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Identification of Chemical Components in Namo-Namo Fruit (*Cynometra cauliflora* L.) from Halmahera Island and its Potential as a Broiler Chicken Feed Addition

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ABSTRACT

Background: To support the sustainability of the broiler industry, the presence of AGP alternatives is urgently needed. Several alternatives to AGP have been recommended, one of which is the use of plant extracts as feed additives. This study sought to ascertain the chemical content of the namo-namo fruit from Halmahera Island and its impact on the performance and carcass attributes of broiler chickens.

Methods: The nutritional content, total phenol and flavonoid levels and antioxidant activity of the Namo-namo fruit extract were analyzed. The *in vivo* experiment involved 250 broiler chicks divided into five treatments: control (without namo-namo fruit extract); 0.25 ml, 0.50 ml, 0.75 ml and 1 ml/kg feed containing namo-namo fruit extract. Body weight and feed intake were measured every week and carcass and internal organ assessments were performed on day 35.

Result: In comparison to the control group, the groups that received the namo-namo fruit extract showed significantly higher body weight gain, feed consumption and feed conversion ($p<0.05$). The broiler chickens' internal organ weights and carcass percentages did not differ significantly ($p>0.05$). Because it enhances performance without adversely impacting the features of the broiler carcass, it can be utilized as a feed additive for broiler chickens. The namo-namo fruit extract from Halmahera Island is found to contain phenols and flavonoids at 1.98 g/100 g and 2.01 g/100 g, respectively.

Key words: Broiler, Carcass characteristics, Feed additives, Namo-namo fruit, Performance.

INTRODUCTION

The ban on antibiotic growth promoters (AGP) in the broiler industry has had negative impacts on the growth and health of broiler chickens, threatening the sustainability of broiler production (Prasetyo *et al.,* 2020). To support the sustainability of the broiler industry, the presence of AGP alternatives is urgently needed. Several alternatives to AGP have been recommended, one of which is the use of plant extracts as feed additives. The use of plant extracts as natural additives in poultry feed has increased in recent years, owing to their bioactive components, which are reported to improve production performance, reduce pathogenic bacteria and lower antibiotic residues in meat and eggs (Omar *et al*., 2016; Jin *et al*., 2020). According to reports, adding plant extracts to poultry feed can improve meat quality, raise body weight and improve nutrient metabolism by reducing cholesterol and preventing the production of peroxide (Sapsuha *et al*., 2021; Sugiharto *et al*., 2022).

Halmahera Island is the largest island in North Maluku Province, Indonesia, known for its rich biodiversity. The flora of Halmahera includes various plant species that have long been utilized by the local population, particularly indigenous communities, for traditional medicine (Irmayanti *et al*., 2022). One of the plant species found on Halmahera Island is Namo-namo (*Cynometra cauliflora* L.). In Indonesia, the name "namo-namo" is used by the people of Ternate, North Maluku Province, to refer to this plant (Fig 1). However, different regions in Indonesia have their own names for the fruit, such as *pukih* (Sunda), *namu namu* (Makassar), *puci anggih* (Bima) and *kuwanjo* (Bali). The Namo-namo plant has distinctive features that differentiate it from other plants, including zigzag-shaped branches with an orderly arrangement, leaves that are pale pink when young and glossy dark green when mature and flat coin-shaped seeds located in the center of its flowers, which are pink in color (Suprayogi *et al*., 2020).

Triterpenoids, flavonoids and saponins have been found in ethanol extracts of Namo-namo fruit in earlier research. The ethanol extract of Namo-namo fruit also has

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antioxidant capacity with an IC50 value of 125.89 ìg/mL and antibacterial activity against foodborne pathogens *S. aureus* and *E. coli*, with inhibition zones of 11.43 mm at a concentration of 20% (Ulpiyah *et al*., 2019; Anliza *et al*., 2021). The growing location can influence the composition and bioactive content of each plant, leading to variability in its effects on livestock performance and growth (Sugiharto, 2016). To date, the bioactive content and composition of the Namo-namo plant from Halmahera Island, as well as its effects on broiler performance, have not been studied. Based on these issues, it is necessary to conduct research to identify the chemical composition of Namo-namo fruit from Halmahera Island and its potential as a feed additive for broiler chickens.

MATERIALS AND METHODS

Preparation of namo-namo fruit extract

Namo-namo fruit was collected from the forests of Halmahera Island in North Maluku Province, Indonesia. The fruit was washed with running water, sliced thinly and dried at room temperature. A blender was used to grind the dried fruit into a powder. It is anticipated that the small particle size (powder form) will maximize the extraction of bioactive components by increasing the surface area in direct contact with the solvent. The Namo-namo fruit powder was placed in an Erlenmeyer flask and methanol was added at a 1:4 ratio (w/v). The mixture was macerated at room temperature for three days, with daily stirring. On the fourth day, a rotary vacuum evaporator was used to evaporate the mixture after it had been filtered through Whatman filter paper, yielding a thick Namo-namo fruit extract (Ado *et al*., 2019).

Phytochemical composition and antioxidant activity of namo-namo fruit extract

The Namo-namo fruit extract was analyzed for its complete proximate nutrient content based on AOAC (2007). methods. The Folin-Ciocalteu method (Sahreen *et al*., 2010) was used to assess the total phenol content and spectrophotometry was used to determine the total flavonoids (Mayur *et al*., 2010). The 2,2-diphenyl-1-picrylhydrazyl hydrate (DPPH) test was used to measure antioxidant activity (Sochor *et al*., 2010). Antibacterial activity against *E. coli* was tested using the disc diffusion (Kirby-Bauer) method.



Fig 1: Namo-namo (*Cynometra cauliflora* L.).

In vivo experiment

This study was approved by the Universitas Khairun Faculty of Agriculture's Animal Ethics Committee (No. 019/KEPH/PH/2024). Between 0 and 7 days of age, 250 unsexed Lohmann broiler chicks were grown together on commercial feed. On day eight, the broilers (147±2.64 g) were divided into five treatments at random, each of which was duplicated five times: T0 (basal feed without Namo-namo fruit extract), T1 (basal feed + 0.25% Namo-namo fruit extract), T2 (basal feed + 0.50% Namo-namo fruit extract), T3 (basal feed + 0.75% Namo-namo fruit extract) and T4 (basal feed + 1% Namo-namo fruit extract). The feed, which came in mash form, was prepared as finisher feed (days 22-35) and starting feed (days 8-21) (Table 1). Up till day 35, food and water were given freely. On day four, all chickens received eye drops of a commercial Newcastle disease (ND) vaccination; on day eighteen, they received drinking water; and on day twelve, they received drinking water containing the Gumboro vaccine. The hens were housed in ventilated broiler houses with sawdust for bedding during the raising phase.

Body weight, feed consumption and feed conversion ratio (FCR) were recorded weekly. On day 35, one chick per replicate, with a body weight representing the average of each replicate, was selected, slaughtered, defeathered and eviscerated. The internal organs were taken out and weighed when they were empty. Measurements were also taken of the commercial and broiler carcasses.

Analysis of variance was used to statistically evaluate the data (SPSS version 25.0). Duncan's test was used to identify significant differences between treatments if the treatment had a significant effect ($p<0.05$) on the measured parameters.

RESULTS AND DISCUSSION

The phytochemical makeup and antioxidant activity of namo-namo fruit extract

Natural compounds called phytobiotics or phytogenics are extracted from plants and added to feed to increase the productivity and health of animals. Phytobiotics include various compounds such as essential oils, plant extracts and spices, which possess antimicrobial, antioxidant and anti-inflammatory properties. The use of phytobiotics in the livestock industry is increasingly popular due to their ability to replace antibiotics as growth promoters (Sugiharto 2016). The phytochemical makeup and antioxidant capacity of the Namo-namo fruit extract from Halmahera Island are displayed in Table 2. Phytochemical analysis indicated phenol and flavonoid contents of 1.98 g/100 g and 2.01 g/100 g, respectively. Our study also showed that Namo-namo fruit from Halmahera Island exhibited antioxidant activity with an IC50 of 4.72 (2,2-diphenyl-1-picrylhydrazyl hydrate, DPPH).

The Namo-namo fruit from Halmahera Island has an IC50 for antioxidant activity and contains bioactive substances like flavonoids and phenols. These results are in line with earlier research showing that the Namo-namo plant exhibits potent antioxidant activity and phytochemical content (Abd Aziz *et al*., 2017; Suprayogi *et al*., 2020). The bioactive compounds in plants are reported to be highly beneficial for animal health and productivity. By enhancing digestive enzymes and the absorption of vital nutrients, certain bioactive substances-like saponins, tannins and flavonoids-can improve digestive efficiency and have a good effect on cattle growth (Bera *et al*., 2019; Perin *et al*., 2019; Zhang *et al*., 2017).

Table 1: Feed compositions of broilers as starter (days 1-21) and finisher (days 22-35).

Items	%, unless otherwise noted	
	Starter (days 1-21)	Finisher (days 22-35)
Yellow corn	56.54	62,78
Soybean meal	36.35	30,11
Palm oil	2.45	2,45
DL-methionine	0.33	0,33
Bentonite	.,2	1,2
Limestone	1.22	1,22
Monocalcium phosphate	1.38	1,38
Premix1	0.18	0,18
Chlorine chlorite	0.08	0,08
NaCl	0.27	0,27
Nutrient contents:		
Metabolizable energy (kcal/kg)2	2,946	3,053
Crude protein (%)	21.20	19.45
Crude fiber (%)	3.67	3.16
Crude fat (%)	4.12	4.25

[1]Premix contained (per kg of diet) of vitamin A 7,750 IU, vitamin D3 1,550 IU, vitamin E 1.88 mg, vitamin B1 1.25 mg, vitamin B2 3.13 mg, vitamin B6 1.88 mg, vitamin B12 0.01 mg, vitamin C 25 mg, folic acid 1.50 mg, Ca-d-pantothenate 7.5 mg, niacin 1.88 mg, biotin 0.13 mg, Co 0.20 mg, Cu 4.35 mg, Fe 54 mg, I 0.45 mg, Mn 130 mg, Zn 86.5 mg, Se 0.25 mg, L-lysine 80 mg, Choline chloride 500 mg, DL-methionine 900 mg, CaCO3 641.5 mg, Dicalcium phosphate 1500 mg.

Table 2: pH, chemical and functional compositions and antibacterial activity of namo-namo fruit extract from Halmahera island.

Items	Values
Moisture (%)	53.28
Ash (%)	0.18
Fat (%)	9.32
Proteins (%)	0.78
Carbohydrates (%)	28.97
Total phenolics (g/100 g)	2.01
Flavonoids (g/100 g)	1.98
DPPH radical scavenging activity (IC50 [µg/mL])	4.72
pH	3.16
Antibacterial activity against *E. coli* (mm)	12.16

The results of the antibacterial inhibition test of the Namo-namo fruit extract using the disc diffusion method (Kirby-Bauer) against *E. coli* growth showed an inhibition zone of 12.16 mm (Table 2), indicating that the Namo-namo fruit extract has moderate inhibitory activity against *E. coli* growth. The study by Ulpiyah *et al.* (2019) demonstrated that the leaves of the Namo-namo fruit could inhibit the growth of the pathogenic bacterium *Porphyromonas gingivalis*, while the study by Abd Wahab *et al*. (2019) showed that ethanol extracts of *C. cauliflora* leaves could serve as a potential antibacterial agent due to the presence of active antibacterial compounds.

Performance of broiler chicken growth

According to this study, broiler chicken body weight gain was significantly ($p<0.05$) increased when Namo-namo fruit extract from Halmahera Island was added to diet (Table 3). There are currently no studies in the literature that describe how Namo-namo fruit extract affects the body weight gain of broilers. Nonetheless, the synergistic activity of the fruit's many phytochemicals, including flavonoids and phenols (Table 2), is probably what makes Namo-namo fruit extract so powerful. This, in turn, enhances the physiological circumstances of the hens. According to reports, phytochemicals including phenols and flavonoids support the preservation of the microbial equilibrium in the broiler's digestive system, thereby enhancing nutrient absorption and chicken health, which leads to better feed utilization and efficiency. Moreover, previous studies have shown that Namo-namo fruit has antibacterial properties (Ulpiyah *et al.,* 2019), antifungal properties (Suprayogi, 2020), antiviral properties (Abd Wahab *et al.,* 2021), antimicrobial properties (Abd Wahab *et al.,* 2019) and antioxidant properties (Abd Aziz *et al.,* 2017; Ado *et al.,* 2019; Samling *et al.,* 2022), which can improve the development performance of broiler chickens by promoting the growth of good bacteria, deactivating harmful bacteria and speeding up metabolism and nutrient absorption in the digestive tract.

Better feed usage is demonstrated by the increase in feed conversion seen in broiler chickens fed Namo-namo fruit extract from Halmahera Island as opposed to the control group (T0). better digestion, especially protein digestion, through higher digestive enzyme activity is probably the cause of the better feed conversion in broilers fed Namo-namo fruit extract (Salgado-Tránsito *et al.,* 2011). Because the bioactive chemicals in plant extracts lead to increased body weight in chickens, previous research has suggested using plant extracts as phytobiotics in broiler feed to boost growth (Basit *et al.,* 2020; Zaikina *et al*., 2022). The use of Namo-namo fruit extract may enhance feed consumption, which in turn can lead to increased body weight. The increase in feed consumption is likely due to the flavonoid and phenol content in the Namo-namo fruit extract, which can improve the flavor of the feed, thereby increasing its palatability and stimulating the chickens'

appetite (Sugiharto, 2016; Sapsuha *et al.,* 2022). An interesting finding was observed regarding the feed conversion ratio (FCR) of broilers. In this study, the inclusion of 1% Namo-namo fruit extract in the feed significantly (p<0.05) reduced the FCR of broilers, indicating improved feed efficiency. This suggests that feeding broilers with Namo-namo fruit extract from Halmahera Island does not adversely affect the digestibility of the chickens.

Weight of internal organs and characteristics of the broiler chicken carcass

The weight of the internal organs of broiler chickens was not significantly affected (p>0.05) by the administration of Namo-namo fruit extract from Halmahera Island, according to the results (Table 4). This indicates that the use of Namo-namo fruit extract does not affect the health of broilers. The relative weight of the internal organs of broiler chickens was unaffected by the addition of telang flower extract to feed, according to Sapsuha *et al*. (2023), who discussed the use of herbal plants in feed. Age, strain type and environmental factors like feed and management techniques can all affect how much weight the internal organs of broilers weigh. According to other research, giving broilers cashew, nutmeg pulp, or bilimbi had no influence on the relative weight of their internal organs (Mareta *et al*., 2020; Sapsuha *et al*., 2021; Martínez *et al*., 2021).

According to the study's findings, broiler chickens' carcass % and commercial carcass cuts were unaffected (p>0.05) by the addition of Namo-namo fruit extract from Halmahera Island (Table 5). According to Mareta *et al*. (2020),

Table 3: Performance of broilers chickens.

Items	Treatment groups					SE	*p* value
	CONT	NFE0.25	NEF0.50	NEF0.75	NEF1.00		
Initial BW (g)	147.48	146.89	147.65	147.78	146.92	1.34	0.42
Final BW (g)	1524.34^{a}	1598.97^{b}	1642.11^{c}	1673.23^{d}	1711.08^{d}	45.85	<0.01
Weight gain (g)	1376.48^{a}	1452.08^{b}	1494.46^{c}	1525.45^{d}	1564.16^{d}	65.12	<0.01
Accumulative FI (g)	2410.24^{a}	2476.18^{b}	2489.62^{b}	2524.65^{c}	2565.72^{c}	31.27	<0.01
FCR	1.75^{a}	1.70^{b}	1.66^{c}	1.65^{c}	1.64^{c}	1.73	0.03

^{a,b,c,d,e} On the same row, different superscripts indicated a significant variation (p<0.05) SE: standard error, FI: feed intake, BW: body weight, FCR: feed conversion ratio.

Table 4: Organs weight of broiler chicks fed treatment diets.

Items	Treatment groups					SE	*p* value
(% live weight)	CONT	NFE0.25	NEF0.50	NEF0.75	NEF1.00		
Liver	2.54	2.45	2.56	2.32	2.14	0.34	0.22
Heart	0.65	0.98	0.79	0.82	0.79	0.60	0.28
Proventriculus	0.55	0.52	0.55	0.56	0.33	0.04	0.32
Gizzard	1.44	1.36	1.52	1.43	1.34	0.36	0.41
Pancreas	0.28	0.32	0.30	0.27	0.29	0.06	0.12
Cecum	0.67	0.57	0.63	0.65	0.61	0.14	0.16
Spleen	0.10	0.07	0.08	0.09	0.11	0.05	0.17
Thymus	0.15	0.16	0.14	0.15	0.16	0.06	0.21
Bursa febricus	0.08	0.09	0.10	0.08	0.10	0.08	0.22

SE: Standard error.

Table 5: Carcass traits of broiler chicks fed treatment diets.

Items	Treatment groups					SE	*p* value
	CONT	NFE0.25	NEF0.50	NEF0.75	NEF1.00		
(% live weight)							
Carcass	66.63	66.78	66.61	67.02	66.74	1.45	0.42
(% eviscerated carcass)							
Breast	38.21	37.90	38.21	37.84	38.24	1.26	0.28
Upper thigh	14.16	14.19	16.31	16.80	15.28	0.68	0.32
Lower Thigh	12.24	12.43	13.46	13.12	13.19	1.18	0.35
Wings	8.72	8.45	7.98	7.83	8.32	0.62	0.12
Back	20.64	20.56	21.78	21.96	20.13	1.45	0.24

SE: Standard error.

there were no appreciable changes in the carcass weight or commercial carcass cuts of broiler chickens when bilimbi was added to the diet. According to Vase-Khavari *et al*. (2019), a different study that used three medicinal plants-*R. coriaria*, *H. persicum* and *M. piperita*-also found no discernible impact on the commercial carcass cuts and carcass weight of broilers.

CONCLUSION

Because it enhances performance without negatively impacting the carcass features of broiler chickens, the Namo-namo fruit extract from Halmahera Island, which includes bioactive substances such phenols and flavonoids, can be utilized as a feed addition.

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Disclaimers

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Informed consent

The Committee of Experimental Animal Care and the Animal Ethics Committee of the Faculty of Agriculture, Universitas Khairun, approved all animal procedures for experiments (No. 019/KEPH/PH/2024).

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

REFERENCES

Abd Aziz, A.F., Bhuiyan, M.S.A. and Iqbal, M. (2017). An evaluation of antioxidant and antidiabetic potential of *Cynometra cauliflora* (Nam-nam, Fabaceae). T*ransactions on Science and Technology.* **4(3-3):** 372-383.

Abd Wahab, N.Z, A. Azizul., N. Badya and N. Ibrahim. (2021). Antiviral activity of an extract from leaves of the tropical plant *Cynometra cauliflora*. *Pharmacognosy Journal*. **13(3):** 752-757. doi: 10.5530/pj.2021.13.96.

Abd Wahab, N.Z., Badya, N., Ibrahim, N. and Kamarudina, M.K.A. (2019). Phytochemistry and antibacterial activity of *Cynometra cauliflora. Indian Journal of Public Health Research and Development*. **10(4):** 806-810. doi: 10.5958/0976-5506. 2019.00795.2.

Ado, M.A., Mediani, A., Maulidiani, I.S., Ghazali, H.M. and Abas, F. (2019). Flavonoids from *Cynometra cauliflora* and their antioxidant, α-glucosidase and cholinesterase inhibitory activities. *Chemistry of Natural Compounds*. **55:** 112-114.

Anliza, S. and N. Rachmawati. (2021). Cytotoxic activity of ethanol extract in Namnam leaves (*Cynometra cauliflora* L.) to Hela cell. *Walisongo Journal of Chemistry*. **4(2):** 107-112.

AOAC. Methods of Analysis, 18th Edition. (2007). Association of Official Analytical Chemist Washington DC, USA.

Basit, M.A., Kadir, A.A., Loh, T.C., Abdul, S.A., Salleh, A., Zakaria, Z.A. and Idris, B.S. (2020). Comparative efficacy of selected phytobiotics with halquinol and tetracycline on gut morphology, ileal digestibility, cecal microbiota composition and growth performance in broiler chickens. *Animals*. **10(11):** 2150.

Bera, I., Tyagi, P.K., P.K., N.A. Mir., P.K. Tyagi., K. Dev., D. Sharma and A.B. Mandal. (2019). Dietary supplementation of saponins to improve the quality and oxidative stability of broiler chicken meat. *Journal of Food Science and Technology*. **56(4):** 2063-2072.

Irmayanti, L., Ashari, R., Umanailo, F., Rangkuti, A.B., Fatrawana, A., Nurdin, A.S. and Nur, M. (2022). Flora Composition and diversity in Mount Sibela Educational Forest, South Halmahera, North Maluku. *In IOP Conference Series: Earth and Environmental Science*. **959(1):** 012015. IOP Publishing.

Jin, L.Z., Dersjant-Li, Y. and Giannenas, I. (2020). Application of aromatic plants and their extracts in diets of broiler chickens. *Feed Additives*. pp. 159-185.

Mareta, I., Nathaniel, G., Yudiarti, T., Widiastuti, E., Wahyuni, H.I. and Sugiharto, S. (2020). Effect of *Averrhoa bilimbi* fruit filtrate and Shrimp paste mixture on performance, gut microbes and blood profile of broilers. *Indonesian Journal of Animal and Veterinary Sciences*. **25(4):** 182-189.

Martínez, Y., Tobar, L.A., Lagos, H.M., Parrado, C.A., Urquía, A.M. and Valdivié, M. (2021). Phytobiotic effect of *Anacardium occidentale* L. leaves powder on performance, carcass traits and intestinal characteristics in broilers. *Brazilian Journal of Poultry Science*. **23(01):** eRBCA-2020.

Mayur, B., Sandesh, S., Shruti, S. and Sung-Yum, S. (2010). Antioxidant and á-glucosidase inhibitory properties of *Carpesium abrotanoides* L. Journal of Medicinal Plants Research. 4(15): 1547-1553.

Omar, J.A., Hejazi, A. and Badran, R. (2016). Performance of broilers supplemented with natural herb extract. *Open Journal of Animal Sciences*. **6(1):** 68-74.

Perin, G., Baldissera, M.D., Fernandes, M., Barreta, M., Casagrande, R.A., Griss, L.G., Fortuoso, B.F., Volpato, A., Stefani, L.M., Boiago, M.M., Cristo, T.G., Santiani, F. and da Silva, A.S. (2019). Effects of tannin-containing diets on performance, gut disease control and health in broiler chicks. *Animal Production Science*. **59(10):** 1847-1857.

Prasetyo, A.F., Ulum, M.Y.M., Prasetyo, B. and Sanyoto, J.I. (2020). Performa pertumbuhan broiler pasca penghentian antibiotic growth promoters (AGP) dalam Pakan Ternak Pola Kemitraan di Kabupaten Jember. *Journal Peternakan*. **17(1):** 25-30.

Sahreen, S., Khan, M.R. and Khan, R.A. (2010). Evaluation of antioxidant activities of various solvent extracts of *Carissa opaca* fruits. *Food Chemistry*. **122(4):** 1205-1211.

Salgado-Tránsito, L., Del Río-García, J.C., Arjona-Román, J.L., Moreno-Martínez, E. and Méndez-Albores, A. (2011). Effect of citric acid supplemented diets on aflatoxin degradation, growth performance and serum parameters in broiler chickens. *Archivos de Medicina Veterinaria*. **43(3):** 215-222.

Samling, B.A., Assim, Z., Tong, W.Y., Leong, C.R., Ab Rashid, S., Kamal, N.N.S.N.M., Muhamad, M. and Tan, W.N. (2022). *Cynometra cauliflora* essential oils loaded-chitosan nanoparticles: Evaluations of their antioxidant, antimicrobial and cytotoxic activities. *International Journal of Biological Macromolecules*. **210:** 742-751.

Sapsuha, Y., Suprijatna, E., Kismiati, S. and Sugiharto, S. (2021). The effect of nutmeg flesh (*Myristica fragrans* Houtt) extract on growth performance, internal organ and carcass of broiler chickens raised at high stocking density. *Livestock Research for Rural Development*. **33(6):** 1-7.

Sapsuha, Y., Suprijatna, E., Kismiati, S. and Sugiharto, S. (2022). Possibility of using nutmeg flesh (*Myristica fragrans* Houtt) extract in broiler diet to improve intestinal morphology, bacterial population, blood profile and antioxidant status of broilers under high-density condition. *Agronomy Reserch*. **20:** 1.

Sapsuha, Y., Sjafani, N., Fatmona, S. and Tjokrodiningrat, S. (2023). Butterfly pea (*Clitoria ternatea*) extract as a potential feed additive for broiler chickens. *Livestock Research for Rural Development*. **35(10):** 75-89.

Sochor, J., Zitka, O., Skutkova, H., Pavlik, D., Babula, P., Krska, B. and Kizek, R. (2010), Content of phenolic compounds and antioxidant capacity in fruits of apricot genotypes. *Molecules*. 15(9): 6285-6305.

Sugiharto, S. (2016). Role of nutraceuticals in gut health and growth performance of poultry. *Journal of the Saudi Society of Agricultural Sciences*. **15:** 99-111.

Sugiharto, S. (2022). Potential benefits of plant-derived products on broiler meat characteristics-A Short Review. *Journal Sain Peternakan Indonesia*. **17(1):** 29-43.

Suprayogi, A., Rahminiwati, M., Satyaningtijas, A., Nugraha, A.T., Sukandar, D., Pangestika, H. and Pratiwi, L. (2020). Identification of Compounds Flavonoids Namnam Leaf Extract (*Cynometra Cauliflora*) As Inhibiting A-Glucosidase. *In Journal of Physics: Conference Series*. **1594(1):** 012005. IOP Publishing.

Ulpiyah, Z,, Shita, A.D.P. and Wahyukundari, M.A. (2019). Inhibition of namnam (*Cynometra cauliflora* L.) leaves extract on the growth of Porphyromonas gingivalis. *Padjadjaran Journal of Dentistry*. **31(2):** 106-111.

Vase-Khavari, K., Mortezavi, S.H., Rasouli, B., Khusro, A., Salem, A.Z. and Seidavi, A. (2019) The effect of three tropical medicinal plants and superzist probiotic on growth performance, carcass characteristics, blood constitutes, immune response and gut microflora of broiler. *Tropical Animal Health and Production*. **51:** 33-42. https://doi.org/10.1007/s11250-018-1656-x.

Zaikina, A.S., Buryakov, N.P., Buryakova, M.A., Zagarin, A.Y., Razhev, A.A. and Aleshin, D.E. (2022). Impact of supplementing phytobiotics as a substitute for antibiotics in broiler chicken feed on growth performance, nutrient digestibility and biochemical parameters. *Veterinary Sciences*. **9(12):** 672.

Zhang, Q., Liu, M. and Ruan, J. (2017). Metabolomics analysis reveals the metabolic and functional roles of flavonoids in light-sensitive tea leaves. *BMC Plant Biology*. **17:** 1-10.