
Effects of Moringa Leaf Flour on Duck Meat Nuggets as a Functional Food for Toddlers**Sari Gando Hidayati¹, Zasmeli Suhaemi², Husmaini³ and Eti Yerizal³**

Tamansiswa University, Nahdlatul Ulama West Sumatera University, Andalas University

emizasmeli@gmail.com

Abstract

This study examined the effect of Moringa Leaf Flour (MLF) on the quality of nuggets made from local duck meat. Its known offers higher nutritional value than chicken meat, particularly its iron content, which meets about half of adult's daily needs. The experiment applied a completely randomized design with four MLF doses (0.0%, 0.5%, 1.0% and 1.5%) with five replications, and also compared duck and chicken nuggets. Measurements included proximate composition (crude protein and fat) and sensory attributes (taste, texture, color). Increasing MLF dose tended to enhance crude protein and decrease lipid content, though not significantly. However, MLF significantly improved sensory characteristics. These finding indicate that MLF can serve as a functional additive to enhance the sensory quality of duck meat nugget while modestly supporting their nutritional profile.

Keywords moringa, functional food, local duck meat, toddler, nugget

A. Introduction

One of the meat that commonly people consumptions is duck meat. The composition of meat's nutrition is fairly comparable with chicken meat (Adzitey et al., 2012). Some researches reported that duck meat contains a high mineral especially substance iron and selenium, with lower calories and higher protein than the meat of chicken (El-moursi et al., 2012). The mineral content especially iron, which can meet about 50% of the daily needs of an adult's body compared to chicken meat which is only 9%. Duck meat also contains high levels of vitamins B, C and antioxidants, while it is not found in chicken meat (Suhaemi et al., 2023).

The development of understanding about functional compounds in food make consumer awareness about health. The development of this understanding also plays a role in shaping food modification trends with additional attributes in the form of health functions (Olmedilla-Alonso et al., 2013).

Innovations making of duck nugget with the addition of Moringa leaves is expected to improve duck meat quality that high benefits as a functional food such as for stunting, which also will further enhance the economic value of ducks.

B. Literature Review and Hypothesis Development

Ducks meat also can be used to create multiple products such as meatballs and sausage (Huda et al., 2010; Huda et al., 2011). But levels of pleasure people towards duck meat is generally much lower when compared to chicken meat. The off-odor meat of duck is more pungent than chicken meat (Lestari et al., 2015). The color of the meat become too dark when it was cooked, with pungent smell and the tough texture of the meat become obstacles in processing duck meat (Dinasih et al., 2017). One of products based on meat is Nugget, the restructured processed ground meat with seasoned, then covered with flour gluten, loosened breadcrumbs (breading), and half- cooked and then frozen to maintain its quality during storage. Researcher reported that nugget of ducks can be accepted by people but has not been fully able to substitute chicken meat, because the taste and the colour aspect they are less attractive compared with chicken nuggets (Putri et al., 2019).

Moringa oleifera leaf was rich in minerals, vitamins and phytochemical content. Moringa leaf extract is widely used in many experiments in the field of malnutrition, accelerating breastfeeding. Also has the potential as antioxidant, anti-cancer, anti-inflammatory, anti-diabetic and anti-microbial properties (Gopalakrishnan et al., 2016). Based on the phytochemical test, Moringa leaves positively contain flavonoids (Immy et al., 2015). Each part of the Moringa oleifera plant has varied chemical content, the leaves, seeds and flowers of this plant are widely used as ingredients for functional food (food fortificant) like in making bread, biscuits, yogurt, cheese or soup (Oyeyinka & Oyeyinka, 2016). Moringa also contains a lot of antioxidants. Food that contains highly antioxidants are recommended to maintain immune function and reduce the risk of cardiovascular disease (Thomas et al., 2010). Laboratory analysis of Moringa leaves also showed a protein content of 33.89% in dry matter with 239.42 antioxidants. Previous studies reported that the best parts of the Moringa plant, with the best nutritional and phytochemical content was in Moringa leaf (Gopalakrishnan et al., 2016); (El-moursi et al., 2012). Moringa oleifera leaf flour which contains a substance active antioxidant and antibacterial, considered to be able to improve performance and prevent damaging the internal organs which good influences both for metabolism and absorption of nutrients in the body that can trigger body growth.

Moringa leaves as fortification in food have been done before in making cookies, with wheat flour as the basic ingredients (Dewi, 2016). The use of Moringa leaves in making wet noodles has also been carried out (Zakaria et al., 2016).

Based on the information above, it is suspected that using duck meat as the main ingredient in nuggets and moringa leaf powder as an additive will increase the nutritional value without reducing the organoleptic quality.

C. Research Method

Procedures

Twenty panellists among Tamansiswa University student were chosen randomly as judges to evaluate taste, texture and, colour. The sample were coded using three-digit random number and presented randomly. Five point hedonic scales were used for the sensory evaluation of nugget, on which a score of one equals “dislike extremely”, and a score of two equals “dislike”, and a score of three equals “almost dislike”, than a score of Four equals “like”, while a score of five is “like extremely”.

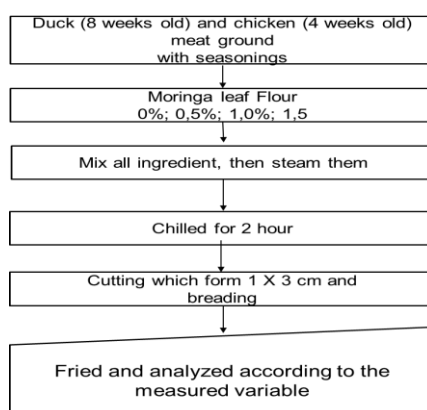


Figure 1. Flow chart for research methods

Data analysis

Nugget products are identical to chicken nuggets, so in this study it was also used as a research sample for making chicken nuggets (CN) with the addition of Moringa leaf flour in addition to duck meat nuggets (DN). The steps taken in this study are explained through the chart in Figure 1.

Research is using analysis of variance (ANOVA) were arranged in a completely randomized design (CRD) with treatment dose of Moringa leaf flour (MLF) which consists of four doses: 0.0; 0.5; 1.0; and 1.5 %, continued with Duncan Multiple Range Test if ANOVA resulted significantly different (Suhaemi, 2011).

The variables measured in this study consisted of two parts, namely nutritional content (total cholesterol, gauze protein and crude fat) and organoleptic value (taste, texture and color). The average organoleptic value of the research nuggets was transformed with $\sqrt{Y} + 0.5$ before being tested by ANOVA. Organoleptic test assessments (taste, texture and color) are described in Table 1.

Table 1 . Organoleptic test score value

Score	Color	Taste	Texture
5	Yellow nuggets	Really like	Really like
4	Brownish yellow	Like	Like
3	Chocolate	Do not like it much	Do not like it much
2	Brown bit dark	Don't like it	Don't like it
1	Dark brown	Very do not like	Very do not like

D. Discussion

Nutrition content of nuggets

The effect of adding MLF in making nuggets on crude fat content. Increasingly higher doses of the addition of MLF real lowering the content of fat coarse nugget both CN and DN , but the content of fat rough CN is higher than the DN for all treatments the addition of MLF. In contrast to the results of total cholesterol and crude fat content, the addition of MLF derived from Moringa oleifera leaves will actually increase the crude protein content. Nuggets of meat ducks (DN), has a content of protein rough that is higher than the nugget of chicken (CN). The effect of adding MLF in making nuggets on crude fat lowering the content of fat coarse nugget both CN and DN, but the content of fat rough CN is higher than the DN for all treatments the addition of MLF. The protein content of nuggets with the basic ingredients of chicken and duck meat is shown in Figure 2. In contrast to the results of total cholesterol and crude fat content, the addition of MLF derived from Moringa oleifera leaves will actually increase the crude protein content. Nuggets of meat ducks, has a content of protein rough that is higher than the nugget of chicken.

The nutrition contents of nugget with chicken and duck meat are given in Figure 2. There are highly significant different ($p < 0,01$) for cholesterol total and crude fat contents, but not significantly different for crude protein content while the percentage of crude protein increased. The crude fat content was in range of 1.48 – 3,81% for duck nugget, and 2.06 – 4.08% for chicken nugget. The cholesterol total of nuggets, there are range of 31.2 – 55.3 mg/100g for duck nuggets, and 34.0 – 55.3 mg/100g for chicken nuggets. The other nutrition is crude protein, there are range of 14,26 – 14,62 % for duck nuggets, and 13,42 – 13,87 % for chicken nuggets.

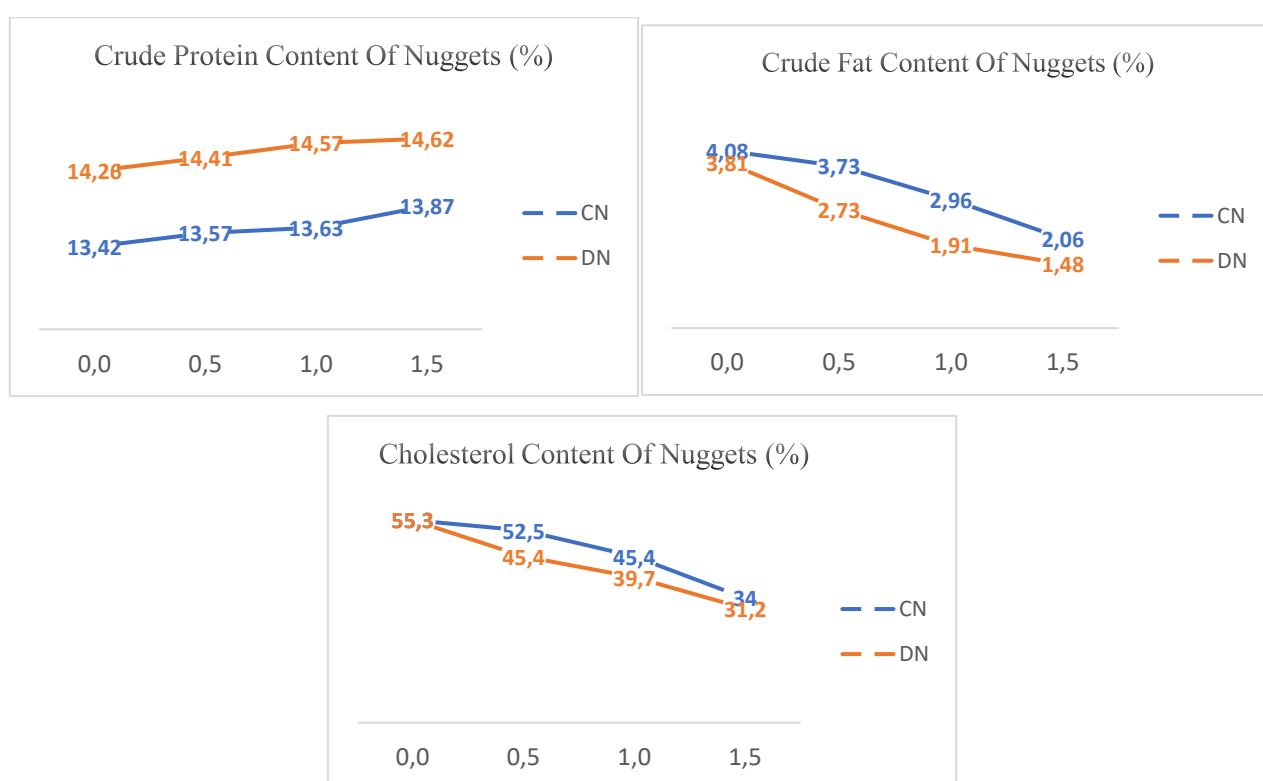


Figure 2. Nutrition content of nuggets for differences additional of MLF

When compared between CN and DN, it turns out that the total cholesterol content of DN is lower than CN (Figure 2) in line with the crude fat content of the nuggets. ANOVA results showed that the dose of MLF would have a very significant effect on the total cholesterol and crude fat content of nuggets, both CN and DN. Based on the inter-treatment test, there was also a significant difference in the total cholesterol and crude fat content of the nuggets for each additional MLF dose from 0.0% to 1.5%.

Previous research results reported that *Moringa oleifera* Lam leaves contain high bioactive substances including saponins, which can reduce the total cholesterol content of food products. (Vázquez-León et al., 2017). This was also reported by other studies, that the results of the phytochemical analysis of *Moringa oleifera* Lam leaves. contains saponins which have a hypolipidemic effect (blood fat lowering effect) which is useful for reducing cholesterol activity (Saini et al., 2016). Cholesterol in the blood is transported by low density lipoprotein (LDL) to be recycled in the liver and then stored in the gallbladder as bile acids. The more fat digestibility, the more bile salts needed and consequently will lower cholesterol levels (Citrawidi et al., 2012).

The above results are also supported by research which reports that the fat content of duck meat is lower than chicken meat (Adzitey et al., 2012). The crude protein content of the nuggets will increase as the addition of MLF in the ingredients for making them. This is because many studies have reported that *Moringa oleifera* leaves contain high protein and amino acids up to 30.3% with 19 amino acids. (Moyo et al., 2011).

Sensory evaluation

For sensory evaluation, twenty panelist were present to evaluate the taste, texture and color. The results of the sensory evaluation show that there were highly significant differences ($P < 0,01$) among the four treatments, 0.0%, 0.5%, 1.0% and 1.5% additional MLF. Taste sensory-evaluation scale of nugget were in the range 3.70 – 4.06 for duck nugget and 4.20 – 4.82 for chicken nugget. Texture sensory was in the range of 2.87 – 3.67 for duck nugget and 3.64 – 4.62 for chicken nugget and color was in the range of 3.02 – 4.14 for duck nugget and 3.96 – 4.91 for chicken nugget.

Table 2. Scale of sensory attributes of nuggets for differences additional of MLF

MLF Doses (%)	Taste		Texture		Color	
	Duck nuggets	Chicken nuggets	Duck nuggets	Chicken nuggets	Duck nuggets	Chicken nuggets
0.0	3.82±0.60 ^a	4.82±0.39 ^a	2.87±0.52 ^a	4.62±0.49 ^a	4.14 ^a ±0.60	4.91 ^a ±0.27
0.5	4.06±0.59 ^b	4.82±0.39 ^a	3.67±0.60 ^b	4.31±0.65 ^b	3.84 ^b ±0.59	4.68 ^b ±0.47
1.0	3.74±0.59 ^b	4.70±0.45 ^b	3.42±0.54 ^c	3.97±0.62 ^c	3.61 ^c ±0.53	4.12 ^c ±0.59
1.5	3.70±0.46 ^c	4.20±0.40 ^c	3.04±0.35 ^d	3.64±0.48 ^d	3.02 ^d ±0.46	3.96 ^d ±0.35

Means within a column with different superscript are highly significant different ($P < 0,01$)

The results of the organoleptic test obtained the taste, texture and color values as shown in Tables 2. These results illustrate that the taste, texture and color values of chicken nuggets are higher than that of duck nuggets. The addition of MLF for the four treatments gave a decrease in all measured organoleptic values, especially for the color value, but the taste value did not give a big decrease even though the ANOVA results and the follow-up test were all significantly different.

The average preference rating for taste was on a scale of 3.82 to 3.70 for duck nuggets, while the score for chicken nuggets as a whole was higher for treatment. Based on Table 5, the taste value of duck nuggets is still close to the like category, while for chicken nuggets all treatments of adding MLF are on a scale between like to very like. The higher the percentage of addition of MLF, the lower the value of the nugget flavour scale. This is in line with other studies on the manufacture of jelly candy using MLF, the increase in MLF use resulted in a decrease in the panellist's preference. (Rahmawati & Adi, 2017).

The texture of the duck nuggets without the addition of MLF (0.0%) produced the lowest scale (2.87), and increased with the addition of 0.5% MLF, then decreased again in the addition of 1.05 and 1.5%. This shows that the addition of MLF helps decrease the density of the nuggets produced, but the addition of 1.0% and above actually results in a decreased texture scale, but still on a scale of 3 and above (less like to like).

The use of duck meat for making nuggets has previously been studied. Researcher reported that nugget of ducks can be accepted by people but has not been fully able to substitute chicken meat, because the taste of duck nuggets already reached the level preferred by the panellists, but for the colour aspect they are less attractive compared with colour chicken nuggets (Putri et al., 2019). Other relevant research reports that the addition of *Moringa oleifera* leaves in the manufacture of wet noodles, reduces the organoleptic value which includes taste, colour, texture and aroma (Zakaria et al., 2016). Likewise, research on making cookies with the addition of *Moringa oleifera* leaves (Dewi, 2016).

E. Conclusion

The higher the dose of *Moringa* leaf flour can increase the Crude Protein content, and reduce crude fat and total cholesterol from the nuggets. The nutritional content of duck meat nuggets is better than chicken nuggets, although the taste and texture of the duck nuggets are

lower, but they are still in the preferred category with a score of close to 4 (preferred), with a color value scoring between 3 and 4 (brown - brownish yellow).

Bibliography

- Adzitey, F., Rusul, G., & Huda, N. (2012). Prevalence and antibiotic resistance of Salmonella serovars in ducks, duck rearing and processing environments in Penang, Malaysia. *Food Research International*, 45(2), 947–952. <https://doi.org/10.1016/j.foodres.2011.02.051>
- Citrawidi, T., Murningsih, W., & Ismadi, V. D. Y. . (2012). The Effect Of Ripening Feed With Papaya Leaf Essence On Blood Cholesterol And Total Fat In Broilers. *Animal Agriculture Journal*, 1(1), 529 – 540. <https://ejournal3.undip.ac.id/index.php/aaj/article/view/723>
- Dewi, F. K. (2016). *Pembuatan Cookies dengan Penambahan Tepung Daun Kelor (Moringa oleifera) pada Berbagai Suhu Pemanggangan* (Skripsi). Program Studi Teknologi Pangan, Fakultas Teknik Universitas Pasundan. <http://repository.unpas.ac.id/26615/1/Artikel.pdf>
- Dinasih, E., R, H., & N, H. (2017). Kualitas Sensoris Daging dari Itik Lokal Jantan (Anas platyhrinchos) yang Diberi Larutan Daun Sirih (Pipper betle linn) dalam Pakan Komersil. *Jurnal Peternakan Nusantara*, 3(1), 1–10.
- El-moursi, A., Talaat, I. M., & Bekheta, M. A. (2012). Physiological response of Moringa oliefera to stigmasterol and chelated zinc. *Nusantara Bioscience*, 4(3), 118–123. <https://doi.org/10.13057/nusbiosci/n040306>
- Gopalakrishnan, L., Doriya, K., & Kumar, D. S. (2016). Moringa oleifera: A review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 5, 49–56. <https://doi.org/10.1016/j.fshw.2016.04.001>
- Huda, N., Lin, O. ., Ping, Y. ., & Nurkhoeriyati, T. (2010). Effect Of Chicken And Duck Meat Ratio On The Properties Of Sausage. *Int. J. Poult. Sci.*, 9(6), 550–555.
- Huda, N., Putra, A. ., & Ahmad, R. (2011). Potential Application Of Duck Meat For Development Of Processed Meat Products. *Poult. Sci.*, 1(1), 1–11.
- Immy, S. R., Aryanti, E., & Suropto. (2015). Phytochemical content of some of local plant species frequently used as raw materials for traditional medicin. *Seminar Nasional Masyarakat Biodiversity Indonesia*, 1(2), 388–391. <https://doi.org/10.13057/psnmbi/m010237>
- Lestari, F., Jakaria, & Rukmiasih. (2015). Sensori dan Karakteristik Asam Lemak Daging Itik Cihateup, Alabio dan Silangannya. *Jurnal Sains Terapan Edisi V*, 5(1), 17.
- Moyo, B., Masika, P. J., Hugo, A., & Muchenje, V. (2011). Nutritional characterization of Moringa (Moringa oleifera Lam.) leaves. *African Journal of Biotechnology*, 10(60), 12925–12933. <https://doi.org/10.5897/ajb10.1599>
- Olmedilla-Alonso, B., Jiménez-Colmenero, F., & Sánchez-Muniz, F. J. (2013). Development and assessment of healthy properties of meat and meat products designed as functional foods. *Meat Science*, 95(4), 919–930. <https://doi.org/10.1016/j.meatsci.2013.03.030>
- Oyeyinka, A. T., & Oyeyinka, S. A. (2016). Moringa oleifera as a food fortificant: Recent trends and prospects. *Journal of the Saudi Society of Agricultural Sciences, Open acces*. <https://doi.org/10.1016/J.JSSAS.2016.02.002>
- Putri, W. A., Wibowo, S., & Silitonga, L. (2019). Kualitas Kimia dan Nilai Organoleptik Nugget Daging Itik dengan Menggunakan Bahan Pengisi yang Berbeda Chemical Quality and Organoleptic Value of Duck Meat Nuggets with Various Fillers. *Jurnal Ilmu Hewani Tropika*, 8(1), 36–41.
- Rahmawati, P. S., & Adi, A. C. (2017). Daya Terima Dan Zat Gizi Permen Jeli Dengan Penambahan Bubuk Daun Kelor (Moringa Oleifera). *Media Gizi Indonesia*, 11(1), 86. <https://doi.org/10.20473/mgi.v11i1.86-93>
- Saini, R. K., Sivanesan, I., & Keum, Y. S. (2016). Phytochemicals of Moringa oleifera: a review of their nutritional, therapeutic and industrial significance. In *3 Biotech* (Vol. 6, Issue 2). <https://doi.org/10.1007/s13205-016-0526-3>
- Suhaemi, Z. (2011). *Diktat metode penelitian dan rancangan percobaan*. Fakultas Pertanian Universitas Tamansiswa.

- Suhaemi, Z., & Dkk. (2020). *Penambahan Tepung Daun Kelor Dalam Pembuatan Nugget Daging Itik Sebagai Pangan Fungsional Alternatif Guna Menurunkan Prevalensi Stunting Di Sumatera Barat*. Laporan Penelitian INSINAS.
- Suhaemi, Z., Fati, N., & Manullang, J. R. (2017). Production Potential of Local Duck in West Sumatera for Healthy Food and Conservation. *International Journal of Poultry Science, Accepted*.
- Suhaemi, Z., Sabrina, S., Yessirita, N., Fati, N., Febriani, F., & Malik, B. (2023). Production potential of the first generation of selected Pitalah and Bayang ducks as a community economic resource in West Sumatra. *Journal of Advanced Veterinary and Animal Research*, 10(3), 378–384. <https://doi.org/10.5455/javar.2023.j690>
- Suhaemi, Z., Ulama, N., & Sumatera, W. (2023). The Quality Improvement of Moringa Leaf Food Processing Innovation to Gain Stunted Toddlers ' Body Mass Through Digital Literacy in Padang. *The 5th International Conference on Technology, Education and Sciences, October*.
- Thomas, R. H., Bernards, M. ., Drake, E. E., & Guglielmo, C. G. (2010). Changes in the antioxidant activities of seven herb and spice based marinating sauces after cooking. *Journal of Food Composition and Analysis*, 23(3), 244–252.
- Vázquez-León, L. A., Páramo-Calderón, D. E., Robles-Olvera, V. J., Valdés-Rodríguez, O. A., Pérez-Vázquez, A., García-Alvarado, M. A., & Rodríguez-Jimenes, G. C. (2017). Variation in bioactive compounds and antiradical activity of Moringa oleifera leaves: influence of climatic factors, tree age, and soil parameters. *European Food Research and Technology*, 243(9), 1593–1608. <https://doi.org/10.1007/s00217-017-2868-4>
- Zakaria, Nursalim, & Tamrin, A. (2016). Pengaruh Penambahan Tepung Daun Kelor Terhadap Daya Terima Dan Kadar Protein Mie Basah. *Media Gizi Pangan*, 21(1), 73–78. <http://mediagizipangan.org/wp-content/uploads/2017/03/12.-zakaria.pdf>