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PHYSICOCHEMICAL, ORGANOLEPTIC AND BUSINESS FEASIBILITY ANALYSIS OF CHICKEN NUGGETS WITH VARYING DOSAGES OF MORINGA LEAVES AND TAPIOCA FLOUR

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ABSTRACT
This study explores the use of Moringa leaves and tapioca flour as additives in chicken nuggets, a popular processed chicken meat product. Moringa leaves are known for their high nutritional content, including vitamins, minerals, and antioxidants. The research aims to determine the optimal dosages of Moringa leaves and tapioca flour for chicken nugget production, providing guidance for producers to enhance product formulations and nutritional value. The study investigates how variations in the doses of Moringa leaves and tapioca flour impact the physicochemical and organoleptic properties of chicken nuggets. An experimental design involving two factors (Moringa leaves and tapioca flour) with multiple levels is utilized. Each treatment combination is repeated to obtain reliable results. The findings indicate significant interactions between the doses of Moringa leaves and tapioca flour, particularly related to water content. The addition of 300g tapioca flour and 200g Moringa leaves resulted in the lowest water content compared to other dose combinations. However, there was no significant interaction observed on ash content, although higher doses of Moringa leaves and tapioca flour tended to increase the ash content in the chicken nuggets. Crude protein levels showed an interaction effect, with the addition of 100g Moringa leaves and increased tapioca flour contributing positively to the crude protein content. Additional doses of Moringa leaves and tapioca flour affected the crude fat content, with the addition of 100g Moringa leaves and increased tapioca flour resulting in increased crude fat. However, higher doses in specific combinations led to varied effects on crude fat content. The addition of Moringa leaves and tapioca flour influenced the crude fiber content in chicken nuggets. Within a certain range, the addition of Moringa leaves positively increased the crude fiber content, while higher doses of tapioca flour also contributed to increased crude fiber. Overall, this research provides insights into the effects of Moringa leaves and tapioca flour on the physicochemical properties and organoleptic qualities of chicken nuggets. The findings offer valuable information for the development of more efficient product formulations with enhanced nutritional value.

KEY WORDS
Chicken nuggets, moringa leaves, tapioca flour, processed meat products, nutritional content, dosage optimization.

Chicken nuggets are one of the popular processed chicken meat products and are widely consumed by the public (Putri, 2018; Zelpina et al., 2020; Sadolona & Agustin, 2021; Rahmawati & Irawan, 2021). The quality of chicken nuggets is very important to ensure the safety and taste of the product. In addition, today's consumers are also increasingly concerned about the health aspects and nutritional value of the food they consume. Therefore, research is needed to improve the quality of chicken nuggets by using natural additives that have health benefits.

Moringa leaves (Moringa oleifera) and tapioca flour are two interesting ingredients to be explored as additions to chicken nuggets. Moringa leaves have a high nutritional content, including vitamins, minerals, and phytochemical compounds such as antioxidants (Toripah, 2014; Badriyah et al., 2017; Luditasari et al., 2019; Suhaemi et al., 2021; Rasdiana & Refdi, 2022; Paramita, 2023). On the other hand, tapioca flour is a material that is often used in the food industry as a binder or filler (Liu et al., 2019; Le-Bail et al., 2020; Ayu et al., 2020; Lemos et al., 2021; Cruz-Romero et al., 2022).

Previous studies have shown the health benefits of moringa leaves and tapioca flour in various food products. However, there is still little research that specifically studies the effect of adding moringa leaves and tapioca flour on the physicochemical and organoleptic properties of chicken nuggets. Therefore, this study aims to fill this knowledge gap by conducting studies related to the addition of various doses of moringa leaves and tapioca flour to chicken nuggets.

GAP Research and Research Update:

Although there have been previous studies exploring the benefits of moringa leaves and tapioca flour in various food products, not many studies have specifically involved these two ingredients in the manufacture of chicken nuggets. This research will make a significant contribution to our understanding of the effect of the addition of moringa leaves and tapioca flour on the physicochemical and organoleptic properties of chicken nuggets (Romuald et al., 2017; Mashau et al., 2021; Rodríguez-Miranda et al., 2022; Hamzah et al., 2022; Francelin et al., 2022; Nuryahyani et al., 2022).

In addition, this research will also provide new data and information regarding the optimal dose of moringa leaves and tapioca flour that can be used in making chicken nuggets. This will provide practical guidance for producers to optimize their product formulations and produce higher quality chicken nuggets with high nutritional value. Research on nuggets has been conducted with various variations of raw materials, but there is still potential to improve the quality of these nuggets. One of the latest innovations in nugget production is the use of a mixture of moringa leaves (Moringa oleifera Lamk.), which can enhance the texture, taste, aroma, and nutritional content of the nuggets.

Preliminary studies on the production of chicken nuggets with the addition of moringa leaves and tapioca showed that adding tapioca flour at a concentration of 25% to 35% of the chicken meat weight yielded acceptable sensory results. However, adding flour above a concentration of 35% led to a decline in the organoleptic properties of the product, causing the nugget texture to become hard. The addition of moringa leaves to the nugget product at concentrations ranging from 5% to 15% resulted in good sensory acceptance. However, concentrations above 15% resulted in a strong moringa flavor and aroma that was less preferred by the panelists. Based on these considerations, there is still no research that determines the appropriate dosage of moringa leaves and tapioca flour to produce moringa chicken nuggets with optimal physicochemical and organoleptic qualities. Therefore, this research is crucial to fill the knowledge gap in this area.

The diversity of doses of moringa leaves and tapioca flour that will be studied is also a novelty in this study. Through this research, it will be known how variations in doses of Moringa leaves and tapioca flour affect the physicochemical and organoleptic properties of chicken nuggets. This can provide valuable information for the development of more efficient products and formulations. It is hoped that this research will provide a better understanding of the effect of the addition of moringa leaves and tapioca flour on physicochemical properties and organs.

METHODS OF RESEARCH

This experiment uses an Experimental Design which includes the design of the factors being tested. The use of a design depends on the factors being tested. Apiocal design is used to see the interaction between 2 or 3 factors where each factor has several levels. This study uses an apical design with 2 factors, and each factor has 3 levels and 3 repetitions (2x3x3) so there are 12 units of observation (Steel and Torrie, 1991).

The factorial design model follows the following formula:

$$Yijk = \mu_{+} + ai + \beta j + (a\beta)ij + \acute{\epsilon}ijk$$

Where: Yijk = Observation value; μ = Middle value; ai = Effect of level I from factor A; βj = Effect of the jth level of factor B; (aβ)ijz = Effect of interaction level I of factor A and level j from factor B; Ćij = The effect of the residual (trial error) level I from factor A and level j from apioc b on the kth repetition.

To assess the viability of a processed chicken nugget business, sales must be analyzed to evaluate consumer demand. Sales are elastic as customer preference rises. Rural processing firms are mostly traditional, like farming enterprises, which are new and face many obstacles. Agribusiness-focused nugget entrepreneurs will confront many challenges. As indicated above, novices encounter "infant industry" problems. Business owners' issues affect their results. This step achieves corporate goals. Thus, business concerns cause entrepreneur business actions. Minimizing challenges maximizes activity.

Processing companies must also understand consumer product preferences. Market segmentation is crucial. It's ready-to-eat or cook. Marketers must be smart to succeed. Marketing systems focus on consumers. Businesses must mirror customers. Business owners must "mirror and match" consumer behavior with their marketing specifications. Business owners perform these tasks. Marketing-focused business organization members are needed to maximize these efforts.

Business operators make technical and non-technical decisions to market processed goods. Marketing, customer behavior, and preferences are non-technical. Technical factors emphasize marketing concepts from specific marketing perspectives. Understanding marketing specs leads to marketing methods. Marketing can be done directly or indirectly.

Direct marketing involves business owners directly interacting with customers. This creates a two-way relationship between business owners and product users. Consumers and businesses set prices. Consumers hope to get fair prices while business owners maximize profits. Producer-to-consumer distribution is short. Due to the short supply chain, incidental costs are low.

Indirect marketing requires multiple marketing entities. Marketing middlemen connect producers and consumers. Each marketing firm maximizes revenues in such marketing. This creates high transaction expenses.

Business owners' profits depend on product sales elasticity. A chicken nugget company feasibility analysis must identify cost components, total production, product value, revenue, profit, and business feasibility. Understanding the components to be studied is necessary to comprehend the aforementioned elements, which will decide a business's viability.

Feasibility Analysis evaluates nugget business finances. This analysis examines costs, production, product value, sales, profit, and company feasibility, to determine if the firm is profitable. Market prospects, input-output analysis, and company feasibility must be reviewed for a complete analysis. These factors indicate chicken nugget business success and profitability.

This study uses chicken meat as a raw material for the manufacture of nuggets, where in the manufacturing process several fillers such as vegetables and seasonings are added. The vegetables used in this study were moringa leaves, carrots, celery and onions as well as spices such as garlic and cooking flavor enhancers, coriander, pepper, white sugar and salt. The binder uses tapioca flour and the coating material uses chicken eggs and panir flour.

This study will be carried out at the Results Processing Laboratory of the Animal Husbandry Training Center (BBPP) - Kupang for processing and organoleptic testing, while the analysis of the nutritional content of nuggets will be carried out at the Chemistry Laboratory of Politani University, Kupang. Organoleptic testing or sensory testing of chicken nuggets is carried out by "Semi-Trained Panelists" consisting of employees of BBPP Kupang.

The study on the nutritional quality and organoleptic properties of chicken nuggets with different doses of moringa leaves and tapioca flour involves 2 factors, where factor A is tapioca flour and factor B is tapioca flour. Each factor has 3 levels and will be repeated 3 times (3 x 3 x 3) resulting in a total of 27 experimental units.

The treatments being tested include:

- Factor A: Moringa Leaf Dose A1 = 5% moringa leaves (50 grams) A2 = 10% moringa leaves (100 grams) A3 = 15% moringa leaves (150 grams);
- Factor B: Tapioca Flour Dose B1 = 250 grams of tapioca flour B2 = 300 grams of tapioca flour B3 = 350 grams of tapioca flour.

Therefore, there are 9 treatment combinations that will be repeated 3 times, resulting in a total of 27 observations. The treatment combinations are as follows: A1B1 = 50g moringa leaves : 250g tapioca flour A1B2 = 50g moringa leaves : 300g tapioca flour A1B3 = 50g moringa leaves : 350g tapioca flour A2B1 = 100g moringa leaves : 250g tapioca flour A2B2 = 100g moringa leaves : 300g tapioca flour A2B3 = 100g moringa leaves : 350g tapioca flour A3B1 = 150g moringa leaves : 250g tapioca flour A3B2 = 150g moringa leaves : 300g tapioca flour A3B3 = 150g moringa leaves : 350g tapioca flour

RESULTS AND DISCUSSION

The results of the analysis of variance showed that there was an interaction between the doses of Moringa leaves and tapioca flour in the manufacture of chicken nuggets. From the observations in Table 1, it can be seen that the addition of moringa leaves and tapioca flour has a significant effect on the water content of the chicken nuggets. In the table, it can be seen that the addition of 300 g of tapioca flour and 200 g of Moringa leaves in the manufacture of chicken nuggets resulted in the lowest water content compared to the other treatment combinations, which was equal to 48,51%.

Table 1 – Interaction of Moisture Content in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Water content (%)		
	Tapioca flour 300 g	Tapioca flour 400 g	Tapioca flour 500 g
Moringa Leaves 100 g	53.31 b	55.08 bc	55.68 bc
Moringa Leaves 200 g	48.51 a	55.52 bc	53.84 b
Moringa Leaves 300 g	55.87 bc	56.89 c	54.77 bc

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

Table 2 – Ash Content in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Ash Content (%)
Moringa Leaves	
100 g	1.64 a
200 g	1.92 b
300 g	1.97 b
Tapioca flour	
300 g	1.62 a
400 g	1.77 a
500 g	2.15 b

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

Based on the results of analysis of variance, it is known that there is no interaction between the treatment of adding moringa leaves and tapioca flour in making chicken nuggets. The results of the observations in Table 2 show that the greater the amount of moringa leaves and tapioca flour added, the ash content in the chicken nuggets also increases. of the three doses of Moringa leaves given, the addition of 100 g of Moringa

leaves gave the lowest ash content, namely 1.64%, while the addition of 200 g and 300 g gave a higher ash content, respectively 1.92% and 1.97%. The addition of 300 g and 400 g of tapioca flour resulted in a lower ash content of 1.62% and 1.77%, while the addition of 500 g of tapioca flour in the manufacture of chicken nuggets gave a higher ash content of 2.15%.

Table 3 – Interactions of Crude Protein in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Crude protein (%)		
	Tapioca flour 300 g	Tapioca flour 400 g	Tapioca flour 500 g
Moringa Leaf 100 g	21.31 a	22.53 b	25.92 de
Moringa Leaf 200 g	25.84 de	25.71 d	26.54 ef
Moringa Leaf 300 g	26.89 f	26.21 def	24.82 c

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

Based on the results of analysis of variance, it is known that there is an interaction between the treatment of adding moringa leaves and tapioca flour in making chicken nuggets. The results of the observations in Table 3 show that the crude protein content in the chicken nuggets which was given an additional 100 g of moringa leaves and the greater amount of tapioca flour resulted in a higher crude protein. However, this is different from the production of chicken nuggets which added 300 g of moringa leaves and the more tapioca flour, the crude protein content of chicken nuggets decreased, namely 24.82%. When analyzed further, the addition of more moringa leaves to the composition of 300 and 400 g tapioca flour will increase the crude protein of the chicken nuggets made, but on the contrary the addition of 500 g tapioca flour which is added more moringa leaves will result in lower crude protein.

Table 4 – Interactions of Crude Fat in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Crude fat (%)		
	Tapioca flour 300 g	Tapioca flour 400 g	Tapioca flour 500 g
Moringa Leaf 100 g	4.197 a	4.644 b	5.030 c
Moringa Leaf 200 g	6.196 f	5.106 c	5.380 d
Moringa Leaf 300 g	5.584 de	5.754 e	5.135 c

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

From the observations, it can be seen that the addition of moringa leaves and tapioca flour affects the crude fat content in chicken nuggets. The addition of 100 g of Moringa leaves added with an increasing amount of tapioca flour will result in a higher crude fat content as well.

Table 5 – Percentage of Crude Fiber in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Coarse Fiber (%)
Moringa Leaves	
100 g	0.50 b
200 g	0.80 c
300 g	0.31 a
Tapioca Flour	
300 g	0.39 a
400 g	0.52 a
500 g	0.70 b

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

However, this is different from the addition of 200 and 300 g of Moringa leaves which, when added with more tapioca flour, results in a lower percentage of crude fat. If analyzed further, it is known that the addition of tapioca flour as much as 300 and 400 g which is then added with more and more moringa leaves will produce higher crude fat as well. Meanwhile, the addition of 500 g of tapioca flour plus 200 g of Moringa leaves resulted in a higher crude fat (5.38%) compared to the addition of 100 g (5.03%) or 300 g of Moringa leaves (5.13%).

Based on the results of analysis of variance, it is known that there is no interaction between the treatment of adding moringa leaves and tapioca flour in making chicken nuggets. The results of the observations in Table 5 show that the addition of 200 g (0.80%) of Moringa leaves produced higher crude fiber compared to the addition of 100 g (0.50%) and 300 g (0.31%) of Moringa leaves. While the addition of tapioca flour which produces more and more crude fiber in the manufacture of chicken nuggets.

Table 6 – Interactions of Carbohydrates in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Carbohydrate (%)		
	Tapioca Flour 300 g	Tapioca Flour 400 g	Tapioca Flour 500 g
Moringa Leaves 100 g	19.34 f	16.32 d	13.11 c
Moringa Leaves 200 g	18.35 e	11.94 b	12.95 c
Moringa Leaves 300 g	11.39 b	10.02 a	13.60 c

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

From the table of interactions between carbohydrates in chicken nuggets with the addition of Moringa leaves and tapioca flour, it can be seen that there is a significant effect between carbohydrates in chicken nuggets with the addition of Moringa leaves and tapioca flour. Increasing the dose of tapioca flour from 300 g to 500 g in combination with the addition of 100 g and 200 g of Moringa leaves showed a significant decrease in the carbohydrate content of chicken nuggets. However, this seemed different from the addition of 300 g of Moringa leaves which produced the lowest carbohydrates when combined with 400 g of tapioca flour and produced the highest carbohydrates when combined with 500 g of tapioca flour.

On the other hand, in the combination of adding 200 g and 300 g of Moringa leaves, it was seen that chicken nuggets with 400 g of tapioca flour had a lower carbohydrate content than at doses of 300 g or 500 g. Whereas the addition of 100 g of Moringa leaves combined with the addition of tapioca flour, the higher the amount, the lower the percentage of carbohydrates.

Table 7 – Amount of Metabolic Energy in Chicken Nuggets with the Addition of Various Doses of Moringa Leaves and Tapioca Flour

Treatment	Metabolic Energy (ME Kcal/kg)
Moringa Leaves	
100 g	2079 ^{ns}
200 g	2019 ^{ns}
300 g	2230 ^{ns}
Tapioca Flour	
300 g	2166 ^{ns}
400 g	1924 ^{ns}
500 g	2237 ^{ns}

Note: Numbers accompanied by the same letter in the same row and column do not differ significantly in the Duncan's test at 5%.

Based on Table 7, it is known that there is no significant difference in the energy metabolism of chicken nuggets given the addition of moringa leaves and tapioca flour. Although there were differences in the amount of metabolic energy in the different treatments, these differences were not statistically significant.

For example, a processed food business operator can sell the following products during a specific period:

Table 8 – Processed Food Business

No.	Product	Volume	Unit Price (Rp)	Amount
1	Chicken Nugget	20 packs	20,000	400,000
2	Moringa Meatball	20 packs	15,000	300,000
3.	sausage	20 packs	10.000	200.000
Total Revenue				900.000

Please note that the currency format has been adjusted for readability by including commas for thousands separators. The table provides information on the type of product, volume sold, unit price, and the total amount earned from the sales of each product. The total revenue for the specified period is 900,000 IDR.

Business Income/Profit Business income refers to the total amount of money earned by a business entity, obtained by subtracting all costs from the total revenue. Therefore, business income is also referred to as profit. Business income can be formulated as follows:

$$I = TR - TC$$

Where: I = Income/profit; TR = Total Revenue; TC = Total Cost.

Business Feasibility Business feasibility analysis is crucial for a producer to avoid losses and ensure business development and sustainability. Financially, business feasibility can be analyzed using several indicators or analytical tools, such as Break-Even Point (BEP), Revenue/Cost ratio (R/C ratio), and Benefit/Cost ratio (B/C ratio). For small-scale businesses, it is recommended to use at least BEP and R/C ratio or B/C ratio as tools for analyzing business feasibility.

Business feasibility analysis can be formulated as follows:

a. Break-Even Point (BEP). There are two approaches to BEP: unit BEP and price BEP. Unit BEP refers to the number of units that must be produced by a business entity to achieve profitability. Example: From the BEP unit calculation, it is determined that 10 units are required. If the producer produces fewer than 10 units, it will incur losses or be deemed unfeasible. On the other hand, if the production exceeds 10 units, it will generate profits or be considered feasible, and producing exactly 10 units will result in neither profit nor loss (break-even point).

Price BEP, on the other hand, refers to the price that should be applied based on the calculation. Example: Based on the calculation, the price BEP is Rp. 10. If the producer sells the product at a cost price lower than Rp. 10, it will incur losses or be deemed unfeasible. Conversely, if the cost price exceeds Rp. 10, it will generate profits or be considered feasible.

b. R/C ratio R/C ratio is the value that indicates the ratio between Revenue (R) and Total Cost (C). The magnitude of R/C ratio determines whether a business is profitable or unprofitable. In general, a business will be profitable if the revenue exceeds the cost. There are three possibilities when comparing Revenue (R) with Cost (C): R/C = 1, R/C > 1, and R/C < 1. However, due to a profit factor of 0.3, the feasibility analysis based on R/C ratio is as follows: a. R/C > 1.3 = Feasible/Profitable b. R/C = 1.3 = Break-Even Point c. R/C < 1.3 = Unfeasible/Loss

Based on the results of this assessment, the quantity of nugget production derived from processing 18 kg of chicken meat is 324 units (unit in packaging). With a price per unit of Rp 20,000, the total revenue is Rp 6,480,000, while the total cost is Rp 4,995,500. Therefore, the revenue-to-cost ratio is 6,480,000/4,995,500 = 1.297 (1.3). Based on the R/C ratio analysis, it can be concluded that the chicken nugget processing activity is feasible and profitable, where every Rp 100 invested will generate a revenue of Rp 130 or a profit of Rp 30.

c. B/C ratio B/C ratio is the value that indicates the ratio between Net Profit (Benefit = B) and Total Cost (C). The magnitude of B/C ratio determines whether a business is

profitable or unprofitable. Due to a profit factor of 0.3, the feasibility analysis based on B/C ratio is as follows: 1. B/C > 0.3 = Feasible/Profitable; 2. B/C = 0.3 = Break-Even Point; 3. B/C < 0.3 = Unfeasible/Loss.

Business feasibility analysis is the first and foremost step that a business owner needs to undertake before initiating their business activities. The purpose of conducting a business feasibility analysis is to determine whether the planned business venture will be profitable or result in losses. Business feasibility analysis involves several steps, including analyzing business costs, analyzing business income, and assessing the overall feasibility of the business.

In terms of marketing the processed products, the results of the business analysis can serve as a benchmark for determining the selling price or market price of the products. By considering the cost price of production (CPP), business owners can sell their products at a certain profit margin. To effectively market their products, business owners need to identify the target market, followed by planning and strategizing their marketing activities. These steps are essential and cannot be skipped if the business is to succeed.

DISCUSSION of RESULTS

The results of the analysis of variance revealed that there was an interaction between the doses of Moringa leaves and tapioca flour in the production of chicken nuggets. This implies that the inclusion of moringa leaves and tapioca flour in chicken nuggets has a mutual influence on the water content. Table 1 demonstrates that the combination of 300 g of tapioca flour and 200 g of Moringa leaves resulted in the lowest water content of 48.51% in the chicken nuggets. These findings suggest that this specific combination significantly reduces the water content of the chicken nuggets (Bou et al., 2004; Bucher et al., 2008; Teruel et al., 2015; Madane et al., 2019; Madane et al., 2020; Pourashouri et al., 2021; Nadeem et al., 2022).

Moisture content is a crucial parameter in processed meat products like chicken nuggets. Elevated water content can lead to diminished product quality, such as a soft texture, reduced shelf life, and increased potential for microbial growth (Das et al., 2008; Ledenbach & Marshall, 2009; Ergun et al., 2010; Bhise & Kaur, 2013; Mir et al., 2017; Bezie, 2019; Monirul et al., 2019; Łopusiewicz et al., 2023). Hence, incorporating the appropriate dosages of moringa leaves and tapioca flour can serve as an effective strategy to reduce the water content in chicken nuggets.

The reduction in water content observed in the chicken nuggets produced by using 300 g of tapioca flour and 200 g of Moringa leaves can be attributed to the binding and water-absorbing properties of both ingredients. Tapioca flour possesses favorable water-binding properties, thereby aiding in water content reduction. Furthermore, Moringa leaves are recognized for their effective water-absorbing properties. Consequently, this combination of dosages may have a synergistic effect on decreasing the water content of chicken nuggets. Furthermore, it is important to acknowledge that this study solely focused on observing the water content in chicken nuggets. For a more comprehensive understanding of the impact of different dosages of Moringa leaves and tapioca flour, further research should involve analyzing physicochemical properties and other sensory attributes such as hardness, softness, color, and other organoleptic qualities.

the analysis of variance results demonstrated an interaction between the doses of Moringa leaves and tapioca flour in the production of chicken nuggets, specifically regarding the water content. The combination of 300 g of tapioca flour and 200 g of Moringa leaves resulted in the lowest water content compared to other dose combinations, indicating its potential as a strategy to reduce the water content in chicken nuggets. However, further research is required to investigate the impact of these doses on the physicochemical and organoleptic properties of chicken nuggets. On the other hand, the analysis of variance results indicated no interaction between the addition of moringa leaves and tapioca flour in chicken nuggets regarding the ash content. This means that the effect of adding moringa leaves and tapioca flour did not influence the ash content of the chicken nuggets.

Table 2 shows that increasing the amount of moringa leaves and tapioca flour added resulted in higher ash content in the chicken nuggets. This suggests that both moringa leaves and tapioca flour contributed to the increase in ash content, as ash content measures the presence of inorganic materials in the sample. The addition of moringa leaves introduces minerals such as calcium, magnesium, and phosphorus, while tapioca flour contains minerals like potassium and phosphorus.

In this study, the addition of 100 g of Moringa leaves resulted in the lowest ash content of 1.64%, indicating the lowest contribution to ash content increase. Conversely, the addition of 200 g and 300 g of Moringa leaves led to higher ash content of 1.92% and 1.97% respectively, suggesting that higher doses of Moringa leaves tend to increase the ash content. Furthermore, adding 300 g and 400 g of tapioca flour resulted in lower ash content, specifically 1.62% and 1.77% respectively, indicating a smaller contribution to the ash content increase. However, adding 500 g of tapioca flour led to a higher ash content of 2.15% (Semjon et al., 2020). To summarize, the analysis of variance results indicate no interaction between the addition of moringa leaves and tapioca flour doses in relation to the ash content of chicken nuggets. Higher doses of moringa leaves and tapioca flour tend to increase the ash content in the product. Nonetheless, adding 100 g of moringa leaves and 300 g of tapioca flour resulted in the lowest contribution to the ash content increase in chicken nuggets. Further research is needed to comprehend the effect of these doses on the physicochemical and organoleptic parameters of chicken nuggets.

Based on the analysis of variance results, there was an interaction between the addition of doses of moringa leaves and tapioca flour in the production of chicken nuggets, particularly in relation to the crude protein content. The observations in Table 3 indicated a significant effect on the crude protein content due to the combination of these additional doses. In this study, adding 100 g of Moringa leaves to chicken nuggets, along with an increasing amount of tapioca flour, resulted in an increase in crude protein content. This suggests that the addition of Moringa leaves at this dose positively contributes to increasing the crude protein content in chicken nuggets. Similarly, adding more tapioca flour also had a positive effect on increasing the crude protein content in the product. However, there was a difference in the effect of adding doses of moringa leaves and tapioca flour to the production of chicken nuggets at higher doses. Specifically, the addition of 300 g of Moringa leaves, combined with an increasing amount of tapioca flour, led to a decrease in the crude protein content of chicken nuggets to 24.82%. This indicates that this particular dose combination may have a negative effect on the crude protein content of the product.

Furthermore, upon further analysis, it was observed that adding higher doses of Moringa leaves to the composition of tapioca flour, specifically 300 g and 400 g, resulted in an increase in crude protein content in chicken nuggets. This indicates that the addition of a higher dose of Moringa leaves to this combination has a positive contribution to increasing the crude protein content. However, it is important to note that the addition of 500 g of tapioca flour, along with an increased amount of Moringa leaves, led to a decrease in crude protein content to 24.82%. In conclusion, the analysis of variance results demonstrated an interaction between the addition of doses of moringa leaves and tapioca flour in the production of chicken nuggets, specifically in relation to the crude protein content. Adding 100 g of Moringa leaves and increasing the amount of tapioca flour positively contributed to increasing the crude protein content in chicken nuggets. Additionally, adding a higher dose of Moringa leaves in combination with 300 g of tapioca flour or 400 g of tapioca flour also resulted in an increase in crude protein content. Further research is necessary to understand the underlying mechanisms and other factors that influence these results and their implications for physicochemical properties.

Regarding the crude fat content, adding 100 g of Moringa leaves, along with an increasing amount of tapioca flour, showed an increase in the crude fat content in chicken nuggets. This suggests that this dose combination positively contributes to increasing the crude fat content in the product. However, there was a difference in the effect of adding doses of moringa leaves and tapioca flour to the production of chicken nuggets at higher doses. Adding 200 g and 300 g of Moringa leaves, along with an increasing amount of

tapioca flour, resulted in a decrease in the percentage of crude fat. This indicates that this particular combined dose may have a negative effect on the crude fat content of the product. Moreover, upon further analysis, it was observed that adding 300 g and 400 g of tapioca flour, along with an increasing amount of Moringa leaves, led to an increase in the crude fat content in chicken nuggets. This indicates that adding a higher dose of tapioca flour, along with an increasing amount of Moringa leaves, positively contributes to increasing the crude fat content in the product. Furthermore, adding 500 g of tapioca flour, along with 200 g of Moringa leaves, resulted in a higher crude fat content of 5.38%

In conclusion, the addition of doses of moringa leaves and tapioca flour affected the crude fat content in chicken nuggets. Adding 100 g of Moringa leaves, along with an increasing amount of tapioca flour, resulted in an increase in crude fat content, while the effect of higher doses of Moringa leaves and tapioca flour in specific combinations led to both decreases and increases in crude fat content. Further research is necessary to understand the underlying factors influencing these results and their implications for the physicochemical and organoleptic qualities of chicken nuggets. Additionally, based on the analysis of variance results, no interaction was observed between the addition of moringa leaves and tapioca flour in relation to crude fiber content, indicating that the effects of these ingredients on crude fiber were independent.

The observations in Table 5 revealed that adding 200 g of Moringa leaves resulted in a higher percentage of crude fiber (0.80%) compared to adding 100 g (0.50%) or 300 g (0.31%) of Moringa leaves. This indicates that adding Moringa leaves within this range has a positive contribution to increasing the crude fiber content in chicken nuggets. Moreover, increasing the amount of tapioca flour also led to an increase in the percentage of crude fiber in chicken nuggets. Previous research supports these findings, as it has shown that Moringa leaves are rich in fiber, and the addition of Moringa leaves to processed products can enhance the crude fiber content. Similarly, tapioca flour contains crude fiber, which contributes to the overall increase in crude fiber in the product. While there was no interaction between increasing doses of moringa leaves and tapioca flour, the effects of each treatment on crude fiber were evident. Specifically, adding 200 g of Moringa leaves resulted in a higher percentage of crude fiber compared to other doses, and increasing amounts of tapioca flour also contributed to an increase in crude fiber.

In summary, the addition of moringa leaves and tapioca flour influenced the crude fiber content in chicken nuggets. Adding moringa leaves within a certain range positively increased the crude fiber content, while adding a higher dose of tapioca flour also led to an increase in crude fiber. These findings align with previous research highlighting the potential of moringa leaves and tapioca flour to enhance the crude fiber content in processed products. Further research is needed to explore the underlying factors influencing these results and their implications for the physicochemical and organoleptic properties of chicken nuggets. Additionally, the analysis using an interaction table between carbohydrates in chicken nuggets and the doses of moringa leaves and tapioca flour demonstrated a significant effect. It was observed that the addition of moringa leaves and tapioca flour influenced the carbohydrate content in chicken nuggets, indicating that the combination of these ingredients had an impact on the nutritional composition of the product.

CONCLUSION

The research concludes that the combination of Moringa leaves and tapioca flour has an impact on the moisture content of chicken nuggets. Chicken nuggets made with 300 g of tapioca flour and 200 g of Moringa leaves exhibited the lowest moisture content. However, small quantities of Moringa leaves and tapioca flour do not affect the ash content of chicken nuggets. On the other hand, increasing the amounts of Moringa leaves and tapioca flour results in an increase in the ash content. Specifically, the addition of 100 g of Moringa leaves and 300 g of tapioca flour contributed to an increase in the ash content of chicken nuggets. Moreover, Moringa leaves and tapioca flour also have an influence on the crude protein levels in chicken nuggets. The inclusion of 100 g of Moringa leaves and a larger amount of

tapioca flour led to an increase in the crude protein content of chicken nuggets. Additionally, Moringa leaves and tapioca flour affect the crude fat content of chicken nuggets. Mixing 100 g of Moringa leaves with a higher quantity of tapioca flour resulted in an increase in crude fat content, while the combination of higher doses of Moringa leaves and tapioca flour in different proportions led to either a decrease or increase in crude fat content. Lastly, the addition of Moringa leaves and tapioca flour alters the crude fiber content in chicken nuggets, resulting in an increase in crude fiber content.

Furthermore, both Moringa leaves and tapioca flour had an effect on the crude fiber content of chicken nuggets, with an increase observed when Moringa leaves were added within a certain range, and higher doses of tapioca flour also leading to an increase in crude fiber content. These findings suggest the potential for utilizing Moringa leaves and tapioca flour to modify the nutritional profile and sensory characteristics of chicken nuggets. However, further research and experimentation are recommended to optimize the dosages, evaluate sensory attributes, and assess consumer acceptance before implementing these formulations on a larger scale.

REFERENCES

1. Alvarado-Ramírez, E. R., Maggiolino, A., Elghandour, M. M., Rivas-Jacobo, M. A., Ballesteros-Rodea, G., Palo, P. D., & Salem, A. Z. (2023). Impact of Co-Ensiling of Maize With Moringa Oleifera On The Production of Greenhouse Gases And The Characteristics of Fermentation In Ruminants. Animals, 13(4), 764.
2. Ayu, R. S., Khalina, A., Harmaen, A. S., Zaman, K., Mohd Nurrazi, N., Isma, T., & Lee, C. H. (2020). Effect of Empty Fruit Brunch Reinforcement In Polybutylene-Succinate/Modified Tapioca Starch Blend For Agricultural Mulch Films. Scientific Reports, 10(1), 1166.
3. Badriyah, B., Achmadi, J., & Nuswantara, L. K. (2017). Kelarutan Senyawa Fenolik Dan Aktivitas Antioksidan Daun Kelor (Moringa Oleifera) Di Dalam Rumen Secara In Vitro. Jurnal Peternakan Indonesia (Indonesian Journal of Animal Science), 19(3), 120-125.
4. Bezie, A. (2019). The Effect of Different Heat Treatment On The Nutritional Value of Milk And Milk Products And Shelf-Life of Milk Products. A Review. J. Dairy Vet. Sci, 11(5), 555822.
5. Bhise, S., & Kaur, A. (2013). Polyols To Improve Quality And Shelf Life of Baked Products: A Review. International Journal of Advanced Scientific And Technical Research, 1(3), 262-272.
6. Bou, R., Guardiola, F., Tres, A., Barroeta, A. C., & Codony, R. (2004). Effect of Dietary Fish Oil, A-Tocopheryl Acetate, And Zinc Supplementation On The Composition And Consumer Acceptability of Chicken Meat. Poultry Science, 83(2), 282-292.
7. Bucher, O., D'aoust, J. Y., & Holley, R. A. (2008). Thermal Resistance of Salmonella Serovars Isolated From Raw, Frozen Chicken Nuggets/Strips, Nugget Meat And Pelleted Broiler Feed. International Journal of Food Microbiology, 124(2), 195-198.
8. Cruz-Romero, M. C., O'flynn, C. C., Troy, D., Mullen, A. M., & Kerry, J. P. (2022). The Use of Potassium Chloride And Tapioca Starch To Enhance The Flavour And Texture of Phosphate-And Sodium-Reduced Low Fat Breakfast Sausages Manufactured Using High Pressure-Treated Meat. Foods, 11(1), 17.
9. Das, A. K., Anjaneyulu, A. S. R., Gadekar, Y. P., Singh, R. P., & Pragati, H. (2008). Effect of Full-Fat Soy Paste And Textured Soy Granules On Quality And Shelf-Life of Goat Meat Nuggets In Frozen Storage. Meat Science, 80(3), 607-614.
10. El-Kassas, S., Abdo, S. E., Abosheashaa, W., Mohamed, R., Moustafa, E. M., Helal, M. A., & El-Naggar, K. (2020). Growth Performance, Serum Lipid Profile, Intestinal Morphometry, And Growth And Lipid Indicator Gene Expression Analysis of Mono-Sex Nile Tilapia Fed Moringa Oleifera Leaf Powder. Aquaculture Reports, 18, 100422.
11. Ergun, R., Lietha, R., & Hartel, R. W. (2010). Moisture And Shelf Life In Sugar Confections. Critical Reviews In Food Science And Nutrition, 50(2), 162-192.

12. Francelin, M. F., Dos Santos, I. F., Claus, T., Visentainer, J. V., Feihrmann, A. C., Gomes, R. G., & Vieira, A. M. S. (2022). Effects of Moringa Oleifera Lam. Leaves Extract On Physicochemical, Fatty Acids Profile, Oxidative Stability, Microbiological And Sensory Properties of Chicken Mortadella. Journal of Food Processing And Preservation, 46(4), E16441.
13. Hamzah, F., Vista, B., Rahmayuni, R., & Praman, A. (2022). Combination of Tuna Fish And Green Spinach On The Quality of Nuggets. Agrointek: Jurnal Teknologi Industri Pertanian, 16(3), 329-336.
14. Islam, M. S., Roy, H., & Afrose, S. (2022). Phosphoric Acid Surface Modified Moringa Oleifera Leaves Biochar For The Sequestration of Methyl Orange From Aqueous Solution: Characterizations, Isotherm, And Kinetics Analysis. Remediation Journal, 32(4), 281-298.
15. Jalgaonkar, K., Jha, S. K., & Mahawar, M. K. (2018). Influence of Incorporating Defatted Soy Flour, Carrot Powder, Mango Peel Powder, And Moringa Leaves Powder On Quality Characteristics of Wheat Semolina-Pearl Millet Pasta. Journal of Food Processing And Preservation, 42(4), E13575.
16. Le-Bail, A., Maniglia, B. C., & Le-Bail, P. (2020). Recent Advances And Future Perspective In Additive Manufacturing of Foods Based On 3d Printing. Current Opinion In Food Science, 35, 54-64.
17. Ledenbach, L. H., & Marshall, R. T. (2009). Microbiological Spoilage of Dairy Products. Compendium of The Microbiological Spoilage of Foods And Beverages, 41-67.
18. Lemos, P. V. F., Marcelino, H. R., Cardoso, L. G., De Souza, C. O., & Druzian, J. I. (2021). Starch Chemical Modifications Applied To Drug Delivery Systems: From Fundamentals To Fda-Approved Raw Materials. International Journal of Biological Macromolecules, 184, 218-234.
19. Liu, R., Sun, W., Zhang, Y., Huang, Z., Hu, H., & Zhao, M. (2019). Preparation of Starch Dough Using Damaged Cassava Starch Induced By Mechanical Activation To Develop Staple Foods: Application In Crackers. Food Chemistry, 271, 284-290.
20. Łopusiewicz, Ł., Kowalczewski, P. Ł., Baranowska, H. M., Masewicz, Ł., Amarowicz, R., & Krupa-Kozak, U. (2023). Effect of Flaxseed Oil Cake Extract On The Microbial Quality, Texture And Shelf Life of Gluten-Free Bread. Foods, 12(3), 595.
21. Luditasari, D. F. A., Puspitasari, A., & Lestari, I. (2019). Aktivitas Antioksidan Daun Bayam Merah (Amaranthus Tricolor L.) Dan Daun Kelor (Moringa Oleifera Lamk) Segar Dan Dengan Pengolahan. Analis Kesehatan Sains, 8(2).
22. Madane, P., Das, A. K., Nanda, P. K., Bandyopadhyay, S., Jagtap, P., Shewalkar, A., & Maity, B. (2020). Dragon Fruit (Hylocereus Undatus) Peel As Antioxidant Dietary Fibre On Quality And Lipid Oxidation of Chicken Nuggets. Journal of Food Science And Technology, 57(4), 1449-1461.
23. Madane, P., Das, A. K., Nanda, P. K., Bandyopadhyay, S., Jagtap, P., Shewalkar, A., & Maity, B. (2020). Dragon Fruit (Hylocereus Undatus) Peel As Antioxidant Dietary Fibre On Quality And Lipid Oxidation of Chicken Nuggets. Journal of Food Science And Technology, 57(4), 1449-1461.
24. Madane, P., Das, A. K., Pateiro, M., Nanda, P. K., Bandyopadhyay, S., Jagtap, P., ... & Lorenzo, J. M. (2019). Drumstick (Moringa Oleifera) Flower As An Antioxidant Dietary Fibre In Chicken Meat Nuggets. Foods, 8(8), 307.
25. Madane, P., Das, A. K., Pateiro, M., Nanda, P. K., Bandyopadhyay, S., Jagtap, P., ... & Lorenzo, J. M. (2019). Drumstick (Moringa Oleifera) Flower As An Antioxidant Dietary Fibre In Chicken Meat Nuggets. Foods, 8(8), 307.
26. Mardewi, N. K., Rasa Astiti, N. M. A. G., Sri Rukmini, N. K., Seri Rejeki, I., Tonga, Y., & Etty Suwitari, N. K. (2017). Supplementation of Moringa (Moringa Oliefera) Powder Into Ration In Increasing The Quality of Broiler's Meat. International Research Journal of Engineering, It & Scientific Research (Irjeis), 3(3), 27-37.
27. Mashau, M. E., Ramatsetse, K. E., & Ramashia, S. E. (2021). Effects of Adding Moringa Oleifera Leaves Powder On The Nutritional Properties, Lipid Oxidation And Microbial Growth In Ground Beef During Cold Storage. Applied Sciences, 11(7), 2944.

28. Mashau, M. E., Ramatsetse, K. E., & Ramashia, S. E. (2021). Effects of Adding Moringa Oleifera Leaves Powder On The Nutritional Properties, Lipid Oxidation And Microbial Growth In Ground Beef During Cold Storage. Applied Sciences, 11(7), 2944.
29. Mir, S. A., Shah, M. A., & Mir, M. M. (2017). Microgreens: Production, Shelf Life, And Bioactive Components. Critical Reviews In Food Science And Nutrition, 57(12), 2730-2736.
30. Mirzapour, Z., Ariaii, P., Safari, R., & Ahmadi, M. (2022). Evaluation The Effect Hydrolyzed Canola Meal Protein With Composite Coating On Physicochemical And Sensory Properties of Chicken Nugget. International Journal of Peptide Research And Therapeutics, 28(3), 97.
31. Monirul, I., Yang, F., Niaz, M., Qixing, J., & Wenshui, X. (2019). Effectiveness of Combined Acetic Acid And Ascorbic Acid Spray On Fresh Silver Carp (Hypophthalmichthys Molitrix) Fish To Increase Shelf-Life At Refrigerated Temperature. Current Research In Nutrition And Food Science Journal, 7(2), 415-426.
32. Nadeem, H. R., Akhtar, S., Ismail, T., Qamar, M., Sestili, P., Saeed, W., ... & Esatbeyoglu, T. (2022). Antioxidant Effect of Ocimum Basilicum Essential Oil And Its Effect On Cooking Qualities of Supplemented Chicken Nuggets. Antioxidants, 11(10), 1882.
33. Nadeem, H. R., Akhtar, S., Ismail, T., Qamar, M., Sestili, P., Saeed, W., ... & Esatbeyoglu, T. (2022). Antioxidant Effect of Ocimum Basilicum Essential Oil And Its Effect On Cooking Qualities of Supplemented Chicken Nuggets. Antioxidants, 11(10), 1882.
34. Nkukwana, T. T., Muchenje, V., Masika, P. J., Hoffman, L. C., & Dzama, K. (2014). The Effect of Moringa Oleifera Leaf Meal Supplementation On Tibia Strength, Morphology And Inorganic Content of Broiler Chickens. South African Journal of Animal Science, 44(3), 228-239.
35. Nuryahyani, R., Kristanti, D., Ishartani, D., & Setiaboma, W. (2022, April). Nutritional And Sensory Properties of Starry Trigger (Abalistes Stellaris) Fish Balls Additional Fresh And Steamed Moringa (Moringa Oleifera) Leaves. In Iop Conference Series: Earth And Environmental Science (Vol. 995, No. 1, P. 012020). Iop Publishing.
36. Paramita, V. D. (2023). Pengaruh Metode Pengeringan Terhadap Kadar Vitamin C Dan Aktivitas Antioksidan Daun Kelor (Moringa Oleifera). Jurnal Agritechno, 29-35.
37. Patil, D., Vaknin, Y., Rytwo, G., Lakemond, C., & Benjamin, O. (2022). Characterization of Moringa Oleifera Leaf And Seed Protein Extract Functionality In Emulsion Model System. Innovative Food Science & Emerging Technologies, 75, 102903.
38. Pourashouri, P., Shabanpour, B., Heydari, S., & Raeisi, S. (2021). Encapsulation of Fish Oil By Carrageenan And Gum Tragacanth As Wall Materials And Its Application To The Enrichment of Chicken Nuggets. Lwt, 137, 110334.
39. Prayitno, S. A., & Rahim, A. R. (2021, February). The Proportion of Moringa And Cassava Leaves On The Chemical And Sensory Properties of Chicken Nuggets. In Journal of Physics: Conference Series (Vol. 1764, No. 1, P. 012032). Iop Publishing.
40. Putri, V. D. (2018). Uji Kualitas Kimia Dan Organoleptik Pada Nugget Ayam Hasil Substitusi Ampas Tahu. Jurnal Katalisator, 3(2), 143-152.
41. Qwele, K., Hugo, A., Oyedemi, S. O., Moyo, B., Masika, P. J., & Muchenje, V. (2013). Chemical Composition, Fatty Acid Content And Antioxidant Potential of Meat From Goats Supplemented With Moringa (Moringa Oleifera) Leaves, Sunflower Cake And Grass Hay. Meat Science, 93(3), 455-462.
42. Rahmawati, N., & Irawan, A. C. (2021). Pengaruh Penambahan Tepung Kacang Merah Terhadap Mutu Organoleptik, Fisik Dan Kimia Nugget Ayam Kampung. Jurnal Ilmiah Fillia Cendekia, 6(1), 46-53.
43. Rasdiana, F. Z., & Refdi, C. W. (2022). Pengaruh Penambahan Serbuk Daun Kelor Terhadap Karakteristik Fisikokimia Dan Aktivitas Antioksidan Permen Jahe Merah. Jurnal Teknologi Pertanian Andalas, 26(1), 38-46.
44. Rodríguez-Miranda, J., Herman-Lara, E., Serrano-Niño, J. C., Sánchez-Ruiz, B. A., & Martínez-Sánchez, C. E. (2022). Effects of Sucrose And Sodium Chloride Pretreatments

On Cassava And Plantain Chips Fried In Cla-Enriched Soybean Oil: An Analysis of Acrylamide Content, Microstructure, And Other Physical Properties. International Journal of Food Engineering, 18(8-9), 571-581.
45. Romuald, M. M., Viviane, D. M., Ysidor, K. N. G., Adama, C., Daouda, S., Olivier, A. Y., & Marius, B. G. H. (2017). Vitamin Contents And Nutritive Contribution of Flours of Palmyra New Shoots Enriched With Moringa Oleifera Leaves And Cowpea (Vigna Unguiculata) Powders. Journal of Advances In Biology And Biotechnology, 1-12.
46. Sadolona, E., & Agustin, R. (2021). Pengaruh Penambahan Minyak Buah Merah Terhadap Kualitas Organoleptik Nugget Ayam. Jurnal Agrosainta: Widyaiswara Mandiri Membangun Bangsa, 5(2), 77-84.
47. Semjon, B., Bartkovský, M., Marcinčáková, D., Klempová, T., Bujňák, L., Hudák, M., ... & Marcinčák, S. (2020). Effect of Solid-State Fermented Wheat Bran Supplemented With Agrimony Extract On Growth Performance, Fatty Acid Profile, And Meat Quality of Broiler Chickens. Animals, 10(6), 942.
48. Simonato, B., Tolve, R., Rainero, G., Rizzi, C., Sega, D., Rocchetti, G., ... & Giuberti, G. (2021). Technological, Nutritional, And Sensory Properties of Durum Wheat Fresh Pasta Fortified With Moringa Oleifera L. Leaf Powder. Journal of The Science of Food And Agriculture, 101(5), 1920-1925.
49. Suhaemi, Z., Yerizal, E., & Yessirita, N. (2021). Pemanfaatan Daun Kelor (Moringa Oleifera) Dalam Fortifikasi Pembuatan Nugget. Jurnal Ilmu Produksi Dan Teknologi Hasil Peternakan, 9(1), 49-54.
50. Sun, B., Zhang, Y., Ding, M., Xi, Q., Liu, G., Li, Y., ... & Chen, X. (2018). Effects of Moringa Oleifera Leaves As A Substitute For Alfalfa Meal On Nutrient Digestibility, Growth Performance, Carcass Trait, Meat Quality, Antioxidant Capacity And Biochemical Parameters of Rabbits. Journal of Animal Physiology And Animal Nutrition, 102(1), 194-203.
51. Temesgen, M., Retta, N., & Tesfaye, E. (2017). Nutrient Composition And Digestibility of Taro Leaf In The Diets of Chicken And Effects On The Meat Quality. J Nutr Health Food Eng, 7(3), 00238.
52. Teruel, M. R., Garrido, M. D., Espinosa, M. C., & Linares, M. B. (2015). Effect of Different Format-Solvent Rosemary Extracts (Rosmarinus Officinalis) On Frozen Chicken Nuggets Quality. Food Chemistry, 172, 40-46.
53. Toripah, S. S. (2014). 4. Aktivitas Antioksidan Dan Kandungan Total Fenolik Ekstrak Daun Kelor (Moringa Oleifera Lam). Pharmacon, 3(4).
54. Zelpina, E., Walyani, S., Niasono, A. B., & Hidayati, F. (2020). Dampak Infeksi Salmonella Sp. Dalam Daging Ayam Dan Produknya Terhadap Kesehatan Masyarakat. Journal of Health Epidemiology And Communicable Diseases, 6(1), 25-32.