

Effect of Using Fermented Moringa Leaf Flour (*Moringa oleifera*) in Diets on Broiler Fat Deposition

Y. Fenita¹, Warnoto¹, U. Santoso¹, Nurmeiliasari¹, Hindrianti¹, and T. Rafian²

¹Departement of Animal Sciences, Faculty of Agriculture, Universitas Bengkulu. Indonesia
²Departement of Animal Husbandry, Faculty of Agriculture, Universitas Lampung. Indonesia

Corresponding Author: yosifenita15@gmail.com

Revised: 2023-12-23, Accepted: 2023-12-24, Publish: 2023-12-30

ABSTRACT

This study aims to evaluate the effect of using fermented *Moringa oleifera* leaf flour in the diet on broiler fat deposition (percentage of neck fat, liver fat, proventriculus fat, gizzard fat, abdominal fat, and sartorial fat). The research was conducted from 20 August to 25 September 2021 at the Commercial Zone and Animal Laboratory (CZAL) of the Animal Husbandry Department and the Animal Husbandry Laboratory, Faculty of Agriculture, Bengkulu University. The design used was a Completely Randomized Design (CRD) with four treatments, five replications, and each replication consisting of 8 chickens. The variables observed were the percentage of abdominal fat, sartorial fat, gizzard fat, liver fat, proventriculus fat, and neck fat. The results showed that the treatment had no significant effect ($P > 0.05$) on gizzard fat, liver fat, and neck fat but had a significant effect ($P < 0.05$) on abdominal fat, sartorial fat, and proventriculus fat. The percentage of gizzard fat ranges from 0.263% - 0.320%, liver fat ranges from 0.026% - 0.036%, neck fat ranges from 0.020% - 0.031%, abdominal fat ranges from 0.334% - 0.441%, sartorial fat ranges from 0.163% - 0.217%, and proventriculus fat ranges from 0.024% - 0.038%. It was concluded that using fermented *Moringa oleifera* leaf flour up to a level of 15% could not reduce gizzard fat, liver fat, and neck fat in broilers. Still, it improved abdominal fat, sartorial fat, and proventriculus fat.

Keywords: Fat deposition, Fermentation, Moringa leaf flour

INTRODUCTION

Animal protein from broiler chickens is one of the nutritional needs required by humans. However, broiler meat contains fat and cholesterol, negatively affecting the body if consumed in large quantities and continuously. Fat reduction is one of the concerns in research on broiler products (Ferrini et al., 2010). Many researchers have studied fat reduction in broilers. The results of his research show that the protein content in the ration can directly influence fat deposition, and increasing protein in the ration can reduce abdominal fat deposits in the chicken's body.

Moringa leaf flour can reduce fat deposition in broilers. Krisnadi (2010) states that moringa leaves contain 27% protein with a balanced amino acid content. According to Gadzirayi et al. (2012), the high protein in Moringa leaves means that Moringa leaf flour is widely considered a substitute for protein sources. Moringa leaf flour as a protein source can only replace soybean meal in a ratio of 1:3. Makkar and Backer (1996) stated that the protein content in Moringa leaves reaches 26-43% of dry matter and can reduce feed costs. The advantage of moringa leaves is that they contain vitamins, proteins, and minerals needed by the livestock's

body (Soetanto et al., 2011). The high protein content of Moringa leaves can reduce fat deposition in broilers, so this could be one of the reasons for researching the use of Moringa leaf flour as a source of protein for broilers.

According to Maryuni and Wibowo (2005) and Lestari et al. (2021), Moringa leaves (*Moringa oleifera*) are a feed supplement that can be fermented. The fermented feed has a high consumption rate and can increase the feed ingredients' quality. Fermented feed is an alternative technology to improve feed quality. A fermentation technology that is popular and widely used commercially in production is using *Aspergillus niger*; it is easy to overgrow and does not produce mycotoxins, so it is not harmful (Maryanty et al., 2010). Krisnan (2005) stated that fermentation of tea waste using *Aspergillus niger* was proven to increase crude protein from only 27.42% to 29.36%, reducing crude fiber content from 23.01% to 21.19%. *Moringa oleifera* leaf flour has the potential to be an excellent living medium for *Aspergillus niger*. It is because Moringa leaf flour contains protein that is by the nutritional requirements of *Aspergillus niger* to grow and develop (Rachmawati & Suriawati, 2019), so using *Aspergillus niger* in Moringa leaf flour is

expected to provide the same results as fermenting tea waste.

Tazi's (2012) research showed that giving 3% -7% Moringa leaves did not affect broiler abdominal fat deposition. Gurbuz and Ismael (2016) stated that providing herbal plants up to 3% also did not reduce abdominal fat deposition in broilers. However, giving Moringa leaves at a higher level, namely 3% -12%, can reduce the deposit of cholesterol content in broiler meat, according to research (Tonga et al., 2016). So, in this research, the Moringa leaf fermentation technique was carried out using *Aspergillus niger* to a level of 5% -15%, which is expected to reduce fat deposition in broilers. This study evaluates the effect of fermented *Moringa oleifera* leaf flour in rations on broiler fat deposition.

MATERIALS AND METHODS

The research was conducted from August 20 to September 25, 2021, in the Commercial Zone and Animal Laboratory (CZAL) enclosure of the Animal Husbandry Department, Faculty of Agriculture, Bengkulu University.

The tools and equipment needed include cages, cage plots, feed containers, drinking water containers, scales, steamers, gas stoves, buckets, brooms, tarpaulins, plastic, knives, blenders (mills), room thermometers, and stationery. The materials used in the research were broiler DOC, rations, moringa leaf flour (*Moringa oleifera*), *Aspergillus niger*, mineral mix, vitacik (vitamin), and disinfectant.

Cage Preparation

Preparation of the cage was carried out before the research began, namely cleaning the cage by spraying the disinfectant Rodalon solution or detergent solution, whitewashing the cage, cleaning cage equipment for feeding and drinking, making cage compartments, installing curtains covering the outside of the cage, using dry husks for the floor of the cage. Prepare the composition of the rations that will be used, prepare disinfectant spray near the cage entrance, and measure the temperature and humidity of the cage using a thermohygrometer placed in the middle of the cage at a height of 40-60 cm. The cage lighting and heating uses a 40-watt incandescent lamp set in the brooding cage. The location of the cages was determined by randomization, and each cage unit was given a code according to the treatment given to make the recording process more accessible.

Making Moringa Leaf Flour (*Moringa oleifera*)

The picked Moringa leaves are placed on a tarpaulin. Drying Moringa leaves is done by airing them on a tarpaulin indoors until the water content in the Moringa leaves decreases and they dry. Drying is not done in direct sunlight because it can damage the nutritional content of Moringa leaves. After drying, the Moringa leaves are ground using a blender to get Moringa leaf flour.

Procedure for Making Fermented Moringa Leaf Flour

Making fermented Moringa leaf flour with the modification of the Ikhwanuddin et al. (2018) method, which uses a ratio of 1 kg of Moringa leaf flour to 800 ml of water. The Moringa leaf flour is steamed with a steamer for ± 30 minutes, calculated after the water boils to sterilize the Moringa leaf flour before fermentation, and the flour is cooled and sprinkled with water. With *Aspergillus niger* as much as 1% (Ikhwanuddin et al., 2018). Adding urea and mineral salts is necessary for fermentation to get good results. According to Akhadiarto (2009), urea ($\text{CH}_4\text{N}_2\text{O}$) is 2.7 g, sulfate (NH_2SO_4) is 3 g, magnesium sulfate (MgSO_4) is 3 g, potassium sulfate (K_2SO_4) is 3 g for every 1 kg of Moringa leaf flour. Next, the Moringa leaf flour is fermented in 1 kg plastic and pierced so that air can enter, then placed at room temperature for 4-5 days. Fermented Moringa leaf flour is dried in the sun until dry, then ground again and sifted until it becomes flour.

DOC Maintenance

Maintenance of 400 DOC for the first 14 days in brooding. Newly arrived broilers are given sugar water to restore energy lost during the journey, and the cage temperature is adjusted to the temperature required by the DOC. The maintenance brooding period is 14 days, with a temperature setting of 30-32°C and humidity of 60-80% (Setiawan and Sujana, 2009). The first ND vaccine is given on the 4th day with eye drops, the Gumboro vaccine is shown on the 14th day, and the second ND vaccine is provided on the 21st day as a repeat vaccination. At the age of 15 days, 160 chickens were selected and kept in experimental cages consisting of 8 broilers per plot. The ration given for the first 14 days is the commercial ration BR 1 SP (PT. Japfa Comfeed Indonesia Tbk), and drinking water using

additional vitacik for DOC maintenance is given ad libitum.

Research Treatment

This research used 160 broilers and distributed them into experimental plots, then divided into four treatments with five replications; each replication contained eight broilers, then given experimental rations after maintenance for the initial 14 days in brooding, aged 15-35 days experimental rations and drinking water were provided ad libitum.

Research Design

The research used a Completely Randomized Design (CRD) of four treatments with five replications, each replication using eight broilers, so 40 broilers were needed for each treatment and 160 broilers for all treatments.

The treatment given is:

P0: Control (using 0% fermented Moringa leaf flour)

P1: The ration uses 5% fermented Moringa leaf flour

P2: The ration uses 10% fermented Moringa leaf flour

P3: The ration uses 15% fermented Moringa leaf flour

Nutritional Content of Feed Ingredients

Feed ingredients are ingredients from agriculture, fisheries, animal husbandry, or other ingredients suitable for use as feed, whether processed or unprocessed. The nutritional content of each experimental feed ingredient is presented in Table 1.

Table 1. Nutrient content of ration ingredients

Feed ingredients	Fat (%)	Fiber Crude (%)	Protein (%)	Ca (%)	P (%)	Energy (kcal)
Fermented Moringa leaf flour ^{a)}	2.21	10.51	30.57	2.09	0.67	2413
Corn ^{b)}	4	2.2	8.9	0.02	0.23	3321
Bran ^{b)}	4.2	1.7	8.5	0.2	1	1810
Mineral mix	-	-	-	32	10	-
Cooking oil	0	0	0	0	0	8840
Fish flour ^{c)}	5.65	1.92	54	3.1	2.1	2728
Soybean meal ^{c)}	3.50	6.28	42.75	0.21	0.11	2834

Source: a) Analysis carried out at the Animal Husbandry Department Laboratory, Bengkulu University (2021)

b) Hartadi et al., (2005)

c) Fenita et al., (2010)

Ration formulation is the composition/formula of feed ingredients given to livestock for 24 hours. All nutritional elements must be balanced with the livestock's needs when

preparing feed formulations. The formulation and nutritional content of the experimental diet using fermented *Moringa oleifera* leaf flour are presented in Table 2.

Table 2. Formulation and nutritional content of experimental diets

Feed ingredients	Treatment			
	P0	P1	P2	P3
Fermented Moringa leaf flour %	0	5	10	15
Corn %	55	55	55	54
Bran %	4	4	4	4
Cooking oil %	2	2	2	2
Fish flour %	8	8	8	9
Soybean meal %	30	25	20	15
Mineral Mix %	1	1	1	1
Total (%)	100	100	100	100
Nutritional Content				
Energy (Kkal/kg)	3144,19	3123,14	3102,09	3075,11
Protein (%)	20,96	20,58	20,21	20,29
Fat (%)	3,60	3,61	3,63	3,68
Sk (%)	3,64	3,88	4,12	4,38
Ca (%)	0,65	0,74	0,84	0,96
P (%)	0,47	0,50	0,52	0,57

Sampling

At the end of the rearing process, 60 chickens aged 35 days were slaughtered as samples taken based on the average body weight in each treatment. Before slaughtering, broilers are fasted for 12 hours to obtain a stable broiler live weight.

Observed Variables

The variables observed in this study were abdominal fat, sartorial fat, gizzard fat, liver fat, proventriculus fat, and neck fat.

a. Abdominal Fat

Abdominal fat is measured by weighing the fat obtained from the fat attached to the abdominal cavity from the base of the cloaca to the gizzard. The percentage of abdominal fat is calculated using the formula (Hasan et al., 2013).

$$\text{Abdominal Fat} = \frac{\text{Abdominal fat weight}}{\text{Living weight}} \times 100\%$$

b. Sartorial Fat

Sartorial fat is measured by weighing the fat attached to both chicken thighs. The formula calculates the percentage of sartorial fat (modification Hasan et al., 2013).

$$\text{Sartorial Fat} = \frac{\text{Sartorial fat weight}}{\text{Living weight}} \times 100\%$$

c. Gizzard Fat

Gizzard fat is measured by weighing the fat attached to the gizzard, with calculations using a formula (modification Hasan et al., 2013).

$$\text{Gizzard Fat} = \frac{\text{Gizzard fat weight}}{\text{Living weight}} \times 100\%$$

d. Liver Fat

Liver fat is measured by weighing the fat attached to the liver using a formula (Hasan et al., 2013).

$$\text{Liver Fat} = \frac{\text{Liver fat weight}}{\text{Living weight}} \times 100\%$$

e. Proventriculus Fat

The fat contained in the Proventriculus is calculated using a formula (modification Hasan et al., 2013).

$$\text{Proventriculus Fat} = \frac{\text{Proventriculus fat weight}}{\text{Living weight}} \times 100\%$$

f. Neck Fat

Neck fat is measured by weighing the fat attached to the neck, calculated using a formula (modification Hasan et al., 2013).

$$\text{Neck Fat} = \frac{\text{Neck Fat weight}}{\text{Living weight}} \times 100\%$$

9. Data Analysis

All variable data obtained is then analyzed using ANOVA (analysis of variance). If the treatment has a significant effect ($P < 0.5$), a further test will be carried out using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Fat Deposition Percentage

The effect of using fermented Moringa leaf flour on the deposition of abdominal fat, sartorial fat, gizzard fat, liver fat, proventriculus fat, and neck fat is presented in Table 3.

Table 3. Fat deposition (abdominal fat, sartorial fat, gizzard fat, liver fat, proventriculus fat, and neck fat)

Variabel	Treatment (%)				P
	P0	P1	P2	P3	
Abdominal Fat	0.441 ^a ± 0.123	0.396 ^{ab} ± 0.095	0.385 ^{ab} ± 0.047	0.334 ^b ± 0.054	0.012*
Sartorial Fat	0.217 ^a ± 0.046	0.186 ^{ab} ± 0.044	0.171 ^b ± 0.056	0.163 ^b ± 0.070	0.048*
Gizzard Fat	0.309 ± 0.068	0.320 ± 0.070	0.306 ± 0.045	0.263 ± 0.055	0.060
Liver Fat	0.032 ± 0.010	0.036 ± 0.011	0.033 ± 0.010	0.026 ± 0.009	0.080
Proventriculus Fat	0.038 ^a ± 0.017	0.034 ^{ab} ± 0.012	0.029 ^{ab} ± 0.010	0.024 ^b ± 0.010	0.023*
Neck Fat	0.026 ± 0.015	0.031 ± 0.016	0.025 ± 0.015	0.020 ± 0.010	0.193

Notes: Superscript 3 different variables in the same row show significantly different ($P < 0.05$),

P0: Control (using 0% fermented Moringa leaf flour),

P1: Ration using 5% fermented Moringa leaf flour,

P2: Ration using 10% flour-fermented moringa leaves,

P3: Ration uses 15% fermented moringa leaf flour.

The results of analysis of various uses of fermented *Moringa oleifera* leaf flour with *Aspergillus niger* showed that the diet had a significant effect ($P < 0.05$) on broiler abdominal fat with percentage values P0: 0.441%, P1: 0.396%, P2: 0.385% and P3: 0.334%. This study's average percentage of abdominal fat was 0.33-0.44%. The percentage of abdominal fat was further tested using Duncan's Multiple Range Test (DMRT), and the results showed that the use of fermented Moringa leaf flour P0: 0.441% was not significantly different from P1: 0.396% and P2: 0.385%. The results of P1: 0.396% are not significantly different from P2: 0.385% and P3: 0.334%, however P0: 0.441% are significantly different from P3: 0.334%. It shows that using rations containing moringa leaf flour (*Moringa oleifera*) up to a level of 15% can reduce abdominal fat deposition in broilers. The percentage of broiler abdominal fat obtained in the study ranged from 0.334% to 0.441%. According to research by Ariyansah (2018), using Moringa leaf flour at 10% and 15% can reduce abdominal fat in broilers.

The results of the analysis of the variety of uses of *Moringa oleifera* leaf flour fermented with *Aspergillus niger* showed that the diet had a significant effect ($P < 0.05$) on broiler sartorial fat with percentage values P0: 0.217%, P1: 0.186%, P2: 0.171% and P3: 0.163%. The abdominal fat percentage results were further tested using the Duncan Multiple Range Test (DMRT), and the results showed that P0: 0.217% was not significantly different from P1: 0.186%. P1: 0.186% is not significantly different from P2: 0.171% and P3: 0.163%, however P0: is significantly different from P2: 0.171% and P3: 0.163%. It shows that the use of fermented Moringa leaf flour up to 15% can reduce sartorial fat deposition. Ariyansah (2018) stated that using moringa leaf flour at 10% and 15% can reduce fat in broilers.

The results showed that the diet had no significant effect ($P > 0.05$) on broiler gizzard fat. The percentage of treatments using fermented *Moringa oleifera* leaf flour using *Aspergillus niger* was P0: 0.309%, P1: 0.320%, P2: 0.306% and P3: 0.263%. The average gizzard fat in this study ranged from 0.263% - 0.320%; this shows that P0: 0.309%, but P1: 0.320% and P2: 0.306% and P3: 0.263% using Moringa leaf flour level 5% - 15% has not been able to reduce and has not been able to have a real influence on broiler gizzard fat deposition. The use of fermented Moringa leaf flour using *Aspergillus niger* had no

natural effect, presumably because the nutrients contained, especially protein, vitamin A, vitamin C, flavonoids, phytosterols, calcium, potassium and iron in Moringa leaves, were not able to have a natural effect on fat deposition in gizzard broilers. as is the case according to research (Gadzirayi et al., 2012 and Soetanto et al., 2011).

The research results using *Moringa oleifera* leaf flour fermented using *Aspergillus niger* showed that the diet had no significant effect ($P > 0.05$) on broiler liver fat. Percentage P0: 0.032%, P1: 0.036%, P2: 0.033%, and P3: 0.026%. This study's average percentage of liver fat ranged from 0.026% to 0.036%. These results indicate that P3: 0.026% using a level of 15% fermented Moringa leaf flour can provide lower results compared to P0: 0.032% without using fermented Moringa leaves; however, P1: 0.036% and P2: 0.026% with a level of 5% -10% has not been able to reduce and provide a real influence on broiler liver fat deposition. The reason why the use of fermented Moringa leaf flour using *Aspergillus niger* has no real effect is thought to be because the nutrients contained, especially protein, vitamin A, vitamin C, potassium, calcium, flavonoids, phytosterols and iron contained in Moringa leaves have not been able to have a real effect on deposition. Broiler liver fat, as is the case according to research (Gadzirayi et al., 2012; Soetanto et al., 2011).

This study showed that diet significantly affected broiler proventriculus fat ($P < 0.05$). The percentage of treatments that used *Moringa oleifera* leaf flour fermented using *Aspergillus niger* was P0: 0.038%, P1: 0.034%, P2: 0.029% and P3: 0.024%. This study's average percentage of proventriculus fat was 0.024 - 0.038%. The percentage of proventriculus fat was further tested using Duncan's Multiple Range Test (DMRT) and showed that the results of the further test P0: 0.038% were not significantly different from P1: 0.034% and P2: 0.029%. P1: 0.034% is not substantially different from P2: 0.029% and P3: 0.024%; however, further test results show that P0: 0.038% is significantly different from P3: 0.024%, which was given 15% fermented Moringa leaf flour diet. Ariyansah (2018) stated that using moringa leaf flour at 10% and 15% can reduce fat in broilers.

The research results using *Moringa oleifera* leaf flour fermented using *Aspergillus niger* showed that the diet had no significant effect ($P > 0.05$) on broiler neck fat. The percentage of neck fat obtained was P0: 0.026%, P1: 0.031%, P2: 0.025% and P3: 0.020%. The

average percentage of neck fat in the study ranged from 0.020% to 0.031%. The percentage of fat obtained shows that P3: 0.020% using 15% fermented Moringa leaf flour can reduce broiler neck fat compared to P0: 0.026% ration without fermented Moringa leaves; however, the use of fermented Moringa leaf flour is P1: 0.31% and P2: 0.25% with a level of 5%-10% has not been able to reduce broiler neck fat deposition. In this study, fermented Moringa leaf flour did not affect neck fat deposition. It is suspected that the nutrients, especially protein, vitamin A, vitamin C, calcium, potassium, flavonoids, phytosterols, and iron contained in Moringa leaves, could not reduce broiler neck fat deposition at level 5% -10 %, as expected, according to research (Gadzirayi et al., 2012; Soetanto et al., 2011).

CONCLUSION

Conclusion

Using fermented *Moringa oleifera* leaf flour up to a level of 15% can reduce abdominal fat, sartorial fat, and proventriculus fat. Still, this level cannot reduce neck, liver, and gizzard fat.

Suggestion

Moringa leaf meal fermented at 15% is recommended to reduce gizzard, liver and neck fat.

REFERENCES

- Akhadiarto. 2009. Pengaruh pemberian tepung bonggol pisang dan tepung daun kelor sebagai pengganti jagung terhadap warna, rasa dan keempukan daging ayam broiler. *Jurnal Teknologi Lingkungan*. Jakarta.
- Ariyansah, M. 2018. Pengaruh pemberian tepung daun kelor (*Moringa oleifera*) terhadap persentase lemak abdominal dan kadar lemak daging ayam broiler. Skripsi. Fakultas Peternakan Universitas Mataram. Mataram
- Ferrini, G, Manzanilla E. G., Menoyo D., Esteve-garcia E, Baucells M. D., Barrotea A. C. 2010. Effects of dietary n-3 fatty acids in fat metabolism and thyroid hormone levels compared to dietary saturated fatty acids in chickens. *Livest Sci.*, 131: 287-291.
- Gadzirayi, C.T., B. Masamha, J. F. Mupangwa, and S. Washaya. 2012. Performance of broiler chickens fed on mature *Moringa oleifera* leaf meal as a protein supplement to soybean meal. *Int. J. poult. Sci.*, 11(1):5-10.
- Gurbuz, Y. and I. A. Ismael. 2016. Effect of peppermint and basil as feed additive on broiler performance and carcass characteristics. *Iranian J. App. Anim. Sci.* 6:149-156.
- Hartadi, H. S. Reksohadiprodjo, dan A. D Tillman. 2005. Tabel komposisi pakan untuk indonesia. Gadjah Mada University Press. Yogyakarta.
- N. F. Hasan, U. Atmomarsono, dan E. Suprijatna. 2013. Pengaruh Frekuensi Pemberian Pakan Pada Pembatasan Pakan Terhadap Bobot Akhir, Lemak Abdominal, dan Kadar Lemak Hati Ayam Broiler. *Animal Agriculture Journal*, 2(1):336-343.
- Ikhwanuddin. M., Noerkhaerin .A. P., Mustahal. 2018. Pemanfaatan dedak padi fermentasi menggunakan *aspergillus niger* sebagai bahan baku pakan ikan nila (*Oreochromis Niloticus*). *Jurnal Perikanan Dan Kelautan. Jurnal Perikanan dan Kelautan*, 8(1):79 – 87.
- Krisnadi, A. D. 2010. Kelor Super Nutrisi. Pusat Informasi dan Pengembangan Tanaman Kelor Indonesia. Blora.
- Krishnan, R. 2005. Pengaruh pemberian ampas teh (*Camelia sinensis*) fermentasi dengan *Aspergillus niger* pada ayam broiler. *JITV*, 10(1): 1-5.
- Lestari, R. D., Lokapirnasari, W. P., Arif, M. A. A., Hidanah, S., Soeharsono, S., Lamid, M.. 2021. Pengaruh Pakan Tambahan Fermentasi Tepung Daun Kelor (*Moringa oleifera*) Terhadap Kadar Kolesterol Itik Mojosari. *Jurnal Medik Veteriner*, 4(2):221-225.
- Manihuruk, F. H., Ismail, I., Rastina, R., Razali, R., Sabri, M., Zuhrawati, Z., & Jalaluddin, M. 2018. Effect of fermented moringa leaf (*Moringa oleifera*) powder in feed to increase broiler carcass weight. *Jurnal Medika Veterinaria*, 12(2):103-109.
- Maryanty, Y., H. Pristianti, dan P. Ruliawati. 2010. Produksi crude lipase dari *Aspergillus niger* pada substrat onggok menggunakan metode fermentasi fase padat. Seminar Rekayasa Kimia dan Proses. Universitas Diponegoro. Semarang.
- Maryuni, S. S., and C.H. Wibowo. 2005. Pengaruh kandungan lisin dan energi metabolis dalam ransum yang mengandung ubi kayu fermentasi terhadap konsumsi ransum dan lemak ayam broiler. *Jurnal Indon Trop Anim Agric.*, 30(1):26-33.
- Rachmawati, S. R., and Suriawati, J. 2019. Characterization of Moringa (*Moringa oleifera* Lam.) Leaf Water Extracts by Chemical And Microbiology. *Sanitas: Jurnal Teknologi Dan Seni Kesehatan*, 10 (2): 102-116.
- Salam, S., Fatahilah, A., Sunarti, D. and Isroli, I. 2013. Berat karkas dan lemak abdominal ayam

- broiler yang diberi tepung jintan hitam (*Nigella sativa*) dalam ransum selama musim panas. Sains Peternakan: Jurnal Penelitian Ilmu Peternakan, 11(2):84-90.
- Santoso, U., Y. Fenita, Kususiayah, O. Widiatoro and S. Kadarsih. 2018. The effect of the medical herb on fat deposition, meat composition, amino acid, and fatty acid composition of broiler meats. J. Indonesian Trop. Anim. Agric., 43(1):54-65.
- Setiawan, I. dan E. Sujana. 2009. Bobot akhir presentase karkas dan lemak abdominal ayam pedaging yang dipanen pada umur yang berbeda. Seminar Nasional. Fakultas Peternakan. UNPAD.
- Soetanto, H., E. Marhaeniyanto, dan S. Chuzaemi. 2011. Penerapan teknologi suplementasi berbasis daun kelor dan pada peternakan kambing rakyat. Buana Sains., 11(1):25-34.
- Tazi, S. M. A. El. 2012. Effect of feeding different levels of Moringa oleifera leaf meal on broiler chicks' performance and carcass quality. Int. J. Sci. Res., 3:147-151.
- Tonga, Y. N. K. Mardewi, N. K. E. Suwitari, N. K. S. Rukmini, N. M.G. R. Astiti and I. G. A. D. S. Rejeki. 2016. Seplementasi tepung daun kelor (*Moringa oleifera*) pada ransum untuk meningkatkan kualitas daging ayam broiler. Seminar Nasional Peternakan 2, Fakultas Peternakan, Universitas Hasanuddin, August 25, 2016. P 45-51.
- Zohdin. 2013. Pengaruh ekstrak daun papaya (*Carica papaya*) terhadap penimbunan lemak ayam broiler. Skripsi. Jurusan peternakan. Universitas Bengkulu. Bengkulu.