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Energy Evaluation and Utilization of Cassava Peel for Lactating Dairy Cows

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***Abstract*—**The experiment was then conducted to investigate the effect of cassava peel addition in the concentrate on the performance of lactating dairy cows. Twenty four Holstein Friesian crossbred (>87.5% Holstein Friesian) lactating dairy cows in mid lactation; averaging 12.2±2.1 kg of milk, 119±45 days in milk, 44.1±6.2 months old and 449±33 kg live weight, were stratified for milk yield, days in milk, age, stage of lactation and body weight, and then randomly allocated to three treatment groups. The first, second and third groups were fed concentrates containing the respective cassava peel, 0, 20 and 40%. All cows were fed *ad libitum* corn silage and freely access to clean water. Dry matter intake, 4%FCM, milk composition and body weight change were affected (P<0.05) by the third treatments (40%). The present study indicated that 20% cassava peel can be used in the concentrate for lactating dairy cows.

***Keywords*—**Cassava peel, Energy evaluation, Milk production, Dairy cattle

I. Introduction

IN Thailand, more than 60% of the cost of milk production is the cost of feeds particularly concentrates. Increases in the cost of feeds inevitably cause increases in cost of milk production. In addition, an increase in demand for renewal energy has affected the price of livestock feeds such as cassava chip and molasses since they are the major raw materials for ethanol production. Both feedstuffs have risen in price to the point where there is interest in reducing the level consumed by the animals. There are many attempts to reduce cost of feeds through the utilization of the cheap raw materials such as agro-industrial by-products. Cassava peel as a kind of cassava as feedstuff, which showed that it has sufficient potential to be a source of energy for cattle. Because Cassava production is 3% cassava peel of cassava plants in this entire amount 552,000 tons per year in Thailand, which is considered a volume. Cassava peel from cassava starch processing factory have Nitrogen-free extract (NFE) is approximately 62.5 to 71.0 percent of the dry weight of gross energy (GE) 1.65 - 2.96 Mcal / kg digestibility energy (DE) 1.03 Mcal / kg [1], [2], [3] that we have the appropriate amount that will be used as the feedstuff. The research on cassava peel as lactating dairy cattle feeds is very limited.

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The aim of this studies were to evaluate the energy values of feedstuffs commonly used in the concentrates and to determine the effect of replacing ground corn by cassava peel in the concentrates on the performance of lactating dairy cows.

II. Materials And Method

A. Animals and Treatments

Twenty four Holstein Friesian crossbred (>87.5% Holstein Friesian) lactating dairy cows in mid lactation; averaging 12.2±2.1 kg of milk, 119±45 days in milk, 44.1±6.2 months old and 449±33 kg live weight, were stratified for milk yield, days in milk, age, stage of lactation and body weight, and then randomly allocated to three treatment groups (8 cows in each group). The first group was fed concentrate containing 0% cassava peel, the second group was fed concentrate containing 20% cassava peel and the third group was fed concentrate containing 40% cassava peel. All cows were fed ad libitum grass silage and freely access to clean water. The experiment lasted for 10 weeks (2 weeks for adjustment period followed by 8 weeks for measurement period).

All cows were individually housed in a 2x3 m^2 pen and were individually fed 8.0 kg concentrate daily, divided into three equal meals, at 07:00, 11.30 and 16:30 h. A basal diet, corn silage, was fed at *ad libitum* amounts after concentrate feeding. Feed consumptions were measured on two consecutive days each week. Samples of feed offered and left after eating were taken and were analyzed as previously described. [4], [5].

All cows were milked twice a day at 05:00 and 15:00 h. Milk yields were individually recorded daily. Samples of milk from individual cow were collected on two consecutive days weekly and then subjected to laboratory analysis (Milko Scan; Foss Electric, Denmark). Live weights of all cows were individually recorded on two consecutive days immediately after morning milking at the start and at the end of the experiment.

All measured data were then subjected to analysis of variance [6] using statistical Analysis System [7] procedure of general linear model (GLM). Mean comparison was done using Duncan's Multiple Range Test (DMRT).

III. Results And Discussion

A. Utilization of cassava peel as energy source in the concentrate for dairy cows

Chemical and nutrient compositions of feeds used in the experiment are given in Table 1. EE slightly decreased as the level of cassava peel in the concentrates increased. In contrast, Ash, CF, NDF and ADF increased with increasing cassava peel level in the concentrates. Energy values reduced with increasing level of cassava peel addition. This can be attributed to higher EE and energy values, and less fiber content of cassava pulp than cassava peel. The present study replaced cassava pulp with cassava peel.

TABLE I
CHEMICAL COMPOSITION (% OF DM) OF FEED USED IN THE EXPERIMENT

Chemical composition (%)	0% Cassava peel	20% Cassava peel	40% Cassava peel	Corn silage
DM	89.9 ± 0.3	90.0 ± 0.1	90.6 ± 0.6	28.1 ± 0.3
CP	22.6 ± 0.5	22.4 ± 1.9	22.7 ± 0.6	5.7 ± 0.1
EE	3.4 ± 0.3	3.2 ± 0.1	3.1 ± 0.3	1.5 ± 0.6
Ash	8.9 ± 0.2	10.2 ± 0.5	11.6 ± 1.6	7.2 ± 0.1
CF	9.3 ± 1.3	12.7 ± 1.0	12.1 ± 2.4	35.8 ± 0.1
NDF	29.3 ± 3.2	31.6 ± 1.7	32.4 ± 0.3	69.5 ± 0.1
ADF	18.6 ± 0.5	18.5 ± 0.4	19.4 ± 0.1	33.4 ± 0.2
ADL	5.4 ± 0.2	5.2 ± 0.5	4.7 ± 0.1	12.2 ± 0.9
NDIN	1.2 ± 0.2	1.2 ± 0.2	1.2 ± 0.1	0.4 ± 0.2
NDINCP	7.9 ± 1.2	7.7 ± 0.6	7.6 ± 0.3	2.7 ± 0.2
ADIN	0.6 ± 0.1	0.7 ± 0.2	0.7 ± 0.1	0.4 ± 0.2
ADINCP	4.1 ± 0.9	4.4 ± 0.1	4.4 ± 0.7	2.8 ± 1.5
TDN_{1X} (%)[1/]	69.3 ± 0.1	66.9 ± 0.6	65.8 ± 0.1	40.2 ± 0.2
DE_{1X} (Mcal/kg)[2/]	3.4 ± 0.1	3.3 ± 0.2	3.3 ± 0.1	1.7 ± 0.1
DE_P (Mcal/kg)[3/]	3.2 ± 0.1	3.1 ± 0.4	3.1 ± 0.1	2.01 ± 0.2
ME_P (Mcal/kg)[4/]	2.8 ± 0.1	2.7 ± 0.4	2.7 ± 0.1	1.6 ± 0.2
NE_{LP} (Mcal/kg)[5/]	1.8 ± 0.1	1.7 ± 0.2	1.7 ± 0.1	0.9 ± 0.2

[1]TDN_{1X} (%) = tdNFC + tdCP + (tdFA x 2.25) + tdNDF – 7 [16]
[2]DE_{1X} (Mcal/kg) = [(tdNFC/100)x4.2]+[(tdNDF/100) x 4.2]+[(tdCP/100) x 5.6]+[(FA/100) x 9.4] –0.3
[3]DE_P (Mcal/kgDM) = DE_{1X} x Discount [16]
[4]ME_p = [1.01 x (DE_p) – 0.45] + [0.0046 x (EE – 3)] [16]
[5]NE_{LP} = ([0.703 x ME_p (Mcal/kg)] – 0.19) + ([(0.097 x ME_p + 0.19)/97] x [EE – 3]) [16]

All cows consumed similar CP intakes of concentrate, corn silage and total diet (Table II). However, DM and NE_{LP} intake has decreased in the group supplemented with 40% of cassava peel. There were significant differences in 4%FCM, milk composition, milk fat, and milk lactose and milk total solid contents of the cows fed the 40% cassava peel diets, these tended to be higher than for those cows fed the control and 20% cassava peel diet. (Table III). Research on feeding concentrates containing cassava peel to lactating dairy cows is very limited.

TABLE II
DRY MATTER (DM), CRUDE PROTEIN (CP), AND NET ENERGY FOR LACTATION (NELP) INTAKES OF EXPERIMENTAL COWS

	0% Cassava peel	20% Cassava peel	40% Cassava peel	SEM	P value
DM intake					
Concentrate (kg/d)	8.40 [a]	8.31 [b]	8.22 [c]	-	-
Corn silage (kg/d)	5.78 [a]	5.56 [ab]	5.33 [b]	0.20	0.06
Total (kg/d)	14.15 [a]	13.85 [b]	13.71 [b]	0.20	0.01
CP intake					
Concentrate (g/d)	1895	1860	1791	45.52	0.27
Corn silage (g/d)	333	321	307	21.56	0.06
Total (g/d)	2229	2181	2099	21.56	0.21
NE_{LP} intake					
Concentrate (Mcal/d)	15.1 [a]	14.5 [a]	13.4 [b]	0.34	0.01
Corn silage (Mcal/d)	5.25 [a]	5.05 [ab]	4.84 [b]	0.19	0.06
Total (Mcal/d)	20.41 [a]	19.60 [ab]	18.30 [b]	0.19	0.01

SEM = standard error of the mean; NELP = net energy for lactation

TABLE III
MILK YIELD, MILK COMPOSITION YIELD, MILK COMPOSITIONS, INITIAL WEIGHT, FINAL WEIGHT, AND LIVE WEIGHT (LW) CHANGE OF EXPERIMENTAL COWS

	0% Cassava peel	20% Cassava peel	40% Cassava peel	SEM	Pr>F
Milk yield (kg/d)	11.9	11.6	10.2	0.81	0.08
4% FCM (kg/d)	12.6 [a]	12.0 [ab]	10.5 [b]	0.80	0.04
Fat yield (g/d)	462 [a]	431 [ab]	378 [b]	30.52	0.02
Protein yield (g/d)	330	324	281	20.25	0.08
Lactose yield (g/d)	545 [a]	534 [a]	450 [b]	29.06	0.04
SNF yield (g/d)	943	920	795	58.77	0.06
Total solid yield (g/d)	1405 [a]	1352 [ab]	1173 [b]	84.74	0.04
% Fat	3.85	3.71	3.73	0.15	0.37
% Protein	2.75	2.79	2.76	0.03	0.43
% Lactose	4.55	4.61	4.46	0.05	0.10
% SNF	7.86	7.91	7.82	0.09	0.58
% Total solid	11.74	11.61	11.54	0.19	0.39
Body weight (kg)					
Pre-experiment	448	433	467	26.65	0.14
Post-experiment	457	444	465	26.80	0.21
Live weight change (g/d)	308 [a]	362 [a]	- 75 [b]	73.19	0.02

SEM = standard error of the mean; FCM = fat corrected milk

[8] Fed Brahman or Charolais-Brahman crossbred yearling beef cattle with concentrates containing 50% cassava chip, 50% cassava pulp or 50% cassava peel at a rate of 1.5% body weight together with *ad libitum* rice straw and found no significant difference body weight gain between the treatment groups although beef cattle on cassava peel consumed less DM than other cattle. [9] Replaced cassava chip by cassava pulp at a rate of 0, 50 and 100% in the concentrates and fed crossbred Holstein Friesian (>87.5% Holstein Friesian) heifers 2% body weight of concentrate plus *ad libitum* rice straw. The results showed that rice straw and total DM intake, eating behavior, fiber digestibility, rumen fermentation end-products, blood metabolite and body weight gain were similar in all treatments.

IV. CONCLUSION

The present study indicated that 20% cassava peel can be used in the concentrate did not affect milk yield, milk composition, fatty acid composition of milk and body weight change of lactating dairy cow.

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