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Improving Feed Quality by Adding Coconut Pulp in the Concentrate Formation to Enhance Production Performance of Kacang Goats

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ABSTRACT

Efforts to increase the physiological productivity of livestock are one of the problems in responding to the increasing demand for livestock meat in Indonesia. A study was done to investigate the effects of adding coconut pulp to a supplemental diet on the productivity and physiological responses of female Kacang goats. A 2 x 3 factorial design was used in which the first factor was two levels of coconut pulp treatments (A1=non-fermented, A2=fermented), and the second factor was three levels of coconut pulp in the supplement (L0=0%, L1=10%, L2=20%). Five animals were used for each treatment. An analysis of variance showed that adding fermented or non-fermented coconut pulp at various levels did not affect weight gain significantly (P>0.05), dry matter intake, feed efficiency, physiological measures (body temperature, respiratory and pulse rates), or hematological parameters (white/red blood cell counts, hemoglobin, hematocrit). Additionally, no significant effects (P>0.05) were observed on slaughter weight, carcass metrics, or non-carcass components. However, the amount of coconut pulp significantly affected (P<0.05) certain parameters: white blood cell count, carcass weight, carcass percentage, and specific non-carcass weight measures, including internal, external, and edible components. Overall, coconut pulp inclusion in the supplemental diet, regardless of fermentation, did not notably influence most productivity and physiological measures, though the level of inclusion impacted specific non-carcass and blood parameters.

Key words: Kacang Goat, Coconut Pulp, Fermentation, Productivity, Physiological Condition and Carcass.

INTRODUCTION

Feed is the most significant factor in livestock farming, accounting for 60-80% of production costs and is often affected by seasonal fluctuations. In addition, the primary fed given to livestock is grass, which cannot meet their needs both in terms of quantity and quality. To overcome the limitation, farms are frequently supplement with high-quality concrete. However, the high costs of the concentrates as well as competition from humans and other livestock demands presents a significant challenge. This indicates that there is a need to explore alternative to traditional fed ingredients by using agricultural waste that does not contribute to environmental pollution. One such effort comprises repurposing agricultural and industrial by-products, such as coconut pulp, for producing animal feed.

According to previous studies, coconut pulp can be obtained from VCO industries and household-scale oil production (Suryani et al. 2020). This pulp can be used directly as animal feed but can be processed first to extend the shelf life and improve its original quality (Khaidir et al. 2015; Singh and Krishnaswamy 2022). Coconut pulp that is not utilized by the community can still be used as an alternative feed for livestock because it contains nutrients needed for growth (Emilia et al. 2021; Radhiah et al. 2022).

In line with these findings, the process of making coconut generates solid waste in the form of coconut pulp, which accounts for approximately 30% of the raw materials used during the process (Ouma 2019; Kristianto 2023). According to Sutanto et al. (2021); Elyana et al. (2018), coconut pulp is an industrial or household waste that has great potential to be used as feed ingredients, because it is still easy to obtain from the remains of traditional oil production.

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Despite the potential, the use of coconut pulp as a substitute for animal feed is not yet widely recognized (Marhamah et al. 2019; Kholishah et al. 2021; Oktaviana et al. 2022). Although it is a by-product of coconut milk production, it has a fairly high crude fiber content (Panjaitan 2021; Londok et al. 2022). In Central Sulawesi, Indonesia, research on the use of plants is still focused, for example the effect of castor leaves on the productivity of Kacang goats (Naser et al. 2023), the effect of moringa powder and fruit on the growth performance of Kacang goats (Sagaf et al. 2024). The effect of giving *Lannea coromandelica* leaf flour on the production performance and hematological value of Kacang goats (Abdullah et al. 2023).

Adequate crude fiber in feed is beneficial for promoting smooth digestion in the intestines. Dietary fiber has been reported to play a crucial role in disease prevention and is an essential component of nutritional therapy (Yulvianti et al. 2015; Alissandra et al. 2019; Laksono et al. 2023). However, despite its high fiber content, coconut pulp has low palatability, lacks several essential amino acids, possesses anti-nutritional properties, and has low digestibility. These factors have limited its use as animal feed, and the full extent of these limitations has yet to be fully explored. To overcome these challenges, improving the quality of coconut pulp through fermentation and processing it into coconut pulp flour is essential. Pre-treating the waste with microorganisms before feeding it to livestock is one approach to enhancing the efficiency of rumen microorganisms, making the utilization of feed more effective in meeting the animals' basic needs for maintenance, production, and reproduction. Therefore, this study aims to determine the effect of adding coconut pulp to the concentrates composition on the productivity and physiological condition of female Kacang goats.

MATERIALS AND METHODS

Experimental Livestock

This study involved 30 female Kacang goats, approximately 12 months old, with body weights ranging from 10 to 20kg. The experiment utilized a Randomized Block Design (RBD) with a 2 x 3 factorial arrangement based on initial body weight. The first factor was the type of coconut pulp: A1=unfermented coconut pulp, and A2=fermented coconut pulp. The second factor was the level of coconut pulp in the concentrate: L0=no coconut pulp, L1=10% coconut pulp, and L2=20% coconut pulp. Each treatment was replicated five times. The goats were housed in tiered pens with a zinc roof, plank flooring, and plank walls, measuring 6 x 10 meters. The pens were divided into 30 sections, each 1.0 x 1.0m, with one goat per section. Each section was equipped with a wooden feed trough and a drinking basin. The goats were acclimated to the new feed over a 14-day period, followed by a 56-day data collection phase. Feed was provided daily to monitor consumption. Body weight was recorded weekly in the morning before feeding. At the conclusion of the study, the goats were slaughtered for assessment of carcass and non-carcass components. This study received approval from the animal ethics committee of the Faculty of Animal Husbandry and Fisheries, Tadulako University, Palu, Indonesia.

Animal Feed

During the study, the feed consisted of concentrate and tubers. The concentrate was composed of 18% ground soybeans, 48% rice bran and 34% ground corn, along with varying levels of fermented and unfermented coconut pulp as treatments. The concentrate was provided at a rate of 1.0% dry matter based on the goats' body weight, while tubers were offered after the goats had consumed the concentrate and treatment as much as possible. The nutritional content of the feed ingredients is detailed in Table 1 and the nutritional content of the treatments is presented in Table 2.

Making Fermented Coconut Pulp

A total of 10 kg of coconut pulp was steamed for 20 minutes and then cooled. After cooling, the tape yeast was sprayed evenly with a dose of 1ℓ/1 ton and placed in plastic to facilitate fermentation for 5 days. Subsequently, the sample was dried for 24 hours and ready to be mixed with other feed ingredients.

Table 1: Nutritional Content of Feed Ingredients Used

Feed Ingredients	Dry Ingredients (%)	Crude protein (%)	Coarse Fiber (%)	Crude Fat (%)	TDN (%)
Ground Soybeans	91.97	31.35	9.73	11.65	61.00
Ground Corn	86.82	9.54	9.92	8.30	80.87
Rice Bran	89.92	10.67	18.39	4.62	61.21
Coconut Pulp (AK)	90.98	7.47	9.01	31.76	66.77
Fermented Coconut Pulp (AKF)	93.12	10.50	6.90	27.34	59.43
Panicum sharmentosum	26.29	11.51	30.20	1.90	59.54

Description results of the analysis of the Feed Nutrition Laboratory of the Faculty of Animal Husbandry and Fisheries, Tadulako University

Table 2: Nutritional Content of Treatment during the Study

Treatment	Dry Ingredients (%)	Crude protein (%)	Coarse Fiber (%)	Crude Fat (%)	TDN (%)
A_1L_0	89.24	14.01	13.95	7.14	67.86
A_1L_1	89.41	13.35	13.46	9.60	67.75
A_1L_2	89.58	12.70	12.96	12.06	67.64
A_2L_0	89.24	14.01	13.95	7.14	67.86
A_2L_1	89.62	13.66	13.25	9.16	67.01
A_2L_2	90.01	13.31	12.54	11.18	66.17

Description A_1L_0 = 0.0% unfermented coconut pulp; A_1L_1 = 10.0% unfermented coconut pulp; A_1L_2 = 20.0% unfermented coconut pulp; A_2L_0 = 0.0% fermented coconut pulp; A_2L_1 = 10.0% fermented coconut pulp; A_2L_2 = 20.0% fermented coconut pulp

Variables and their Measurements

Some of the dependent variables observed in this study included production performance, rectal temperature, respiratory rate, and pulse rate.

Production performance

Weight gain was calculated as the difference between the final weight and the initial weight during the observation period. Weighing was carried out at the beginning and end of the reported week by referring to the formula:

$$PBBH(\text{g/head/day}) = \frac{W_2 - W_1}{T_2 - T_1}$$

Description: PBBH is daily weight gain (grams), W1 is initial weight, W2 is final weight, T1 is time of first weighing, and T2 is time of final weighing. Ration consumption based on dry matter (grams) was obtained by calculating the difference between the amount of feed given and the amount of feed remaining, then multiplied by the resulting dry matter content, expressed in grams/head/day, while the efficiency of ration use was obtained by dividing PBBH by daily dry matter consumption.

Rectal temperature, respiratory rate, pulse rate (pulse frequency)

Rectal temperature (SR), respiratory rate (FR), and pulse rate (DN) were measured daily at noon (12.30 UTC+8) and morning (3.30 UTC+8). SR was measured for 1 minute using a clinical thermometer inserted into the rectum. FR was calculated by counting the diaphragm movements for 1 minute, and DN was measured by hand on the femoral vein for 1 minute.

Blood collection

Blood was taken from the jugular vein of the experimental animals at the beginning of the study and the end of the experiment, before feeding at 07.30am, in a tube containing ethylene diamine tetra acetate (EDTA). With a disposable needle, 5mL of whole blood was taken aseptically from the jugular vein. The rest was placed in a simple tube with 2mL of blood in a vacutainer tube containing EDTA for serum examination. The EDTA tube was immediately closed and the contents were stirred slowly for one minute by inverting or shaking. Furthermore, the hematocrit value (Packed cell volume=PCV) and hemoglobin (Hb) concentration of the blood samples were determined immediately after blood sampling. After dilution, the number of red blood cells and white blood cells was determined using a Neubauer hemocytometer.

Carcass observation

After the livestock were fasted overnight, all goats were slaughtered for carcass examination. This involved severing the jugular vein and carotid artery and allowing the goats to bleed for several minutes. The goats were then skinned and eviscerated immediately after bleeding. Each goat's body parts were separated, weighed, and recorded. The carcass percentage was calculated by dividing the hot carcass weight by the slaughter weight or empty body weight. After removing all digestive tract contents, which were included as part of the slaughter weight, the empty body weight was determined. The hot carcass weight was calculated after removing the head, as well as the contents of the chest, abdomen, and flanks, along with the skin and legs. In this report, total edible non-carcass components (edible offal) were defined as the sum of the kidneys, heart, liver, tongue, small and large intestines, reticulorumen, omasum, abomasum, tail, and total fat. Total inedible non-carcass components (non-edible offal) were calculated by summing the skin, digestive tract contents, sexual organs, bladder, spleen, lungs with trachea, diaphragm, and esophagus.

Data analysis

This study was processed statistically using RBD. Observation data obtained were analyzed by analysis of variance (F test), when there was a significant effect continued with the Least Significant Difference (LSD) Test to determine the average difference in the effect of treatment.

RESULTS AND DISCUSSION

Production performance

The results of observations on the effect of adding coconut pulp to the concentrate composition on the production performance of female Kacang goats are presented in Table 3.

The analysis of variance indicated that the addition of fermented and unfermented coconut pulp at various levels in the concentrate composition did not significantly affect (P>0.05) body weight gain, dry matter intake, or feed utilization efficiency in female Kacang goats.

The observed weight gain, dry matter intake, and feed utilization efficiency were attributable to the nutrient contributions from the fermented and unfermented coconut pulp at different levels, which did not alter the overall nutritional composition of the feed. Initially, the concentrate's nutritional content was 14.01% protein and 67.86% Total Digestible Nutrients (TDN) before the addition of coconut pulp. After incorporating 20% coconut pulp, the nutrient content was 12.70% protein and 67.64% TDN for unfermented coconut pulp, and 13.31% protein and 66.71% TDN for fermented coconut pulp (Table 2). This is consistent with the recommended protein requirements for goats, which range from 12-14% (Nsahlai et al. 2004; Souza et al. 2021; Fu et al. 2023). Consequently, the lack of significant impact on body weight, dry matter intake, and feed efficiency when coconut pulp was added at various levels can be attributed to the fact that these levels remained within the recommended protein range for goats.

Physiological conditions

The results of observations on the effect of adding coconut pulp to the concentrate composition on the physiological conditions of local goats are presented in Table 4.

Analysis of variance showed no interaction (P>0.05) between the addition of fermented and unfermented coconut pulp with different levels in the concentrate composition on body temperature, respiration frequency, pulse frequency, number of white blood cells, number of red blood cells, hemoglobin levels, and hematocrit values

Table 3: Average weight gain, feed consumption, and feed utilization efficiency in Kacang goats fed with additional coconut pulp in the concentrate composition

Parameter	Coconut Pulp	Level (%)			Average
		0.0	10.0	20.0	
Weight Gain (g/head/day)	Without Fermentation	39.29	35.54	33.68	36.17
	Fermentation	37.32	38.07	36.07	37.15
	Average	38.30	36.80	34.88	
Dry Feed Consumption (g/head/day)	Without Fermentation	495.89	463.06	469.32	476.09
	Fermentation	489.24	481.70	484.37	485.11
	Average	492.57	472.38	476.84	
Efficiency of Dry Feed Use	Without Fermentation	0.080	0.076	0.072	0.076
	Fermentation	0.077	0.080	0.075	0.077
	Average	0.078	0.078	0.073	

Table 4: Average Physiological Condition of Kacang Goats Given Additional Coconut Pulp in the Concentrate Arrangement

Parameter	Coconut Pulp	Level (%)			Average
		0.0	10.0	20.0	
Rectal Temperature(°C)	Without Fermentation	38.93	38.68	38.64	38.75
	Fermentation	38.87	38.87	38.75	38.83
	Average	38.90	38.78	38.69	
Respiratory Rate (times/minute)	Without Fermentation	51.30	46.11	46.02	47.81
	Fermentation	52.88	51.21	48.19	50.76
	Average	52.09	48.66	47.11	
Pulsus Rate (times/minute)	Without Fermentation	80.58	75.83	75.59	77.33
	Fermentation	79.60	78.78	77.68	78.69
	Average	80.09	77.30	76.64	
White Blood Cells (thousands/mm^3)	Without Fermentation	15.23	20.44	21.62	19.10
	Fermentation	16.10	19.78	20.34	18.74
	Average	15.66a	20.11b	20.98b	
Red Blood Cells (millions/mm^3)	Without Fermentation	9.84	9.63	9.44	9.64
	Fermentation	9.83	9.83	9.82	9.83
	Average	9.84	9.73	9.63	
Hemoglobin (g/dL)	Without Fermentation	9.83	8.74	8.66	9.08
	Fermentation	9.30	9.24	9.22	9.25
	Average	9.56	8.99	8.94	
Hematocrit (%)	Without Fermentation	24.85	24.36	24.30	24.50
	Fermentation	24.75	24.72	24.54	24.67
	Average	24.80	24.54	24.42	

Description - Different letters towards the row indicate significant differences (P<0.05).

of female Kacang goats. Additionally, the provision of fermented and unfermented coconut pulp in the concentrate composition did not provide a significant effect (P>0.05) on body temperature, respiration frequency, pulse frequency, number of white blood cells, number of red blood cells, hemoglobin levels, and hematocrit values of female Kacang goats. The level of pulp provision in the concentrate composition did not provide a significant effect (P>0.05) on body temperature, respiration frequency, pulse frequency, number of red blood cells, hemoglobin levels, and hematocrit values, except for the number of white blood cells of female Kacang goats.

The results of this study indicated that the body temperature of the goats obtained was higher than the results of the report by Hairmoko and Padang (2019) namely 38.23-38.48ºC. The body temperature of the goats was within the normal range according to the statement of Rajion et al. (2001) that the normal body temperature in goats ranged from 38.40-39.40ºC and the SR of goats in normal conditions was 39.20-40.20ºC (Rahardja et al. 2011).

This was related to metabolic activity, where the heat production produced was the same because the nutritional content was within the range of goat needs. The feed consumed by livestock could affect the rate of heat production in the body called the calorigenic effect of feed and maintain homeostasis conditions (Härter et al. 2017; Costa et al. 2019; Fu et al. 2023).

The respiratory frequency that did not differ between treatments was caused by relatively similar feed consumption, resulting in no different results for the respiration frequency of Kacang goats. The level of feed consumption affected the rate of respiration frequency in ruminant livestock and could increase the body's metabolic process, therefore, the body heat produced also increased (Navarro et al. 2019; Palulungan et al. 2022; Loučka et al. 2023).

The frequency of pulses that did not differ between treatments was caused by the amount of feed consumption for each treatment not differing, both unfermented and fermented treatments with different levels in the concentrate composition, therefore affecting the frequency of pulses in livestock. This was as stated by Gonzalez-Rivas et al. (2020); Nirwana et al. (2021) that the frequency of pulses was closely related to the metabolic rate of livestock, where factors that influenced the frequency of pulses in livestock included gender, muscle activity, environmental temperature, and feed consumption levels.

The results of the LSD Test showed that the number of white blood cells in female Kacang goats given 10-20% coconut pulp in the concentrate composition was significantly different ($P<0.05$) from female Kacang goats not given coconut pulp in the concentrate composition.

The number of white blood cells that did not differ between the treatments of fermented and unfermented coconut pulp feed ingredients was probably due to the possibility that fermented and unfermented coconut pulp feed ingredients were not foreign objects or feed ingredients containing toxins. Therefore, livestock responded by forming white blood cells that were not different, but after adding coconut pulp levels to the concentrate composition, the body responded to it as a foreign object or toxic substance. Elnaggar et al. (2016); Agustina et al. (2023) explained that leukocytes were mobile/active units of the body's defense system. Leukocytes had several basic properties, namely chemotaxis (attracted to certain chemicals), diapedesis (able to pass through the capillary membrane of blood vessels), amoeboid movement (moving like an amoeba), and phagocytosis (eating foreign objects) (Sipos 2019; Bradford and Contreras 2024). This could carry out their functions defensively (preventing foreign objects from entering the body) and reparatively (repairing damaged body parts) (Ruiz-Campillo et al. 2017; Hussen and Al-Sukruwah 2022; Scatà et al. 2023).

The average number of erythrocytes from this study was lower than the results conducted by Sarmin (2020); Soeyono et al. (2020). Reports by Widyono et al. (2014), on female Kacang goats that were intensively raised, obtained an average number of erythrocytes of 13.23±1.74 x 10^6/µL. Meanwhile, from the study by Bijanti et al. (2011), on female Kacang goats in Mojosarirejo Village, Gresik, an average number of erythrocytes was obtained of 14.57±2.3 x 106/µL.

The decrease in the number of erythrocytes in female Kacang goats related to feed could be caused by a lack of protein and several minerals from feed that were needed in the process of erythrocyte formation such as Iron (Fe), Cobalt (Co), and Cuprum (Cu) (Iftitah et al. 2022; Shevchenko et al. 2023). The lack of minerals was caused by goats' insufficient nutritional intake from feed consumption.

The results of the examination of hemoglobin levels in female Kacang goats could be seen in Table 4, and this was 8.66-9.30g/dL. The hemoglobin levels obtained tended to be lower compared to the study results reported by Crilly and Plate (2022) 6.80-10.13g/dL and by Tresia et al. (2023) 9.16-10.84g/dL.

The hemoglobin levels obtained from the study results showed values that tended to be higher compared to the existing literature. This was due to the influence of the quality and quantity of feed given on the formation of hemoglobin however hemoglobin levels tended to be high. Singh et al. (2018), Sudarman et al. (2019) and Roza et al. (2024) stated that buffaloes given high-concentrate feed showed higher hemoglobin levels. These were also related to the Iron content in the feed (Zerfu et al. 2023). Iron was mainly needed in the process of erythrocyte formation, namely in hemoglobin synthesis (Lambrecht et al. 2021; Nohara et al. 2022). The element Iron was the main component of hemoglobin, however, Iron deficiency affected hemoglobin formation (Choi et al. 2021; Iftitah et al. 2022; Anggita et al. 2023). Reduced Iron absorption caused the amount of ferritin (Iron stored in the body) to also decrease which had an impact on the amount of Iron that was used for hemoglobin synthesis and could cause anemia (Antoniani et al. 2018). Tana et al. (2018) and Soul et al. (2019) stated that hemoglobin levels were also influenced by the season, body activity, the presence or absence of erythrocyte damage, handling direction during examination, and nutrition in feed.

The results of the hematocrit value examination in female Kacang goats could be seen in Table 4. The average hematocrit value in female Kacang goats was 24.30-24.85%. The hematocrit value obtained was lower than the results of the reported study (Widyono et al. 2014) and higher than the report of (Bijanti et al. 2011). The previous report (Widyono et al. 2014), showed a hematocrit value of 28.58%, and another study (Bijanti et al. 2011), obtained a hematocrit value of 15.32%. Differences in hematocrit values were influenced by several factors such as age, livestock activity, water consumption, environmental temperature, and nutritional content in the feed, especially protein, minerals, and vitamins needed to maintain normality and hematocrit values (Corrales-Hernández et al. 2018; Kertawirawan et al. 2022).

Hematocrit values had a very close relationship with the number of erythrocytes. A decrease in the number of erythrocytes was generally followed by a decrease in hematocrit values. The pattern of increasing hematocrit values in this study showed appropriate values in goats. An increase in hematocrit values accompanied by an increase in hemoglobin levels and the number of red blood cells were thought to be caused by a lack of Iron and vitamin B6 in animals (Corrales-Hernández et al. 2018; Kertawirawan et al. 2022; Francisco et al. 2023)

Carcass and non-carcass

The results of observations on the effect of adding coconut pulp in the concentrate composition on the weight and percentage of carcasses and non-carcasses of female Kacang goats are presented in Table 5.

Analysis of variance showed that there was no interaction ($P>0.05$) between the addition of fermented and unfermented coconut pulp with different levels in the concentrate composition on the slaughter weight, non-carcass weight (internal, external, and edible) and non-carcass percentage (internal, external and edible) of female Kacang goats, but had a significant effect ($P<0.05$) on carcass weight and percentage. The provision of fermented and unfermented coconut pulp in the concentrate composition had no significant effect ($P>0.05$) on the slaughter weight, carcass weight, carcass percentage, non-carcass weight (internal, external, and edible), and non-carcass percentage (internal, external, and edible) of female Kacang goats. The level of coconut pulp provision in the concentrate composition had no significant effect ($P>0.05$) on the slaughter weight and edible non-carcass percentage and had an effect ($P<0.05$) on the carcass weight, carcass percentage, non-carcass weight (internal, external and edible) and non-carcass percentage (internal and external) of female Kacang goats.

Table 5: Average Weight and Percentage of Carcass and Non-Carcass of Kacang Goats Fed with Additional Coconut Pulp in the Concentrate Arrangement

Parameter	Coconut Pulp	Level (%)			Average
		0.0	10.0	20.0	
Slaughter weight (kg/head)	Without Fermentation	14.78	13.24	13.72	13.92
	Fermentation	14.13	14.02	13.71	13.95
	Average	14.45	13.63	13.72	
Carcass weight (kg/head)	Without Fermentation	6.91a	5.78c	5.77c	6.15
	Fermentation	6.33ab	6.24ab	6.02bc	6.20
	Average	6.62a	6.01b	5.90b	
Carcass Percentage (%/head)	Without Fermentation	46.82a	43.61bc	42.06c	44.16
	Fermentation	44.72b	44.65b	43.90b	44.42
	Average	45.77a	44.13b	42.98b	
Non-carcass weight (kg/head)	Without Fermentation	3.17	2.52	2.50	2.73
	Fermentation	2.91	2.74	2.64	2.76
	Average	3.04a	2.63b	2.57b	
Non-Carcass Percentage (%/head)	Without Fermentation	21.46	19.20	18.28	19.65
	Fermentation	20.59	19.48	19.31	19.79
	Average	21.03a	19.34b	18.79b	
Internal non-carcass weight (kg/head)	Without Fermentation	0.828	0.584	0.689	0.700
	Fermentation	0.718	0.654	0.641	0.671
	Average	0.773a	0.619b	0.665b	
Percentage of Internal Non-Carcass (%/head)	Without Fermentation	5.61	4.44	5.07	5.04
	Fermentation	5.07	4.66	4.70	4.81
	Average	5.34a	4.55b	4.88b	
External non-carcass weight (kg/head)	Without Fermentation	2.342	1.934	1.810	2.029
	Fermentation	2.197	2.088	1.998	2.094
	Average	2.269a	2.011b	1.904b	
Percentage of non-External Carcass (%/head).	Without Fermentation	15.85	14.76	13.21	14.61
	Fermentation	15.52	14.82	14.61	14.98
	Average	15.69a	14.79b	13.91b	
Edible non-carcass weight (kg/head).	Without Fermentation	1.983	1.645	1.712	1.780
	Fermentation	1.795	1.763	1.703	1.754
	Average	1.889a	1.704b	1.707b	
Percentage of non-edible carcasses (%/head).	Without Fermentation	13.43	12.45	12.48	12.79
	Fermentation	12.67	12.65	12.41	12.58
	Average	13.05	12.55	12.45	

Description - Different letters towards the row indicate significant differences (P<0.05).

The results of this study showed that the slaughter weight of each treatment did not show significant differences, but the carcass weight, percentage, non-carcass weight, and percentage (internal non-carcass, external non-carcass, and non-carcass fit for consumption) differed along with the increasing level of provision of fermented coconut pulp and non-fermented coconut pulp. This was in accordance with Chanjula and Cherdtong (2018) and Obeidat et al. (2020) that nutrition is a factor that could affect livestock carcass production.

The results of the LSD Test showed that the carcass weight of goats that did not receive the addition of fermented coconut pulp and without fermentation in the concentrate composition was significantly higher (P<0.05) compared to 10% unfermented coconut pulp, 20% fermented coconut pulp, and unfermented coconut pulp, but not significantly different (P>0.05) with 10% fermented coconut pulp. A total of 10% unfermented coconut pulp was also not significantly different (P>0.05) with 20% fermented coconut pulp and 20% unfermented coconut pulp in the concentrate.

This was caused by various factors and thought to affect the proportion of carcass weight, especially the nutritional content of feed consumed by livestock. The nutritional content of the concentrate given was 14.01% and decreased with the addition of fermented coconut pulp and unfermented coconut pulp as a substitute for concentrate. Livestock carcass growth was influenced by many factors, namely genetics, gender, castration, physiology, age, body weight, and feed given both in quantity and quality (Fthenakis and Papadopoulos 2018; Purnami et al. 2021; Spandan et al. 2022). However, gender, breed of livestock, and nutrition were factors that greatly influenced the growth of carcass components (Bambou et al. 2021; Ale et al. 2022; Campelo-Lima et al. 2022; Farid et al. 2023).

The results of the LSD Test showed that the percentage of goat carcasses that did not receive the addition of raw coconut pulp in the concentrate composition was significantly higher (P<0.05) compared to other treatments, while LSD that did not receive fermented coconut pulp was not significantly different (P>0.05) from those that received 10% raw and fermented coconut pulp, and 20% fermented coconut pulp. The reports that received 10% unfermented coconut pulp were not significantly different from those given fermented coconut pulp and 20% unfermented coconut pulp.

The decreasing carcass percentage with increasing coconut pulp as a substitute for concentrate, both unfermented and fermented, was due to the nutritional quality obtained by goats during the study as shown in Table 2. Therefore, the carcass percentage was closely related to the nutritional quality consumed by livestock (Njoga et al. 2021; Ncube et al. 2022). Nutrition was one of the important factors affecting body weight (Kahi and Wasike 2019; Berthel et al. 2022; Charis et al. 2022; Nelson et al. 2023). When the feed quality was good and the amount of consumption was sufficient, it accelerated growth and eventually increased body weight gain which caused high slaughter weight (Coloma-García et al. 2020; Tahuk and Bira 2023). Faster-growing livestock was more efficient in converting food into body weight gain, therefore increasing carcass weight and subsequently affecting carcass percentage (Reynolds et al. 2020; Dahmer et al. 2022; Wang et al. 2023; Yang et al. 2023).

The LSD Test results showed that the non-carcass weight and percentage (internal, external and edible) of goats that did not receive additional coconut pulp in the concentrate composition were significantly ($P<0.05$) higher than the treatments that received 10% and 20% coconut pulp. However, those received 10% and 20% coconut pulp did not show any significant difference ($P>0.05$) in the non-carcass weight and percentage (internal, external, and edible) of female Kacang goats.

Growth and development could result in changes in body weight and measurements, including live, carcass, and non-carcass weight. When there was an increase in live weight, there was an increase in carcass and non-carcass weight (García-Muñiz et al. 2019; Vorlaphim et al. 2021; Zhan et al. 2023; Cai et al. 2023). This report showed that the slaughter weight was not significantly different between treatments however the weight of carcass components and non-carcass weight also did not show significant differences, but tended to decrease with increasing provision of unfermented and fermented coconut pulp. This was supported by Shen et al. (2021); Keçici et al. (2022) that changes in carcass components with increasing carcass weight were due to differential growth of carcass tissue, however changes in carcass components were proportional to the increase in carcass weight.

The relative growth of some non-carcass components was the same as the relative growth rate of the livestock body (Mohammed et al. 2012). Salim and Abdulkareem (2019); Hundal et al. (2020); Alkass et al. (2023) stated that the rumen, reticulum, and omasum increased rapidly in weight in early postnatal life, but the percentage of the digestive tract decreased when it reached maturity. Furthermore, the small intestine developed faster than the large intestine and abomasum. The weight of the digestive and metabolic organs varied greatly depending on the physiological status and the food given (Al-Owaimer et al. 2013; Khatun et al. 2019).

Conclusion

Adding coconut pulp into the feed composition for Kacang goats is feasible. This is because the addition of coconut pulp both fermented and non-fermented, at various levels did not significantly affect body weight gain, dry matter consumption, dry matter use efficiency, body weight gain, respiration rate, pulse rate, or other parameters such as white blood cell count, red blood cell count, haemoglobin level, haematocrit value, slaughter weight, carcass weight, carcass weight, non-carcass weight, and non-carcass weight (internal, external, and edible). In addition, feeding fermented and unfermented coconut pulp in the ration had no significant effect on body weight, respiration rate, and pulse rate. The only result obtained was that the provision of coconut pulp in the ration significantly affected leucocyte count, slaughter weight, carcass weight, carcass percentage, and non-carcass percentage in Kacang goats.

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