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Production Performance, Nutrient Digestibility and Food Consumption of Etawa Crosbreed Dairy Goats Fed *Gliricidia sepium*, Concentrate of Palm Kernel Cake and Cassava Leaves

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ABSTRACT

The objective of this research was to assess the consumption, digestive efficiency, productivity, and milk quality of Etawa crossbreed dairy goats (ECDG) when they were provided with a diet comprising conventional mixed forage, cassava leaves (CL), *Gliricidia sepium* (Gs), in addition to palm kernel cake concentrate (PKCC). In this research, a fully randomized design was employed, which included four treatments and four replications. The treatments were defined as follows: Treatment A consisted of company rations, which included a combination of 50% company forages and 50% company concentrate (CC). Treatment B involved a diet comprising 50% *Gliricidia sepium* and cassava leaves (Gs+CL), 35% CC, and 15% PKCC. Treatment C utilized 50% (Gs+CL), 25% CC and 25% PKCC, while Treatment D incorporated 50% (Gs+CL), 15% CC, and 35% PKCC. The variables under investigation included: the quality of milk (lactose, total solid, water content, protein, fat-free solids, fat, density and acidity level), consumption of organic material (OMI), efficiency of organic matter breakdown (OMD), milk production, intake of dry matter (DMI), intake of crude protein (CPI), digestibility of crude protein (CPD), and digestibility of dry matter (DMD). Data interpretation made use of analysis of variance, with an additional examination provided for detecting dissimilarities among treatments through Duncan's multiple range method. The results of this analysis showed that variables such as digestibility, milk quality, milk production, and feed intake were not significantly affected by the treatment (P>0.05). The utilization of PKCC, along with a blend of *G. sepium* and cassava leaves, effectively sustained feed digestibility, milk quality, feed intake, and production in ECDG. Substituting the forage provided by the company with a combination of *G. sepium* and cassava, and substituting the concentrate provided by the company with PKCC, did not result in any noticeable effects on milk quality, production, intake, or Etawa crossbreed dairy goats' digestibility. The mixture comprising 15% company concentrate, 35% PKCC, and 50% cassava and *G. sepium* successfully maintained milk quality, production, digestibility, and milk consumption in Etawa crossbreed dairy goats.

Key words: Cassava leaves, *Gliricidia sepium*, Palm kernel cake, Milk production, Etawa crossbreed dairy goats.

INTRODUCTION

In the development of Etawa crossbreed dairy goat (ECDG) husbandry, two significant challenges are the limited availability of forage and the escalating cost of concentrate. The encroachment of residential areas is leading to a reduction in forage supply for animal diets. Concurrently, the cost of concentrated feed consistently increases. As highlighted by Arief et al. (2018a), there is an urgent need to explore alternative feed sources to enhance the efficiency and productivity of livestock businesses. Hence, it becomes imperative to identify substitute forage and concentrate sources that offer elevated production rates and superior quality of nutrition.

Gliricidia sepium is a woody plant that is easy to find because it is easy to grow and is usually used as a living fence in rural areas. *G. sepium* leaves have nutrients that can be used as fodder by livestock. The nutritional composition of *Gliricidia sepium* leaves is as follows: crude protein content 16.82 - 25.08%, crude fiber 8.61-24.57%, crude fat 2.19-12.29%, ash 6.67-10.15%, and total digestible nutrients 35.42-40.21%

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(Adrizal et al. 2021; Arief and Pazla, 2023). Zain et al. (2020) reported that *G. sepium* can enhance nutrient digestibility and reduce methane production. Consequently, Low methane production was found to increase feed efficiency (Antonius et al. 2023). Moreover, Pazla et al. (2023a) reported that *G. sepium* produced higher dry matter and organic matter degradation than several other legumes, such as *Calliandra calothyrsus*, *Arachis hypogaea*, *Leucaena leucocephala*, *Arachis pintoi*, and *Calopogonium mucunoides.*

The study by Suyitman et al. (2017a) observed that cassava leaves, which are recognized for their content of Branched Chain Amino Acids (BCAA) including leucine, isoleucine, and valine, had percentages of 8.75, 8.43 and 4.4, respectively. By encouraging the proliferation of cellulolytic bacteria, these BCAAs significantly enhance the digestibility of vital nutrients like organic matter, dry matter, and acid detergent fiber (Zain et al. 2002). Additionally, the incorporation of the leaves of cassava among palm stems subjected to ammoniation has been noted to enhance rumen microbial growth and improve the digestibility of acid detergent fiber (ADF), dry matter (DM), and neutral detergent fiber (NDF) as observed in the research by Nurhaita dan Ningrat (2011). Furthermore, the research carried out by Suyitman et al. (2020) showcased the positive effects of adding cassava leaves to Simmental cattle diets, enhancing both digestibility and performance of production.

Originating from a mixture of feed components renowned for their nutritional advantages in promoting livestock growth and productivity, PKCC is formed (Arief et al. 2021a). These components include corn, rice husk, essential minerals, and palm kernel meal. PKCC is characterized by energy content, measured as total digestible nutrient, within the range of 60-64%, and a crude protein content of 14-16% (Arief et al. 2020). The primary objective of this study was to assess the effects of substituting the company-provided forages with a blend of cassava and *G. sepium*, as well as changing the concentrate of company with PKCC, on the production, digestibility, the intake, and ECDG quality.

MATERIALS AND METHODS

Animal Ethics

This study has been granted approval by the ethics committee at Universitas Andalas, Faculty of Medicine, which ensures that the study is conducted in compliance with animal welfare principles. The approval reference number for this research is 33/UN.16.2/KEP-FK/2023.

Experimental Site

Toni Farm company served as the research location. This company is situated in Payakumbuh, West Sumatra, Indonesia, at coordinates approximately -0.2330638 latitude,100.6268024 longitude, with an elevation of 516 meters above sea level. The area undergoes two distinct seasons. Starting in September, there is a rainy season that extends to February and a dry season follows from March, extending to August. The investigation took place during the months of June to August in the year 2023, with the temperature in the area during the study period ranging between 22 and 35°C.

Animal Experiment and Feeding Formulation

The study involved 16 Etawa crossbreed dairy goats (ECDG) with the mean body weight of 60±2.31 kilograms, all in their second lactation. They were allocated in a completely randomized design with four distinct treatment groups, each having four replicates. The treatments were as follows: Group A received the company's standard ration as a control, comprising 50% company-provided forages and 50% company concentrate (CC). Group B was provided with a mixture of 50% *G. sepium* and cassava leaves (Gs+CL), along with 35% CC and 15% PKCC. Group C's diet consisted of a blend of 50% *G. sepium* and cassava leaves (Gs+CL), 25% CC and 25% PKCC. Group D was fed with 50% *G. sepium* and cassava leaves (Gs+CL), along with 15% CC and 35% PKCC. The ratio of forage to concentrate in all groups was maintained at 50:50.

The concentrate of PKCC was prepared by blending the following feed components: 1% minerals, 22% corn, 40% palm kernel cake, and 37% rice bran. These ingredients were thoroughly mixed to achieve a homogeneous mixture and subsequently stored in a plastic container to maintain a moisture content below 12%.

The forage of the company comprised bush and native greenery. The company prepared its concentrate by combining various feed ingredients, including jackfruit skin, skinless cassava, and tofu dregs. These ingredients were thoroughly mixed and provided to the animals in a fresh state. The feeding schedule consisted of giving cassava leaves, company forages, and *G. sepium* three times daily, distributed at 8:00 AM, 1:00 PM, and 6:00 PM. The concentrate was provided in two doses daily, at 7:00 AM and at noon. In compliance with the NRC (2007) guidelines, the experimental diet was devised to satisfy the nutritional prerequisites of dairy goats with a weight of 60 kilograms and able to generate 2-3 kilograms of milk each day, featuring a fat content of 4%. The chemical makeup of all feed ingredients utilized in the study can be found in Table 1. Meanwhile, for a detailed account of the overall nutritional composition of the experimental ration and how these feed ingredients are distributed within the treatment diets, consult Table 2.

To evaluate the nutritional composition of the research feed ingredients, proximate analysis was conducted, involving the determination of ash, dry matter, ether extract, crude protein, and crude fiber, following the AOAC international (2016) guidelines. Fiber fractions, including ADF, NDF, cellulose, lignin, were assessed using the Van Soest (1982) technique. The calculation of TDN (total digestible nutrients) was carried out using the Moran (2005) method, and the determination of nitrogen-free extract followed the procedure outlined by Jamarun et al. (2021).

Total digestible nutrient (%) = 5.31 +1.444 Cfat + 0.937 NFE + 0.412 CP + 0.249 CF

Nitrogen-free extract = 100 - (ash + Cfat + CP + CF)

Note:

TDN = Total digestible nutrient
CP = Crude protein
CF = Crude fiber
Cfat = Crude fat
NFE = Nitrogen-free extract.

The research spanned a total of 45 days, which were divided into three distinct phases: a 25-day adaptation period, followed by a 15-day preliminary period, and finally, collection period of 5 days. The variance between the initial ration quantity and the remaining ration was used to determine fresh ration intake.

DMI (Kg/h/day) = Fresh Intake * DMCR
OMI (Kg/h/day) = DMI * OMCR
CPI (Kg/h/day) = DMI * CPCR

Note:
DMI = Intake of Dry matter
OMI = Intake of Organic matter
CPI = Crude protein intake
DMCR = Dry matter content of the ration
OMCR = Organic matter content of the ration
CPCR = Crude protein content of the ration

At 6:00 AM, samples of feces were collected and then weighed. In each treatment group, 10% of these freshly collected feces were set aside for analysis. These reserved samples were dried in the sun and subsequently crushed into a powder to examine their chemical composition. Feed digestibility was determined using the following formulas, which involve computing the difference between fecal production and ration intake:

Digestibility of Dry Matter (DMD %)
= [(DMI - Feces) / DMI] * 100%
Digestibility of Organic Matter (OMD %)
= [(OMI - Feces) / OMI] * 100%
Digestibility of Crude Protein (CPD %)
= [(CPI - Feces) / CPI] * 100%

The goats underwent milking two times daily, during both morning and evening hours, employing a mechanically operated machine for milking. Throughout the data collection period, the milk production was assessed over a span of 5 days. Initially, the measurements were recorded in liters and later converted into kilograms.

A 250ml milk sample was obtained from each treatment group throughout the collection period. The analysis of milk quality encompassed a range of components, including protein, lactose, fat, solid non-fat, total solids (milk dry matter), pH, and specific gravity. The Lactoscan Pro 202 instrument was used to examine these components.

Statistical Analysis

The study employed a fully randomized model design, in accordance with the approach described by Steel and Torrie (1991). The analysis involved examining intake, nutrient digestive efficiency, dairy output, and quality of milk. The variance was determined through SPSS software (IBM SPSS Statistics, USA; version 21.0). To assess the differences between treatments, Duncan's Advanced Multiple Range tests were employed.

RESULTS

Treatment Approaches for Etawa Crossbreed Dairy Goat Farming

Substituting the forages provided by the company with a blend of cassava and *G. sepium*, along with replacing the company's concentrate with PKCC, demonstrated no substantial changes (P>0.05) in terms of enhancing milk production. The use of cassava leaves, *G. sepium* and the expectation of PKCC is to enhance the production of milk.

Table 1: Chemical content of feed ingredients

Chemical Content (%)	Feed stuff				
	CF	CL	Gs	PKCC	CC
Dry Matter	26.03	31.10	21.42	93.06	30.67
Organic Matter	87.93	89.85	94.85	94.07	94.33
Crude Protein	25.43	27.15	19.11	12.53	08.32
Crude Fiber	23.02	19.12	19.75	19.05	20.37
Crude fat	2.73	3.52	2.98	3.50	5.82
TDN	61.46	70.21	66.07	77.54	78.26
NFE	31.75	39.26	53.01	58.99	59.82
Ash	12.07	10.15	05.15	5.93	5.67

TDN: total digestible nutrient; NFE: nitrogen free extract, Gs: *Gliricidia sepium*; PKCC: palm kernel cake concentrate;CC: company concentrate CF: company forages; CL: cassava leaves.

Table 2: Ration composition and chemical content of treatment rations

Feedstuff	Treatment			
	A	B	C	D
Company Forages	50	0	0	0
Casava leaves	-	15	15	15
Gliricidia sepium	-	35	35	35
Palm concentrate	-	15	25	35
Company Concentrate	50	35	25	15
Total	100	100	100	100
Chemical Composition				
Dry Matter	28.35	36.86	43.09	49.33
Organic Matter	91.13	93.80	93.75	93.75
Crude Protein	16.87	15.55	15.97	16.40
Crude Fiber	21.69	19.77	19.64	19.50
Crude Fat	4.28	4.32	4.08	3.85
TDN	69.86	72.68	72.61	72.53
NFE	45.79	54.23	54.06	54.06
Ash	8.87	6.20	6.23	6.25

Fig. 1 illustrates the daily milk production averages when forages supplied by the company are replaced with a combination of the leaves of cassava and *G. sepium*, and the concentration of the company is substituted with PKCC in various ratios. The findings of the study indicate that treatment D had the greatest variability in milk production, whereas the control group (treatment A) showed the lowest variability.

Treatment of Milk Quality in Etawa Crossbreed Dairy Goats

According to the results of the statistical analysis, no significant variations (P>0.05) were noticed in any of the milk quality parameters. The substitution of the standard forages with a combination of cassava and *G. sepium*, along with the replacement of the regular concentrate with PKCC, did not have any discernible impact on milk quality. Detailed data on the average milk quality resulting from these substitutions in various proportions can be found in Table 3.

Treatment for Food Consumption in Etawa Crossbreed Dairy Goats

The findings of the study lead to the conclusion that the data pertaining to crude protein intake, dry matter intake, and organic matter intake, as a result of substituting the usual concentration of the company with PKCC and the alteration of the company's standard forages to a mix of *G. sepium* and cassava leaves, have been summarized in Table 4. It was observed that, in each treatment, the substitution

Table 3: Milk quality of the treatment rations

Parameters	Treatments			
	A	B	C	D
pH	6.31±0.07	6.22±0.02	6.03±0.05	6.13±0.38
Fat level (%)	3.96±1.80	4.19±1.40	5.89±1.50	3.50±1.90
Lactose (%)	4.84±0.12	4.87±0.24	4.99±0.23	5.06±0.24
SNF (%)	9.08±0.21	8.93±0.45	9.13±0.42	9.22±0.43
Protein (%)	3.22±0.07	3.23±0.16	3.32±0.17	3.37±0.16
Total Solid (%)	12.01±0.11	12.66±0.16	14.20±0.10	11.80±0.08
Specific Gravity (g/mL^3)	1.0298±0.003	1.0296±0.002	1.0289±0.002	1.0318±0.003
Water content (%)	87.99±0.11	87.34±0.16	85.80±0.10	88.20±0.08

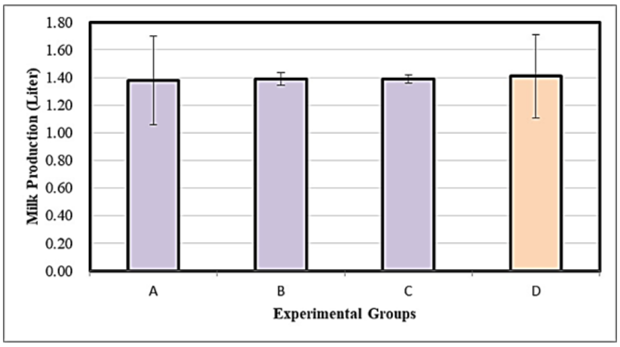

Fig. 1: Milk production (liter). There is non-significant difference among treatments (P>0.05).

Table 4: Consumption of dry matter, organic matter and crude protein

Parameters (kg)	Treatments			
	A	B	C	D
Dry matter	1.98±0.01	1.93±0.05	1.89±0.06	1.81±0.04
Organic matter	1.80±0.02	1.81±0.05	1.77±0.03	1.70±0.04
Crude protein	0.33±0.003	0.30±0.02	0.30±0.008	0.29±0.02

There is non-significant difference among treatments (P>0.05).

Table 5: Digestibility of dry matter, organic matter and crude protein

Parameters	Treatments			
(%)	A	B	C	D
Dry matter	68.39±0.07	69.55±0.07	68.61±0.06	70.43±0.04
Organic matter	68.98±0.06	70.68±0.06	69.97±0.03	71.89±0.03
Crude protein	72.01±0.02	73.32±0.01	72.33±0.008	74.66±0.05

There is non-significant difference among treatments (P>0.05).

of the company concentrates with PKCC and the substitution of the forages of the company with cassava leaves and tithonia in the diet did not lead to statistically significant distinctions (P>0.05) in terms of consumption of crude protein, consumption of dry matter, and assimilation of organic matter.

Treatment of Digestibility in Etawa Crossbreed Dairy Goats

The study's findings are highlighted in Table 5, illustrating the outcomes related to the digestibility of dry matter (DMD) and crude protein (CPD), and organic matter (OMD) as a consequence of substituting the conventional concentrate of the company with PKCC and switching the company's provided forages with cassava leaves and *G. sepium*. Notably, Table 5 reveals that this treatment, involving the substitution of the concentrate supplied by the company with PKCC and the substitution of the forages of the company with a blend of *G. sepium* and cassava leaves, did not produce any statistically significant impact (P>0.05) on DMD, OMD, and CPD.

DISCUSSION

Treatment on Milk Production in Etawa Crossbreed Dairy Goat

Replacing the forages provided by the company with a combination of *G. sepium* and cassava and exchanging the concentrate supplied by the company with PKCC, did not yield statistically significant differences (P>0.05) in improving the production of milk. The feed quality significantly influences the production of milk of dairy goats. An increase in milk production is anticipated when incorporating *G. sepium*, cassava leaves, and PKCC, as they respond to variations in feed quality.

The research findings indicate that Treatment D exhibited the highest variability in milk production, while the smallest variation was observed in Treatment A (control). Fluctuations in feed quality can be attributed to the lack of significant disparities among A, B, C and D Treatments. The formulated rations demonstrated consistent levels of crude protein, specifically, A at 16.87%, B at 15.55%, C at 15.97%, and D at 16.40% (refer to Table 2). Moreover, milk production is influenced by the intake of dietary protein. According to Arief et al. (2023a; 2023b), feed protein is known to contribute to the formation of lactose, which, being water-binding, leads to increased milk production. In the research that was carried out, the lactose content was assessed for every treatment, resulting in the following values: Treatment A had a lactose content of 4.84%, Treatment B had 4.87%, Treatment C had 4.99% and Treatment D had 5.06% (Table 3).

Treatment on Quality in Etawa Crossbreed dairy Goat's Milk

The composition of nutrients in the feed has a substantial impact on milk quality. High-quality milk must adhere to establish the standards quality. The statistical analysis revealed that, across various milk quality parameters, no statistically notable variances (P>0.05) were found. The replacement of the standard forages with a blend of cassava and *G. sepium*, along with the substitution of the concentrate of the company with PKCC, had no discernible influence on milk quality. The acceptable range, as defined by the Thai Agricultural Standards of 2008, was met by the milk quality observed in Treatments A, B, C, and D. These findings suggest that ECDG responds positively to diets containing PKCC concentrate and a combination of *G. sepium* forages and cassava leaves.

The reason for the absence of variation in milk quality among the treatments (P>0.05) was attributed to the similarity in feed quality factors (TDN and CP) between them. Arief et al. (2018a) further reinforced this research by asserting that the type of feed has an impact on milk production. High-quality feed is shown to enhance the metabolism of animals, enhancing the availability of energy and essential vitamins for milk component synthesis (Arief et al. 2018b). Moreover, the quality of milk exhibited no discernible variation due to the consistent intake of organic matter, dry matter, and crude protein across all treatments. The intake and digestibility of the same feed do not appear to noticeably affect the final fermented product in the rumen. The production of Volatile Fatty Acids (VFAs) is a direct outcome of rumen fermentation (Pazla et al. 2018a). The production of Volatile Fatty Acids (VFAs) provides the necessary energy for the growth and development of rumen bacteria, as indicated by Jamarun et al. (2019) and Pazla et al. (2023b). Additionally, VFAs serve as essential substrates for milk synthesis, as emphasized in their study (Jamarun et al. 2020). These findings are consistent with the results obtained in the study by Pazla et al. (2022). Pazla et al. (2021b; 2022) similarly observed no variations in milk quality when ECDG animals were provided with a mixture of elephant grass and tithonia forage, along with a concentrate composed of corn, palm kernel cake, rice bran, and tofu dregs. The same quality of goat's milk was also reported by Marques et al. (2022) when alfalfa and cassava in combination was provided as forage.

Treatment of Feed Intake in Etawa Crossbreed Dairy Goats

The consumption of dry matter is essential for generating energy for producing milk due to its composition of organic components like carbohydrates, protein, and fat (Jamarun et al. 2021). The research findings in Table 5 demonstrate the outcomes of substituting PKCC for company concentrate and substituting company forages with cassava leaves and *G. sepium* in CPI, OMI and DMI measurements. In each treatment, no statistically significant differences (P>0.05) were detected in the values of CPI, OMI and DMI when company concentrate was replaced with company and PKCC forages were replaced with cassava leaves and *G. sepium* in the ration. The lack of significant differences in each treatment may be attributed to the specific composition of the rations. When substituting the concentrate of the company with PKCC and replacing forages supplied by the company with cassava leaves and *G. sepium*, it is crucial to carefully consider the content of dry matter of each feed component. The concentrate provided by the company contains a dry matter content of 30.67%, whereas PKCC boasts a significantly higher dry matter content of 93.06% (Table 1). In contrast, minimal variation in the content of dry matter of the forages provided by the company when combined with cassava leaves and *G. sepium* was observed. As anticipated, a notable rise in the content of dry matter of the rations was brought about by the substitution of these ingredients (28.35% for ration A, 36.86% for ration B, 43.09% for ration C, and 49.33% for ration D) (Table 2). Nevertheless, even with the rise in the dry matter concentration of the rations, there were no significant differences observed in terms of intake. The relationship between nutrient intake, the quantity of dry matter in consumed feed and the nutrient composition of provided feed was confirmed by Pazla et al. (2018b; 2023c). It was revealed by the research findings that substantial amounts of feed can be consumed by livestock, a characteristic influenced by their individual needs. The results obtained exceeded the reported average daily dry matter intake, which ranged from 1.55 to 1.66kg per day for subjects with an average body weight of 43kg, as documented by Setyaningsih et al. (2013). This aligns with the perspective of Arief et al. (2021b), who argue that the quantity of feed required by animals, especially goats, is tied to their feeding capacity and overall body weight. The influence of dry matter intake is likely attributed to the livestock rumen.

The palatability of the feed and the livestock's preference for a specific type of feed are additional significant factors affecting dry matter intake. In this research, it was observed that dairy goats exhibited a preference for the palatability of *G. sepium*, cassava leaves, and PKCC when administered. This observation aligns with the perspective of Pazla et al. (2021c) and Pazla et al. (2023d), who assert that the interest and appetite of livestock are directly influenced by the palatability of the feed. Palatability is significantly affected by factors such as flavor, texture, smell, and taste. Throughout the study, distinct flavors were noted in *G. sepium*, PKCC and cassava leaves. It should be noted that the intake of organic matter closely mirrors the consumption of dry matter, given that organic matter comprises a component of dry matter, while the other component consists of inorganic matter. The variation in the intake of organic matter corresponds to the pattern of dry matter intake and is primarily influenced by the constituents within dry matter, as outlined by Kamalidin et al. (2012). This conclusion finds support in the work of Febrina et al. (2017), who underscore the strong correlation between organic matter and dry matter. If livestock have a low intake of dry matter, it will correspondingly result in a reduced intake of organic matter. Crude protein, ether extract, and crude fiber, being inherent components of organic material, play a pivotal role in determining the consumption of organic matter.

A significant contributor to an increased intake of organic material is a high consumption of dry matter. However, it is essential to recognize that the boost in organic matter intake is not solely attributed to the feed itself; livestock also plays a pivotal role in this regard. The livestock's capacity to consume feed and their preferences are additional factors that significantly contribute to the enhanced consumption of organic material. As noted in the study by Murni et al. (2012), factors that influence intake include the age and body weight of the animal, along with the palatability, quality, and digestibility of the feed. The consistent intake of crude protein across different treatments (P>0.05) can be explained by the similar protein content in the rations utilized in these treatments (A=16.87%, B=15.55%, C=15.97%, D=16.40%) (Table 2). A clear relationship exists between the intake of both dry and organic matter and the intake of crude protein in the feed. Pazla et al. (2021c) provide additional support to this conclusion by confirming that there is a positive relationship between feed protein and the intake of energy, dry matter and protein. The volume of feed ingested also influences the consumption of other vital nutrients. According to Martawidjaja et al. (1999), feed protein consumption is influenced by two main factors: the consumption of dry substance and the protein concentration. In this study, the consumption of crude protein surpassed the levels reported in prior research. Marwah et al. (2010) recorded a daily intake of 0.34 kg/head when employing concentrate and *Calliandra calothyrsus*, while Krisnan et al. (2015) documented a daily intake of 0.24 kg/head using concentrates, *Leucaena leucocephala*, and *Pennisetum purpupoides*.

Treatment of Digestibility in Etawa Crossbreed Dairy Goats

The treatment involving the substitution of the company-provided concentrate with PKCC and the replacement of company-supplied forages with a combination of *G. sepium* and cassava leaves is clearly depicted in the data presented in Table 6. It can be observed that there were no statistically significant effects (P>0.05) on CPD, OMD, or DMD. The absence of significant differences in the treatments is likely due to the similar crude fiber content in rations A, B, C, and D. The variance in lignin content among these rations is only 2.83%. Furthermore, both *G. sepium* and cassava exhibit lower crude fiber content when compared to the forages provided by the company. On the contrary, the crude fiber content in PKCC is quite similar to that of the company's concentrate. The presence of lignin, a woody material that is indigestible to rumen microbes, is responsible for the reduced digestibility in livestock feed with a high crude fiber content (Pazla et al. 2020; Pazla et al. 2021d).

The chemical composition of the feed strongly influences the digestibility of organic matter, dry matter, and crude protein. It's worth emphasizing that the chemical compositions of rations A, B, C, and D are nearly identical. In this research, the rations were formulated to have total digestible nutrient (TDN) content varying between 69 and 72%. To facilitate the digestion of feed ingredients, it is essential to provide an adequate and balanced supply of both energy and protein (Pazla et al. 2021a). These elements are necessary for the microbial activity in the rumen, enabling the breakdown of various food components such as crude protein, organic matter, and dry matter. Crude protein undergoes fermentation in the rumen, a process that results in the production of ammonia (NH_3) as reported by Suyitman et al. (2021). The research conducted by Putri et al. (2019) and Putri et al. (2021) has demonstrated that NH_3 enhances the microbial population in the rumen. The energy source for rumen microbes is provided by TDN obtained from the diet. Rumen microbes, in their substantial numbers, have a pivotal role in the digestion of dietary components. The treatment rations, characterized by their consistent protein and TDN composition, lead to a relatively uniform digestibility of organic matter, crude protein, and dry matter, with no significant differences (P>0.05). Jamarun et al. (2017) and Zain et al. (2019) highlighted the influence of both ration composition and microbial activity on feed digestibility, a conclusion that corresponds with this observation.

Conclusion

The substitution of forages supplied by the company with a blend of *G. sepium*, and cassava along with the substitution of the company concentrate with PKCC, had no discernible impact on the production, digestibility, intake, and quality of milk from Etawa crossbreed dairy goats. The effective maintenance of intake, production, milk quality, and digestibility from Etawa crossbreed dairy goats was achieved with the particular mixture of 50% *G. sepium* and cassava, 15% concentrate supplied by the company, and 35% PKCC.

Author's Contributions

Conceptualization: Arief and Roni Pazla, Data Curation: Roni Pazla. Formal analysis: Roni Pazla and Rizqan. Funding acquisition: Arief and Novirman Jamarun. Methodology: Arief, Roni Pazla, and Novirman Jamarun. Project administration: Rizqan. Supervision: Arief and Novirman Jamarun. Validation: Roni Pazla. Writing-original draft: Roni Pazla and Arif. Writing-review and editing: Rizqan.

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