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Milk Production, Consumption and Digestibility of Ration Based on The Palm Kernel Cake, Tithonia (*Tithonia Diversifolia*) and Corn Waste on Etawa Crossbreed Dairy Goat

Arief, Rusdimansyah, S Sowmen and R Pazla

¹Department of Animal Production, Faculty of Animal Science, Andalas university, Padang, 25163, Indonesia. E-mail: aarief@ansci.unand.ac.id

Abstract. This study aims to evaluate milk production, consumption and digestibility of rations in Etawa Crossbreed Dairy Goats (ECDG) fed with concentrate of palm kernel cake (CPKC), tithonia (*Tithonia diversifolia*) and corn waste. The design used was a completely randomized design with 4 treatment rations and 5 replications. Treatment A = 7.5 kg tithonia + 4 kg tofu waste, B = 7.5 kg tithonia + 2 kg tofu waste + 1.2 kg CPKC, C = 2 kg corn waste + 5.5 kg tithonia + 2 kg tofu waste + 1.2 kg of CPKC, D = 4 kg of corn waste + 3.5 kg of tithonia + 2 kg of tofu waste + 1.2 kg of CPKC. Data were analyzed by ANOVA and DMRT as further tests. The parameters measured were milk production, consumption and digestibility of the ration. The results showed that the treatment had an insignificant different effect ($P > 0.05$) on milk production, ration consumption and digestibility. The conclusion of this study is the use of CPKC, tithonia and corn waste able to maintain milk production, consumption and digestibility ration.

1. Introduction

One of the by-products of a palm oil industry is the Palm kernel cake (PKC), its availability is increasing, in line with the development of oil palm plantations which grows around 18% each year. Nutritional content of PKC is very good; crude protein (CP) 15-20%, extract ether (EE) 2.0 - 10.6%, crude fiber (CF) 13-21.30%, NDF 46.7 - 66.4%, ADF 39.6 - 44% , crude energy 19.1 - 20.6 MJ / kg, ash 3-12%, calcium (Ca) 0.20 - 0.40% and phosphorus (P) 0.48 - 0.71% [1]. Ref. [2] stated that PKC has a high nutrient content with CP 16.07%, EE 8.23%, CF 21.30%, Ca 0.27%, P 0.94%, and Cu 48, 4% ppm. The variations in nutrient content are caused by differences in the processing of PKC, which is chemical or physical processing.

Based on its nutritional content and availability, PKC has considerable potential as animal feed, especially ruminants. PKC as part of concentrate feed has been widely tested as ruminant feed. Ref. [3] reports that the administration of PKC in combination with the fermented palm fronds and solid gives a good response. Likewise, the addition of PKC in goat concentrate [4], a combination of PKC with palm fronds and palm mud as goat feed [5] and PKC combined with palm sludge and molasses in concentrate on goat rations [6].

Tithonia plants are shrubs that have the potential to be used as alternative animal feed, in addition to rapid growth, this plant also has a high nutritional content. The content of nutrients based on the dry ingredients contained in the leaves and flowers of tithonia can be seen from the results of the study of Ref. [7]: dry matter (DM), organic matter (OM), CP, CF, NDF, ADF, cellulose and lignin respectively 25.57%, 84.01%, 22.98% , 18.17%, 61.12%, 40.15%, 34.59% and 4.57%.



Ref. [8] explained that tithonia contains antinutrients in the form of phytic acid, tannin, oxalate and saponin. The antinutrient substances most prominent as a limiting factor in the provision of tithonia as animal feed is the presence of antinutrient substances in the form of phytic acid compounds of 79.1 mg/100g which are antinutrients with the highest content compared to other antinutrients. Nevertheless, the tithonia plant can still be used as ruminant animal feed because ruminants have the enzyme phytase to overhaul the phytate. Corn crop waste has the potential to be used as feed other than tithonia, but only for ruminants because of its high fiber content. Corn straw is an important feed ingredient for cows when grass is difficult to obtain, especially in the dry season. Corn straw preserved by sun drying produces a variety of by-products that can be used as animal feed.

In the eastern part of Indonesia, corn straw, besides being given in fresh form, can be dried or processed into durable feed such as pellets, cubes and stored for animal feed reserves [9]. Whereas in America and other countries such as Argentina and Brazil which are corn producing countries, corn waste is very abundant [10]. Corn waste treatment is necessary for continuous feed continuity. Although most of the waste is given to livestock by grazing livestock directly in the planting area after the corn is harvested or directly brought to the breeder cages.

The palatability value measured qualitatively shows that leaves and corn husk are preferred by livestock compared to stems or cob [11]. Almost equal proportions of waste were reported by Ref. [12] is waste from several varieties of corn developed by the Corn and Cereals Research Institute, Maros. The proportion of stems varies between 55.38 - 62.29% and the proportion of leaves between 22.57 - 27.38%. Based on the description above, a study was conducted to see the effect of the use of rations containing PKC, tithonia and corn waste on milk production, consumption and digestibility of ECDG.

2. Materials and Method

The material used in this study was 20 ECDG during lactation 1 and 2 originating from RantiangAmeh dairy farms, Canduang District, Agam Regency, West Sumatra Province, Indonesia.

The method used in this research is complete random design (CRD) with 4 treatments and 5 replications in the form of concentrated and forage formulas. The treatment ration was:

A = 7,5 kg tithonia + 4 kg tofu waste

B = 7,5 kg tithonia + 2 kg tofu waste + 1,2 kg CPKC

C = 2 kg corn waste + 5,5 kg tithonia + 2 kg tofu waste + 1,2 kg CPKC

D = 4 kg corn waste + 3,5 kg tithonia + 2 kg tofu waste + 1,2 kg CPKC

The mathematical model of a complete randomized design (CRD) used according to [13]. The parameters measured were milk production, consumption of dry matter, consumption of organic matter, consumption of crude protein, dry matter digestibility (DMD), organic matter digestibility (OMD) and crude protein digestibility (CPD).

3. Results and Discussion

Data on the analysis of milk production and consumption of ECDG fed with CPKC, tithonia and corn waste are presented in Table 1.

Table 1. Milk Production and Consumption of ECDG fed with CPKC, Tithonia and Corn Waste

Parameters (Kg)	Treatments			
	A	B	C	D
Milk Production	0,84	1,22	1,01	1,12
DM Consumption	3,52	3,91	3,90	3,79
OM Consumption	3,08	3,50	3,48	3,36
CP Consumption	0,84	0,93	0,93	0,90

Table 1 shows that the treatment did not have a significant effect ($P > 0.05$) on milk production and ration consumption. Ration despite differences in composition of feed ingredients between treatment rations.

3.1. Milk Production

Optimum milk production is the main goal of raising dairy cattle or dairy goat, while good milk quality determines the sale value, especially fat content. According to Ref. [14], among non-genetic factors, feed is the main factor influencing the production and quality of milk produced.

Results of analysis of variance showed that the treatment had no significant effect ($P > 0.05$) in increasing daily milk production. These results reflect the combination of CPKC, tithonia and corn waste can be used as an alternative feed in maintaining daily milk production. Non significant difference between treatments A, B, C and D due to nutrient digestibility of all treatments also did not difference (Table 2) which affects the availability of nutrients for the formation of milk components is also the same, crude protein consumed by ECDG will be a precursor in the formation of NH_3 in the rumen. NH_3 will be used as a source of nitrogen for the growth of rumen microbes, as a result the activity of microbes in the rumen becomes optimal so that the process of fermentation of polysaccharides to Volatile fatty acids (VFA) is also optimal. The optimal production of VFA will optimize the energy source in livestock as a result of better productivity, so that the milk production produced is also more optimal. Ref. [15] shows that the provision of palm oil industrial waste in ECDG rations can increase the VFA content of rations. Ref. [16] also added that feeding that is rich in protein is evident in improving metabolism and can increase the ability of microbes to degrade feed in the rumen. According to Ref. [17] has a lot of amino acid content for microbial growth in the rumen including methionine, leucine, isoleucine and valine, this is also one of the factors supporting the effectiveness of microbes in degrading feed.

The yield of milk production increased with the combination of CPKC, tithonia and corn waste in the ration although it was not statistically significant. This proves CPKC, tithonia and corn waste can optimize milk production. The increase in milk production is in line with the combination of several protein feed ingredients in the ration of donations from CPKC, tithonia and corn waste so as to maintain cells in the mammary gland and the production of hormones and enzymes that play a role in milk biosynthesis. Tannins in tithonia also play a role in protecting the protein from rumen degradation by forming complex bonds of protein-tannin so that the protein is not degraded in the rumen but this protein will reach the small intestine so that the animal's body can be utilized optimally for milk production needs. Research by Ref. [18] added that feeding animals that contain protein by-pass in the rumen will increase microbes and amino acids to be absorbed in the small intestine and increase protein synthesis in livestock bodies. Ref. [19] added that by-pass protein would be digested directly in the abomasum and intestine enzymatically.

The results obtained in this study are lower than the results of research by [20] and (2018) [21] which also uses palm oil waste based feed of 2.00 l/e/day and 1.83 kg/e/h. Ref. [22] states that ECDG in lactation 1 has 0.5 liter / day / head milk production and an increase of 1.5 liter / head / day on the second lactation. The results of this study are higher than [15] getting milk production of 0.65 kg / day / head in the provision of concentrate rations based on palm oil industry waste. Milk production of Etawa crossbred dairy goat can be seen in Figure 1.

3.2. Rations Consumption

The rations consumption of ECDG fed CPKC and the combination of forage of tithonia and corn waste is presented in Table 1. Based on the analysis of DM, OM and CP consumption variations, it was found that the treatment had a non-significant effect ($P > 0.05$) on the consumption of DM, OM and CP.

Table 1 explains that the use of CPKC, tithonia and corn waste in rations is able to maintain the value of consumption of DM, OM and CP rations. This shows that CPKC, tithonia and corn waste can be used in ECDG rations. In general, the consumption of DM in the results of this study showed that the ration provided was palatable enough for ECDG. [23] states the level of consumption of food substances greatly affects the performance of livestock production, while the level of consumption of a feed reflects the level of palatability of the feed. Palatability of a feed ingredient can be assessed from the level of animal consumption. The higher the value of ration consumption means the ration has good palatability. According to Ref. [24], factors that influence feed consumption are palatability. Ref. [25] added that the factors influencing feed consumption were taste, odor, physical texture and chemical composition of feed given. The results of this study are higher than the results of Ref. [15] study which obtained DM consumption of ECDG lactation goats from rations based on palm fronds concentrate 1.08 - 1.10 kg /

head / day and research by Ref. [26] obtained dry material consumption from sheep fed with forage tithonia and Bengal grass of 0.885 kg / day. The results of this study are still higher than the research of [4] which uses tithonia ration and palm oil industry waste with an average consumption of DM of 3.41 kg / head / day.

The consumption pattern of OM follows the DM consumption pattern and has a positive correlation. This is because the substances contained in OM are part of the DM. As DM consumption increases, OM consumption also increases and vice versa as reported by Ref. [27, 28, 29].

Table 1 shows the average consumption of crude protein ranges from 0.84 to 0.93 kilograms/head/day. Protein is one of the foods that play a role in the growth and production of milk, therefore consumption of protein can describe the quality of the ration examined in this study. Crude protein is one of the organic ingredients contained in the ration, so the consumption of crude protein is largely determined by the consumption of dry matter and the crude protein content in the ration. High levels of crude protein in the ration and accompanied by high consumption of dry matter will result in high consumption of crude protein as well.

No difference in protein consumption in the treatment was related to the protein content of ration which was almost the same in each treatment. Ref. [30] states that the CP consumption will increase in line with the increase in dietary protein content so that the protein that can be utilized is increasingly large. According to Ref. [31], the level of difference in consumption is influenced by several factors, including livestock factors (body weight, age and condition of livestock caused by the environment), the level of feed digestibility, feed quality, and palatability.

Crude protein consumption in this study was higher than the research results of Ref. [32] who reported the consumption of CP in lactation ECDG from the combination of forage grass king, lamtoro and concentrate that is 0.24 kg / head / day and higher than the results of the study of Ref. [33] who used forage of calliandra and concentrate that is 0.34 kg / head / day.

The negative effects of using CPKC, tithonia and corn waste have not been seen in reducing ration consumption. Consumption of DM, OM and CP is still the same in all treatments. This proves the provision of CPKC, tithonia and corn waste in rations can be used by farmers as ingredients to reduce tofu waste. Several studies on CPKC, tithonia and corn waste added to the ration mixture did not have a negative effect on the consumption, digestibility, production and quality of milk from livestock [21] [34] [35] [36]). Milk production and ration consumption can be seen in Figure 1.

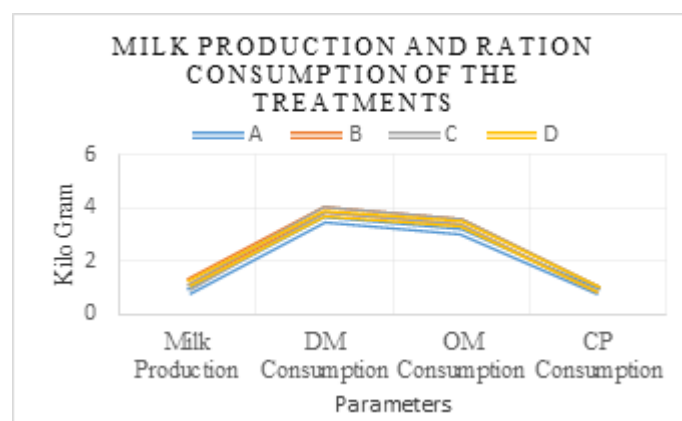


Figure 1. Milk Production and Ration Consumption of the Treatments

3.3. Ration Digestibility

The level of digestibility in this study was not influenced by treatment. This means that CPKC, tithonia and corn waste can play a role in maintaining digestibility. Digestibility of different substances of CPKC, tithonia and corn waste is presented in Table 2.

Table 2. Digestibility of CPKC, Tithonia and Corn Waste in the Treatments

Parameters (%)	Treatments			
	A	B	C	D
DMD	81.08	80.67	80.31	81.08
OMD	81.93	81.70	81.24	81.91
CPD	85.08	84.76	84.39	85.43

Dry matter digestibility is one indicator to determine ration quality. The higher DMD, the higher the nutritional opportunities that livestock can use for their growth [37]. DMD in this study was higher when compared with the results of research by Ref. [26] which combined tithonia with Bengal grass by 78.54%. [36] obtained dry matter digestibility of 70.98% for the use of 30% tithonia mixed in the concentrate in goat rations.

From Table 2 above it can be seen that the average DMD ranges between 80.31 - 81.08%. Based on statistical analysis, it was shown that the treatment had an insignificant different effect ($P > 0.05$) on DMD. The results of the study showed that the administration of CPKC, tithonia and corn waste to DMD in lactation ECDG was the same.

Digestion of food substances from feed ingredients will determine the quality of the feed, because it will be known what percentage is digested and how much is released through feces. High DMD in ruminants shows high levels of nutrients digested especially those digested by rumen microbes. The higher the percentage of digestibility of feed ingredients, the better the quality.

From Table 2 above it can be seen that the value of OMD ranges between 81.24 - 81.93%. Based on statistical analysis, it was shown that the treatment had an insignificant different effect ($P > 0.05$) on OMD. Table 2 shows the OMD value increases with DMD. The pattern of OMD is in line with DMD, because most of the dry matter consists of organic matter and what distinguishes it is ash content according to the results of research obtained by Ref. [15]; and Ref. [38].

Average digestibility of crude protein ranges from 84.39 - 85.43%. Based on statistical analysis shows that the treatment gives no significant difference ($P > 0.05$) on the digestibility of crude protein. Digestion is closely related to the chemical composition of feed ingredients [31]. Digestibility of protein ration is directly proportional to the quality of the feed ingredients, especially the CP content. The higher the consumption of CP rations the higher the digestibility. [39] stated that an increase in crude protein content would increase the rate of propagation and rumen microbial population so that the ability to taste food becomes greater. Ref. [40] add that the digestibility of the ration will be influenced by the composition of the feed, nutrient content and digestion process in the rumen and post rumen tract.

The results of this study show that the effect of CPKC, tithonia and corn waste in the treatment did not have a real effect on the increase in digestibility of crude protein, meaning that the administration of CPKC, tithonia and corn waste was able to maintain CPD. Protein digestibility value has a relationship with the condition of the bacterial population in the rumen, especially those that are proteolytic, namely bacteria that produce extracellular protease enzymes. Most likely the proportion of proteolytic bacteria from each treatment is not much different. The results of this study are higher than the results of the study of [38] who obtained digestion of crude protein combination of tithonia and elephant grass with concentrates consisting of palm kernel cake, corn, tofu waste and rice bran of 74.67% - 80.52%. Ration digestibility of treatments can be seen in Figure 2 below.

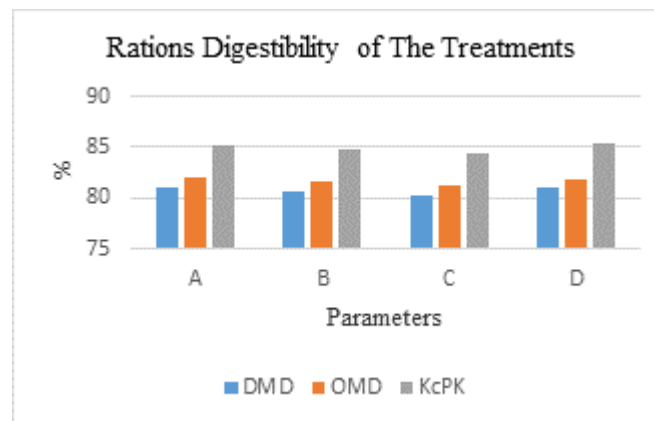


Figure 2. Ration Digestibility of The Treatments

4. Conclusion

The results showed that the use of palm kernel cake as a concentrate and the combination of tithonia and corn waste as a forage could be recommended as an alternative feed without reducing milk production, consumption and digestibility of the ration.

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