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Efforts to Enhance Etawa Crossbred Goat Production Through Innovative Utilization of Local Moringa Plants (*Moringa oleifera*) in Concentrate

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ABSTRACT

Background: The sustainability and availability of animal feed ingredients are important concerns in Etawa Crossbreed (EC) goats production. A method to increase production is by utilizing local moringa (*Moringa oleifera*) plants as local concentrate ingredients for feed. This research aimed to determine the best composition to provide local moringa (*Moringa oleifera*) plants with quality, cheap, easily obtained and available concentrate feed at all times in order to increase the productivity of Etawa crossbreed goats.

Methods: The data obtained from the experiment were analyzed through a completely randomized design (CRD) analysis of variance. Furthermore, the treatments that had a significant effect were later subjected to the Honestly Significant Difference (HSD) test. The experimental treatments consisted of P1: Concentrate with a mixture of 40% tofu dregs, 40% rice bran and 20% local moringa plants, P2: concentrate with a mixture of 30% tofu dregs, 30% rice bran and 40% local moringa plants, P3: Concentrate with a mixture of 20% tofu dregs, 20% rice bran and 60% local moringa plants and P4: Concentrate with a mixture of 10% tofu dregs, 10% rice bran and 80% local moringa plants.

Result: The results showed that the provision of concentrate with local moringa components had a very significant effect ($P<0.01$) on body weight gain, dry matter feed consumption and feed utilization efficiency as well as carcass weight and percentage but it does not have a significant impact on blood profiles, such as leukocytes, erythrocytes, hemoglobin and hematocrit ($P>0.05$). The best composition was with 80% local plants which did not interfere with the health of Etawa crossbreed goats.

Key words: Blood profile, Carcass, Goat, Innovation, *Moringa oleifera*, Productivity.

INTRODUCTION

National economic growth is highly dependent on the livestock sector because it delivers essential nutrition which supports productive human lifestyles (Mehrabi *et al.,* 2020). Indonesia also depends on the sector as a fundamental part for ensuring food safety and economic development and sustainable growth (Nugroho *et al.,* 2022; Sutardi *et al.,* 2022). Therefore, livestock production, in particular goat farming, requires expansion throughout Central Sulawesi Province to contribute to national food security initiatives. The selection of Central Sulawesi is due to its role as the main buffer for the National Capital and geographically located directly opposite East Kalimantan Province. However, the process has been limited by the quality of feed due to the tropical climate, including dry and rainy seasons. Furthermore, in tropical regions, green fodder typically exhibits a high crude fiber content coupled with a low crude protein content (Fatmawati *et al.*, 2023). In the rainy season, the availability of feed is abundant but becomes very scarce in the dry season (Duguma and Janssens, 2021). The continuously limited supply of feed has encouraged farmers to change provision patterns (Ayele *et al.,* 2021). The situation also leads Indonesian farmers to generally raise livestock extensively through traditional methods. An example is the engagement in grazing which provides the livestock with only nutritional intake from field grass without any concentrate.

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The population of goats in Indonesia was reported to be 18,904,347 and the quantity of goast meat produced from 2018 to 2022 was 328.1 thousand tons (Hayatudin, 2023). The number is quite large and widespread with the Kacang goats identified to be the first while the Etawa crossbreed (EC) was the second (Fauzi *et al.*, 2024). It was also reported that the population of Etawa crossbreed goats in Central Sulawesi in 2022 was 612,870.

Research has been conducted to determine how Kacang goats can get high-quality feed by using local

moringa (*Moringa oleifera*) plants. This was achieved using distinct feeding methods for leaves and fruits which significantly affected productivity. Local moringa plants showed potential to function as an alternative feed to improve Kacang goats productivity for community members (Sagaf *et al.,* 2024). The Etawa crossbreed goats serves as the research subject because it represents local goats that possess superior genetic quality than the Kacang breed which Indonesian people typically raise. The two production values of Etawa crossbreed goats enable the ability to function as both a milk-producing and meat-producing animal (Pazla *et al.,* 2022). The goats are produced through the crossbreeding between Jawarandu and Etawa goats with the raising process identified to have some advantages, including easy breeding, fast sexual maturity, relatively easy maintenance, not requiring a large area of land, less capital, adapting well to environmental conditions and capacity to eat all types of food such as leaves, grass, fruit skins and agricultural waste.

Etawa crossbreed goats certainly requires special attention because of its higher economic value compared to Kacang goats. In the enhancement of livestock production, feed constitutes a primary component, as it can influence production value, accounting for 60-80% of the total livestock maintenance expenses (Shandilya *et al*., 2019). Efforts have also been made to use local moringa materials as a good alternative to increase the production of Etawa crossbreed goats because of the high and complete nutritional value as well as consistent availability in sufficient quantities. Local moringa plants are quite popular among the Indonesian people, especially in Central Sulawesi Province. This is due to the ease of growing in tropical areas of the world, including Indonesia. Moringa can grow up to 7-11 meters, in the form of shrubs or trees with strong roots, long-lived, brittle woody stems or easily broken, upright, dirty white, thin-skinned, rough surface and rarely branched. It is a good source of macronutrients containing Ca and K elements as well as micronutrients such as Mn in addition to polyunsaturated fats. All the elements are important in providing human nutrition (Monteiro *et al.,* 2022).

Local moringa is a type of plant that is very rich in nutritional content in the form of protein and bioactive compounds such as alkaloids, flavonoids, phenolics, glucosinolates, carotenoids, sterols, saponins, phenolic acids, tannins and isocyanates (Shah and Oza, 2022). These compounds contain phenolic acids and flavonoids which function to increase growth performance (Suong *et al.,* 2022), dry matter intake and feed digestibility (Ban *et al.,* 2022), production, the health of ruminant livestock as well as other parameters (Taethaisong *et al.,* 2022). The introduction of moringa leaves into concentrate was reported to have provided positive results on metabolism in goats (Leitanthem *et al.,* 2023). It also increased growth performance and nutrient digestibility through easy digestion as observed in the improvement of the activities conducted by decomposing bacteria in the rumen (Hao *et al.,* 2021; Cholewiñska *et al.,* 2020). Moreover, the research showed that the influence affected nutrient digestibility as well as cellular immunity and hematobiochemical parameters in liver and kidneys without raising production expenses (El-Deeb *et al.,* 2018).

Research about Etawa crossbreed goats remains limited compared to the focus on cattle, sheep and pigs although goats maintain significant importance in developing nations and have superior characteristics than other livestock species (Olmo *et al.,* 2024). This shows the potential of local moringa plants as the main concentrate ingredient needs to be explored with additional feed components such as tofu dregs and rice bran to develop sustainable and quality feed formulations. Total mixed ration serves as a crucial factor influencing the metabolism of unsaturated fatty acids in the rumen of goats (Yildiz and Erdogan, 2018). The analysis of Etawa crossbreed goats production through concentrate mixing containing various ratios of local moringa leaves and fruit needs further investigation. Therefore, this research examined different feed compositions of local moringa plants with the aim of developing inexpensive but accessible and high-quality concentrate feed to enhance Etawa crossbreed goats productivity.

MATERIALS AND METHODS

The study area

This research was conducted at the Student Research Farm of Tadulako University, located in Boyaoge Village, Tatanga District, Palu City, Central Sulawesi Province, Indonesia. The research was carried out over a period of 8 months, from March to October 2024. The study was conducted in several stages as follows: the first stage involved the adaptation of the goats to the research farm, which took place from March 9 to March 22, 2024. The second stage, from March 23 to April 6, 2024, focused on the adaptation of the goats to the experimental feed. The third stage involved data collection, which was conducted from April 7 to October 12, 2024.

Research materials

A total of 16 female Etawa crossbreed goats aged ± 10 months to 1 year with an initial body weight range of 8 kg to 13 kg were used as research material. The goats were placed in a raised pen with a zinc roof, plank floor and plank walls. The plot of each pen had dimensions of 1.5 × 1.0 meters with each containing a feed trough made of plastic bucket and basin for drinking water.

Feed used

The green fodder used was elephant grass (*Pennisetum purpereum*) as the basic feed while the concentrate consisted of local moringa plants as the main component mixed with rice bran and tofu dregs as additional feed sources based on the nutritional content of the feed as

presented in Table 1 and 2. Before the moringa was used in the concentrate mixture, the leaves and fruit were dried under the sun for seven days, ground and mixed with a ratio of 50%:50% into granules.

Research design

This research used a completely randomized design (CRD) with four treatments and four replications. The treatments tested were: P1 = Concentrate with a mixture of 40% tofu dregs, 40% rice bran and 20% local moringa plants; P2 = Concentrate with a mixture of 30% tofu dregs, 30% rice bran and 40% local moringa plants; P3 = Concentrate with a mixture of 20% tofu dregs, 20% rice bran and 60% local moringa plants; P4 = Concentrate with a mixture of 10% tofu dregs, 10% rice bran and 80% local moringa plants.

Research procedure

The research process was divided into three sequential stages which started with adaptation followed by introduction and finished with data collection. The goats required two weeks to adapt to their new environment with pens and feed during the adaptation and introduction stages. Meanwhile, body weight of goats was measured every weekend prior to feeding during the data collection stage. Etawa crossbreed goats were fed concentrate at 08:00 a.m. at 1% dry matter of the body weight. Moreover, elephant grass was provided *ad libitum* after the concentrate feed was consumed. This was followed by the provision of drinking water *ad libitum*.

Blood samples were collected through the jugular vein in the neck of the goats using a 3 ml syringe, placed into an EDTA vacutainer tube and stored in a cool box containing ice cubes to be subsequently in determining the number of erythrocytes, leukocytes, hemoglobin and hematocrit values. The samples were sent to the Central Sulawesi Provincial Health Laboratory for further analysis. Furthermore, carcass data and percentages were collected at the end of the analysis.

Observed variables and their measurement

1. Weight gain was calculated by subtracting the final weight from the initial weight.
2. Feed consumption was measured daily by calculating the difference between the given and the remaining feed.

Table 1: Nutritional content of feed ingredients.

Feed ingredients	Dry matter (%)	Crude protein (%)	Crude fiber (%)	Crude fat (%)	TDN (%)
Elephant grass	17.52	9.43	30.6	2.03	53.72
Tofu dregs	88.35	23.39	19.44	9.96	73.03
Rice bran	9.6	10.67	18.39	4.08	61.21
Moringa oleifera	91.44	20.40	15.77	10.86	69.37

Source: Analysis results of the agrotechnology laboratory, faculty of agriculture, Tadulako University, (2024).

Table 2: Nutritional content of concentrate feed in each treatment tried.

Feed ingredients	Composition (%)	Dry matter (%)	Crude protein (%)	Crude fiber (%)	Crude fat (%)	TDN (%)
			P1			
Tofu dregs	40	35.34	9.36	7.78	3.98	29.21
Rice bran	40	35.97	4.27	7.36	1.85	24.48
Moringa oleifera	20	18.54	4.51	2.52	1.46	13.87
Total	100	89.85	18.13	17.65	7.30	67.57
			P2			
Tofu dregs	30	26.51	7.02	5.83	2.99	21.91
Rice bran	30	26.98	3.20	5.52	1.39	18.36
Moringa oleifera	40	37.08	9.02	5.04	2.93	27.75
Total	100	90.56	19.23	16.39	7.30	68.02
			P3			
Tofu dregs	20	17.67	4.68	3.89	1.99	14.61
Rice bran	20	17.98	2.13	3.68	0.92	12.24
Moringa oleifera	60	55.62	13.52	7.55	4.39	41.62
Total	100	91.27	20.34	15.12	7.31	68.47
			P4			
Tofu dregs	10	8.84	2.34	1.94	1.00	7.30
Rice bran	10	8.99	1.07	1.84	0.46	6.12
Moringa oleifera	80	74.16	18.03	10.07	5.86	55.50
Total	100	91.99	21.44	13.86	7.31	68.92

Source: Analysis results of the agrotechnology laboratory, faculty of agriculture, tadulako university, (2024).

3. Feed efficiency was determined through the division of the weight gain by the total feed consumption and multiplied by 100%.
4. Carcass weight was measured by determining the weight of the livestock after slaughter, minus the weight of the head, lower legs (carpus and tarsus joints), skin, blood and internal organs (chest cavity and abdominal cavity contents) such as stomach, intestines, heart, lungs, esophagus, liver, spleen, kidneys and diaphragm.
5. The carcass percentage was calculated from the cut weight divided by the carcass weight multiplied by 100%.

Data analysis

The data obtained from the experiment were analyzed for variance according to the instructions (Abdel-Rahman *et al*. 2019). The treatments with significant effect were further subjected to the Honestly Significant Difference (HSD) Test using the following mathematical model:

$$Yij = \mu + \beta j + \varepsilon ij$$

Description:
μ = Population mean.
βj = Treatment of the j^{th} treatment.
εij = Error of the i^{th} experiment.

RESULTS AND DISCUSSION

The effect of treatment on weight gain of etawa crossbreed goats

The results on weight gain, dry matter consumption of feed and efficiency of concentrate feed use with different levels can be seen in Table 3.

Body weight gain

The analysis of variance showed that the use of local moringa plants as concentrate feed had a very significant effect (P<0.01) on body weight gain, dry matter consumption of feed and feed efficiency in Table 3. The results of the HSD showed that giving local moringa plants in concentrate increased the body weight gain of Etawa crossbreed goats. Treatment P4 with an average of 89.19 (gr/head/day) was the highest of all treatments. This research showed more significant results compared to previous observation of Rohmah *et al.* (2020) that the average increase in body weight of Jawarandu goats fed with additional soybean meal and moringa leaves ranged from 50.09 to 66.70 (gr/head/day). Meanwhile, the weight gain recorded in this research was lower compared to the report of Permata Sari *et al.* (2024) that the addition of moringa leaf flour to feed led to a weight gain of 68.27 to 123.93 (gr/head/day) in Boer crossbreed goats. The addition of a 10% tofu dregs concentrate mixture with 10% rice bran and 80% moringa granules increased Etawa crosbreed goats body weight gain through its complete nutrition content and high protein levels in moringa. The administration of 80% *Moringa oliefera* enhanced feed metabolism and absorption as well as digestibility which led to optimal body weight gain. Nur *et al.* (2017) stated that the nutritional content of moringa leaves, especially protein, was important in supporting the metabolic process of livestock due to the significant role in achieving optimal body weight gain. The high value also showed feed was utilized efficiently due to the high nutrient content contained to be used by livestock for basic life functions, biological processes and protein to increase productivity (Naser *et al.*, 2023). Weight gain, as a commonly used parameter, can be used as a reference to assess production standards in livestock businesses.

Feed dry matter consumption

The HSD results showed that feeding local moringa plants as a concentrate had a very significant effect (P<0.01) on dry matter consumption of feed. The feeding in the P4 treatment with a mixture of 10% tofu dregs, 10% rice bran and 80% local moringa granules was observed to be higher than other treatments while the lowest was in the P1 treatment. This was because the provision of local moringa plants in concentrate increased palatability with further effects on feed consumption and weight gain of the goats. The level of feed consumption depends mainly on palatability among other factors (Enke *et al.,* 2022). The ingredients and feed types consisting of rice bran and tofu dregs together with local moringa plants shared similar palatability levels that affected feed consumption. The anti-nutritional substances in local moringa plants including saponins and tannins make feed palatable by reducing the bitter taste but also impair nutrient absorption in the digestive tract. However, this situation does not affect the consumption of dry matter in Etawa crossbreed goats feed. The dry matter consumption recorded was higher than the 441.14-370.51 gr/day reported in the previous research by Malik (2021) using *Indofera zollingeriana* feed and *Brachiaria decumbens* grass. A mixture of Gamal (*Gliricidia sepium*), Lamtoro (*Leucaena leucocephala*) and Sengon (*Albizia chinensis)* leaf flour were formulated at a 1:1:1 ratio and 10% was included in the concentrate feed for

Table 3: Average weight gain, dry matter consumption of feed and efficiency of concentrate feed use with different levels.

Parameter	Treatment			
	P1	P2	P3	P4
Body weight gain (gr/head/day)	50.89[a]	61.78[b]	72.81[c]	89.19[d]
Dry feed consumption (gr/head/day)	527.11[a]	531.95[b]	531.00[b]	549.10[c]
Efficiency of concentrate feed use	0.092[a]	0.107[b]	0.135[d]	0.126[c]

Description: Numbers followed by different letters towards the row indicate a significant difference.

young male Etawa crossbreed goats in the research by Marhaeniyanto *et al*. (2020). The process led to dry matter consumption of feed with a range of 665.40 to 708.30 gr/head/day. Moreover Ammar *et al.* (2024) stated that tannins and saponins considered as antinutritional substances in moringa grains did not affect dry matter consumption in goats. It was also observed that the protein from 80% moringa did not affect feed consumption in goats due to the ability of the livestock to tolerate the bitter taste. In addition to palatability, other factors that affected feed consumption were sufficient energy and protein requirements in all treatments and the improvement in the nutritional content of the feed.

Feed utilization efficiency

The results of the HSD presented in Table 3 showed that local moringa plants in concentrate had a very significant effect ($P<0.01$) on feed utilization efficiency. The highest value was reported for P3 while the lowest was in P1. The efficiency depended on the amount of feed consumed by goats and the subsequent weight increase. The protein content of local moringa plants was much at an extremely high percentage of 80%. It was observed that the fast absorption rate of high bypass protein in the digestive tract prevented excessive energy usage for rumen fermentation synthesis. Moreover, feed quality together with feed quantity significantly influenced the utilization efficiency of feed because of the digestible substance content (de Andrade *et al.*, 2024). Efficient feed utilization was described as the condition where animals consumed less feed while maintaining high body weight gain (Budisatria *et al.,* 2021). The accomplishment of this condition requires feed containing appropriate nutrients alongside balanced characteristics of energy and protein. Another important point is that livestock can achieve highest efficiency when feeding small quantities leads to significant weight gain.

Effect of treatments on blood profile of etawa crossbreed goats

The results of leukocytes, erythrocytes, hemoglobin and hematocrit associated with the blood profile of Etawa crossbreed goats fed with local plants at different levels can be seen in Table 4.

Table 4: Average leukocytes, erythrocytes, hemoglobin and hematocrit blood profile of etawa crossbreed goats fed with local *moringa* plants at different levels.

Parameter	Treatment			
	P1	P2	P3	P4
Leukocytes (10^3/mm^3)	9.27	9.25	9.42	9.41
Erythrocytes (10^6/mm^3)	10.23	10.2	10.19	11.1
Hemoglobin (g/dl)	9.55	9.4	9.45	9.42
Hematocrit/PCV (%)	23.87	24.05	23.07	23.2

Description: Analysis results of the Central Sulawesi Provincial Health Laboratory. (2024).

The analysis of variance showed that the local moringa plant added to the feed concentrate did not have a significant effect ($P>0.05$) on leukocytes, erythrocytes, hemoglobin and hematocrit. The number of leukocytes recorded in the Etawa crossbreed goats was 9.27 (10^3/mm^3), 9.25 (10^3/mm^3), 9.42 (10^3/mm^3) and 9.41 (10^3/mm^3) for P1, P2, P3 and P4 respectively. Testing blood metabolites together with hematology provides significant indicators for determining livestock physiology along with nutrition and health status (Mansilla *et al*., 2023). The leukocyte value in P3 was the highest while the lowest was in P2 treatment. This shows an increase in the quantity of the parameter and the normal number required in goats ranges from 6-16 (103/mm^3). The trend further shows that the levels in all the treatments are in the normal range, thereby reflecting the absence of problems in the goats. The leukocytes recorded were also almost the same or close to the 16.59 -19.23 10^3/mm^3 found in previous research conducted by providing different levels of banana stem flour feed in concentrate to Kacang goats (Sagaf and Wirawan, 2023).

The erythrocytes found in the samples were 10.23 (10^6/mm^3), 10.2 (10^6/mm^3), 10.19 (10^6/mm^3) and 11.1 (10^6/mm^3) for P1, P2, P3 and P4 respectively. The highest value was recorded in P4 produced with a mixture of 10% tofu dregs, 10% rice bran and 80% local moringa while the lowest was in P3 with 20%, 20% and 60% respectively. These results showed that the erythrocyte levels of the goats are normal because the required value ranges from 8-18 (10^6/mm^3) (Mazzuca *et al.*, 2021). According to Wahyuni *et al.,* (2021), dried moringa leaves contain amino acids in the form of arginine, histidine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. The amino acids do not affect or interfere with the formation of red blood cells, thereby leading to the normal condition recorded. It was observed that the provision of local moringa plants up to 80% did not affect the number of erythrocytes but excessive tannin and saponin content could influence the quantity. The formation of erythrocytes requires nutritious feed containing proteins together with vitamins and minerals for optimal blood metabolic processes. Protein together with iron and copper and cobalt need to be present in sufficient amounts for this process. The normal erythrocyte condition resulted from adequate nutrients found in all the feeds distributed to livestock through their respective treatments. The experimental results confirmed that adequate nutritional elements strongly influence the erythrocyte counts found in goats. Reports from previous research confirmed that appropriate feed-based nutrient satisfaction led to improved erythrocyte count and maintenance of normal range (Younis, 2020). The research showed that goats received normal erythrocyte values while being fed with local moringa plant-based meals.

The average hemoglobin identified in the Etawa crossbreed goats was 9.55 (g/ml), 9.4 (g/ml), 9.45 (g/ml) and 9.42 (g/ml) for P1, P2, P3 and P4, respectively. The highest value was recorded in P1 while the lowest was

found with the P2. All the treatments proved to have no significant impact because research subjects showed equivalent physical activity in cages because lung oxygen intake remained consistent and blood showed typical hemoglobin levels. The results were in line with the observation of Hambakodu *et al.* (2024) that normal hematologic outcomes ranged between 8 to 12 g dL. The normal levels confirmed that the goats efficiently processed nutrients which provided enough dietary support for forming new hemoglobin. Hemoglobin is a component of red blood cells that performs the function of binding oxygen to be circulated throughout the body to support metabolism. This shows that the level of hemoglobin depends on the oxygen needs of the body. The need for more oxygen leads to higher hemoglobin levels and the production of the component is influenced by feed and environment that is capable of reducing nutritional deficiencies.

The results showed that the hematocrit in Etawa crossbreed goats was 23.87%, 24.05%, 23.07% and 23.2% for P1, P2, P3 and P4 respectively. Hematocrit refers to the percentage of red blood cells in 100 ml of blood (Bucciarelli *et al.,* 2024) which is often expressed as a percentage (%). The lowest hematocrit was recorded in P3 while the highest was in P2 but all the treatments with local moringa plants did not have any significant effect on the hematocrit in Etawa crossbreed goats blood. The values found in this research were within the normal range of 22.55%-24.05% which could be due to the complete and sufficient protein, mineral vitamins and iron in super feed concentrate produced using local moringa plant. This is in line with the submission of Mazzuca *et al.* (2021) that the normal hematocrit level in goats is 22%-38%. The trend showed that the introduction of the plants did not have a negative impact on nutrient and oxygen transportation in goats. Hematocrit also describes the blood viscosity which subsequently affects the rate of nutrient and oxygen transportation. The level can change based on the quality of nutrients in the feed consumed, especially protein, vitamins and minerals.

Effect of treatment on carcass and carcass percentage of etawa crossbreed goats

The carcass weight and percentage of Etawa crossbreed goats were assessed after the consumption of the local moringa plant in concentrate at different levels. The results recorded are presented in the following Table 5.

Table 5: Average carcass weight and percentage of etawa crossbreed goats given local moringa (*Moringa oleifera*) feed in concentrate at different levels.

Parameter	Treatment			
	P1	P2	P3	P4
Carcass (Kg)	7.86[a]	8.81[b]	9.26[c]	10.66[d]
Carcass (%)	45.60[a]	50.54[b]	52.04[c]	55.50[d]

Description: Numbers followed by different letters towards the row indicate a significant difference.

The analysis of variance showed that the inclusion of local moringa plants as feed in concentrate had a very significant effect (P<0.01) on carcass weight and percentage. The highest carcass weight was recorded in P4 containing 10% tofu dregs, 10% rice bran and 80% moringa while the lowest was in P1 with 40%, 40% and 20% respectively. This trend showed that the treatments had a very significant effect (P<0.01) on carcass and carcass percentage probably due to the nutrient content. The treatments were produced using local moringa plants at 20%, 40%, 60% and 80% in the concentrate, leading to the possibility of forming fat deposits along the digestive tract. This had a further positive impact on the carcass weight and percentage because the fat formed and present in the meat caused a balance between energy and protein to meet the needs of livestock and increase productivity to ensure optimal growth rate and carcass production. Moreover, feed containing high protein and energy content can significantly increase the rate of body weight gain with subsequent direct improvement in carcass weight and percentage. This agreed with the submission of Portillo-Salgado *et al.* (2023) that the percentage of carcass could be modified by different factors such as gender, age, race, maintenance system and feed. The quality of feed nutritional contents remains vital for livestock growth while producing superior nutritional quantity results in enhanced productivity. Ruminants require proper rumen microbial conditions since their feed undergoes digestion by rumen bacteria before getting assimilated into livestock body tissue. The percent of carcass varies according to age together with body weight and gender and nutritional quality also affects it as does fat accumulation (Abo *et al.,* 2022). According to Ekiz *et al*. (2020), high carcass percentage reflected more slaughter weights due to larger feed portions while low slaughter weight was associated with decreased feed portions.

CONCLUSION

The body weight gain and dry feed consumption along with feed utilization efficiency as well as carcass weight and percentage showed very significant effects (P<0.01) when concentrate was provided with local moringa plant components. Meanwhile, the treatment showed no meaningful influence (P>0.05) on blood parameters which included leukocytes, erythrocytes, hemoglobin and hematocrit levels. The 80% composition was found to be the most effective formulation because it avoided health complications in Etawa crossbreed goats. This showed of using local moringa plants as a concentrate component to increase the production of Etawa crossbreed goats and subsequently ensure successful livestock development in the research area. The use of 80% local moringa plants in concentrate has direct implications for the efficiency of Etawa crossbred goat feed due to the availability of abundant feed ingredients that are available at all times and make it easier to grow in the research area.

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Conflict of interest

All authors declare that they have no conflict of interest.

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