NUTRIENT INTAKE, DIGESTIBILITY AND RUMEN STUDIES IN GOATS FED VARYING LEVELS OF CASSAVA PEELS AND BREWER'S DRIED GRAIN

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ABSTRACT

Dry matter intake, nutrient digestibility and some rumen and blood metabolites were investigated in goats fed five diets composed of cassava peel and brewer's dried grains (BDG) in the ratios of approximately 82:8, 69:20, 57:33, 44:45 and 32:58. Urea and molasses were included in each diet at 2% and 7.5% respectively and the crude protein levels of the diets were approximately 8%, 11%, 14%, 17% and 20%.

There were no significant ($P > 0.05$) differences in Dry matter and Organic matter intake but N intake increased up to Diet 4. There were dietary effects on the digestibility of DM, N, crude fibre, acid detergent fibre, either extract, nitrogen free extract and energy but not OM. The highest digestibility values were obtained on diet 4 for most of the nutrients.

The concentrations of rumen ammonia and blood plasma urea increased from Diet 1 to Diet 5. There were significant ($P < 0.05$) dietary effect on rumen fluid pH. Rumen protozoal count increased from Diet 1 to Diet 5.

The depression in digestibility of Diet 5 would indicate that BDG should not be included at up to 58% in the diet of goats.

Key Words: Digestibility, rumen studies, cassava peels, brewers' grains, goats.

INTRODUCTION

The most difficult problem in ruminant production in the tropics is the scarcity of energy and protein feedstuffs during the dry season. The available forages are dry, the protein content is very low, there is marked decrease in voluntary intake and digestibility (Oyenuga, 1957) and the animals lose substantial weight. This has led to the search for cheap sources of energy and protein to supplement the low quality forages of the dry season.

The processing of cassava into the fer-

mented form "gari" generates 10 to 15% by weight of all cassava tuber processed, as cassava peels. However, the low crude protein content of cassava peel (53.3%) according to Oyenuga (1968) requires that it be supplemented with protein to produce a complete feed suitable for livestock. Agro-industrial by-products such as brewer's dried grains (BDG) are inexpensive and are available. The protein of BDG is highly insoluble and resistant to ruminal degradation. A combination of cassava peel, BDG and urea supplying rumen degradable N (RDN) would make a cheap feed supplying energy and

protein for ruminants.

The present experiment was therefore set up to examine nutrient intake, digestibility and certain rumen characteristics in goats fed diets composed mainly of cassava peel and BDG at varying protein levels.

MATERIALS AND METHODS

Five diets (Table 1) based on sun-dried cassava peel and brewer's dried grains were formulated with estimated crude protein levels of 8, 11, 14, 17 and 20% molasses was added to reduce dustiness.

West African dwarf male goats with an average weight of 14 kg consisting of one rumen-fistulated and two non-fistulated, were placed on each diet in turn, each round lasting for three weeks. Each animal

was kept in a metabolism cage. Feed and water were provided *ad libitum*.

During the collection period, faeces was collected once daily before the morning feeding and oven-dried at 105°C for 24 hours. The dried faeces for each animal was bulked and stored in sample bottles. Urine was also collected once daily and 10% of urine so collected was preserved with toluene and stored at -10°C.

Rumen fluid was obtained one hour before and two hours after feeding by suction through a plastic tube, strained through two layers of cotton cloth and stored at -10°C. Blood samples were collected into a centrifuge tube containing heparin and centrifuged at 2000 r.p.m. for 20 min. to separate the plasma which was also stored at -10°C.

Table 1
Composition of Experimental Diets fed to West African Dwarf goats

Ingredients (%)	Diets				
	1	2	3	4	5
Cassava peel	81.7	69.2	56.7	44.2	31.7
Brewer's dried grains	7.5	20.0	32.5	45.0	57.5
Urea	0.6	0.6	0.6	0.6	0.6
Bone meal	2.0	2.0	2.0	2.0	2.0
Mineral/Vitamin premix	0.2	0.2	0.2	0.2	0.2
Common salt	0.5	0.5	0.5	0.5	0.5
Molasses	7.5	7.5	7.5	7.5	7.5
Total	100.0	100.0	100.0	100.0	100.0
Chemical composition (%)					
Crude protein	7.80	10.86	13.90	17.07	20.30
Crude fibre	11.77	12.00	11.00	11.20	11.10
Ether extract	6.60	6.30	6.14	6.17	6.20
Ash	11.50	11.20	11.40	11.20	11.50
Nitrogen free extract	50.73	50.14	49.16	45.96	40.90
Acid detergent fibre	31.60	29.00	28.60	28.80	28.00
Gross energy (MJ/kg)	17.95	17.95	18.45	19.20	20.04
Digestible energy (MJ/kg)	12.25	12.88	13.80	14.35	13.39

The proximate components of the feeds and the N content of the faeces and urine were analyzed according to the A.O.A.C. (1970) methods. Acid detergent fibre (ADF) was determined by the method of Van Soest (1973). Gross energy of the feeds and faeces was determined using Parr adiabatic bomb calorimeter. Rumen ammonia and blood plasma urea concentrations were determined by the method of Fawcett and Scott (1960) as modified by Chaney and Marbach (1962). The pH of the rumen fluid was measured using a Crison pH/MV meter and protozoa were counted using a Nikon light microscope.

RESULTS

Table 2 shows no differences in DM and OM intakes. The digestibility coefficients of DM, OM, nitrogen free extract (NFE) and energy were high but digestibility coefficients of crude fibre (CF) were generally low for all the diets. The crude protein of Diet 1 was poorly digested but that of Diets 3 to 5 was well digested. The correlation coefficient between crude protein digestibility and protein level was significant ($r = 0.87$ $P < 0.05$). The general trend was an increase in digestibility from Diet 1 to Diet 4 and a decline in digestibility on Diet 5 for DM, CF, ADF, NFE and energy. Digestibility of either extract (EE) did not increase beyond Diet 3 and that of crude protein (CP) increased up to Diet 5. The highest values for digestibility were obtained on Diet 4 for most of the nutrients.

The rumen ammonia N (RAN) concentrations (Table 3) increased with dietary N levels from Diet 1 to Diet 5 both before and after feeding. Rumen ammonia values before feeding were not significantly different from those after feeding. The blood plasma urea N (PUN) also increased with dietary N and values after feeding were higher ($P < 0.05$) than before feeding. The rumen fluid pH

before feeding varied from 5.70 on diet 1 to 6.25 on diet 3 and that after feeding varied from 5.27 on Diet 1 to 6.00 on Diet 5. The trend was that of increasing pH from Diet 1 to Diet 5. There was a depression ($P < 0.05$) in pH after feeding. The rumen protozoa count both before and after feeding increased progressively from Diet 1 to Diet 5 with a marked increase from Diet 1 to Diet 2. There were no significant increases ($P < 0.05$) in protozoal count after feeding. There were high correlations between RAN and (a) PUN ($r = 0.63$) and (b) protozoal count ($r = 0.73$).

The mean DM intake of 2.78% of live-weight obtained for goats on Diets 1 to 5 compared favourably with 3% recommended by Devendra and McLeroy (1982).

The increase in nutrient digestibility from Diets 1 to 4 indicated that BDG is more digestible than cassava peel on those diets. The increase in DM digestibility of the diets with increase in protein levels up to Diet 4 is in agreement with the reports of Robinson and Forbes (1970). Adegbola *et al* (1977a) found that level of dietary protein did not affect DM digestibility. The increase in the digestibility of protein with higher dietary protein levels has been reported (Stobo and Roy, 1973). The decrease in DM, OM, CF, ADF, NFE and energy digestibility on Diet 5 could be due to the bulkiness of this diet as a result of high level of BDG inclusion. Bulky diets tend to move more rapidly out of the rumen, resulting in lower nutrient digestibility. The generally high NFE digestibility is expected since the sugar and starch components are highly digestible.

The increased in the concentrations of RAN with higher levels of dietary protein is consistent with other reports (Elliott and Topps, 1964; Hume, 1970; Adegbola *et al* 1977b). There were no differences in pH values which are generally low on account of the cassava peel especially after feeding (Mba and Olatunji, 1972). The increases in blood urea-N concentrations with higher

Table 2
Dry matter intake and Nutrient Digestibility in Goats

	Diets					Mean	SEm
	1	2	3	4	5		
Dry matter intake, g/d	367.2	428.4	395.7	453.4	304.0	389.74	25.92
g/kg live-weight	2.62	3.06	2.83	3.24	2.17	2.78	0.19
Organic matter intake, g/d	314.2	380.4	350.6	402.6	268.8	343.32	23.81
g/kg liveweight	2.24	2.72	2.50	2.88	1.92	2.45	0.17
Nutrient digestibility (%)							
Dry matter	63.30 ^a	71.12 ^{bc}	76.24 ^c	77.45 ^c	68.11 ^{ab}	71.24	2.61
Organic matter	70.42	74.33	75.92	79.37	70.63	74.13	1.68
Crude Protein	27.63 ^a	60.46 ^b	72.89 ^c	75.56 ^c	77.08 ^c	62.72	9.24
Crude fibre	29.97 ^a	35.08 ^a	42.88 ^{ab}	46.04 ^b	31.98 ^a	37.19	3.12
Acid detergent fibre	34.15 ^a	43.27 ^a	57.44 ^b	70.03 ^c	48.22 ^{ab}	50.62	6.14
Ether extract	57.92 ^a	66.44 ^{ab}	70.98 ^b	68.99 ^b	49.65 ^c	62.80	3.97
Nitrogen free extract	83.29	83.07	80.67	85.00	79.61	82.33	0.97
Energy	61.96 ^a	71.80 ^b	74.89 ^b	78.20 ^b	65.21 ^a	70.41	3.01

⁺ Means with similar or no superscript are not significantly different from one another ($P > 0.05$).
SEM = Standard error of the mean.

Table 3
The pH, Ammonia-N, Protozoa count of rumen fluid and the Blood plasma Urea-N of Goats

	Periods ⁺	1	2	3	4	5	Mean	SEM	
pH	BF	5.70	6.23	6.25	6.16	6.00	6.07	0.10	BF > AF
	AF	5.27 ^b	5.50 ^{ab}	5.70 ^a	5.90 ^a	6.00 ^a	5.67	0.13	
Ammonia-N (mg/100 ml)	BF	9.40 ^c	10.05 ^{bc}	11.10 ^b	12.00 ^b	14.75 ^a	11.46	0.93	
	AF	8.60 ^c	9.40 ^c	11.80 ^b	12.01 ^b	15.60 ^a	11.48	1.22	
Protozoa count (x 10 ⁵ /ml)	BF	3.33 ^d	6.90 ^c	7.83 ^b	9.70 ^a	9.93 ^a	7.54	1.20	
	AF	3.03 ^e	6.33 ^d	7.78 ^c	9.50 ^b	10.60 ^a	7.45	1.32	
Blood plasma Urea-N	BF	8.80 ^b	8.90 ^b	13.01 ^{ab}	14.01 ^a	14.83 ^a	11.91	1.28	AF > BF
	AF	9.67 ^c	9.83 ^d	13.00 ^c	14.33 ^b	15.25 ^a	12.42	1.15	

⁺ Means with similar or no superscript are not significantly different from one another ($P > 0.05$).

Crude fibre
Ether extract
Ash
Nitrogen
Acid detergent
Gross energy
Digestible energy

is significantly different from one another ($P > 0.05$).
increases in
with higher

dietary protein levels and the significantly high correlation between rumen ammonia-N and blood urea-N are consistent with other reports (Lewis, 1957; Adegbola *et al.*, 1977b). The concentrations of ruminal ammonia N of the diets would appear to be sufficient for efficient microbial synthesis (Satter and Slyter, 1974; Leng *et al.*, 1977).

Rumen protozoa increased with higher levels of dietary protein, the increase was more pronounced from Diet 1 to Diet 2. Protozoal number is dependent on rumen ammonia concentration and pH of rumen fluid and both factors are also dependent on type of diet (Kane and Lawlor, 1969). Grinding of forages (Thorley *et al.*, 1968) and concentrate feeding (Christiansen *et al.*, 1965) lowered protozoal count. Protozoal count is also reduced at pH below 5.5 (Slyter, 1976) usually encountered with concentrate feeding. The diets used in present work would appear to support a sufficiently high number of protozoa (Hungate, 1966). The cassava peel-BDG-urea diets were well accepted by the goats. The rumen ammonia, blood urea and protozoal count were adequate and similar to those obtained using other diets. A combination of cassava peel, BDG and urea would be a low cost diet for feeding ruminants since none of the ingredients is utilized for human consumption. The depression in nutrient digestibility on Diet 5 indicates that the Level of BDG in the diet should be less than 57%.

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