CASSAVA FORAGE AS A PROTEIN IN SUGAR CANE DIETS FOR CATTLE: EFFECTS OF DIFFERENT LEVELS WITHOUT UREA ON GROWTH AND ON RUMEN FERMENTATION[1]

Luz Meyreles, N A MacLeod[2] and T R Preston[3]

Centro Dominicano de Investigación Pecuaria con Caña de Azúcar CEAGANA, Santo Domingo, Repulica Dominicana

Two experiments were carried out with cassava forage and sugar cane, with and without urea. In experiment 1 (36 animals), levels of 0, 15, 30 and 45% of cassava forage (fresh basis) were compared. The rest of the diet was chopped whole sugar cane and minerals. urea was not given. In experiment 2 (24 animals) levels of 20 and 40% of cassava forage with and without urea were compared, using a factorial design. There was a significant increase in live weight gain in experiment 1 in the animals receiving cassava as compared with the unsupplemented control, but the level of performance reached was low (175 g/d). Performance in experiment 2 was similar. There were no differences between levels of cassava forage but there was a tendency for better performance with urea than without. Voluntary consumption index increased in the first experiment with levels of cassava forage but there were no differences due to treatment in experiment 2. pH values were high and were unaffected. treatment in either experiment ; results were similar for protozoal biomass . Rumen ammonia rose with increase in the proportion of cassava forage in the diet in experiment 1 and was higher with urea than without in experiment 2. In experiment 1, molar proportion of acetic acid fell slightly as the level of cassava forage was increased. The only effect of treatment on molar VFA in experiment 2 was a tendency for butyric acid to be in higher proportions in the diet with urea than without. The results indicate that the combination of urea and cassava forage in sugar cane diets is not detrimental in terms of animal performance. The reason for the poor overall performance on sugar cane diets when cassava forage is used as a protein source is still not known.

Key words: Sugar cane, cattle, cassava forage, urea, rumen fermentation

In an earlier paper in this series on the evaluation of cassava forage as a protein source in sugar cane diets (Meyreles et al 1977), the poor growth performance (a maximum of 190 gld live weight gain) was in marked contrast with the results reported by Moore (1976) where growth rates were of the order of 600 g/d. The only apparent difference between the two experiments was the inclusion of urea in the rations used by Meyreles et al .

The objective of the two experiments described here was to examine the effect of using the cassava forage with and without urea.

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Materials and Methods

Treatments and Design:

Experiment 1: The treatments were proportions of cassava forage (fresh basis) of 0, 15, 30 and 45% replacing chopped whole sugar cane. The design was a random block with three replications of groups of three animals on each treatment. The trial lasted 70 days.

Experiment 2: In this experiment two levels of cassava forage (20 and 40%) were evaluated in the presence or absence of urea in a 2 x 2 factorial design with 2 replications of groups of 3 animals. In this experiment 24 males Holstein Zebu bulls were used in groups of 3 animals per treatments combination. This experiment lasted 56 days.

Animals: In experiment 1, one of the replicates consisted of Holstein X Zebu bulls, one of Holstein X Zebu heifers and one of Zebu males. In the second experiment all the animals were Holstein X Zebu males. Initial weights were of the order of 200 kg.

Diets: Two varieties of sugar cane were used during the experiment (980 and C0-44-90) with a stage of maturity between 18 and 19 months, a mean DM content of 27.8% 14.2 !Brix and pH 5.15. The cassava was the variety Zenon which is the normal variety used in the Dominican Republic for root production. The average age since the previous cutting was 3 to 4 mth. DM content was on average 26.6% with 17% protein in DM.

Housing: The animals were housed in pens with a cement floor (3.5 m2 per animal) in an open sided building.

Procedure: The chopped sugar cane was supplemented with sulphur using a solution containing 5g ammonium sulphate/100 ml water which was added to the cane at the rate of 50 ml/kg fresh cane. In the second experiment the urea treatments were based on the addition of an aqueous solution containing (per litre) 180 g urea/50 g ammonium sulphate and added to the sugar cane at the rate of 50 ml/kg of fresh cane. All animals received daily,30 g dicalcium phosphate and 30 g salt. The sugar cane was chopped in a forage harvester (Gehl CB 600) to a particle size of approximately 10 mm; the cassava forage was the aerial part harvested approximately 30 cm above ground level. It was chopped in a stationary forage chopper (model Gehl). The sugar cane was chopped one day (the urea added, when appropriate) and fed the following day. The cassava was managed similarly, it was put on top of the sugar cane at the moment of feeding which was once daily.

Measurements: The animals were weighed individually at the beginning of the experiment and subsequently at weekly intervals. Live weight gain was determined by regression of live weight on time on experiment. Peed intake was determined daily. At the end of each experiment, samples of rumen liquid were taken by stomach tube from two animals on each replicate, one sample before feeding and the other 3 hr after feeding.

On the rumen fluid, determinations were made of pH and protozoal biomass, ammonia and molar VFA proportions (see Minor et al 1977 for description of methods).

Results

Animal performance:

Although there was a significant increase in live weight gain in experiment 1 in the animals receiving cassava forage, as compared with the unsupplemented control (table 1) the level of performance was low (170 g/d). and of the same order recorded when cassava was fed with urea in the experiment described by Meyreles et al (1977) . The level of performance in experiment 2 was similar (table 2). As in experiment 1, there were|no|differences between the different levels of cassava forage but there was a tendency for better performance with urea than without (P .16). Voluntary intake tended to increase with levels of cassava forage in experiment 1 but showed no such tendency in experiment 2.

Rumen fermentation:

Data for rumen fermentation parameters are given in tables 3 and 4.

Experiment 1: Rumen pH tended to fall after feeding but the values were generally high and not affected by treatment. Protozoal biomass was also unaffected by treatment. Rumen ammonia rose with increase in the proportion of cassava forage in the diet, and was higher three hours after feeding. The molar proportions of VFA showed a slight tendency for reduced levels of acetate and increased levels of propionate, and butyrate when cassava was introduced into the diet. Rumen ammonia levels were higher with the higher levels of cassava forage.

Table 1 :
Effect of level of cassava forage on animal performance in experiment 1 (70 day trial)

	Cassava forage %				
	0	15	30	45	SEx
Live weight, kg					
Initial	185	211	194	204	
Daily gain	-0.184[b]	0.166[a]	0.148[a]	0.155[a]	± .039 P <.001
Feed intake, kg/d					
Sugar cane	11	12	10	10	
Cassava	-	2.51	4.98	9.40	
Ammonium sulphate	.028	.030	.026	.026	
Minerals	.060	.060	.060	.060	
Total DM	3.16	4.23	4.24	5.30	
Consumption index[1]	1.76[c]	1.95[bc]	2.12[b]	2.52[a]	± .066 P <.001
Cassava protein, g/d		427	847	1598	

[1] Daily DM intake (kg)/100 kg LW; abc Means without superscript in common differ at P <.05

Table 2:
Mean values of a growth and feed intake in experiment 2 (56 day trial)

Urea	With		Without		SEx
Cassava forage, %	20	40	20	40	
Live weight, kg					
Initial	172	171	158	178	
Daily gain	0.24[a]	0.24[a]	0.14[b]	0.19[b]	.034
Feed intake, kg/d					
Sugar cane	12	8.8	10.0	8.7	
Cassava forrage	3.4	6.9	3.4	6.7	
Urea	.108	.079	-	-	
Ammonium sulphate	.030	.022	.025	.022	
Minerals	.060	.060	.060	.060	
Total DM	4.26	3.65	4.21	4.13	
Consumption index[1]	2.40	2.27	2.40	2.27	
Cassava protein, g/d	581	1171	570	1141	

[1]Daily DM intake (kg)/100 kg LW [ab] Means, without common superscript differ at P <.05

Table 3:
Rumen fermentation parameters (expt 1)

	Cassava forage %					
	0	15	30	45	SEx	Significance
pH						
0hr	6.80	6.83	6.85	6.78	±0.09	NS
3 hr	6.58	6.73	6.81	6.78	±0.14	NS
Protozoal biomass % PCV in rumen fluid						
0hr	0.10	0.38	0.57	0.64	±0.26	NS
3 hr	0.13	0.19	0.36	0.38	±0.15	NS
VFA, % molar						
Acetic						
0hr	73	75	66	65	±1.90	P <.01
3 hr	70	66	64	61	±1.70	P <.02
Propionic						
0hr	14	13	16	19	±0.88	P < .002
3 hr	17	19	19	19	±0.99	NS
Butyric						
0hr	13	16	16	15	±1.15	P <.16
3 hr	12	14	16	19	±1.15	P < .01
Ammonia mg/litre						
0 hr	57	50	65	91	± 8.77	P <.03
3 hr	73	69	109	106	±13.07	P < .10

Table 4:
Rumen fermentation parameters (expt 2)

	Urea			Cassava forage, %		
	With	Without	Significance	20	40	SEx
pH						
0 hr	7.12	7.17	NS	7.15	7.14	±.112
3 hr	6.85	7.03	P<.18	6.93	6.95	±.077
Protozoal boimass, %PCV in rumen						
in rumen fluid						
0 hr	0.23	0.12	NS	0.20	0.15	±.11
3 hr	0.33	0.14	P<.20	0.29	0.18	±.087
VFA % molar						
Acetic						
0 hr	77.6	81.1	P<.20			
3 hr	71.2	73.7		73.4	71.5	±1.454
Propionic						
0 hr	13.9	12.2		13.8	12.4	±1.17
3 hr	16.7	16.9		16.4	17.2	±1.23
Butyric						
0 hr	8.5	6.7	P<.10	7.7	7.5	±.579
3 hr	12.2	9.4	P<.14	10.3	11.3	±1.063
Total VFA, m-equiv/litre[2]						
0 hr	105	90		91	104	
3 hr	79	92		93	79	
Ammonia mg/litre[3]	251	96	P<.01	194	153	

[1] None of the differences between levels of cassava was significant
[2] Not analysed statistically [3] Mean for 0 and 3 hr

Experiment 2: Neither presence or absence of urea nor level of cassava forage affected pH, protozoal biomass or total VFA. Rumen ammonia was higher with urea than without and tended to increase with time after feeding. There were no effects of treatments on molar VFA other than a tendency for molar butyric acid proportion to be higher with urea than without. Samples after feeding were lower in acetic and higher in propionic and butyric acids than samples taken before feeding.

Discussion

The results of the two experiments indicate that combined utilization of urea with cassava forage does not seem to be detrimental in terms of animal performance. The factor limiting growth rate on diets of sugar cane and cassava forage thus still remains to be elucidated. The tendencies for differences in the different parameters of rumen fermentation are more or less in line with what would be expected according to different levels of fermentable nitrogen in the d diet whether this arises from cassava or from urea, and of fermentable carbohydrate, i.e. one effect of replacing sugar cane

with cassava forage is to reduce the dietary concentration of soluble (fermentable) sugars and increase that of fermentable nitrogen. The increase in rumen ammonia as cassava forage level was increased probably was attributable to this change. The apparent relationship between cassava level and molar propionate in experiment 1 (r = .8% and .5% for 0 and 3hr after feeding) is similar to what was reported by Alvarez and Preston (1976) and Ferreiro and Preston 1976) when they added increasing amounts of urea to a sugar cane diet.

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