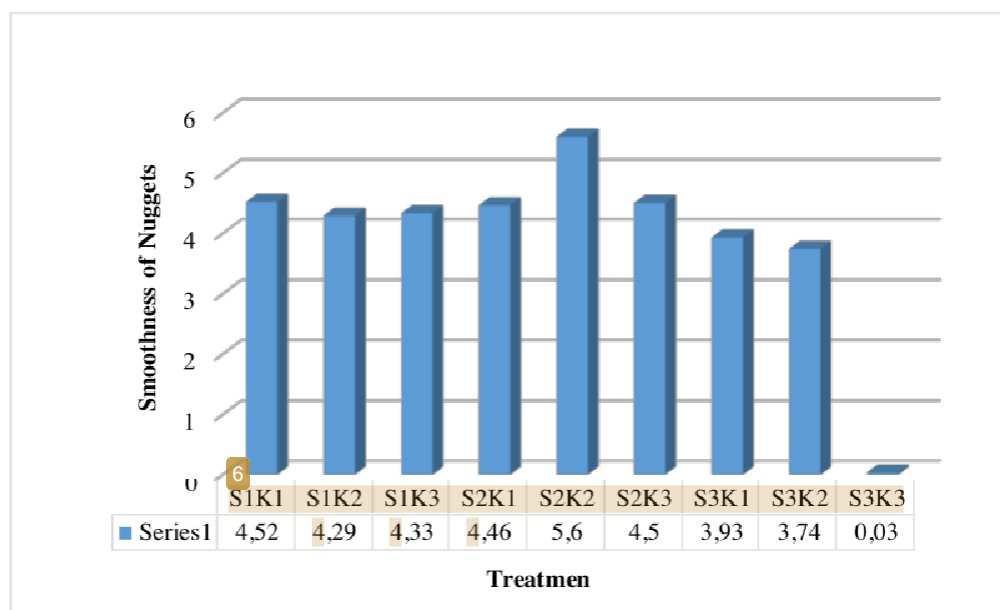


Figure 4. Smoothness of nuggets.

The histogram above shows that the addition of cassava leaves 50% and 50% moringa leaves in the chicken nugget produce the smoothness of the nuggets that liked by panelist. And at the addition of cassava leaf treatment, 60% and moringa leave 60% produce a sense of nugget is very disliked by the panelist. The results of the analysis of the organoleptic test of the smoothness nugget method are presented in the following table.

Table 12. Organoleptic test result smoothness parameters

Diversity sources	average + deviation standar	Significant
A Factor	1.59 + 0.817	
B Factor	1.57 + 0.817	0,000**
smoothness	2.83 + 1.038	

** : very real

The table analysis of organoleptic test results in the value of the nuggets indicates that there is a very noticeable difference between the addition of cassava leaves and the leaves shown with a significant value of $0.000 < 0.05$. Differences occur in the texture of chicken nuggets caused by the addition of cassava leaves and moringa leaves, cassava leaves are high in fiber content so that the texture of the resulting nugget will be solid and lint.

3.2.5. Effectiveness Test

Based on the effective tests results on all research parameters consisting of chemically tested and organoleptic tests as listed in Table 13. Indicates that the concentration of the addition of cassava leaves and the concentration of adding moringa leaves in the S2K2 treatment is the best treatment because it has the highest yield (VR) value. The average VR all research parameters can be seen in the following table.

Table 13. Nugget effectiveness test results

Parameter	Value of results (VR) treatment								
	S1K1	S1K2	S1K3	S2K1	S2K2	S2K3	S3K1	S3K2	S3K3
Protein	0.00	0.00	0.02	0.01	0.02	0.05	0.06	0.08	0.14
Crude fiber	0.00	0.01	0.02	0.04	0.07	0.10	0.10	0.12	0.14
calcium	0.00	0.02	0.03	0.03	0.05	0.07	0.07	0.08	0.13
Vitamin C	0.00	0.04	0.06	0.07	0.08	0.09	0.09	0.10	0.13
Taste	0.03	0.01	0.00	0.03	0.13	0.02	0.01	0.03	0.01
Colour	0.06	0.05	0.05	0.05	0.13	0.07	0.05	0.02	0.00
Aroma	0.07	0.06	0.08	0.08	0.11	0.03	0.05	0.03	0.00
Smoothness	0.06	0.05	0.05	0.05	0.10	0.05	0.05	0.03	0.00
Total	0,22	0,23	0,32	0,36	0,68	0,48	0,47	0,49	0,55

The table above shows that a nugget of cassava leaves and the best moringa leaves are S2K2 with the concentration of cassava leaves 50% and the concentration of moringa leaves 50% has the highest yield of 0.68 so that the treatment is the best treatment with a parameter value of protein levels = 10.15%, vitamin C levels = 181.92 mg, calcium levels = 112.38 mg, Crude fiber content = 9.41%, colour = 6.2 (likes), taste = 6.37 (likes), aroma = 5.12 (somewhat fond), elasticity = 5.6 (likes).

4. Conclusion

The interaction between the addition of cassava leaves and the moringa leaves of the chicken nuggets has no real difference to protein and crude fiber content, and the real effect on the levels of vitamin C and calcium of the nuggets. The addition of cassava leaves and moringa leaves has a real effect on protein levels, vitamin C levels of calcium and the crude fiber content of chicken nuggets. The addition of cassava leaves and moringa leaves are the best treatment with the highest yield (VR) value: S2K2 with the concentration of cassava leaves and moringa leaves amounting to 50%: 50% have the highest yield of 0.68 so that the treatment is the best treatment with parameters produces protein levels = 10.16%, vitamin C levels = 181.80 mg, calcium levels = 112.30 mg, Crude fiber content = 9.40%.

References

The Proportion of Moringa and Cassava Leaves on the Chemical and Sensory Properties of Chicken Nuggets

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