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The Effects of Feeding Dried Fermented Cassava Peel on Milk Production and Composition of Etawah Crossedbred Goat

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***Abstract*—**Twelve lactating Etawah Crossedbred goats were used in this study. Goat feed consisted of *Cally andra callothyrsus, Pennisetum purpureum,* wheat bran and dried fermented cassava peel. The cassava peels were fermented with a traditional culture called *"ragi tape" (*mixed culture of *Saccharomyces cerevisae, Aspergillus sp, Candida, Hasnula* and *Acetobacter).* The goats were divided into 2 groups (Control and Treated) of six does. The experimental diet of the Control group consisted of 70% of roughage (fresh *Callyandra callothyrsus* and *Pennisetum purpureum* 60:40) and 30% of wheat bran on dry matter (DM) base. In the Treated group 30% of wheat bran was replaced with dried fermented cassava peels. Data were statistically analyzed using analysis of variance followed SPSS program. The concentration of HCN in fermented cassava peel decreased to non toxic level. Nutrient composition of dried fermented cassava peel consisted of 85.75% dry matter; 5.80% crude protein and 82.51% total digestible nutrien (TDN). Substitution of 30% of wheat bran with dried fermented cassava peel in the diet had no effect on dry matter and organic matter intake but significantly (P< 0.05) decreased crude protein and TDN consumption as well as milk yields and milk composition. The study recommended to reduced the level of substitution to less than 30% of concentrates in the diet in order to avoid low nutrient intake and milk production of goats.

***Keywords*—**Fermented Cassava Peel, Milk Production, Composition, Etawah Crossedbred Goat.

I. Introduction

FARMERS in the villages have been restricting the utilization of cassava by products, since it was known that those materials contained cyanogenic glycosides compounds, which is potentially toxic. One of the most common cassava by products used for goat feed were the leaves and peel. Cassava peel is part of household waste and traditional home industry which processed cassava. The increasing demand for cassava for industrial use has resulted in the production of large quantities of peel. Therefore need to be processed to produce livestock feed. Some efforts have been conducted to reduce the cyanide content of cassava peel, for example by sun drying and fermentation [5], [6] [1]. The result of fermentation has been shown to increase crude protein content of cassava peel [9]. Feeding cassava peel up to 55% of the main energy source did not depress growth rate of West African Dwarf sheep [2]. This study was conducted to investigate the effect of feeding fermented cassava peel on the nutrient intake and milk production of lactating goats. Fermentation in this study was conducted using a mixed culture medium called "*ragi tape"*.

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II. Materials and Methods

Twelve lactating Etawah Crossedbred goats aged between 2 to 3 years were used in this study. They were kept individually in slatted floor pens, equipped with feeding through and bucket for watering. Goat feed consisted of *Callyandra callothyrsus, Pennisetum purpureum,* wheat bran and dried fermented cassava peel.

The cassava peels used for this study were collected from a processing home industry in Yogyakarta. Majority of the peel were obtained from red colour cassava variety. In this study cassava peels was fermented with a traditional culture called "*ragi tape"* (a mixed culture of *Saccharomyces cerevisae, Aspergillus sp, Candida, Hasnula* and *Acetobacter).*

Cassava peel was cut into small pieces about 3 cm x 3 cm, soaked in the boiled water for 5 minutes then drained and cooled up. Afterward it was mixed with "*ragi tape"* (1 g for each 1 kg of cassava peel). The mixture of cassava peel and *ragi tape* was kept in a box covered with banana leaves and allowed to ferment in ambient temperature (26 to 31°C) for 2 days. The fermentation was terminated by opened up the leaves covering box and exposed the fermented cassava peel product under sun-drying for 1 to 2 days. After sun-drying, the product was milled for samples analysis and the rest was used for feeding the goat.

Nutritional composition (dry matter, organic matter, crude protein, fat and fibre) were determined using AOAC method. The goats were weighed and divided into 2 groups of six does (Control and Treated groups). The experimental diet of the Control group consisted 70% of roughage (fresh *Callyandra callothyrsus* and *Pennisetum purpureum* 60:40) and 30% of wheat bran on dry matter (DM) base. In the Treated group 30% of wheat bran was replaced with dried fermented cassava peels (TABLE I). Each goat was fed and observed for 60 days. The goat was offered total feed dry matter as much as 4,5 % of body weight. It was estimated that the diet supplied the total crude protein and energy (TDN) requirement of lactating goats based on [8].

The goats undergo preliminary period of adjustment to accustom them to feed for 7 days. During the adjustment, dried fermented cassava peel was introduced by gradually replacing the quantity of wheat bran offered. Feed intake was recorded daily by subtracting the refusal feed from feed offered. Milk production was recorded from the volume of milk collected daily. The live-weight of the does was recorded

at the beginning and the end of the experimental period to determine body weight changes. Statistical analysis was conducted using analysis of variance followed SPSS program.

TABLE I
COMPOSITION OF THE EXPERIMENTAL DIETS

Ingedients	Content (%) of DM	
	Control	Treatment
Callyandra callothyrsus	42	42
Pennisetum purpureum	28	28
Wheat bran	30	21
Dried fermented cassava peel	0	9

III. RESULTS

A. Feed Composition and Feed Intake

Part of this study that has been reported previously showed that fermentation with *"ragi tape"* significantly (P< 0.05) reduced hydrogen cyanide (HCN) content of cassava peel from 878.80 mg/kg to 36.29 mg/kg [12].

The nutrient composition of dried fermented cassava peel in this study consisted of 85.75% dry matter; 5.80% crude protein; 0.67% extract ether; 8.86% crude fibre and 82.51% total digestible nutrien (TDN). In compared with fresh cassava peel, the TDN, crude protein and crude fibre content were slightly decreased. Previously [12] reported the content of TDN, crude protein and crude fibre in fresh cassava peel at the level of 85,11%; 7.54% and 9.75%, respectively.

TABLE II
NUTRIENT COMPOSITION OF FEED IN THE CONTROL AND TREATED DIETS

Ingredient	Feed composition (%)			
	DM	OM	CP	Energy (TDN)
C. callothyrsus	28.00	93.35	25.56	55.80
P. purpureum	16.00	86.77	11.00	56.50
Wheat bran	89.00	92.21	17.00	83.41
Control diet	42.94	91.16	18.93	64.28
C. callothyrsus	28.00	93.35	25.56	55.80
P. purpureum	16.00	86.77	11.00	56.50
Wheat bran+ DFCP (70:30)	88.02	89.75	12.82	83.14
Treated diet	42.64	90.43	17.68	64.19

DFCP = dried fermented cassava peel

Table II indicated that replacement of 30% of wheat brand with dried fermented cassava peel could attain the similar energy level as that available in the control diet. Although crude protein content of the mixtute of wheat bran and dried fermented cassava peel (70:30) in the treated diet was less than CP content of wheat bran as a single concentrate in the control diet, in the overal ration the nutrient composition was similar (Table II).

The average nutrient content of feed offered during the experimental period is presented in Table III. There was no significant difference of nutrients content between control and treated diet. This indicated that both control and treated diet had the similar level of nutrient to support the requirement of lactating goats. Based on [8] nutrient content of feed was sufficient to supply total crude protein and energy (TDN) requirement for maintenance and milk production of lactating goats both in control and treated groups.

TABLE III
NUTRIENT CONTENT OF FEED OFFERED TO GOATS DURING THE EXPERIMENTAL PERIOD

Feed ingredient	Control diet	Treated diet
Dry matter (g)^{ns}	2104.9 ± 15.6	2016.3 ± 26.5
Organic matter (g)^{ns}	1859.0 ± 13.8	1769.8 ± 23.3
Crude protein (g)^{ns}	413.1 ± 3.0	382.1 ± 5.1
Energy (g TDN)^{ns}	1353.6 ± 10.4	1271.9 ± 16.4

ns: no significant difference

The dietary treatment had no significant effect on total dry matter (DM) and organic matter (OM) intake (TABLE IV) but significantly decreased crude protein and TDN intake of goat in the treated group (P<0.05). In this study, the refusal feed was only consisted of thick stem (stalk) of callyandra or grass. Wheat bran and dried fermented cassava peel was not refused by goats.

TABLE IV
NUTRIENT CONSUMPTION OF LACTATING GOATS DURING THE EXPERIMENTAL PERIOD

Nutrient component	Control diet	Treated diet
DM (g)	1765.9± 20.1^{ns}	1700.7± 29.4^{ns}
DM (g/kg BW)	43.9 ± 0.6^{ns}	42.9 ± 0.4^{ns}
OM (g)	1561.8 ± 17.8^{ns}	1496.7 ± 25.6^{ns}
OM (g/kg BW)	38.9 ± 0.5^{ns}	37.8 ± 0.3^{ns}
CP (g)	370.6 ± 3.5^{a}	331.8 ± 5.8^{b}
CP (g/kg BW)	9.2 ± 0.1^{a}	8.3 ± 0.1^{b}
TDN (g)	1177.7 ± 12.6^{a}	1115.1 ± 17.5^{b}
TDN (g/kg BW)	29.3 ± 0.4^{a}	28.2 ± 0.2^{b}

a, b means within row with different superscripts were significantly different at P<0.05. ns no significant difference
DM = dry matter, OM= organic matter, TDN = total digestible energy

The average body weight of goat at the beginning of feeding trial was 40.9 ± 0.3 kg in control group and 39.8 ± 0.7 kg in treated group. The treatment signifantly affected body weight of goats (P<0.05). During the period of experimental diet the goats undergo total weight gain of 5.32 kg and 2.32 kg, respectively for control and treated group. The average daily gain was 88.6 and 38.6 g/day.

B. Production and Composition of Milk

Mean values for milk yields and composition during 60 days of study are shown in TABLE V. Substitution of 30% of wheat bran with dried fermented cassava peel decreased milk yields and milk composition significantly (P< 0.05). Milk production in this study was recorded from the second month of lactation when the goat started to wean their kids.

TABLE V
MILK PRODUCTION AND COMPOSITION DURING THE EXPERIMENTAL PERIOD

Variables	Group of goat	
	Control	Treated
Milk yield (ml/day)	669.7 ± 13.2[a]	556.7 ± 16.3[b]
Spesific gravity	1.0318 [a]	1.0312[b]
Milk fat (%)	4.10 ± 0.04[a]	2.98 ± 0.05[b]
Total solid (%)	13.40 ± 0.05 [a]	11.87 ± 0.08[b]
Solid non fat (%)	9.30 ± 0.01 [a]	8.88 ± 0.04 [b]
Total solid production (g/day)	8880.0 ±167.6 [a]	6196.0 ± 145.2 [b]
Milk fat production (g/day)	26.63 ± 0.47[a]	14.39 ± 0.28[b]

a, b means within row with different superscripts were significantly different at P<0.05.

IV. DISCUSSION

The result of the study showed that fermentation of cassava peel with "*ragi tape"* had reduced HCN content to non toxic level. According to [7] less than 50 mg HCN counted to be non toxic level. The concentration of HCN in fermented cassava peel in this study was higher than that in cassava peel fermented with pure *Saccharomyces cerevisae* and *Lactobacillus spp* reported by [10] at the level of 6.2 mg/kg. It was probably caused by the difference of variety and type of microorganism used in the fermentation process. Similarly [10] reported the cyanide content of cassava peels fermented with waste water from the inoculated cassava product was below the deleterious level of 30 mg/kg and therefore it was not poisonous. It because microorganism that conducted fermentation was capable of partially degrading cyanogenic glucosides and the breakdown products. The potency of dried fermented cassava peel as energy source was also supported by the report of [10] stated that cassava peel was found to have 83% rumen degradability. Based on the results above, dried fermented cassava peel was safely to feed the goat. Previously [6] reported an increasing of dry biomass of crude protein, true protein, crude fat, crude fibre, ash and total dietary fibre in cassava peel as a result of fermentation with *Trichoderma viride*. It has been reported an increasing of protein content in fermented fresh cassava peel from 3.41 % to 5.53 % after 8 days incubation with 3.09 g/kg inoculum [9]. In this study, fermentation of cassava peel with "*ragi tape*" did not increase crude protein content. It was probably caused by short period of fermentation, since the incubation was only 2 days. On the contrary this study found a decreased of crude protein content from 7,54% to 5.80%.

In term of nutrient composition, dried fermented cassava peel was a good source of energy, as it contained 82.51% total digestible nutrien (TDN). According to [9]. cassava peel is high in soluble carbohydrates (62%) and low in fibre (16%) with a moderate level of nitrogen (1%). The availability of energy in the dried fermented cassava peel in this study was proved by the decreasing of crude fibre content. Enzyme from fungi breakdown polysaccharide into less complex structure of fermented cassava peel during biodegradation with *Aspergillus niger* [3] This recent study did not investigate the structure of fibre, however there was an evidence that fermentation with "*ragi tape*" decreased crude fibre content and furtherly this materials could support availability of energy. The focus of this study was to obtain cassava peel with low HCN but highly contained energy, so that beneficial to encourage farmers to collect and process cassava peel by such manner to produce feed energy source for dairy goat. Based on the estimation of nutrient requirement using NRC, the amount of nutrient in the diet in which 30% of wheat bran was substituted with dried fermented cassava peel was sufficient to support maintenance and milk production [8]. The data presented in TABLE IV proved that feeding dried fermented cassava peel had no significant effect on DM and OM consumption but decreased CP and TDN consumption of lactating goats. Dried fermented cassava peel counted to be palatable with the fact that no refusal by goats. Less amount of CP and TDN consumption found in the treated group was a result of depresion of roughage consumption (Callyandra or grass) and low content of CP and TDN in dried fermented cassava peel. However the level of DM and OM as well as crude protein consumption were higher than those previously reported on lactating Etawah Crossedbred goats fed cassava peel chips with 42.90; 31.38 and 7.85 g/kg body weight respectively for DM, OM and CP. This data was on the contrary with [14] reported that feeding urea treated cassava peel could improve DM intake of West African Dwarf goats. The nutrient consumption of goat in this study indicated that dried fermented cassava peel could be used to attain high level of nutrient intake when that was combined with good quality roughage

Substitution of wheat bran with dried fermented cassava peel significantly affected milk production. The production of 556.7 ml/d counted to be low. The average milk production of Etawah Crossedbred goats in the smallholder was reported to be 992 g/day [15]; 774 ml/day [11]; while those fed cassava peel chips produced 664 ml/day [13]. Feeding dried cassava peel also decreased milk fat, total solid and solid non fat content. Apart from the effect of low consumption of CP and TDN, low milk production and milk composition of goat in this study was influenced by the period of collection where the goats has passed their peak production. On the contrary, the goat during this period undergo weight gain. However weight gain of goats in the treated group was less than that in control group (38.6 g/day vs. 88.6 g/day). This data showed that substitution of wheat bran with dried fermented cassava peel supplied less amount of nutrient for both maintenance and milk production. In this study despite no effect of substitution on DM consumption, the negative effect was found in milk production, milk composition and consumption of CP and TDN. The data indicated that dried fermented cassava peel caused low efficiency of feed utilization. Previously has been reported the rumen volatile fatty acid (VFA) concentration of fermented cassava peel was 76.99 m mol/liter. This level indicated low effectivity VFA to support rumen microbes growth. Most of VFA was produced by degradation of carbohydrate in feed [17]. According to [16] the optimum concentration of rumen VFA which effective to support rumen microbes growth was around 80 to 160 m mol/liter. Based on

the results above, fermented cassava peel had low potency to supply carbohydrate in the rumen.

The study concluded that fermentation with "*ragi tape*" reduced HCN content of cassava peel. Dried fermented cassava peel contained high TDN but low CP. Substitution of 30% of wheat bran with dried fermented cassava peel had no significant effect on DM and OM consumption but decreased CP and TDN consumption, milk production and milk composition. There was recommended to reduce the level of substitution to less than 30% of concentrates in the diet.

V. Conclusion

Fermentation with "*ragi tape*" reduced HCN content of cassava peel. Dried fermented cassava peel contained high TDN but low CP. Substitution of 30% of wheat bran with dried fermented cassava peel had no significant effect on DM and OM consumption but decreased CP and TDN consumption, milk production and milk composition. There was recommended to reduce the level of substitution to less than 30% of concentrates in the diet of lactating Etawah Crossedbred goats.

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