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Rumen Metabolities of Bovine Fed Cassava Peels in a Humid Tropical Environment

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Abstract: Twelve young white Fulani bulls with average live weight of 97kg and age 40 weeks were used to determine rumen metabolites of bovine feed cassava peel in a 3 x 4 factional treatment for a complete randomized design experiment. Three diets containing increasing percentage of cassava peels (0, 20 and 40 percent) in sun-dried form were offered *ad-libitum* to the experimental animals. Feed intake and body weight changes were measured. Samples of rumen liquor was taken through a rumen tube using a vacuum pump at 0, 0.5, 1.5 and 2.5h after feeding. The pH, total volatile fatty acid, rumen ammonia-nitrogen and osmolality were determined. The average daily intake of total dry matter was highest in diet T_2 (20%) on the 10 day of feeding. However treatment had no significant effect ($p > 0.05$) on mean average daily intake level. When their average daily intake was adjusted to their respective metabolic body weights (Kg $BW^{0.075}$) those on diet T_1 (control) had almost the same value with T_2 and T_3, respectively. Inclusion level had no significant effect ($p > 0.05$) on rumen pH, and osmolality. Mean NH_3-N was statistically the same ($p > 0.05$). However correlation coefficient between time and NH_3-N was positive in diet T_2. ($p < 0.05$)Concentration of total VFA in rumen fluid increased for all level of cassava peel inclusion and was affected by time after feeding ($p < 0.05$) with highest value occurring at 1.5h inclusion level of cassava peel. At 40% level of inclusion caused a decrease in rumen NH_3-N concentration when sampled at 1.5h. Knowledge of pH and osmolality may benefit the animal through improvement of acid base status. Inclusion of cassava peels in the diet of cattle up to 20% or slightly above 30% is recommended since it gave better NH_3-N accumulation in the rumen after ingestion.

Key words: Rumen metabolites, bovine and cassava peels, fulani bulls

Introduction

In most tropical areas the seasonality of grass growth is such that some degree of supplementary feeding is required. This need for extra feeding becomes more necessary as large population of cattle in this area depends on natural grassland for their nutritional needs and are therefore faced with seasonal fluctuation. Oyenuga (1962), stated that the haggard conformation of the animals, their leggedness and the low qualities and toughness of their meat show that these animals are badly and poorly fed.

To increase the productivity as well as exploit fully their genetic potentials, efforts should be directed towards feeding alternative and ready available source of energy and protein.

The accurate assessment of the energy content of feeds and thorough knowledge of the factors influencing their yield are essential to ensure efficient utilization. Cassava peels have little human competition in their use as livestock feed. This therefore means an adequate and readily abundant supply of the peels on bovine, it rest on its anatomical endowment and the advantage of utilizing roughages more efficiently than other domestic animals which are generally grouped together as non ruminants. The limitation revolves round high hydrogen cyanide content which could be reduced by proper processing. According to Obioha and Anikwe (1982), chemical composition could be an important factor in recommending cassava peels for livestock feed. Chalmer and Synge (1954), suggested using nitrogen balance experiment to estimate nutrient value of the protein in the food consumed by ruminants. As this technique is costly tedious and time consuming. Abou Akkada and El-Shazly (1963) suggested the use of rapid method of assessing the nutritive value of protein feeds. These are based on the determination of changes in the urea concentration of the blood or in ruminal ammonia nitrogen and other product of protein break down in the rumen.

The rumen fluid according to its freezing point is usually slightly hypotonic with respect with plasma, but period of slight hyper tonicity occur after an easily fermentable diet is given. The osmolality of the medium is properly of considerably importance to the growth of the microbes, particularly the protozoa. Ammonia is the chief end product of protein hydrolyses in the rumen (Abou Akkada and El-Shazly, 1963), part of which is absorbed via portal system.

The manner in which it is absorbed has not been investigated in details, but Blackburn and Hobson

(1960) presented evidence that ammonia is absorbed more readily than ammonia ion. He found that the extent of absorption was related not only to the concentration present in the rumen but also to the acidity of the solution within the rumen. The pH of the rumen dose not deviate from neutrality and is usually within the range of 5.0-7.0. After feeding, the pH decrease and the speed and extent of the decrease are related to the composition of the diet. The decrease in pH is especially marked when diet contain appreciable quantity of rapidly fermentable sugar. The lower the pH, the more the absorption.

Numerous experiment have since shown that major VFA's produced in the rumen are acetic, propionic and butyric acid and all play important role in the energy metabolism of ruminants. Recently, the amount of the relative proportion of the individual acids absorbed have been demonstrated to influence the value of diet for fattening and for milk production A knowledge of the factor that control the production of VFA'S in the rumen is thus necessary in the assessment of the nutritive value of feeding stuff. At present time, however, no satisfactory routine method for assessment of the relative proportion of VFA's produced is available and so food in this project can be assessed solely in terms of their effects on total concentration in its rumen digesta. While there is paucity of information on the utilization of cassava peels as part of cattle rations, review by Seerely (1972), Devendra (1977), and Obioha (1977), contain account in this area. This experiment was therefore designed to investigate the potential for including cassava peels in the diet of growing bulls and to serve as a cheep substitute for concentrates and thus reduce high cost of livestock feeds.

Materials and Methods

Location: The experiment was conducted at the metabolism unit university, of Nigeria Teaching and Research Farm. The cassava peels were collected from Garri mills at Orie Oba market near Nsukka, Enugu State Nigeria.

Diets and feeding: The cassava peels for the diet were sorted to remove extraneous matter, mixed thoroughly and spread out on a clean concrete slab and sun-dried with periodic turning for 9 days. There was adequate protection against rain or other contaminants. As the end of the drying period, the peel was begged and properly stored pending in corporation into the diets. Maize silage was obtained from the silage pit of the department of Animal Science of the University, the distillers grain in sun-dried form was obtained from the feed mill unit of the University Teaching and Research Farm.

Three diets containing increasing percentage of cassava peels (0, 20 and 40%) in sun-dried form were offered *ad-lib* to the experimental animals and water continuously made available. Before feeding the cassava peels, distillers grain and silage were floor mixed thoroughly to preclude selection of the more palatable components (Table 1).

Table 1: Composition of the Experimental diets of graded levels of Cassava peels fed to Bovine

Ingredients	T_1	Levels	$\%T_3$
Cassava peels	0	26	40
Maize silage	89	69	49
Distillers grain	10	10	10
Minerals	1	1	1
Total %	100	100	100
Analyzed composition			
DM%	89.33	89.03	89.35
CP	9.18	7.00	6.56
CF	33.10	22.30	18.90
EE	2.80	2.70	2.60
NFE	44.24	57.03	61.29
ASH	7.80	5.00	4.60
HCN (mg/kg)	10.8	64.8	81
G.E. (mj/kg)	6.5	20.0	19.54

Experimental animal and management: Twelve young bulls of about 10 months old and similar body weight averaging 97kg were used for the study. Four of the experimental animals were allocated at random to each of the three diets. The trial ran for 18 days. Each experimental period lasted for 14 days during which no collection was made to ensure the adoption of the ruminal micro-organism to the feed being consumed by the animal and 2 days of restricted feeding for measurement of rumen fermentation

Data collection and statistical analysis: Individual intake of diets and orts were calculated. Initial body weight and the final weight was measured at the end of the experiment. Feed to gain ratio was calculated for the entire period. Sample of rumen liquor was taken via a rumen tube using a vacuum pump at 0, 0.5, 1.5 and 2.5hr after feeding. pH was determined immediately on a pH research meter, electronic instrument-Fisher Accumet model 320 expanded scale and sample of rumen fluid then was centrifuged to separate feed residues and stored in a deep freezer, for total volatile fatty acid. Osmolality and rumen ammonia nitrogen. The method of Berthelot colour reaction was used in rumen ammonia nitrogen determination (Novozanksky *et al.*, 1974). Rumen Osmolality was determined using Osmometer model, Osmette A, automatic osmometer precision system incorporated. Total VFA were determined by stem distillation as described by Kromann (1976).

The data collected were subjected to analysis of variance (Steel and Torrie, 1960) appropriate for a complete randomized design in a 3 x 4 factorial treatment and F.L.S. D. test use to detect the difference between treatment means.

Table 2: Performance of cattle given different levels of cassava peels

Item	T_1	T_2	T_3
Number of Animals	4	4	4
Feed efficiency	80 ± 14	76 ± 17	74 ± 6
Intake as percent of Body wt(kg)	1.23±02	1.31±0.08	1.4±0.3
pH	6.3±0.18	6.5±0.07	6±0.4
Osmolality	362.7±16[a]	344.2±16.1[b]	359±26.4[c]
VFA	2.5±0.3	2.5±0.3	2.95±0.4
NH_3-N	19.73±3.9	19.6±6	18.3±3.7
Correlation coefficient			
Between time and NH_3-N	-0.167[a]	0.330[b]	-0.270[c]
Average initial weight	92.5	98.5	100
Average final weight	91	93.3	98.5

Value are means ± S.D. of 4 cattle, NH_3N, VFA pH and Osmolailty concentration. S.D. = standard deviation.
Means within rows with difference superscripts a,b,c, are significantly different at ($p < 0.05$).

Results and Discussion

The performance of cattle given different levels of cassava peels is shown in Table 2. The average daily intake was low the first four days and then increased with time and drops within the tow days of sample collection probably due to stress and disturbances as a result of sample collection. The average daily intake of total dry matter was highest in diet T_2 (20%) on the 10 day of feeding. However, treatment had no significant effect ($P > 0.05$) on the mean average daily intake level. When their average daily intake was adjusted to their respective metabolic body weights (kg $BW^{0.075}$), those on diet T_1 (control) had almost the same value with T_2 and T_3, respectively. There was no significant difference ($P > 0.05$) between the treatment means and the feed efficiency. Rumen pH was maintained at a high level perhaps due to high salivation as a result of rumen tubing, however, there were no treatment effect ($P > 0.05$). Inclusion level had significant effect ($P < 0.05$) on rumen osmolality. Mean ammonia nitrogen was statistically the same ($P > 0.05$). However, correlation coefficient between time and rumen ammonia-nitrogen was positive ($p < 0.05$) in diet T_2 (20%).

The effect of feeding different levels of cassava peels on rumen metabolites on bovine is shown in Table 3. Concentration of total VFA in rumen fluid increased for all level of cassava peel inclusion and was affected by time after feeding ($P < 0.05$) with highest value occurring at 1.5hr after feeding. The lowest value occurred in treatment T_1 (0%). The present observation indicates that the concentration of VFA determined in the rumen liquor just before 1.5hr after feeding were much higher with diet T_3 (40%) than with treatment T_1 (0%). This demonstrates clearly that the activity in the rumen when the cattle was fed on diet T_2 and T_3 was higher than when it was fed T_1 with zero level of cassava peel inclusion. Variation in the major proportion of the individual acids through a feeding cycle are in general small and thus a single sample drawn at any time through a feeding cycle is usually adequate to characterize a diet.

To test the effect of the diet on ruminal ammonia nitrogen, it is more realistic to compare the increase in ammonia nitrogen above the initial values at feeding time rather than their absolute value. The comparison of such difference is justified since only these differences can be ascribed to the action of the food. In this present study, although the average dry matter intake was approximately the same, the inclusion level of cassava peels, particularly at 40% level, caused a decrease in rumen ammonia concentration when sampled at 2.5h after feeding but the concentration was highest in T_2 (20%). When sampled at 1.5h. It appears that the diet with 20% cassava peel meal produced better result than those on zero and 40 percent inclusion level, since the efficiency of utilization of nitrogen of non protein nitrogen (NPN) supplement is related to the rate of the ammonia accumulation in the rumen after ingestion. A pH greater than pH 6 has been determined to be optimal for rumen proteolysis and deamnation of amino acid. (Blackburn and Hobson, 1960). The increase at 2.5h after feeding may have occurred as a result of neutralization of sodium hydrogen carbonate of saliva with liberation of carbon dioxide.

In this trial after feeding osmolality rises and steady declines. There were significant difference ($P < 0.05$) between mean osmolality level and their interaction with time after feeding. The rise in osmolality value may be due to the solutes of the diets consumed. Hypotonicity of rumen fluid may limit intake of silage diets. However, rumen, osmolality (316.5-3825 mosm/kg) did not appear to be a factor affecting daily consumption of diets in this present study as osmolality never reached the critical limit of 400 mosmol/kg suggested by Bargen (1972).

With a feeding regime in which a restricted amount of feed was offered at fixed intervals throughout a day, the rate of fermentation in the rumen as assessed by the VFA, NH_3-N concentration, pH and osmolality levels were not constant but minimal immediately before feeding and reached a peak shortly after feeding. Knowledge of pH and osmolality may benefit the animal through improvement in acid base status. On processing method, from the trial it can be suggested that drying process considerably reduced the cyanide content of the

Table 3: Effect of feeding different amounts of cassava peel on rumen VFA, NH_3-N, pH and Osmolality on bovine

%Cassava peel inclusion	Time after feeding (hr)	VFA mg/ 100 ml	NH_3-N mg /100 ml	PH	Osmolality mosm/kg
	0	1.9±0.2[a]	18.2±0.3[a]	6.6±.5	354±1 [a]
D_1 (0)	0.5	2.5±0.3[b]	20.1±0.6[b]	6.8±.2	374.8±20[b]
	1.5	2.9±0.4[c]	25.8±1.4[c]	5.6±.6	382.5±11[c]
	2.5	2.3±0.4[d]	14.8±0.6[d]	6.1±.3	33[t8]±.14[d]
	0	2.3±0.3[a]	10.9±0.2[a]	6.6±.5	323±8[a]
D_2 (20)	0.5	2.5±0.3[b]	23.0±1.7[b]	6.7±5	336.8±20[b]
	1.5	2.9±0.3[c]	26.9±1.9[c]	5.7±4	369.5±23[c]
	2.5	2.3±0.3[d]	17.6±1.6[d]	6.8±.4	348.3±35[d]
	0	2.2±0.1[a]	17.5±0.9[a]	6.6±3	316.5±10[a]
D_3 (40)	0.5	3.1±0.4[b]	18.6±1.3[b]	6.8±4	373±18[b]
	1.5	3.4±0.4[c]	23.9±1.3[c]	6.5±.4	386.5±9[c]
	2.5	2.8±0.5[d]	13.3±1.6[d]	6.4±.3	359.3±34[d]

Within column mean±sd with different superscripts are significantly different at ($P < 0.05$)

cassava peel meal which is apparently not toxic when incorporated into the diets of growing cattle.

Given the above therefore, the result indicates that total replacement of concentrate diet with sun-dried cassava peels for growing cattle appears exceptionally attractive given continuing technical advances in cultural and processing sector. Although the bovine can tolerate up to 40 percent level of inclusion of cassava peels in their diet, 20 percent or slightly above 30 percent is recommended since it gave better ammonia nitrogen accumulation in the rumen after ingestion.

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