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Effects of Durian Seed Meal on Nitrogen Retention, AMEn, Performance, and Carcass Quality of Broilers: A Corn Meal Alternative

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ABSTRACT

This research aims to examine nitrogen retention, metabolic energy (AMEn) value, performance and carcass quality of broiler chickens using durian seed waste (*Durio zibethinus*) potential alternatives to replace corn meal in poultry feed. The study employed a completely randomized design (CRD) with five treatments and five replications for each treatment, involving five chickens per replication. The treatments included different levels of durian seed meal (DSM) replacement in the rations replace corn meal: 0%, 10%, 20%, 30%, and 40% or DSM use of 0%; 5%; 10%; 15%; 20% in rations broiler chickens. Research parameters encompassed the analysis of nutrient composition (protein percentage, fat, crude fiber, calcium & phosphorus, and Gross Energy kcal/kg) from processed durian seeds, as well as livestock testing by measuring nitrogen retention, metabolic energy, feed consumption, body weight gain, feed conversion, percentage of carcass, and percentage of abdominal fat in broiler chickens. The research findings revealed that durian seed flour possesses a nutritional composition of 8.25% protein, 82.68% BETN, and a gross energy value of 3905 kcal/kg. Statistical tests on performance and carcass quality yielded significant differences ($P<0.05$). Based on the results of the BNJ test and discussion the conclusion of this. Nitrogen Retention ranges from 60.54–62.58%, Metabolic Energy (AMEn), 3171.93–3252.83 kcal/kg and durian seed meal has potential as an alternative to corn meal up to 40% or can be used up to 20% in broiler rations.

1. INTRODUCTION

Durian seeds (*Durio zibethinus* Murr) are agricultural by–products often considered as waste, particularly during the durian fruit season. Durian fruit is one of the fruits that is popular with many people. Durian fruit produces solid waste in the form of durian seeds and durian skin. [1]. This part of the durian fruit is the most common what is consumed is the coated part of the fruit or flesh, while the other parts are limited to food waste. The weight percentage of this part is low, only 20–35%. This means skin (60–75%) and seeds (5–15%) have not been utilized optimally [2].

To produce one kilogram of durian seed meal, approximately 100 durian seeds are required, with each durian fruit typically containing around 25 seeds; hence, the production of one kilogram of durian meal necessitates seeds from approximately four durian fruits [3]. Concurrently, ongoing efforts to explore alternative raw materials for livestock rations, particularly those aimed at replacing corn, the predominant source of fiber in feed rations, are being pursued. Utilizing waste–based materials is one approach in this regard. North Sulawesi, known for its durian fruit production, presents a significant potential resource in this endeavour. Proximate analysis of durian skin flour (*Durio zibethinus* Murr) reveals a water content of 8.89% and dry matter content of 91.11%, with protein at 4.73%, fat at 0.90%, crude fiber at 41.24%, and BETN at 44.82% [4] Processing durian skin into meal renders it a versatile semi–finished product, offering prolonged shelf life and diverse applications in both food and feed industries. Proximate analysis conducted at the [5] indicates that steamed durian seed meal comprises 1.56% fat, 9.95% protein, 0.58% crude fiber, 6.24% ash, BETN at 81.67%, and a gross energy of 3604.13 kcal/kg [6] Additionally, [7] reports protein content at 9.79%, carbohydrates at 30%, calcium at 0.27%, and phosphorus at 0.9% in durian seeds. Based on the nutrient content, it shows that durian seed meal can be used as a feed ingredient for broiler chickens as an energy source in the ration. The main aim of raising broiler chickens is to gain body weight and high carcass quality that is safe for human consumption [8].

Broiler chickens are chickens that have a rapid growth rate in a short period of time [9] According to [10], broilers are meat chickens that experience very rapid growth at the age of 1–5 weeks. Optimal broiler productivity must be supported by the provision of sufficient feed, both quality and quantity, for this reason it is necessary to provide the right ration according to their needs. In general the nutrition in chicken rations consists of carbohydrates, fat, protein, minerals, vitamins and water [11]. The principle of determining the digestibility of nutrients is to calculate the amount of food substances consumed minus the number of nutrients released through feces [12]. Measurement of Nitrogen Retention in the ration aims to determine the quality of the ration given. High nitrogen retention will result in high growth as well, because the protein that is retained is greater. In addition to the importance of determining nitrogen retention, metabolic energy is also crucial. According to [13], metabolic energy is the energy used for metabolizing food substances in the body, and its units are expressed as kilocalories per kilogram. Ration conversion is a measure that can be used to assess the efficiency of use and quality of rations. Ration conversion is a comparison between the amount of ration consumed and the increase in body weight within a certain period of time. One measure of efficiency is to compare the amount of rations given (input) with the results obtained, be it meat or eggs (output) [10].

2. Materials and methods

The material for this research is local feed raw material in the form of durian seeds taken from the durian culinary center in Manado City and its surroundings. This research used 125 DOC chickens which were placed randomly in 25 cages, each cage containing 5 chickens. The treatment for using durian seed meal (DSM) in the ration is: DSM 0%; DSM 5%; DSM 10%; DSM 15%; DSM 20%.

Procedure

1. Preparation of durian seed meal. Durian seeds are obtained from waste from the place where durian fruit is sold in the Manado Boulevard area, collected then washed, cleaned of the flesh attached to the seeds and steamed for about 20 minutes, then dried in the sun in the laboratory area of the Unsrat Animal Husbandry Faculty, then ground into flour, and then grinding the durian seeds. Then saved for use.
2. Preparation before the chicken arrives. Before the chickens arrive, the box (brooder) that will be used is cleaned, painted, and then disinfected. The heating source used is a 75 watt incan-descent

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lamp with 3 lamps in one brooder measuring 150 x 60 x 50 cm

3. Preparation after the chicken arrives
4. The chicken is weighed and the initial body weight is recorded, then placed in a box (brooder) and given sugar water. After 6 hours the chickens arrived and were given vitachick to relieve stress, and given food.
5. Data maintenance/retrieval. After one week the chickens were taken at random to be weighed and put into each cage unit. Each unit housed 5 chickens. During the research period, food was given on a scheduled basis, namely 2 times a day, namely in the morning at 07.00 WIT and in the afternoon at 17.00 WIT. Before being fed, the remaining food in the food container is weighed. Meanwhile, drinking water is provided unlimitedly (ad libitum). The cage is cleaned every morning before feeding and in the afternoon after feeding. Chickens will be weighed once a week during the research. Carcass quality and abdominal fat weight were measured and weighed at the end of the rearing period.

Chemical analysis

The results of proximate analysis for the nutrient content of the feed ingredients that make up the ratio, the composition of the use of the ingredients that make up the ratio and the nutrient content of the treated ratio can be seen in Table 1.

Table 1. Composition of Feed ingredients in Rations

Feed ingredients	Protein	Crude fiber	Fat	Ca	P	ME Kcal/kg
	%					
Corn meal **	8.01	3.45	7.71	0.17	0.70	2865.75
Durian Seed meal ***	0.35	0.17	0.09	0.29	0.17	3355.44
Fish meal**	63.60	0.50	9.30	5.81	3.23	2830.00
Soybean meal**	42.02	6.40	13.22	0.21	0.65	3603.00
Coconut meal**	20.55	15.88	15.07	0.21	0.49	3724.50
Rice bran**	8.36	16.53	6.58	0.18	0.84	2564.25
Top Mix**	–	–	–	5.38	1.44	
Coconut Oil**	–	–	100.00			8812.00

*) [6]; **) [14] ***) [5]

Table 2. Composition of Feed Ingredients in Treatment Rations

Feed ingredients	RO	R1	R2	R3	R4
Corn meal	50.00	45.00	40.00	35.00	30.00
Durian Seed meal	0.00	5.00	10.00	15.00	20.00
Fish meal	12.00	12.00	12.00	12.00	12.00
Soybean meal	15.00	15.00	15.00	15.00	15.00
Coconut meal	10.00	10.00	10.00	10.00	10.00
Rice bran	11.50	11.50	11.50	11.50	11.50
Top Mix	0.50	0.50	0.50	0.50	0.50
Coconut oil	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

Table 3. Nutrient composition of treatment rations

Nutrients *)	RO	R1	R2	R3	R4
Crude protein (%)	21.33	21.00	21.72	22.08	22.29
Crude Fiber (%)	6.91	7.54	6.71	5.72	7.70
Crude Fat (%)	11.18	11.36	10.32	10.01	9.62
Ash (%)	6.11	6.58	6.06	5.77	5.99
Calcium (%)	0.85	0.88	0.88	0.83	0.86
Phosphor (%)	0.67	0.82	0.78	0.75	0.74
Gross Energy (kcal/kg)	4381.00	4457.00	4344.00	4350.00	4315.00

*) [5]

Calculation and Analysis

1. Durian seed meal nutritional content: through proximate analysis and Bomb Calorimeter for gross energy analysis.
2. Nitrogen Retention (NR) [15]

$$NR(\%) = \frac{(\text{Fi X Nf}) - (\text{E X Ne})}{(Fi\ X\ N\ f)} \text{x}100\%$$

Note:
NR = Nitrogen Retention (%)
Nf = Nitrogen feed (%)
Ne = Nitrogen Excreta (%)
Fi = Feed intake (g)
E = Total Excreta

1. Metabolic Energy (AMEn) [15]

$$AMEn = \frac{(\text{Fi X GEf}) - (\text{E X GEe}) - (\text{NR x K})}{(Fi)}$$

Note:
AMEn = Apparent metabolic energy corrected for nitrogen retention (Kcal/kg)
Fi = Feed intake
E = Excreta
Gef = Gross energy ration
Gee = Gross energy Excreta
NR = Nitrogen Retention (g) NR= (Fi x Nf) – (E x Ne)
K = Correction Constant for retained nitrogen energy value (8.73 Kcal/kg for each gram of nitrogen)

1. Feed consumption = Feed given – remaining feed (g/head/day).
2. Body Weight Gain = Final weight–initial weight (g/head)/ total day
3. Feed Conversion, is calculated by dividing the amount of feed consumed by the increase in body weight during maintenance. Feed Conversion = Feed consumed (g/day)/ Body weight gain (g/day)
4. Carcass percentage (%) = Carcass weight / Live Weight x 100%
5. Carcass weight is obtained by weighing the weight of the chicken after slaughter and subtracting the blood, feathers, head, feet and internal organs except the lungs and spleen.
6. Abdominal Fat Percentage (%) is obtained by taking fat that is attached to the stomach (near the cloaca) and that is attached to the digestive organs
7. Fat percentage (%) = Abdominal Fat Weight / Live Weight x 100%

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Data Analysis

Data were analyzed by using analysis of variance was a Completely Randomized Design (CRD) (with 5 treatments and 5 replications. Further testing was carried out with the Honestly Significant Difference Test (BNJ) [16].

3. Results and discussion

Nutrient Composition of Durian Seed meal (*Durio zibethinus*)

The chemical composition of a feed ingredient or product indicates its nutritional value and quality. Data from analyses carried out in the laboratory of the Faculty of Animal Husbandry, Bogor Agricultural Institute and the Ciawi Bogor Livestock Research Institute are listed in the following table.

Table 4. Chemical Composition of Durian Seed Meal (*Durio zibethinus*)

	Protein	Crude fiber	Fat	Ash	Ca	P	GE*
Durian Seed Meal (DSM)**	8.25	4.00	2.08	2,99	0,29	0,17	3605.00

Sumber: *) [17]; **) [5]

Based on the results of laboratory analysis, it turns out that durian waste in the form of seeds contains sufficient nutritional value with a content of Extracted Material without Nitrogen (BETN) and high gross energy. The protein content of the processing results in this study was 8.25% lower compared to the results obtained by [18], namely 10.41% protein and according to [6] durian seed protein was 9.95%, but almost equivalent to corn, namely 9.2% and higher than other flours, namely wheat flour 8.9%; rice flour 7%. The BETN content of durian seed flour was 82.68% higher than the results obtained by [5] namely 81.67%. The gross energy value in this study was 3605 kcal/kg, the same as the results from [5] namely 3604.13 kcal/kg.

Nitrogen Retention and Metabolic Energy Value (AMEn)

The results of the analysis of Nitrogen Retention and Metabolic Energy Value (AMEn) of the Ration between Durian seed meal (DSM) can be seen in Table 5.

Table 5. Nitrogen Retention and Metabolic Energy Value (AMEn) of the Ration between Durian seed meal (DSM)

Treatment	Parameter					
	Nitrogen Retention (%)			Metabolic Energy Value (AMEn) (Kcal/kg)		
DSM 0%	60.54	±	1.88	3222.21	±	55.26
DSM 5%	60.71	±	2.43	3251.83	±	74.40
DSM 10%	61.36	±	0.34	3181.14	±	11.16
DSM 15%	62.83	±	4.73	3171.93	±	149.94
DSM 20%	62.58	±	1.99	3226.72	±	57.73

Note: The treatments had an effect that was not significantly different (P>0.05)

Nitrogen Retention

Nitrogen retention is the amount of nitrogen in feed protein that enters the body and is then absorbed and used by livestock. Nitrogen retention (NR) is a method for assessing ration quality. The nitrogen retention value is obtained from the difference between feed nitrogen minus the excreta nitrogen value. The average RN value of rations using durian seed meal ranges from 60.54%–62.58%. Respectively, the RN treatment values were DSM 0% (60.54%), DSM 5% (60.71%), DSM 10% (61.36%), DSM 15% (62.83%), and DSM

20% (62.58%). According to [19], the efficiency of protein retained by broilers is 67% of the protein diet consumed. So only 67% is retained for daily tissue growth, feather replacement and replacement of lost endogenous nitrogen. The nitrogen retention value obtained in this study was 62.54% lower than 67%.

This is possibly because durian seeds contain antinutrients, namely cyclopropane fatty acids and oxalic acid. High amounts of cyclopropane fatty acids, oxalic acid and tannins in ration formulations can result in decreased absorption of nutrients including protein [20]. Based on the results of the analysis of the diversity of treatments, replacing corn with durian seed meal in broiler rations had not significant different (P>0.05) on the Nitrogen Retention value of the ration, meaning that the use of durian seed meal was 0; 10; 20; 30 and up to 40% replacement of corn in the diet had a similar effect on nitrogen retention. This is because all treatments contain almost the same protein value, so the nitrogen retention value is not different, apart from that, nitrogen retention is also influenced by feed consumption. Nitrogen retention has a real relationship with protein consumption in the ration, that is, the higher the protein consumption, the higher the nitrogen retention, so that growth will increase [12]; [21].

Metabolic Energy Value (AMEn) of the Ration

The metabolic energy of a feed ingredient is the difference between the gross energy content of the feed ingredient and the energy lost through excreta [22] the metabolic energy value in this study is the apparent metabolic energy value corrected by the nitrogen retention value (AMEn). The average metabolic energy value of the treatment rations ranged from 3171.93 kcal/kg–3252.83 kcal/kg. The highest energy value was obtained in treatment DSM 5% (3251.83 kcal/kg), followed by DSM 20% (3226.72 kcal/kg), DSM 0% (3222.21 kcal/kg), DSM 10% (3181.14 kcal/kg), DSM 15% (3171.93 kcal/kg).

The metabolic energy value produced in this study, if calculated with the gross energy value consumed, is in the range of 3977.38–4102.48 kcal/kg, then this result is still in the total metabolic energy range, which is around 70–90% of the gross energy [23].

The results of analysis of variance showed that the treatment level of partial replacement of corn with durian seed meal up to 40% or the use of 20% in the ration had no significant effect (P>0.05) on the metabolic energy value (AMEn) of the ration. This means that the metabolic energy value measured in this study shows that the quality of the ration is of equal quality, because according to [24], the value of the results of the metabolic energy measurement is important to know in the process of preparing the ration and this value is influenced by the content and balance feed nutrition.

Effect of Treatment Level DSM on Performance and Carcass Quality of Broiler

Data on the effect of using durian seed meal on feed consumption, body weight gain, feed conversion, carcass percentage and abdominal fat are presented in the following table 6.

Table 6. Effect of Treatment Level DSM on Ration Consumption, Body Weight Gain, Ration Conversion; Carcass Percentage and Abdominal Fat

Treatment	Parameter														
	Consumption (g)			Body Weight Gain (g)			Feed Conversion			Carcass (%)			Abdominal Fat (%)		
DSM 0%	2317.66^{a}	±	23.85	1265.92^{a}	±	32.34	1.83^{a}	±	0.06	72.13	±	0.64	1.76^{a}	±	0.05
DSM 5%	2281.08^{a}	±	16.36	1247.69^{a}	±	18.03	1.83^{a}	±	0.03	72.07	±	0.72	1.73^{a}	±	0.04
DSM 10%	2226.25^{ab}	±	33.22	1209.17^{a}	±	14.79	1.84^{a}	±	0.03	71.06	±	0.97	1.59^{ab}	±	0.04
DSM 15%	2179.25^{bc}	±	55.49	1187.59^{a}	±	31.94	1.84^{a}	±	0.07	70.29	±	0.59	1.49^{b}	±	0.03

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DSM 20%	2077.08^{c}	±	8.16	963.00^{b}	±	10.61	2.16^{b}	±	0.02	70.49	±	0.80	1.46^{b}	±	0.05

Note: Different superscripts towards the column indicate significant differences (P<0.05)

Ration Consumption

Ration consumption is the amount of feed consumed by broiler chickens which is given ad libitum within a 24 hour period. The range of ration consumption for broiler chickens is between 2077.08–2317.66 g per bird for 21 days or the average consumption per bird per day is 98.94–112.94 g. The highest amount was in treatment DSM 0% durian seed meal) followed by DSM 5% durian seed meal); DSM 10% durian seed meal); DSM 15% durian seed meal and DSM 20% durian seed meal, the numbers show that the higher the level of use of durian seed meal causes a decrease in broiler chicken ration consumption.

The results of the diversity analysis showed that the treatment using durian seed meal had a significant effect (P>0.05) on broiler chicken ration consumption. The BNJ test results (appendix b) show that treatment DSM 0% has the same effect as DSM 5% and DSM 10% but is different from DSM 15% and DSM 20%; DSM 5% has the same effect as DSM 10% but is different from DSM 15% and DSM 20%; DSM 10% is the same as DSM 15% but different from DSM 20% while DSM 15% is the same as DSM 20%. The amount of feed consumed in this study was lower than the results of research by [25], an average of 119.04 g per head per day.

Weight Gain

According to [26] that the increase in body weight is obtained from the comparison between the difference between the final weight and the initial weight and the length of maintenance. The range of ration consumption for broiler chickens is between 963–1265.92 g per bird for 21 days and an average weight gain per bird per day of 45.86–60.28 g. The highest amount was in treatment DSM 0% followed by DSM 5%; DSM 10%; DSM 15% and DSM 20% numerically show that the higher the level of replacement of corn with durian seed meal causes a decrease in body weight gain in broiler chickens. The results of the diversity analysis showed that the treatment using durian seed meal had a significant effect (P<0.05) on body weight gain.

The results of the BNJ test showed that treatments DSM 0%, DSM 5%, DSM 10% and DSM 15% we're not significantly different in influencing the weight gain of broiler chickens but were significantly different from DSM 20%. [27] Stated that body weight gain is closely related to the amount of feed consumed. If feed consumption decreases it will disrupt growth. Feed consumption in this study shows that the higher the level of use of durian seed meal has a significantly lower effect on the amount consumed.

Feed Conversion

The feed conversion value is calculated based on the comparison between the amount of ration consumed divided by the amount of weight gain produced in a certain period of time. According to [28], that a low feed conversion rate indicates that the efficiency of feed use is good, because the more efficient the chickens consume feed to produce meat. The ration conversion range for broiler chickens is between 1.83–2.28. The lower the ration conversion value, the more efficient the use of ration by livestock. The results of the diversity analysis showed that the treatment using durian seed meal had a significant effect (P<0.05) on ration conversion. The results of the BNJ test show that the treatments DSM 0%, DSM 5%, DSM 10% and DSM 15% are not significantly different in influencing the ration conversion of broiler chickens but are different from DSM 20%.

Carcass Percentage

The carcass percentage is calculated from the carcass weight divided by the live weight multiplied by one hundred percent. The range of broiler chicken carcass percentages is between 72.13–70.29 percent. The lower the ration conversion value, the lower the carcass percentage. The results of the diversity analysis showed that the treatment using durian seed meal had not significant effect (P>0.05) on the percentage of broiler chicken carcasses. This shows that the higher level of use of durian seed meal does not have a significant impact on the percentage of carcasses produced. [29] and [30] stated that achieving carcass weight is closely related to slaughter weight and body weight gain.

Abdominal Fat Percentage

Abdominal fat percentage is often used as an indication of the amount of excess fat or energy consumed by broiler chickens. The results of this study show that the average percentage of abdominal fat ranges between 1.46–1.76%. The results that can be obtained are still in the range obtained by [31] that the percentage of abdominal fat ranges from 0.73–3.86% of live weight. The formation of body fat in chickens occurs due to excess energy consumed. The energy used by the body generally comes from carbohydrates and fat reserves. Carbohydrate sources in the body are able to produce body fat which is stored around the viscera and under the skin [32]; [33].

4. Conclusions

The conclusion of this research is that durian seed meal contains 8.25% protein; extract material without nitrogen 82.68%, gross energy 3605 kcal/kg, nitrogen retention ranges from 60.54–62.58%, metabolic energy (AMEn) 3171.93 kcal/kg–3252.83 kcal/kg. Durian seed meal has potential as an alternative to corn meal up to 40% or can be used up to 20% in broiler rations.

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