Feeding coconut meal improves milk production and the quality of Etawah Grade goats

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Feeding coconut meal improves milk production and the quality of Etawah Grade goats

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Abstract

The objective of the study was to evaluate the effect of feeding concentrate with different amounts of coconut meal (CM) on the production performance of pregnant and lactating Etawah Grade goats. Four concentrates containing different amounts of CM were offered to female Etawah grade goats from late pregnancy until they weaned their kids. Increasing the amounts of CM in the concentrate increased the bodyweight of does both during their late pregnancy and lactation, and improved production and composition of colostrum and the milk produced by does prior to weaning of their kids. Dairy goat farmers can feed their pregnant and lactating Etawah grade goats a concentrate with fifty per cent CM for increased average daily weight gain and reduced mortality of kids prior to weaning.

Keywords: *colostrum, milk, nutrient intake, pre-weaning kids, weight gain*

Introduction

Goat milk and its products are important daily food sources of protein, phosphate and calcium for people in developing countries, where the availability of cow's milk is limited (Park 2019). Etawah grade goats, in Indonesia locally known as "Kambing PE" are considered to be an alternative to cows and provide fresh milk and income for rural people. When managed properly these goats are able to produce milk that exceeds the amount needed by their offspring. Farmers may also drink fresh milk, or utilize the milk for other needs. However, many farmers pay insufficient attention to management of pregnant does. Every effort is focused on the does at parturition and later as a result of the perceived importance of lactation. Lower quality feeds, nutritionally unbalanced diets and inadequate housing all characterize poor pregnant animal management practices. Lack of proper care during late pregnancy can result in decreased yield and quality of colostrum; diminished milk yield and component concentrations; and increased incidence of health disorders in does and kids (van Saun and Sniffen, 1996).

In early lactating does, mammary gland metabolism increases, and is more sensitive to lower protein and energy intake due to decreased appetite post parturition. Does in this physiological state need diets of high nutrient density in the form of concentrates to provide sufficient nutrient intake to produce milk (Lefrileux et al 2008). An effective concentrate should be a source of soluble carbohydrate, undegradable protein and glucose; and also produce high level of volatile fatty acids especially propionic acid for milk synthesis. Insufficient nutrient intake during late pregnancy and early lactation may result in low birth weights and milk production. This in turn will affect the health and development of the kids. Lactating Etawah grade goats also need roughage and concentrates with energy and nutrients sufficient for good milk production.

A local resource, coconut meal (CM), is available for producing concentrate that contains water soluble carbohydrate and non-degradable protein, is relatively cheap and has not been widely used as a concentrate by local farmers. Concentrate mixtures with varying amounts of copra cake have been evaluated on crossbred Anglo-Nubian × Fiji local goats (Aregheore, 2006). Voluntary feed intake reduced as the amount of copra cake in the concentrate increased, but the animals body weight increased and digestibility of dry matter, crude protein and total digestible nutrient (TDN) improved significantly. Studies of feeding concentrate to Etawah grade goats by Adriani et al (2014) showed that feeding 60% roughage and 40% concentrate increase milk production without affecting feed consumption and milk composition. Recent study conducted by Da Silva et al (2021) showed that increasing amount of CM replacing corn and soybean meal in the concentrate negatively affected intake of dry matter and organic matter by Santa Inês lambs. The objectives of the current study were to evaluate the effect of feeding concentrate containing different amounts of CM to late pregnant and lactating Etawah grade does on their milk and colostrum production and composition, and the birth weight and weight gain of kids up to weaning.

Materials and methods

The feedstuffs used in this experiment were field grass for the basal diet and four test concentrates consisting of a mixture of two portions of rice bran and one portion of corn meal with different amounts of CM i.e. 0, 25, 50 and 75. The levels of CM were selected based on the results of a preliminary study with three-month-pregnancy Etawah grade does given a concentrate containing 50% CM and the same field grass as the basal diet. These goats ate well with an average dry matter intake of 4.9% of their live weight. The field grass and concentrate were analyzed for dry matter, ash, organic matter, crude protein, crude fat and crude fiber according to standard methods (AOAC 1990) and the results of these analyses are presented in Tables 1 and 2.

Table 1. Chemical composition of feedstuffs on a dry matter basis fed to Etawah grade does, during pregnancy and lactation

Feeds	Nutrient Composition (%)				
	Dry matter	Crude protein	Fat	Crude fiber	Ash
CM	92.0	19.2	2.1	14.4	7.99
Corn meal	89.0	8.5	3.8	2.5	2.76
Rice bran	91.0	11.0	5.0	12.0	13.09
Field grass	23.6	1.32	0.46	6.2	3.57

Table 2. The proportion of feed components used to make concentrates and the chemical composition, of dietary treatments (on dry matter basis)

Feed Component, %	Coco Meal, %				Field grass
	0	25	50	75	.
Corn meal	33.4	25	16.7	8.4	.
Rice bran	66.6	50	33.3	16.6	.
Total	100	100	100	100	.

Chemical composition, %					
Dry Matter	90.3	90.7	91.2	91.6	23.6
Crude protein	10.2	12.4	14.7	16.9	5.6
Crude fat	4.6	4.0	3.3	2.7	1.9
Crude fiber	8.8	10.2	11.6	13.0	26.3
N-Free extract	55.9	53.8	51.8	49.7	51.0
Ash	10.9	10.3	9.7	9.2	15.1
Dry Matter	90.3	90.7	91.2	91.6	23.6

The goats were maintained in individual cages located in a semi-open building. The basal diet was provided *ad libitum* and offered three times a day i.e. 07.00 am; 12.00 noon and 15.00 pm. The amount of concentrate offered was approximately 2% of initial live weight of the does and provided once a day in the morning. Drinking water was available *ad libitum*.

Animals and design of the experiment

Sixteen three-month- second pregnancy Etawah grade does weighing 26.4 ± 2.1 kg were randomly allocated into four concentrate treatments i.e. T_0, T_1, T_2, and T_3 containing 0, 25, 50 and 75% CM respectively adopting a completely randomized design. Each treatment has four replicates.

Variables studied include

· Daily feed intake of each doe was calculated by subtracting feed refusals from the amount of feed offered. Field grass and concentrate refusals were manually separated and weighed with analytic scale and put into an oven with temperature 60^{o}C until their dry weights were constant before chemical analyses.

· Body weight of all does were measured weekly to the nearest 0.1 kg.

· Birth weights of kids were measured soon after dislocating their placentas and then the kids were weighed weekly for 10 weeks.

.Colostrum for the first five days of lactation, from each doe, was collected daily by hand milking, and a 50 ml daily samples were stored in freezer at 0^{o}C.

· From day six of lactation milk production from each doe was collected daily for 10 weeks. Similar amounts of milks samples, taken every week, were stored in a freezer for later analyses.

All colostrum and milk samples were thawed, pooled and subsampled for determination of their chemical composition.

The data were statistically analyzed using the General Linear Model (GLM) procedure of SAS^{Ò} (Der and Everitt, 2001), and significant differences between treatment means were tested using the LSMEANS procedure. Response functions were estimated using regression analysis relating levels of CM in the concentrate with colostrum and milk yield, and their composition.

Results and discussion

Nutrient intake and general performances

Daily intakes of dry matter, crude fat, and crude fiber by pregnant and lactating does given field grass as the basal diet with incrasing amount of CM in the concentrate did not vary ($p>0.05$), but the crude protein intake increased significantly (Tabel 3). Dry matter intake of the does was 3.45% of their live weight, higher than that reported by Burns et al (2005), which may be due to their different physiological status. Pregnant and lactating goats need higher amounts of nutrients to support fetus development and milk production.

Table 3. Nutrient intakes and body weight change of Etawah grade does, during pregnancy and lactation, offered concentrates containing different amounts of CM.

Nutrients	CM, %					
	0	25	50	75	SEM	*p*
During pregnancy						
Dry matter intake, g/d	1,503	1,548	1,496	1,528	69.28	0.98
Crude protein intake, g/d	153.7	173.7	183.3	216.0	9.12	0.05
Crude Fat intake, g/d	75.6	82.7	84.8	97.5	4.14	0.38
Crude fiber intake, g/d	326.9	325.0	302.0	286.1	8.46	0.76
Average final body weight, kg	42.1	43.6	42.5	48.0	0.88	0.05
Dry matter intake, % body weight	3.57	3.55	3.52	3.18	0.12	0.756
During lactation						
Dry matter intake, g/d	1538.1	1809.9	1613.3	1552.7	95.01	0.22
Crude protein intake, g/d	141.9	247.8	174.9	183.7	8.12	0.02
Fat intake, g/d	67.2	82.3	78.8	80.5	3.6	0.06
Crude fiber intake, g/d	349.3	402.2	346.4	322.4	21.6	0.14
Average final body weight, kg	38.1	39.6	39.5	45.0	0.88	0.05
Dry matter intake, % body weight	4.04	4.57	4.08	4.08	3.45	0.03

Means within the same row with different superscripts are significantly different ($p<0.05$) SEM= standard error of the mean

The final body weights of both pregnant and lactating does fed on the concentrate with 75% CM ($p<0.05$) was consistent with the levels of protein in the concentrate (Table 3). This indicates that protein content of the total diet less than 17% may not fulfill the does' nutrient requirement, and the pregnant Etawah grade does feed on field grass as a basal diet should be offered a diet containing about 17% crude protein to increase their body weight (Mathius et al 2002; Thiruvenkadan et al 2009).

Birth weight is an important factor influencing growth during postpartum development of kids. Birth weights of kids in this study varied ($p<0.05$) from 2.78 kg for offspring from does fed on control diet to 3.3 - 3.6 kg for kids from does that received concentrate with CM. Two kids died prior to weaning from does that received control diet but none from those given concentrate with CM. Susilorini et al (2017) suggested that a new born kid

with higher birth weights will grow faster than kids with lower birth weights, because goats that have higher birth weights have more nutrient reserves, so the opportunity to grow and live is also greater.

Production and composition of colostrum and milk

Colostrum is the milk produced by ruminants during the first five days of lactation (Marounek et al 2012). It has a very important biological function in neonates by promoting immunoglobulin transfer from the dam to the newborn and providing protection against infections (Hernández-Castellano et al 2015). It is not only a good source of macronutrients and micronutrients, but also contains many biologically-active constituents (Bernabucci et al 2013). The results of our study showed that feeding concentrates with increasing amount of CM resulted in significant increases in yield of colostrum and its protein contents (Table 4; Figure 1 and 3), which are in line with protein intake (Table 3). Although the fat concentration did not varied among treatments ($p>0.05$), a positive trend was observed. A quadratic responces in colostrum yield indicate that the highest colostrum yield was achieved when the concrentrate contained around 50% CM.

Looper (2012) argued that manipulation of diet has little effect on lactose and mineral proportion of cow milk. However, an interesting finding in this study was that increasing CM intake depressed the lactose content of the colostum.

Table 4. Production and composition of colostrum from Etawah grade does offered concentrates containing different amounts of CM.

Parameters	CM,%				SEM#	*p*
	0	25	50	75		
Colostrums, ml/d	323^{b}	420^{a}	456^{a}	463^{a}	23.5	0.0101
Colostrum Composition, %						
Dry matter	19.6^{c}	21.6^{bc}	23.2^{b}	29.8^{a}	0.87	0.0002
Protein	8.8^{c}	9.5^{c}	11.3^{b}	17.1^{a}	0.46	0.0001
Fat	7.7^{a}	8.7^{a}	9.4^{a}	10.8^{a}	0.72	0.1738
Lactose	2.16^{a}	1.86^{ab}	1.52^{b}	0.90^{c}	0.14	0.0012
Ash	0.95^{a}	0.96^{a}	0.96^{a}	0.97^{a}	0.02	0.9289

Means within the same row with different superscripts are significantly different ($p<0.05$) SEM# = standard error mean

A quadratic responces in colostrum production indicate that the optimum level of CM in the concentrate based on rice bran was between 60 – 70% and polynomial increase in protein content improvements in both milk yield and protein content as the amount of CM increased

Table 5. Production and composition of milk from Etawah grade does offered concentrates containing different amounts of CM.

Component	CM, %				SEM#	*p*
	0	25	50	75		
Milk Yield, ml/d	761.3^{a}	900.0^{a}	862.5^{a}	1062.5^{a}	81.2	0.1209
Milk Composition (%)						
Dry matter	13.57^{b}	13.73^{b}	14.03^{ab}	14.30^{a}	0.15	0.0391
Protein	3.67^{a}	3.77^{a}	3.84^{a}	3.87^{a}	0.07	0.2439
Fat	5.06^{a}	5.09^{ab}	5.21^{ab}	5.31^{a}	0.07	0.1184
Lactose	4.05^{a}	4.08^{a}	4.21^{a}	4.29^{a}	0.07	0.1504
Ash	0.76^{a}	0.77^{a}	0.78^{a}	0.79^{a}	0.02	0.7870

Means within the same row with different superscripts are significantly different ($p<0.05$) SEM# = standard error mean

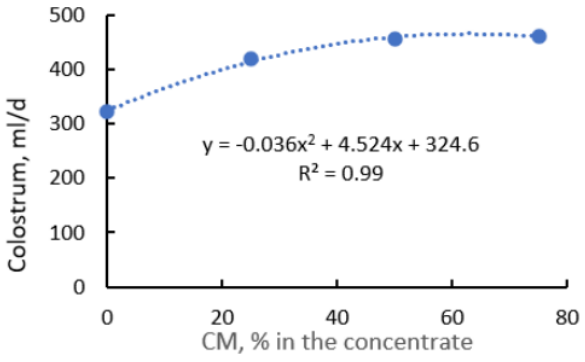

Figure 1. Effects of levels of CM in the concentrate on composition of colostrum

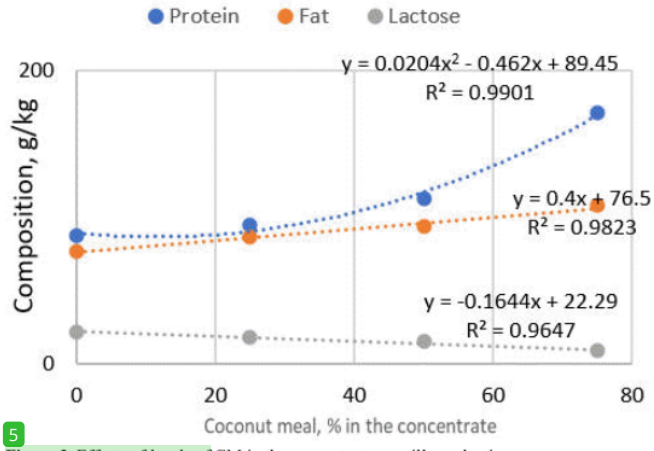

Figure 2. Effects of levels of CM in the concentrate on milk production

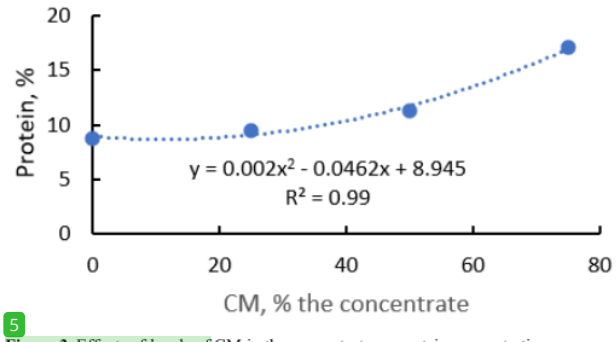

Figure 3. Effects of levels of CM in the concentrate on protein concentration

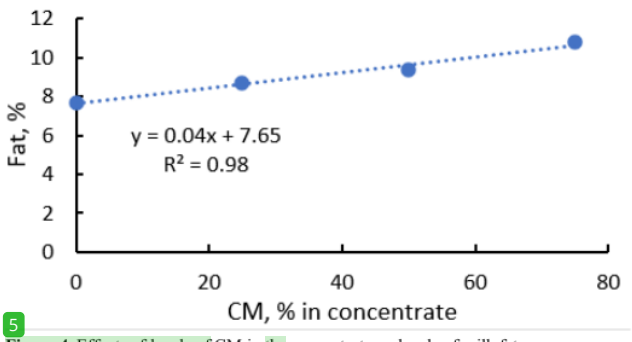

Figure 4. Effects of levels of CM in the concentrate on levels of milk fat

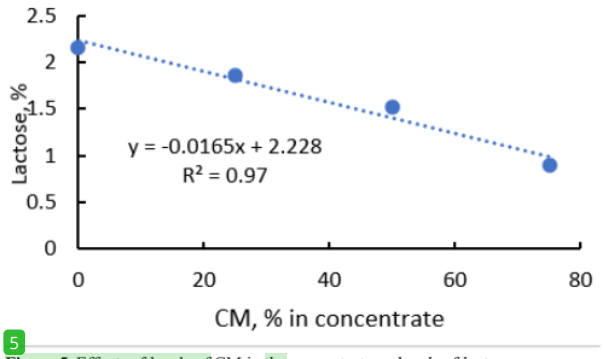

Figure 5. Effects of levels of CM in the concentrate on levels of lactose

Results of our study showed that colostrum production of the does given concentrates without CM (T_0) and nutrient composition of the colostrum (except lactose and ash content) were significantly ($p<0.01$) lower than those given concentrates containing CM (Table 5). Whereas colostrum production among goats fed on CM concentrates (25; 50; 75, were not significantly different ($p>0.05$) but tended to increase ($p=0.12$) in line with increasing the levels of CM. (Bernabucci et al 2013) suggested many different factors are involved in the production and the composition of colostrum and milk, including the female health status, environmental conditions, feeding practices and species. Our results indicate the importance of dietary protein for colostrum production. Higher concentrations of protein in the concentrates because of increasing amounts of CM brought about increases in colostrum production, as well as its content of dry matter, protein and fat. Romero et al (2013) reported that postpartum time, lactation period and litter size all significantly affected the composition of colostrum.

An increase in colostrum production and improved composition reduced the mortality of pre-weaning kids from 33.3% (0, without CM) to 0% (25; 50; 75 with CM). This could be due to colostrum improving the immune system of a new born offspring resulting in increased resistance to diseases later in their life (Lefrileux et al 2008).

Feeding field grass as a basal diet and concentrate consisting of rice bran and corn and CM to Etawah grade goats did not significantly affect milk production in this study (Table 5). However, there was a tendency ($p = 0.12$) that milk yield quadratically increased as the levels of CM in the concentrate increased (Figure 6).

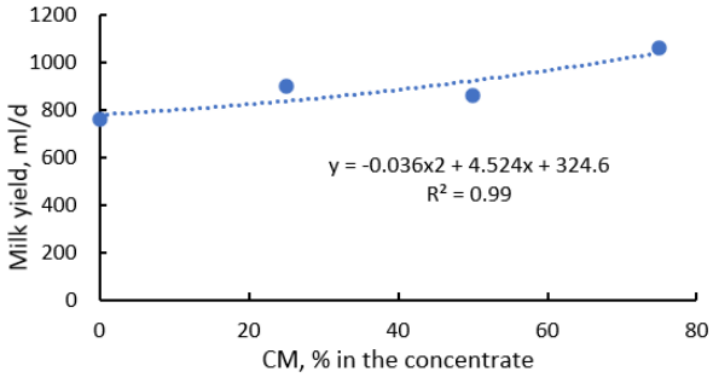

Figure 6. Effects of levels of CM in the concentrate on milk yield of Etawah grade goats

Generally, the quality of roughage in the tropics especially field grass as a basal diet, is relatively low, and it is only able to fulfill maintenance requirements for non-pregnant or lactating dairy animals. For milk production, more nutrients should be provided through concentrate feeds (Lefrileux et al 2008) as the amount of soluble carbohydrates in roughages is relatively low. Therefore, it is important to provide concentrates containing nutrient mixtures of high energy, protein and minerals for increasing fermentation products particularly propionate required for milk synthesis.

A review regarding milk feeding and weaning methods for goat kids conducted by Lu and Potchoiba (1988) concluded that farmers may wean earlier than the traditional weaning age of 3 months, assuming that kids have body weights of 9 kg, at 8 weeks of age or when it able to consume at least 30

kg/day of solid feed. Therefore, the weight gain of kids prior to weaning is an important factor to be considered before deciding the time of their weaning. The weight gain of kids prior to weaning increased significantly ($P<0.01$) when the does were fed on concentrates with CM (Table 5). Our results are slightly better than those reported by Sodiq (2012) and Astuti et al (2019) where the weight gains of their crossbred Etawah goats kids, prior to weaning, were around 126 g/d. Higher weight gain of the kids in our study is expected given the does milk production and milk composition (Table 5). This indicates that there were positive correlations between "milk production and composition" and weight gain of kids prior to weaning, because milk is a dominant feed of kids prior to weaning.

Conclusions

- Increasing amounts of CM in concentrates offered to pregnant and lactating Etawah grade does, fed field grass as a basal diet, did not influence nutrient intakes except protein, nor did not affect milk production and composition, but it increased average daily weight gain and reduced mortality of kids prior to weaning.
- Feeding concentrates is necessary for pregnant and lactating goats fed on field grass as basal diet. A concentrate consisting of corn meal, rice bran and 25% CM is sufficient for pregnant and lactating Etawah grade does fed on field grass.

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