EFFECT OF DRIED CASSAVA PEELING ON THE RUMEN ENVIRONMENT OF LAI SIND CATTLE FED NATURAL GRASS BASE

Pham Ho Hai

ABSTRACT

A Latin square experiment (4x4) of 4 treatments (T) was conducted on four Lai Sind bull with an average body weight of 290 kg. T1: basal die (natural grass ad bilitum with 1 kg cassava root meal daily plus 20 g salt mineral); T2, T3 and T4: basal diet plus 0.25; 0.50 and 0.75 kg DM dried cassava peeling per 100 kg LWt respectively.

The results showed that the ruminal pH and NH_3-N concentrations were not affected by adding dried cassava peeling at 0.75 kgDM/100 kg BW. Supplying dried cassava peeling at 0; 0.25; 0.5; 0.75 kg DM/100 kg BW decreased the amount of protozoa from 1.865 x 10^8/ml to 1.443x10^8/ml and increased the amount of bacteria from 1.342x10^5/ml to 2.672x10^5/ml on average, but there was no significant difference between treatments. The in Sacco DOM of natural grass was 54.83%, 63.22% of T4 and T1 ration after 72 hrs of incubation respectively. There was no significant difference of DDM of natural grass and dried cassava peeling between treatments after 48, 72 hrs of incubation.

Key words: Lai Sind, Dried Cassava Peeling, DOM (degradable organic matter), DDM (Degradable dry matter), Rumen environment.

1. INTRODUCE

There are abundant amounts of dried cassava leaf (0.96 tones/ha) and dried cassava peeling (1.75 tons/ha) at root harvesting. Actually, they are underutilized and usually put directly on to the soil as compost (Ravindran và Rajaguru, 1988; Dương Nguyen Khang and Wiltorsson, 2000). A factor limiting its utilization as a feedstuff is related to the high cyanogenic glucosides content, which produces the cyanide (HCN) toxin. Cyanide concentration of nearly 1,000 mg kg-1 dry matter (DM) had been reported in cassava forage (Man and Wilktorsson, 2001; 2002). Earlier reports indicated that feeding large amounts of untreated cassava products could result in the death of animals, particularly non-ruminants (Hill, 1973). In cattle and sheep, HCN can be lethal at level of 2-4 mg HCN kg-1 body weight (Kumar, 1992). However, rumen bacteria have the capacity to hydrolyze β-D-glucosides (Majak and Cheng, 1984; 1987) and to utilize the glucose as an energy source. The toxic HCN can be rapidly absorbed, eructated or further metabolized in rumen content.

Sun-drying alone eliminated almost 86% of the initial HCN content (Devendra, 1977; Gome *et al*, 1988). When combining chopping and wilting, HCN in the dried meal was reduced HCN level which is safe for monogastric animals (Ravindras et al, 1987). Doan Duc Vu (2000); Nguyen Thi Thu Hong (2001); Duong Nguyen Khang (2004); Trinh Van Trung *et al* (2004) studied cassava leaf foliage and dried as protein resource in beef and dairy rations which brought good effectiveness. In practice, the farmers have used dried and withered cassava peeling in beef ration at low level, but there has not been any research to announce. The aims of the present study were to examine the effects of

different levels of dried cassava peeling (DCP) to rumen pH, rumen ammonia and rumen micro-flora population in cattle fed natural grass basal diet.

2. MATERIALS AND METHODS

2.1. Materials

The experiment was carried out at the experimental farm of Can Tho University, Can Tho city, Vietnam. Four Lai Sind bull (26-28 months of age and 290 kg live weight (LWt) on average) with permanent rumen cannula were used for experiment.

Experiment animals were individually placed in a barn with open walls. Clean and fresh water was available *ad libitum* during the whole experiment.

2.2. Experiment design

The experiment was arranged in Latin square. Each treatment period lasted for 30 days. The first two weeks of each period were for animals and micro-flora adaptation to the new diets. Data on daily feed intake were taken during 7 days of the third week. Feed samples for analysis were taken before feeding during the last 3 days of the same week, *in Sacco* degradability during the following 3 days of the fourth week, and rumen samples during the last 2 days of each period.

2.3. Diet and treatment

The basal diet consists of natural grass *ad bilitum* and with supplementation of dried cassava peeling (1 kg DM/animal/day) and 20 g of a mixture of salt and minerals, two times daily at 7:00 hrs and 15:00 hrs. Cassava root meal was bought on the market at one occasion.

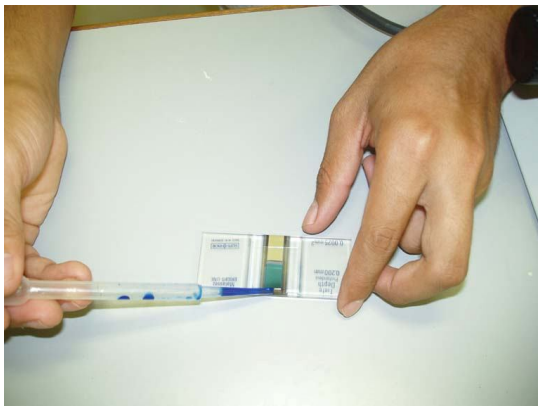
Basal diet plus 0, 0.25, 0.50 and 0.75 kg DM of DCP/day were added to T1, T2, T3 and T4, respectively. The DCP was collected at the same time from one field after harvesting the roots. The peels were air dried on ground. The animals had access to feeds for the whole day.

2.4. Measurement

- *Dry matter intake*: All the feeds were weighed before feeding and supplied separately to the bull. Natural grass was *ad billitum*. The cassava root meal and amount of DCP were supplied according to the treatments throughout the experimental period. Refused feeds were weighed each morning during 7 days of the third week. The feeds were also sampled at these occasions and analyzed for calculation of daily dry matter by AOAC method (1990).
- *Chemical compositions of feed ingredients, and degradability of natural grass and dried cassava peelings.*
- Feed samples were analyzed crude protein (CP), ether extract (EE), crude fiber (CF) and total ash to estimate ME and CP in take. The CP, EE, CF and ash were determined by AOAC method (1990). *In Sacco* degradation of natural grass and DCP was conducted during 72 hrs of each period to determine degradable dry matter (DDM) and degradable organic matter (DOM). The bags were 60x120mm and made from nylon filter cloth with a pore size of 28 microns, according to the procedure described by Orskov and Hovell, 1980. The bags were attached to plastic tubes and incubated in the rumen for 6, 12, 24, 48 and 72 hours. After incubation, the bags were washed by hand under running tap water until the water until the water ran clear, and then dried in a microwave oven to a constant weight.
- *Protozoa population in the rumen*

- At day 28 and 29 of each period, ruminal fluid samples were collected before feeding in the morning and then at an interval of 2 hours over an 8-hour period through a probe placed in a caudal position in the ventral part of the rumen. Protozoa population in the rumen fluid was estimated by diluting at a ratio of ¼ with Blue Methylen and counting protozoa under light-microscopy (10 x magnification) using a 0.2 mm deep dollfus counting Mallaze chamber. All fields in the counting chamber were filled for protozoa counting by Dehority method (1984).
- *Bacterial population in the rumen*
- Rumen fluid was diluted at the ratio of ¼ with 0.05% formol to make solution A. The solution a then was diluted at the ratio of 1/7 with distilled water and centrifuged at 1,500 rounds/minute in 10 minutes to make solution B. Diluting 1 ml B solution with 1 ml glugol solution and counting Neubauer chamber. Five fields in the counting chamber were filled for counting bacteria by Warner method (1962).
- *pH and concentration of ammonia nitrogen in the rumen fluid.*
- The rumen fluid pH was determined immediately after collection by pH metter. The concentration of ammonia nitrogen in the rumen fluid (NH_3-N) was determined by absorbing boric acid and standard with H_2SO_4 0.1N (Preston, 1995).

Data were analyzed by ANOVA using General Liner Model and Pairwise comparison in Minitab Statistical Software version 12.21.



3. RESULTS AND DISCUSSION

3.1. Feed intake.

Average daily feed intake was presented in Table 1. The natural grass dry matter intake showed a continuous decrease with increasing level of DCP supplementation. There are significant difference between T4 (highest level DCP) and T1 (non DCP). The lowest natural grass intake of 1.71 kg DM/100 kg LWt/day was found in the diet of highest DCP level (T4) followed by T3, T2 and T1 with 1.91, 2.04 and 2.12 kg DM/100 kg LWt/day, respectively. Meanwhile, total dry matter intake has no difference between the treatments.

Table 1. Daily intakes of dietary ingredient by Lai Sind bull

Item	*Diet*			
	T1	*T2*	*T3*	*T4*
Total DMI (kg/100 kg LWt)	2.44±0.16	2.56±0.22	2.64±0.04	2.65±0.19
DMI of NG* (kg/100kg LWt)	2.12±0.13^{a}	2.04±0.20^{ab}	1.91±0.04^{ab}	1.71±0.17^{b}
HCN intake (mg/kg LWt)	0	0.7	1.4	2.1
Contrate/roughage (%)	12,8	20,1	26,8	34,8
ME (kcal/kg DM)	*2,073*	*2,123*	*2,170*	*2,227*
CP (% /DM)	*10.9*	*10.7*	*10.5*	*10.1*
CF (%/DM)	*32.6*	*30.6*	*28.9*	*26.7*

** Natural grass;*

Different superscripts in the same row are significantly different at P<0.05

3.2. Effect of dried cassava peeling levels on rumen pH and ruminal NH_3-N

The ruminal pH fluctuated in the range 6.27-6.70 of the ration with and without DCP, with average value of 6.42 at 0h. The ruminal pH in all treatments. When cattle fed increasing amounts of DCP, the average ruminal pH value has trend of augment from 6.29 (T1) to 6.52 (T4), but there was no significant difference between treatments (Table 2). It has long been recognized that animals fed concentrate diets generally have a lower ruminal pH than those fed forages (Kaufmann *et al*, 1980; Lana *et al*, 1998). Coop and Blakley (1949); Meyreles *et al* (1977); Majak and Cheng (1984) reported that when the cattle were fed increasing amount of cyanogenic glucoside to the LSD on the ruminal pH >6.0, it was an advantageous environment for glucogenic hydrolysis to make free HCN.

The hydrolysis happened very fast, 75% free HCN absorbed pass the rumen wall in 15'; the remain was eliminated on saliva in the thiocyante form. Oke (1978) recorded that, some bacteria in the rumen synthesize cobalt, adding CN- to make cyanocobalamin in liver. So, the ruminal pH will increase when the cattle were fed big amount of DCP.

The average ruminal NH_3-N of treatments were not exceeded beyond normal physiology (Preston and Leng, 1991), ranging within 160.75, 159.30, 151.25 and 135.96 mg/liter of T1, T2, T3 and T4 respectively. The ruminal NH_3-N concentrations were been varying . The ruminal NH_3-N concentrations were decreased DCP(Table 2).

The results presented in the Table 2 show that protozoal and bacterial populations in the rumen were influenced by the DCP levels. The highest protozoa population was found in the diet of 0.5 kg DM of DCP/100 kg LWt. The lowest bacterial population was found in the diet of 0.75 kg DM of DCP/100 LWt. Majak and Cheng (1984); Majak *et al* (1990) reported that, the high free HCN level in the rumen inhibits the amount of rumen bacteria. Kanjanapruthipong and Leng (1998) recorded that at the concentration of ruminal fluid ammonia of 60 to 180 mg/l, the protozoal population increased. At a concentration of about 200 mg/l of ruminal fluid ammonia, the protozoal growth decreased, while the bacterial growth increased. This is requirement for ammonia for optimum bacterial growth on a roughage based diets.

Table 2. Levels of ruminal pH and NH_3-N, number of protozoa and bacterial populations in rumen fluid of Lai Sind evirated bull after feeding

Criteria	*Time after feeding (h)*	*Diet*				*Mean*	*P*
		T1	*T2*	*T3*	*T4*		
Ph	0	6.39	6.34	6.27	6.70	*6.42±0.07*	0.122
	2	6.36	6.30	6.33	6.69	*6.41±0.08*	0.274
	4	6.32	6.29	6.32	6.55	*6.37±0.08*	0.760
	6	6.23	6.19	6.26	6.38	*6.27±0.08*	0.926
	8	6.15	6.15	6.22	6.30	*6.20±0.07*	0.907
	Mean	*6.29*	*6.25*	*6.28*	*6.52*		
NH_3-N	0	148.75	159.38	159.38	127.50	*148.75±5.49*	0.117

(mg/l)	2	189.69	177.97	177.23	167.13	*178.00±5.95*	0.228
	4	172.09	163.10	143.23	133.88	*153.07±6.61*	0.250
	6	149.53	151.20	133.73	113.69	*137.04±6.55*	0.292
	8	143.69	145.32	142.70	137.60	*142.30±10.40*	0.997
	Mean	*160.75*	*159.39*	*151.25*	*135.96*		
Bacteria	0	1.986	1.805	1.572	1.578	*1.735±0.099*	0.480
($x10^8$/ml)	2	1.970	1.780	1.695	1.552	*1.749±0.076*	0.483
	4	1.872	1.728	1.675	1.443	*1.679±0.070*	0.432
	6	1.813	1.490	1.430	1.397	*1.533±0.062*	0.171
	8	1.585	1.447	1.383	1.242	*1.414±0.054*	0.162
	Mean	*1.865*	*1.650*	*1.551*	*1.443*		
Protozoa	0	1.588	3.083	3.560	3.285	*2.879±0.281*	0.060
($x10^5$/ml)	2	1.378	2.523	3.095	3.098	*2.523±0.247*	0.069
	4	1.690	2.648	3.700	2.720	*2.689±0.297*	0.280
	6	1.053	2.125	2.520	2.160	*1.964±0.253*	0.122
	8	1.000	1.700	2.490	2.098	*1.839±0.314*	0.144
	Mean	*1.342*	*2.429*	*3.073*	*2.672*		

3.3. Effects of cassava peeling dried meal levels on *insacco* degradability of feeds in the rumen.

The degradable dry mater (DDM) of natural grass and DCP were rather low about 50-60% after 72hrs of incubation. Increasing levels of DCP also affected the degradability of natural grass and DCP after 6, 12, 24, 48 and 72 hrs of incubation. Table 3 showed that, increasing the level of DCP decreased degradability of natural grass and DCP, but there were no significant difference between treatments. This demonstrated that DCP level has no affect to DDM of feed.

Table 3. Degradable dry matter (DDM) of feed samples after incubation

Time after feeding (h)	*Diet*				*Mean*	*P*
	T1	*T2*	*T3*	*T4*		
Natural grass						
6	18.92	19.76	18.87	17.55	*18.78±0.91*	0.120
12	23.85	25.11	23.31	21.89	*23.54±1.33*	0.271
24	28.83	32.22	29.82	29.62	*30.12±1.46*	0.587
48	53.30	51.55	49.18	48.34	*50.59±2.26*	0.506
72	59.63	57.25	56.10	53.99	*56.74±2.35*	0.230
Dried cassava peelings						
6	15.11	17.10	20.41	17.45	*17.52±2.19*	0.067
12	23.16	22.08	21.61	19.51	*21.59±1.53*	0.293
24	26.90	28.96	28.50	25.74	*27.53±1.48*	0.711
48	36.31	35.46	39.73	36.49	*37.00±1.88*	0.498
72	47.49	46.49	44.70	42.96	*45.41±2.00*	0.719

The degradable organic matter (DOM) of natural grass was decreased from 53.75% in T1 to 49.17% in T4 after 48 hrs of incubation. DOM of natural grass was 54.83% in T4 lower than 63.22% in T1 after 72 hrs of incubation, there was significant difference between that treatments (P=0.02). Meanwhile, DOM of DCP was 18.88% in T4 higher than 16.13% in T1 (P=0.048) after 6 hrs of incubation.

Just after putting samples into the rumen, the ruminal bactria in T1 was not adapted to free HCN yet, the DOM of DCP therefore was lower than other treatments. After 12, 24, 48 and 72 hrs of incubation, DOM of DCP were decreased with increasing level of DCP supplemented, but there are no significant difference between treatments (Table 4). This proves that HCN of DCP affected to DOM of roughage (natural grass) but no affected to DOM of concentrate (DCP).

According to Doan Duc Vu et al, 2000; the DDM, DOM of natural grass were 52.1% and 45.6%. Đinh Van Cai *et al* (2002) reported that, DDM and DOM of natural grass were 59.06 and 59.32%, respectively after 72 hrs of incubation. The data in Table 4 showed that, DDM and DDM of natural grass were equivalent with Cai's results but higher than Vu report. This proves that, DCP decreased DOM of natural grass but there was no significant difference between treatments.

Table 4. Degradable organic matter (DOM) of feed samples after incubation

Time after feeding (h)	*Diet*				*Mean*	*P*
	T1	*T2*	*T3*	*T4*		
			Natural grass			
6	18.22	18.30	19.71	18.32	*18.64±0.72*	0.241
12	23.93	26.69	24.68	22.75	*24.51±1.65*	0.244
24	29.20	33.61	30.96	30.92	*31.17±1.82*	0.345
48	53.75	52.19	50.53	49.17	*51.41±1.99*	0.632
72	63.22^{a}	60.83^{ab}	57.15^{ab}	54.83^{b}	*59.01±3.74*	0.020
			Dried cassava peeling			
6	16.13^{a}	18.23^{ab}	22.00^{b}	18.88^{ab}	*18.81±2.43*	0.048
12	24.72	23.39	23.13	20.82	*23.02±1.62*	0.389
24	28.02	30.09	29.95	26.69	*28.69±1.63*	0.630
48	37.02	36.58	40.60	35.67	*37.47±2.16*	0.637
72	48.59	47.68	46.09	43.55	*46.48±2.21*	0.551

Different superscripts in the same row are significantly different at P<0.05

4. CONCLUSIONS

- Adding 0.75 kg DM of DCP/LWt to the diet had not caused change of the pH; NH_3-N ruminal fluid.
- Using DCP at 0.50 and 0.75 kg DM/100 kg LWt in the beef rations decreased bacterial population from 1.865 x 10^8/ml to 1.443x10^8/ml in ruminal fluid but increased protozoa population from 1.342x10^5/ml to 2.672x10^5/ml, on average. The amounts of bacterial and protozoa were not exceeded beyond normal physiology.
- The DOM of natural grass in the ration with 0.75 kg DM of DCP/kg LWt was lower than ration without DCP after 72 hrs of incubation. There was no significant difference of DDM of natural grass and DCP after 48, 72 hrs of incubation between treatments.

REFERENCES