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*by* Arief Arief

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# Production Performance, Feed Intake and Nutrient Digestibility of Etawa Crossbreed Dairy Goats Fed Tithonia (*Tithonia diversifolia*), Cassava Leaves and Palm Kernel Cake Concentrate

Arief[1*], Roni Pazla[2], Novirman Jamarun[2] and Rizqan[1]

[1]Department of Livestock Production Technology, Animal Science Faculty, Universitas Andalas, Padang City, 25163, West Sumatera, Indonesia
[2]Department of Nutrition Science and Feed Technology, Animal Science Faculty, Universitas Andalas, Padang City, 25163, West Sumatera, Indonesia
***Corresponding author:** aarief@ansci.unand.ac.id

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## ABSTRACT

This research aimed at the intake, digestibility, production, and milk quality of Etawa crossbreeds dairy goat (ECDG) fed conventional mixed forage; tithonia (*Tithonia diversifolia*) (T) and cassava leaves (CL) with palm kernel cake concentrate (PKCC). A completely randomized design (four treatments and four replications) was used in this study. The treatments consisted of followings: A was company rations (50% company forages + 50% company concentrate(CC)), B (50% (T+CL) + 40% CC + 10% PKCC), C (50% (T+CL) + 30% CC + 20% PKCC), D (50% (T+CL)+ 20% CC + 30% PKCC). The variables analyzed were as follows; milk production, milk quality (total solid, lactose, protein, fat, solid non-fat, water content, specific gravity, pH, Ca and P minerals), dry matter intake (DMI), organic matter intake (OMI), crude protein intake (CPI), dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD). Data analysis used analysis of variance—a further test to determine differences between treatments using Duncan's multiple ranges. The Analysis showed that the treatment had no significant effect (P>0.05) on feed intake, digestibility, production, and milk quality. Using palm kernel cake concentrate and a mixture of tithonia and cassava leaves was able to maintain the feed intake, feed digestibility, production, and milk quality of ECDG. Replacement of company forages with a mixture of cassava and tithonia and replacement of company concentrate with PKCC did not affect the intake, digestibility, production, and quality of Etawa crossbreed dairy goat's milk. The combination of 50% (cassava and tithonia) + 10% company concentrate + 40% PKCC was able to maintain the intake, digestibility, production, and quality of Etawa crossbreed dairy goat milk.

**Key words:** Cassava Leaves, Etawa Crossbreed Dairy Goat, Milk Production, Palm Kernel Cake Concentrate, Tithonia Diversifolia.

## INTRODUCTION

The availability of forage and the high price of concentrate are severe problems in developing the Etawa crossbreed dairy goat (ECDG) farming. The increase in residential areas impacts reducing forage for animal feed. At the same time, the price of concentrate is getting more expensive day by day. Arief et al. (2018a) stated that alternative feed exploration is very urgent to increase productivity and efficiency of livestock business. So, it is necessary to find alternative sources of forage and concentrates with high production and good nutritional quality.

Tithonia (*Tithonia diversifolia*) is a forage with good nutritional content (Pazla et al. 2021a). The crude protein content is 22.89%, and organic matter is 84.01% (Pazla et al. 2018a). Tithonia is also rich in P mineral, which can potentially increase the number of rumen bacterial populations (Fasuyi et al. 2010; Adrizal et al. 2021; Pazla et al. 2021b). Oluwasola and Dairo (2016) reported that tithonia plants are also rich in amino acids. The mixture of tithonia with elephant grass as a fiber source in ECDG ration can optimize intake, digestibility, and milk production (Pazla et al. 2022).

Cassava leaves contain Branched Chain Amino Acids (BCAA) such as isoleucine, valine, and leucine 4.4, 8.43,

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and 8.75%, respectively (Suyitman et al. 2017a). BCAAs increase nutrient digestibility like dry matter, organic matter, and acid detergent fiber through the growth of cellulolytic bacteria (Zain et al. 2002). Supplementation of cassava leaves on ammoniated palm stems increased rumen microbial growth and digestibility of DM, ADF, and neutral detergent fiber (NDF) (Nurhaita and Ningrat 2011). Suyitman et al. (2020) reported that supplementing cassava leaves in Simmental cattle rations improved digestibility and production performance.

Palm kernel cake concentrate (PKCC) is made from a mixture of feed ingredients that have good nutrition for livestock growth and production, such as rice bran, corn, palm kernel cake, and minerals. Energy (total digestible nutrient) and crude protein (CP) of PKCC are 60-64 and 14-16%, respectively (Arief et al. 2020). This research aims to determine the impact of replacing company forages with a mixture of cassava and tithonia and replacing company concentrate with PKCC on intake, digestibility, production, and quality of ECDG.

## MATERIALS AND METHODS

### Animal Ethics

This research has referred to the ethics of research using livestock based on the law of the government of the Republic of Indonesia Number 18 of 2009 article 66, which discusses animal maintenance, killing, treatment, and reasonable care.

### Experimental Site

This study was carried out on Toni Farm company, Payakumbuh, West Sumatra, Indonesia (-0.2330638,100.6268024, and 516 m asl); this area has two seasons (dry and rainy). The rainy season is from September to February, and summer is from March to August. This research was conducted in May – June 2022. The temperature of this area at the time of the study was in the range of 22-35˚C.

### Animal Experiment and Feeding Formulation

The livestock used in the study were 16 ECDG with an average body weight of 60±1.23kg and were in the second lactation, distributed in a completely randomized design with four treatments (ration formulation) and four replicates. The treatments consisted of followings: A was company ration as control (50% company forages + 50% company concentrate (CC)), B (50% (T+CL) + 40% CC + 10% PKCC), C (50% (T+CL) + 30% CC + 20% PKCC), D (50% (T+CL)+ 20% CC + 30% PKCC). The ratio of tithonia with cassava was 1:1

PKCC concentrate was made by formulating the following feed ingredients, namely 37% rice bran + 40% palm kernel cake + 22% corn, and 1% minerals. All materials were mixed homogeneously and stored in plastic at less than 12% moisture content.

The company forage was bush and native grass. The company's concentrate was made by formulating feed ingredients along with tofu dregs, jackfruit skin, and skinless cassava. All ingredients were stirred evenly and given in a fresh state. Meanwhile, forage company forages, cassava leaves, and tithonia were given three times a day: in the morning at 08.00, at noon at 13.00, and in the afternoon at 18.00. The concentrate was given twice daily, in the morning at 07.00 and noon.

The experimental ration was formulated based on the NRC (2007) to fulfill the nutrition of dairy goats weighing 60 kg and having the capacity to produce 2-3kg of milk with 4% fat content per day. The chemical composition of each feed ingredient used is presented in Table 1. The composition of the feed ingredients in the treatment ration and the nutritional composition of the treatment ration are presented in Table 2.

Proximate analysis (dry matter, ash, crude protein, extract ether, and crude fiber) of research feed ingredients was carried out based on AOAC international (1995). Fiber fractions (cellulose, lignin, ADF, and NDF) were analyzed according to the technique described by Van Soest (1982). TDN was calculated based on Moran (2005). The nitrogen-free extract was calculated according to Jamarun et al. (2021).

TDN (%) = 5.31 +1.444 Cfat + 0.412 CP + 0.937 NFE + 0.249 CF

NFE= 100 - (ash+ CP+Cfat+CF)

Note:

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

The study lasted 45 days, divided into three periods: the adaptation period of 25 days, the preliminary period of 15 days, and the 5-day collection period. The fresh ration intake was calculated by calculating the difference between the amount of ration and the rest of the ration.

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

Note:

DMI= Dry matter intake
OMI= Organic matter intake
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

Feces were collected at 6am. All fresh feces were weighed, 10% was taken for each treatment, then dried in the sun. The dried feces were then ground into a fine powder for analysis of chemical composition samples. The difference between ration intake and fecal production calculates feed digestibility. The formula used is:

DMD (%) = (DMI- Feces)/ DMI * 100%)
OMD (%) = (OMI- Feces)/ OMI * 100%)
CPD = (CPI- Feces)/ CPI * 100%)

Goats were milked twice a day, in the morning and evening, using a mechanical milking machine. Milk production was calculated for five days during the collection period in liters and converted to kg (Fig. 1) and FCM (Fat Corrected Milk) 4% based on the formula of Mavrogenis and Papachristoforou (1988):

4%FCM (kg)= M (0.144+ 0.1444F)

Note:

M = Milk production in kg
F= Fat content in %

**Table 1:** Chemical composition of feed ingredients

| Nutrients (%) | Company forages | Feed stuff | | | | | | | | | Company Concentrate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | CL | JS | Rice bran | Tofu waste | PKC | Corn | PKCC | Skinless cassava | |
| DM | 26.03 | 23.13 | 26.21 | 13.01 | 87.8 | 28.4 | 91.83 | 85.8 | 93.24 | 29.04 | 23.81 |
| OM | 87.93 | 84.65 | 86.33 | 95.02 | 90.8 | 97.67 | 91.41 | 99.1 | 90.23 | 98.78 | 96.92 |
| CP | 25.43 | 25.07 | 30.18 | 12.06 | 10.72 | 20.11 | 12.36 | 7.70 | 13.46 | 11.66 | 17.27 |
| CF | 28.02 | 22.62 | 19.92 | 28.01 | 11.6 | 19 | 26.68 | 2.44 | 18.33 | 4.28 | 20.98 |
| NDF | 48.27 | 55.03 | 56.13 | 71.54 | 55.13 | 59.28 | 66.7 | 49.96 | 62.84 | 37.38 | 61.86 |
| Cfat | 2.73 | 1.62 | 3.10 | 4.00 | 8.73 | 1.25 | 8.23 | 3.50 | 4.96 | 1.13 | 2.07 |
| TDN | 54.53 | 53.54 | 56.44 | 68.8 | 66.63 | 74.61 | 65.4 | 81.9 | 66.36 | 86.53 | 73.46 |
| NFE | 31.75 | 35.34 | 33.13 | 50.93 | 59.75 | 57.31 | 44.14 | 85.46 | 53.48 | 81.71 | 56.62 |
| ASH | 12.07 | 15.35 | 13.67 | 5.00 | 9.2 | 2.33 | 8.59 | 0.90 | 9.77 | 1.22 | 3.08 |
| ADF | 36.45 | 34.2 | 33.69 | 58.55 | 29.35 | 26.65 | 46.10 | 36.76 | 36.02 | 8.92 | 35.33 |
| Hemi | 11.82 | 20.83 | 22.44 | 12.99 | 25.78 | 32.63 | 20.60 | 13.20 | 26.82 | 28.46 | 26.53 |
| Lignin | 11.72 | 5.81 | 6.87 | 8.54 | 06.90 | 2.3 | 17.29 | 07.50 | 3.92 | 6.49 | 4.38 |
| Cellulose | 24.4 | 27.54 | 28.48 | 24.46 | 15.52 | 22.93 | 43.25 | 29.52 | 16.97 | 14.07 | 22.95 |

Dry matter (DM), Organic matter (OM), Crude protein (CP), Crude fiber (CF), Neutral detergent fiber, Crude fat (Cfat), Total digestible nutrient (TDN), Nitrogen free extract (NFE), Acid detergent fiber (ADF), Hemicellulose (Hemi), *Tithonia diversifolia* (T). Cassava leaves (CL), Jackfruit skin (JS), Palm kernel cake (PKC), Palm kernel cake concentrate (PKCC)

**Table 2:** Composition of ration and nutritional content of treatment ration

| Feedstuff | Treatments | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Company Forages | 50 | 0 | 0 | 0 |
| *Tithonia diversifolia* | - | 25 | 25 | 25 |
| Cassava Leaves | - | 25 | 25 | 25 |
| PKCC | - | 10 | 20 | 30 |
| Company Concentrate | 50 | 40 | 30 | 20 |
| Total | 100 | 100 | 100 | 100 |
| Nutrient Composition | | | | |
| Dry Matter | 24.91 | 31.10 | 38.04 | 44.98 |
| Organic Matter | 92.43 | 90.54 | 89.87 | 89.20 |
| Crude Protein | 21.35 | 22.07 | 21.69 | 21.31 |
| Crude Fiber | 24.49 | 20.85 | 20.59 | 20.33 |
| NDF | 55.07 | 58.82 | 58.92 | 59.01 |
| Crude Fat | 2.40 | 2.50 | 2.79 | 3.08 |
| TDN | 64.00 | 63.52 | 62.81 | 62.10 |
| NFE | 44.18 | 45.11 | 44.80 | 44.48 |
| Ash | 7.57 | 9.46 | 10.13 | 10.80 |
| Lignin | 8.05 | 5.31 | 5.27 | 5.22 |

Neutral detergent fiber, Total digestible nutrient (TDN), Nitrogen free extract (NFE), Palm kernel cake concentrate (PKCC)

During the collection period, 250ml of milk samples was taken for each treatment. The components for the milk quality test (total solid (milk dry matter), protein, fat, lactose, solid non-fat, specific gravity, and pH) were tested using Lactoscan Pro 202.

**Statistical Analysis**

A completely randomized design (Model) (Steel and Torrie 1991) was used to analyze intake, feed digestibility, production, and milk quality. The data were analyzed with the study concludes that of variance using the Excel 2019 program at a significance level of @=0.05. Duncan's Advanced Multiple range tests were used to test the differences between treatments.

## RESULTS

**Milk Production of Etawa Crossbreed Dairy Goats Treatment**

Replacement of company forages with a mixture of cassava and tithonia and replacement of company concentrate with PKCC were not significantly different (P>0.05) in increasing milk production (Fig. 1). Using cassava leaves, tithonia, and PKCC is expected to increase milk production. The average daily milk production results from replacing company forages with a mixture of cassava leaves and tithonia and replacing company concentrate with PKCC in various percentages are presented in Table 3. The study concludes that of the variance of the highest milk production after being converted to 4% FCM was in treatment D, and the lowest was in treatment A (control).

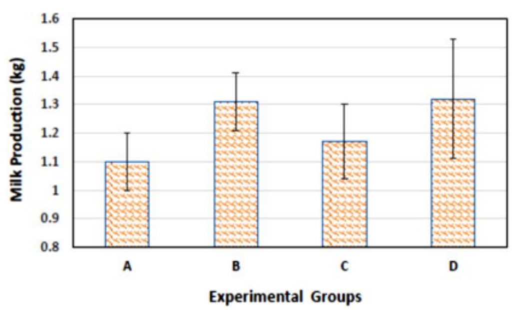


**Fig. 1:** Milk Production of Etawa crossbreed dairy goat's treatment.

**Milk Quality of Etawa Crossbreed dairy Goat Treatment**

The results of statistical analysis showed that there was no significant difference (P>0.05) in all milk quality parameters. Replacing the company forages with a mixture of cassava and tithonia and replacing the company's concentrate with PKCC did not affect milk quality. The average milk quality results from replacing company forages with a mixture of cassava leaves and tithonia and replacing company concentrate with PKCC in various percentages are presented in Table 4.

**Feed Intake of Etawa Crossbreed dairy Goats Treatment**

The study concludes that results of dry matter intake, organic matter intake, and crude protein intake by replacing company concentrate with PKCC and replacing

**Table 3:** Quality of Etawa crossbreed dairy goat's milk with various treatments

| Parameters | Goat milk | | | |
|---|---|---|---|---|
| | A | B | C | D |
| pH | 6.23±0.05 | 6.32±0.06 | 6.36±0.05 | 6.52±0.07 |
| Fat Level (%) | 4.52±2.27 | 4.44±1.26 | 3.91±2.29 | 5.29±1.21 |
| Lactose (%) | 4.52±0.19 | 4.44±0.31 | 3.91±1.23 | 5.29±1.35 |
| SNF (%) | 9.53±2.27 | 9.46±1.26 | 9.01±2.29 | 8.99±1.21 |
| Protein (%) | 3.46±0.05 | 3.44±0.07 | 3.28±0.07 | 3.26±0.09 |
| Specific Gravity | 1.033±0.07 | 1.032±0.11 | 1.031±0.13 | 1.030±0.07 |
| Phosphorus (%) | 3.17±0.25 | 3.40±0.37 | 3.19±0.49 | 2.92±1.45 |
| Calcium (%) | 2.51±0.12 | 2.46±0.17 | 2.32±0.21 | 2.90±0.51 |
| Water Content (%) | 14.05±1.72 | 13.89±2.57 | 12.91±1.98 | 14.28±1.81 |
| Dry Matter (%) | 85.95±1.72 | 86.11±2.57 | 87.09±1.98 | 85.73±1.81 |

Solid non-fat (SNF); There is no significant between treatments (P>0.05). Treatment A= Company ration (50% company forages+50%company concentrate (CC)), B=(50%(T+CL)+40% CC+10% PKCC), C=(50%(T+CL)+30% CC+20%PKCC), and D=(50%(T+CL)+20% CC + 30% PKCC). *Tithonia diversifolia* (T), Cassava leaves (CL Palm kernel cake), and Palm kernel cake concentrate (PKCC).

**Table 4:** Ration Intake of Etawa Crossbreed Dairy Goats Treatment

| Intake (kg/e/day) | Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Dry matter | 2.44±3.21 | 2.51±2.47 | 2.48±3.11 | 2.46±2.68 |
| Organic matter | 2.20±3.09 | 2.27±2.13 | 2.25±3.26 | 2.21±2.39 |
| Crude protein | 0.60±1.91 | 0.65±1.87 | 0.62±1.37 | 0.61±1.49 |

There is no significant between treatments (P>0.05). Treatment A= Company ration (50% company forages+50%company concentrate (CC)), B=(50%(T+CL)+40% CC+10% PKCC), C=(50%(T+CL)+30% CC+20%PKCC), and D=(50%(T+CL)+20% CC + 30% PKCC). *Tithonia diversifolia* (T), Cassava leaves (CL Palm kernel cake), and Palm kernel cake concentrate (PKCC).

**Table 5:** Digestibility of Etawa crossbreed dairy goats treatment

| Digestibility (%) | Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Dry matter | 65.85±1.19 | 66.17±1.89 | 67.23±1.78 | 67.98±1.55 |
| Organic matter | 67.76±1.17 | 68.02±1.76 | 68.88±1.63 | 69.32±1.48 |
| Crude protein | 69.56±1.03 | 70.34±1.11 | 71.38±1.24 | 71.97±1.41 |

Footnote is same as that of Table 4.

company forages with tithonia and cassava leaves are presented in Table 5. Replacing company concentrate with PKCC and replacing company forages with tithonia and cassava leaves in the ration gave no significant difference (P>0.05) in each treatment on the value of dry matter intake, organic matter intake, and crude protein intake.

### Digestibility of Etawa Crossbreed Dairy Goats Treatment

The study concludes that results of dry matter digestibility (DMD), organic matter digestibility (OMD), and crude protein digestibility (CPD) by replacing company concentrate with PKCC and replacing company forages with tithonia, and cassava leaves are presented in Table 5. Table 5 shows that the treatment of replacing company concentrate with PKCC and replacing company forages with a mixture of cassava leaves and tithonia had no significant effect (P>0.05) on DMD, OMD, and CPD.

## DISCUSSION

### Milk Production of Etawa Crossbreed Dairy Goats Treatment

Replacement of company forages with a mixture of cassava and tithonia and replacement of company concentrate with PKCC were not significantly different (P>0.05) in increasing milk production. Milk production in dairy goats is strongly influenced by feed quality. Good quality feed will increase milk production. Using cassava leaves, tithonia, and PKCC is expected to increase milk production.

The study concludes that the variance of the highest milk production after being converted to 4% FCM was in treatment D, and the lowest was in treatment A (control). The insignificant difference between treatments A, B, C, and D could be caused by the feed quality. The prepared rations had a crude protein that was not much different between A (21.35%) rations, B (22.07%), C (21.69%), and D (21.31%) rations (Table 2). The intake of feed protein also influences milk production. Prihatminingsih et al. (2015) stated that feed protein plays a role in forming lactose. Lactose is water-binding, so the more lactose is formed, the more milk will be produced. In the research conducted, the lactose content obtained in each treatment was A=4.52%, B=4.44%, C=3.91%, and D=5.29% (Table 4).

Good dairy goats have a high amount of milk production and are standardized at 4% FCM (Christi and Rohayati 2018). From the average value of 4% FCM milk production, it can be seen that the highest production was in treatment D (1.32kg/head/day). This indicates that after being standardized to 4% FCM, it turns out that treatment D has a high milk fat content, which affects the production of 4% FCM milk. Based on the results of the study, it was found that the milk fat content in each treatment was: A=4.52%, B=4.44%, C=3.91%, and D=5.29% (Table 4), with the highest increase in milk fat content in treatment D was thought to be because the fat from the D ration was higher from other rations (Table 2), causing high milk production as well. Milk production of 4% FCM is carried out to equalize the energy level in the milk contents.

**Quality of Etawa Crossbreed dairy Goat's Milk Treatment**

Nutrient components in feed significantly affect the quality of milk. Good quality milk meets milk quality standards. The results of statistical analysis showed that there was no significant difference (P>0.05) in all milk quality parameters. Replacing the company forages with a mixture of cassava and tithonia and replacing the company's concentrate with PKCC did not affect milk quality. The quality of milk produced in treatments A, B, C, and D was within the normal range based on Thai Agricultural Standards (2008). This value indicates that the response of ECDG to rations containing PKCC concentrate and forages of cassava leaves and tithonia is quite good. The feed quality factors (TDN and CP), which were almost the same between treatments, were thought to be the reason the milk quality did not differ between treatments (P>0.05). Arief et al. (2018a) strengthened this study, stated that the sort of feed influences the milk produced. The good feed also improve animal metabolism by increasing the supply of electricity and vitamins for the synthesis of milk components (Arief et al. 2018b). In addition, the same intake of dry matter, organic matter, and crude protein among treatments also caused no difference in the milk quality. The intake and digestibility of the same feed do not affect the final fermented product in the rumen. Volatile fatty acid (VFA) is a product of rumen fermentation. VFA manufacturing offers enough strength for rumen bacteria to develop and grow (Jamarun et al. 2019) and the supply of uncooked substances for milk synthesis (Jamarun et al. 2020). This results are similar with the study from Pazla et al. (2022). They also found no difference in milk quality in ECDG given a mixture of tithonia forage with elephant grass with the addition of a concentrate consisting of corn, rice bran, tofu dregs, and palm kernel cake. Marques et al. (2022) also found the same quality of goat's milk when given forage with a combination of cassava and alfalfa.

**Feed Intake of Etawa Crossbreed Dairy Goats Treatment**

Intake of dry matter can produce energy for milk production because it contains food substances consisting of organic materials such as protein, fat, and carbohydrates (Jamarun et al. 2021). The study concludes that results of DMI, OMI, and CPI by replacing company concentrate with PKCC and replacing company forages with tithonia and cassava leaves are presented in Table 5. Replacing company concentrate with PKCC and replacing company forages with tithonia and cassava leaves in the ration showed no significant difference (P>0.05) in each treatment on the value of DMI, OMI, and CPI. The insignificant difference in each treatment could be caused by the type of ration given. In replacing the company's concentrate with PKCC and company forages with tithonia and cassava leaves, it is necessary to pay attention to the dry matter content of each feed ingredient. The dry matter content of the company's concentrate is 23.81%, while the dry matter content of PKCC is 93.24% (Table 1). Meanwhile, the dry matter content of company forages with tithonia and cassava did not differ much. Of course, the difference in the substituted ingredients changed the form of an increase in the dry matter content of the ration (ration A 24.91%, ration B 31.10%, ration C 38.04%, and ration D 44.98%) (Table 2). However, there was an increase in the dry matter content of the ration, and it had no significant difference against intake. This is supported by Pazla et al. (2018b) that the amount of nutrient intake depends on the amount of dry matter in the feed consumed and the nutrient content of the feed given. In the research conducted, it was also observed that livestock have the ability to eat high feed, which is also influenced by the needs of the livestock themselves, following the opinion of Arief et al. (2021b), which states that the volume of feed needed by livestock, especially goats, depends on their ability to eat feed and total weight body. The results obtained were higher than that of Setyaningsih et al. (2013), whose average dry matter intake was 1.55-1.66kg/e/day with an average body weight of 43kg. This is presumably because the capacity of the livestock rumen influences dry matter intake.

Another factor that plays a role in dry matter intake is the level of palatability or livestock preference on the feed given. In this study, it was found that the level of palatability of tithonia, cassava leaves, and PKCC in its administration was favored by dairy goats. This is under the opinion of Pazla et al. (2021c) that the palatability of feed directly affects interest and causes appetite in livestock. Flavor, texture, smell, and taste significantly affect palatability. Based on the observations made during the study, it was found that Tithonia, cassava leaves, and PKCC have a flavor. The intake of organic matter is in line with the intake of dry matter because organic matter is part of dry matter, which has been reduced by inorganic matter. The pattern of increasing and decreasing organic matter intake is strongly influenced by the components contained in dry matter (Kamalidin et al. 2012). This is also supported by Febrina et al. (2017) that organic matter is carefully associated with dry matter since organic matter is a part of dry matter; if the intake of dry matter from livestock is low, it will be followed by a low level of intake of organic matter as well. Intake of organic matter is also primarily determined by the constituent components of the organic material itself, namely crude protein, extract ether, and crude fiber.

High intake of dry matter is a factor that causes a high intake of organic matter, but the factor that increases intake of organic matter is not only feed; livestock is also one of the factors that can increase intake of organic matter. The ability of livestock to eat feed and the level of preference is also a factor in increasing the intake of organic matter. Murni et al. (2012) stated that other factors influencing intake are animal body weight, feed digestibility, palatability, feed quality, and the age of livestock. Intake of crude protein that did not differ between treatments (P>0.05) was due to the protein content of the ration between treatments that were not much different (A=21.35%, B=22.07%, C=21.69%, D=21.31%) (Table 2). The intake of crude protein feed is directly proportional to dry and organic matter intake. Pazla et al. (2021c) stated that feed protein positively correlated with dry matter, protein, and energy intake. The amount of feed consumed affects other nutrients consumed. Martawidjaja et al. (1999) stated that the factors influencing feed protein intake are dry matter intake and protein content. Intake of crude protein in this study was higher than Marwah et al. (2010), who received crude protein intake of ECDG of 0.34kg/head/day by feeding *Calliandra calothyrsus* and concentrate, and Krisnan et al. (2015), who reported 0.24kg/head/day by feeding *Pennisetum purpupoides*, *Leucaena leucocephala* and concentrates.

### Digestibility of Etawa Crossbreed Dairy Goats Treatment

Table 5 shows that the treatment of replacing company concentrate with PKCC and replacing company forages with a mixture of cassava leaves and tithonia had no significant effect (P>0.05) on DMD, OMD, and CPD. The non-significant difference between treatments was due to the lignin content of the A, B, C, and D rations not being much different. The difference in the lignin content of the ration is only 2.83%. In addition, the lignin content of tithonia and cassava is lower than that of the company forages. In contrast, the lignin content of PKCC is not much different from that of the firm concentrate. High lignin content in livestock rations reduces digestibility because lignin is a timber substance that cannot be digested using rumen microbes (Pazla et al. 2020; Pazla et al. 2021d; Ciptaan et al. 2022).

The chemical composition of the ration also influences the digestibility of dry matter, organic matter, and crude protein. The chemical composition of rations A, B, C, and D is almost identical. The rations of this study were prepared with a TDN content of 62-64%. In digesting feed ingredients, sufficient and balanced protein and energy are needed for rumen microbial activity to digest food substances, including dry matter, organic matter, and crude protein. Crude protein undergoes fermentation in the rumen, which produces ammonia ($NH_3$) (Suyitman et al. 2021). $NH_3$ increases the rumen's microbial population (Putri et al. 2019; Putri et al. 2021). TDN derived from the diet acts as an energy source for rumen microbes. The large population of rumen microbes affects the digestibility of food substances. The same protein and TDN composition in the treatment rations causes the digestibility of dry matter, organic matter, and crude protein to be relatively the same (P>0.05). This follows the opinion of Jamarun et al. (2017), which states that feed digestibility is influenced by the ration composition and the activity of microorganisms.

### Conclusion

Replacement of company forages with a mixture of cassava and tithonia and replacement of company concentrate with PKCC did not affect the intake, digestibility, production, and quality of Etawa crossbreed dairy goat's milk. The combination of 50% (cassava and tithonia)+10% company concentrate+40% PKCC was able to maintain the intake, digestibility, production, and quality of Etawa crossbreed dairy goat milk.

### Author 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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