



Chemical Quality (Water Content, Protein, Fiber) and Organoleptic Properties of Chicken Nuggets with Addition of Vegetables

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ABSTRACT. This study aimed to assess the chemical quality (moisture content, protein, and fiber) and organoleptic properties of chicken nuggets with the addition of vegetables. The materials used included chicken breast, wheat flour, tapioca flour, bread crumbs, eggs, pepper, salt, ice water, carrots, broccoli, spinach, and young corn. Five treatments were applied: P0 (no vegetable addition), P1 (carrot addition), P2 (broccoli addition), P3 (spinach addition), and P4 (young corn addition). The research employed a Completely Randomized Design (CRD) for analyzing chemical quality and a Randomized Block Design (RBD) for examining organoleptic properties. Preferences were tested using the Kruskal-Wallis test. The chemical quality measurements included moisture content, protein, and crude fiber, while the organoleptic measurements assessed color, aroma, texture, taste, and preference. The results showed that the addition of vegetables significantly ($P < 0.05$) affected moisture content but had no significant effect ($P > 0.05$) on protein and fiber content. Furthermore, the addition of vegetables significantly ($P < 0.05$) influenced the color, aroma, and taste of the nuggets, but did not significantly affect ($P > 0.05$) texture and preference. It was concluded that incorporating 10% vegetables into chicken nuggets increased moisture content without affecting protein and fiber levels or overall preference. The addition of carrots yielded the highest scores for aroma and taste preference.

Keywords: broccoli, carrot, chicken nuggets, spinach, young corn

INTRODUCTION

Increasing public awareness of the importance of consuming animal protein has spurred efforts to diversify processed food products, including processed meat items such as chicken nuggets. According to Wulandari and Sukesu (2013), nuggets are minced meat products that are seasoned, coated with flour and breadcrumbs, and then frozen to maintain quality during preservation. Nuggets not only enhance economic efficiency and food diversification but also cater to consumer safety and comfort, aligning with modern lifestyle demands at an affordable price. The quality of nuggets is significantly influenced by their nutritional content, the ingredients used, and the processing methods employed. The National Standardization Agency (2014) reports that nuggets are primarily made from chicken meat, with additional ingredients such as flour or seasoned flour and breadcrumbs, requiring a minimum protein content of 9%. Furthermore, Sri Santi Utami *et al.* (2018) state that vegetables like carrots and broccoli can be incorporated into nuggets, with vegetable content reaching up to 60%, resulting in a protein content of 16%. Incorporating vegetables serves as a source of fiber, and each vegetable type brings unique benefits, allowing consumers to choose nuggets that meet their nutritional needs and preferences.

The nutritional content of nuggets, including water, protein, and fiber, significantly affects their quality and shelf life. Lower water content is associated with a longer shelf life, while the protein and fiber content influences the nutritional intake that affects overall health (Merenkova *et al.*, 2020; Umar, 2021).

In addition to nutritional content, consumer appeal, which reflects public taste preferences, is crucial in food processing. This appeal can be assessed through organoleptic testing, a method that employs human senses to evaluate aroma, taste, and texture. Organoleptic testing is a sensitive approach to measure consumer acceptance and preference regarding taste, color, and texture. The crispiness and overall sensory experience of the product are evaluated, making organoleptic testing a simple, cost-effective method for determining product quality and consumer preferences (Nuranisa *et al.*, 2019).

MATERIALS AND METHODS

This research was conducted at the Integrated Laboratory of the Faculty of Animal Husbandry, Jambi University, using materials as detailed in Table 1. The tools utilized for this study included knives, plates, bowls, basins, spoons, rulers, food processors, nugget molds, gas stoves, and steamers. The development of chicken nuggets was based on the modified procedure from Hastuti *et al.* (2016). The process began with grinding 300 grams of chicken meat, 100 grams of ice water, and 25 grams of salt in a food processor until smooth.

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Once the meat was well ground, the following ingredients were added: 80 grams of wheat flour, 80 grams of tapioca flour, 100 grams of eggs (both white and yolk), 10 grams of garlic, and 30 grams of vegetables, which were also ground according to the treatment specifications. After the ingredients were thoroughly mixed, the mixture was removed from the food processor and kneaded until smooth. The dough was then placed into molds and steamed for 30 minutes. Following steaming, the nuggets were chilled and cut into pieces. Samples from each treatment were subsequently analyzed for water content, protein, fiber, and organoleptic properties, including color, aroma, texture, and taste.

Table 1. Composition of materials used according to treatment.

Ingredients for making nuggets	Composition of use	
Main ingredient		
Chicken meat	300 grams	100%
Additional Ingredients		
Garlic *	10	3.33
Paneer Flour *	100	33.33
Flour *	80	26.66
Tapioca flour *	80	26.66
Fine pepper *	5	1.67
Salt *	25	8.33
Egg *	100	33.33
Ice water*	100	33.3
Treatments		
Control	P0 = 0	0
Carrot *	P1 = 30	10
Broccoli	P2 = 30	10
Spinach *	P3 = 30	10
Baby corn *	P4 = 30	10

Description: The chicken nugget formulations in this study were categorized based on the addition of vegetables to the chicken meat as follows: P0: No vegetable addition (control), P1: Addition of carrots, P2: Addition of broccoli, P3: Addition of spinach, P4: Addition of baby corn

Experimental Design

The design employed in this study was a Completely Randomized Design (CRD), consisting of five treatments with four replications for determining water, protein, and fiber content. For the organoleptic testing properties and public appeal assessment, a Randomized Block Design (RBD) was utilized, featuring five treatments and involving 30 semi-trained panelists as a group.

Observed Variables

The variables observed to determine the chemical quality of the nuggets included water, protein, and fiber content, while the organoleptic

properties assessed were color, aroma, texture, and taste.

Data Analysis

The data obtained were analyzed using analysis of variance, employing a Completely Randomized Design (CRD) for chemical quality assessment and a Randomized Block Design (RBD) for the analysis of organoleptic properties. Additionally, public appeal was evaluated using the Kruskal-Wallis test.

RESULTS AND DISCUSSION

Water content

The determination of water content in food ingredients is conducted by drying the samples in an oven at a temperature of 105-110°C for 5 hours or until a constant weight is achieved (Daud *et al.*, 2020). The results of the water content tests for chicken nuggets with the addition of vegetables are presented in Table 2. Analysis of variance indicates that the addition of vegetables significantly ($P < 0.05$) increases the water content of the produced nuggets. Notably, the water content of nuggets with broccoli is significantly higher than that of nuggets with other vegetables and those without vegetable additions. This aligns with the National Standardization Agency (2014), which states that the maximum water content in chicken nuggets is 50%, while for combination chicken nuggets, it is a maximum of 60%. Variations in water content among the nuggets are influenced by the ingredients used. Laksono *et al.* (2012) reported that the water content of chicken nuggets increased with the addition of white oyster mushrooms, ranging from 60.06% to 61.19%. Furthermore, Utami *et al.* (2018) noted that nuggets containing 30% chicken meat and 70% carrots-broccoli had a water content of 56.64% and 25.46% carbohydrates.

Protein

Protein plays a crucial role in determining the texture of the produced nuggets. During the steaming process, proteins undergo coagulation, resulting in gel formation within the meat, which contributes to the tenderness of the nuggets (Wellyalina *et al.*, 2015). The results of the analysis of variance in this study indicated that the protein content of chicken nuggets was not significantly ($P > 0.05$) affected by the addition of vegetables during the manufacturing process, with average protein levels ranging from 8.50% to 14.10%. This protein content aligns with the National

Standardization Agency (2014) requirements, which stipulate that chicken nuggets must contain at least 12% protein, while combination chicken nuggets should have a minimum of 9% protein.

Fiber

The results of the analysis of variance indicated that the addition of vegetables to chicken nuggets did not significantly affect ($P>0.05$) the fiber content. The average fiber value obtained in this study ranged from 0.26% to 0.98%. These findings are consistent with previous studies that incorporated vegetables into nugget formulations. For instance, Titdoy *et al.* (2021) reported that the crude fiber content of nuggets containing young galangal stems (*Alpinia galanga*) ranged from 0.52% to 2.62%. Similarly, Shada *et al.* (2022) found that the crude fiber content of chicken nuggets with the addition of up to 40% kalakai filler (*Stenochlaena palustris*) ranged from 0.85% to 1.36%. Permadi *et al.* (2012) noted that the crude fiber content in chicken nuggets with the addition of white oyster mushrooms (*Pleurotus ostreatus*) up to 50% ranged from 2.16% to 6.93%, with the highest fiber content observed in nuggets containing 40% white oyster mushrooms. Vegetables serve as a source of fiber in food, and their incorporation into food mixtures will influence the overall fiber content. Nainggolan and Adimunca (2005) found that the fiber content in vegetables ranges from 1.1% to 3.3%, suggesting that the addition of 10% vegetables to food could contribute approximately 0.11% to 0.33% of dietary fiber.

Table 2. Average water, protein and fiber content of nuggets for each treatment

Treatment	Variable		
	Water content (%)	Protein (%)	Fiber (%)
P0	52.13 ^c ± 1.25	14.08 ± 1.67	0.98 ± 0.30
P1	55.13 ^b ± 0.48	11.03 ± 1.39	0.71 ± 0.71
P2	57.25 ^a ± 0.96	11.73 ± 2.17	0.27 ± 0.30
P3	55.38 ^b ± 0.63	11.35 ± 4.05	0.26 ± 0.31
P4	55.25 ^b ± 0.65	8.61 ± 0.79	0.48 ± 0.27

Description: P0= Chicken nuggets without addition vegetables, P1= Chicken nuggets with addition of carrots, P2= Chicken nuggets with addition of broccoli, P3= Chicken nuggets with addition of Spinach, P4= Chicken nuggets with addition of baby corn. Different superscript letters in the same column indicate significant differences ($p<0.05$).

Organoleptic Properties

The impact of incorporating vegetables (carrots, broccoli, spinach, and baby corn) into chicken nuggets on the panelists' preferences for

color, aroma, texture, and taste is presented in Table 3.

Color

The results of the Kruskal-Wallis analysis indicate that chicken nuggets made with different vegetables significantly affect the panelists' preferences for color ($P<0.05$). The Duncan multiple range test revealed that treatments P0 (without vegetable addition), P1 (with carrot addition), and P2 (with broccoli addition) were significantly preferred compared to the nuggets made with spinach (P3). This suggests that the choice of vegetables impacts the color of the nuggets, even at a 10% inclusion level. These findings align with the study by Tangkere *et al.* (2019), which reported that adding up to 20% carrots to chicken nuggets resulted in a higher preference for color compared to nuggets without carrots or those with only 10% carrots. As the proportion of carrots in the nuggets increased, panelists showed a greater preference for the color, attributed to the orange pigment in carrots enhancing the visual appeal (Susanti *et al.*, 2020). The color of a product is crucial, as it forms the first impression that can significantly influence the acceptance or rejection of the item (Lanusu *et al.*, 2017).

Panelist feedback highlighted the variability in color among treatments, with some nuggets appearing bright and others darker. The highest preference scores for color were observed in treatments P1 and P2, both scoring 4.00, while the lowest score of 3.13 was noted for P3, indicating a low preference for nuggets with added spinach. This finding is consistent with Rasyid *et al.* (2020), who noted that increasing spinach content diminished panelist preference for color, likely due to spinach's natural green pigment (chlorophyll). Excessive spinach can lead to a darker color effect in the final product.

Aroma

The results of the Kruskal-Wallis analysis indicate that chicken nuggets made with different vegetable treatments significantly affected the preference for aroma ($P<0.05$). According to Duncan's multiple range test, nuggets without additional vegetables (P0) had a similar aroma to those supplemented with carrots (P1) and baby corn (P4). This similarity arises from the unique aromas of each vegetable, which can mask the distinctive aroma of chicken meat while introducing a variety of scents.

Table 3. Average preference scores for color, aroma, texture and taste of chicken nuggets with added vegetables

Treatments	Variable			
	Color	Aroma	Texture	Flavor
P0	3.73 ^{ab} ± 1.05	3.90 ^a ± 0.76	3.73 ± 0.87	4.23 ^a ± 0.82
P1	4.00 ^a ± 0.79	4.13 ^a ± 0.63	3.77 ± 0.97	4.10 ^{ab} ± 0.92
P2	4.00 ^a ± 0.87	3.43 ^{bc} ± 0.94	4.13 ± 0.57	3.70 ^{bc} ± 0.70
P3	3.13 ^c ± 1.01	3.30 ^c ± 0.95	3.60 ± 0.86	3.67 ^c ± 0.84
P4	3.40 ^{bc} ± 0.97	3.77 ^{ab} ± 0.73	3.90 ± 0.96	3.97 ^{abc} ± 1.00

Description: P0= Chicken nuggets without addition vegetables, P1 = Chicken nuggets with addition of carrots, P2= Chicken nuggets with addition of broccoli, P3= Chicken nuggets with addition of Spinach, P4= Chicken nuggets with addition of baby corn. Different superscript letters in the same column indicate significant differences ($P < 0.05$) Criteria, Very dislike (1-1.49), dislike (1.50-2.49), normal (2.50-3.49), like (3.50-4.49), very like (4.50-5)

These findings align with the research conducted by Utami *et al.* (2018), which found that adding vegetables to chicken nuggets could effectively reduce the prominence of the chicken meat aroma. Similarly, Aristika *et al.* (2022) reported that the inclusion of moringa leaf flour in nuggets tended to impart a strong aroma, which could overshadow the fragrances of spices and other seasonings used in the preparation, leading to a less aromatic profile overall.

Based on feedback from 30 panelists, the aroma of chicken nuggets with different vegetable treatments varied significantly. The assessment revealed that treatment P1 (addition of carrots) had the highest preference score of 4.13, while treatment P3 (addition of spinach) received the lowest score of 3.30. According to Octaviyanti *et al.* (2017), aroma plays a crucial role in influencing an individual's taste for food. An unpleasant odor can diminish appetite and overall enjoyment of a dish. This aligns with findings from Fitriyani (2013), which indicated that spinach inherently possesses an unpleasant odor that tends to persist even when mixed into processed foods, regardless of the amount used.

Texture

Based on the results of the Kruskal-Wallis analysis, chicken nuggets with different vegetable treatments did not significantly affect the panelists' preference for texture ($P > 0.05$). The lack of significant differences in texture can be attributed to the fine grinding and even mixing of all added vegetables with starchy binders such as tapioca flour, rice flour, cornstarch, sago flour, and wheat flour (Permadi *et al.*, 2012). Additionally, the coating material used, particularly breadcrumbs, contributed to a consistent crispiness across all treatments. Texture is closely associated with touch and includes physical attributes such as hardness and elasticity. Hardness is defined as the force required to compress a material or product, leading to a desired change in its form (Rujiah *et al.*, 2013).

Feedback from the 30 panelists indicated that the texture of the nuggets was relatively similar across treatments, with no observable differences in hardness or elasticity. These findings suggest that the addition of vegetables, even at a level of 10%, did not significantly alter the texture of the nuggets, primarily because all ingredients were finely ground and uniformly mixed.

Flavor

Based on the results of the Kruskal-Wallis analysis, chicken nuggets with different vegetable treatments significantly affected the taste preference value ($P < 0.05$). Duncan's multiple range test indicated that treatment P0 (without added vegetables) was significantly different from treatments P2 (broccoli) and P3 (spinach), while it was relatively similar to P1 (carrots) and P4 (baby corn). Additionally, P2 (broccoli) was comparable to P3 (spinach). This variation is likely due to the distinct flavors of each vegetable, both in their raw state and after cooking. Different vegetables used in each treatment impart unique flavors to the nuggets.

This finding aligns with research by Hastuti *et al.* (2016), which noted that the addition of moringa leaves can alter the specific taste profile of chicken nuggets. Taste is a critical factor influencing consumer acceptance of food products, as it is one of the key determinants of quality, particularly in smoked products (Nursiwi *et al.*, 2013). Comments from the 30 panelists revealed noticeable differences in taste among the nuggets with various treatments. Panelists expressed a preference for the taste of nuggets with added carrots (P1) over those with spinach, while noting no significant difference in taste between nuggets with no added vegetables, broccoli, or baby corn. This observation is consistent with the findings of Hermanaputri *et al.* (2017), which indicated that a higher proportion of spinach resulted in lower preference ratings among panelists. This decrease in preference may be attributed to the naturally

unpleasant taste of spinach, which can dominate the overall flavor profile of the nuggets when used in greater quantities.

CONCLUSION

Based on the results of this study, it can be concluded that the addition of 10% vegetables to chicken nuggets increases the water content of the nuggets without affecting the protein and fiber content or the preference for their texture. Among the vegetables tested, the addition of carrots yielded the highest preference values for aroma and taste.

SUGGESTION

It is recommended that future research explore the effects of reducing the vegetable levels used in nuggets and investigate the incorporation of different types of vegetables to assess their impact on the overall quality and consumer acceptance of the product.

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