CASSAVA FORAGE AS A PROTEIN SUPPLEMENT IN SUGAR CANE DIETS FOR CATTLE EFFECT OF DIFFERENT LEVELS ON GROWTH AND RUMEN FERMENTATION

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36 animal of initial weight 160 to 200 kg and approximately 1 year of age were used to evaluate levels of cassava forage of 0, 15, 30 and 15 (fresh bests) replacing chopped whole sugar cane/urea. The cassava was cut at between 3 and 5 months of age and contained on average 20% DM and 15 8% N x 6.25 tn DM. The sugar cane contained 25.5, DM and the Brix was 12.4°. Both the sugar cane and the cassava forage were chopped to a particle size of approximately 10 mm. The sugar cane mixture with urea (and ammonium sulphate) was allowed to ferment for 24 hr prior to feeding while the cassava was also left 24 hr but separately from the sugar cane. Over the 80 day trial, daily live weight gain was - 14 187 105 and 144 g/d for increasing levels of cassava forage (significantly higher for the combined cassava treatments vs the control. P <.03). Voluntary intake was low on all treatments (range 1.72 to 1.92 kg DM/100 kg LW). Studies on the composition of rumen fluid from these and other fistulated animals receiving the same treatments showed uniformly high values f pH (in excess of 6.8) and high levels of rumen ammonia (15 to 22 mg NH /100 ml) which did not vary between treatments. It is concluded that the probable reason for the poorer performance on the cassava forage was the high rumen ammonia levels caused by the high solubility of the cassava protein in combination with urea.. There was no evidence of any possible toxic effect due to hydrocyanic acid.

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

The justification for the use of cassava forage as a protein source for cattle feeding in the tropics has been discussed by Meyreles et al (1977). A preliminary report on the use of this forage to supplement sugar cane for fattening cattle (Moore 1976) indicated that there were no differences in performance of steers fed sugar cane supplemented with either 1.8 kg/d of cotton seed cake, 1.52 kg/d of cassava forage (dry basis) or 1.94 kg/d of desmodium forage (dry basis); live weight gains were 659 622 and 584 g/d respectively. Apparently there were no problems of toxicity due to the cyanogenic glucosides in the cassava. In fact, it was reported that even when cassava forage was the sole component of the ration over a 90 day period, there were no symptoms of toxicity. In contrast with almost all other work elsewhere on the use of sugar cane, urea was not used in the experiment reported by Moore.

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Two experiments were carried out to investigate the effect of different levels of cassava forage as a protein supplement for growing cattle fed the standard sugar cane/urea diet used in this Centre.

Materials and Methods

Experiment 1:

Treatments and Design: The treatments were proportions of cassava forage (fresh basis) of 0, 15, 30 and 45% replacing chopped whole sugar cane/urea. The design was a random block with 3 replications and groups of 3 animals on each treatment. One replication was of Zebu X Holstein males, one of females of the same breed and the third of Zebu males. Average initial weight was in the range 180 to 195 kg.

Diets: The forage cassava was the variety Zenon considered to be a sweet (i.e. low glucoside) type. It was harvested at between 3 and 6 months with a tendency for the more mature material to be used towards the end of the experiment. Average composition was dry matter 20% and crude protein in dry matter 15.8 (see Meyreles et al 1977 for further details). The sugar cane was variety 980 and was approximately 12 months of age at the time of harvesting. Throughout the experiment the average dry matter was 25.5% and the Brix 12.4. Both the sugar cane and the cassava were chopped to a particle size of approximately 10 mm using a forage chopper (Gehl).

After chopping the sugar cane was mixed with a solution of urea:ammonium sulphate (180 g urea 50 g ammonium sulphate and 770 g water) at the rate of 50 ml/kg of fresh sugar cane. The mixture was allowed to pre-ferment for 24 hr before it was given to the animals. The cassava was chopped and left for 24 hr before feeding but it was kept separate from the sugar cane until the moment of feeding. All the cattle received 30 g of dicalcium phosphate and 30 g of salt daily. The total ration was given once daily in the morning, in amounts which exceeded requirements.

Throughout the experiment, which lasted 80 days, the animals were housed in paved corrals (3.4 m2/head) in a roofed building open at one side. Weighing was at weekly intervals

Experiment 2:

Procedure: The treatments were the same as in experiment 1. of rumen fluid were taken from two animals in each group of the replicate of Holstein X Zebu males in experiment 1 and from 4 Zebu males fitted with rumen cannulas and tied in individual stalls. These latter animals had been receiving the same experimental diets as those in experiment 1. Rumen fluid was taken at before and 1, 2, 3 and 4 hr after feeding. pH and protozoa biomass (Leng et al 1976) were determined immediately; other samples were preserved with sulphuric acid for subsequent analysis for ammonia.

Table 1:
Mean values for animal performance according to level of cassava n diet

	Cassava forage, %				
	0	15	30	45	SEx
Live weight, kg					
Initial	183	195	185	189	
Final	182	209	194	203	
daily gain	-.040[b]	.187[a]	.105[a]	.144[a]	± .058(P<.13)
Feed intake, kg/d					
Sugar cane	13.0	14.4	10.5	9.48	
Cassava forage	-	2.55	4.30	6.93	
Urea	.117	.129	.094	.085	
Ammonium sulphate	.033	.036	.026	.024	
Minerals	.060	.060	.060	.060	
Dry matter	3.22	4.04	3.44	3.70	
Consumption index[1]	1.72	1.92	1.74	1.83	± .073 (P <.30)
Cassava protein, g/d		78	132	212	

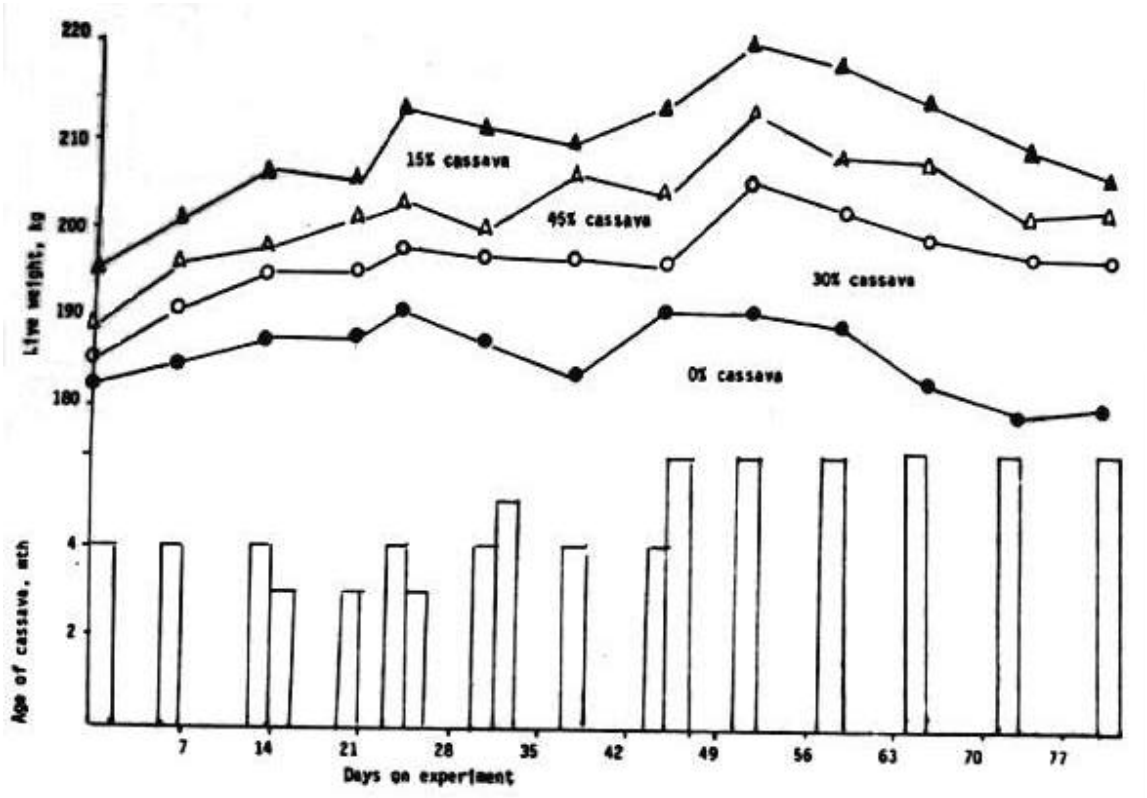
[1] Daily DM intake (kg/100 kg LN)
[ab] Control is significantly less (P <.03) than all cassava treatments considered together

Results and Discussion

Mean values for animal performance parameters and the amounts of feed consumed daily are given in table 1. Live weight gain was calculated by regression of the mean live weight of each group against time on experiment. The analysis of variance was carried out according to a factorial design 4 x 3 with one repetition, the factors being the 4 levels of cassava forage and the 3 different breed/sex groups.

In marked contrast with the results reported by Moore (1976), the level of animal performance on the cassava forage treatment was extremely low and barely showed a significant improvement compared with the control which received only sugar cane and urea. Also in contrast with the use of almost all other protein supplements, there was no relationship between amount of supplementary protein and level of performance, despite the fact that the higher level of cassava forage provided the equivalent of 220 g/d true protein. This is considerably higher than the protein provided by 1.2 kg/d of rice polishings (150 g protein/d) which has been shown to support live weight gains of 800 and 900 g/d (Preston et al 1976).

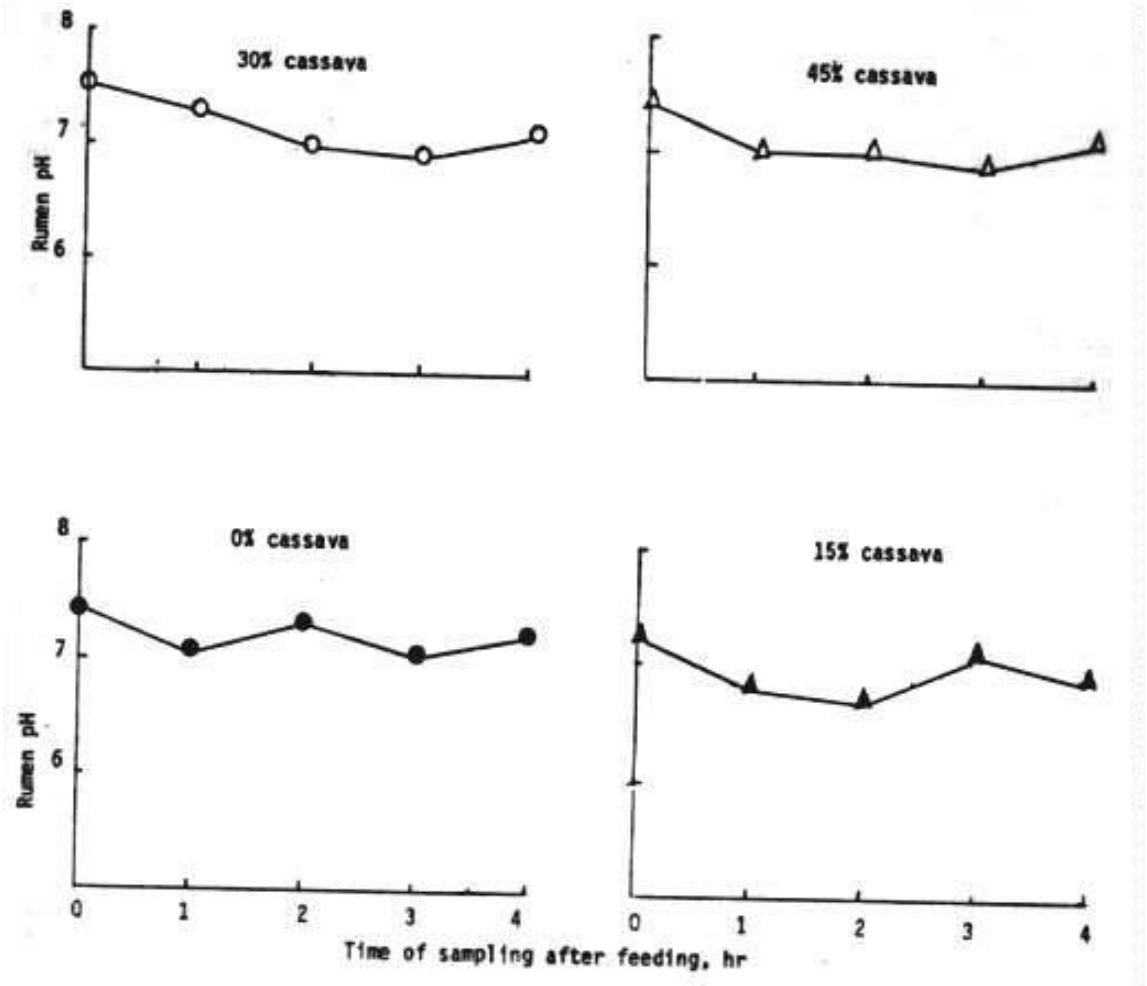
Figure 1:
Changes in live weight during the experiment and the age of the cassava when harvested



There were some indications from the pattern of live weight gain (figure 1) of a higher level of performance on the cassava in the first 24 days, followed by a steady deterioration towards the end of the experiment. However, this trend was noticed equally in the group receiving no cassava forage, and probably reflected low levels of consumption on all treatments at the start of the trial, resulting in increasing fill which in turn gave distorted values for live weight. In other subsequent observations, when feeding was ad libitum from the beginning, rate of live weight gain was also low (Meyreles, unpublished data).

The fact that animal response was not related to the level of cassava and, specifically that there was no apparent depressing effect of the highest level would seem to indicate that the causative factor for the poor performance was not hydrocyanic acid. Such conclusion is supported by the observation of Moore (1976).

Figure 2:
Effect of level of cassava forage on rumen pH



The findings relating to the pattern of rumen fermentation are summarised in figures 2, 3 and 4. noteworthy aspects of these data are the uniformly high pH on all treatments (no values were recorded below 6.82, the lower than normal values for protozoa biomass and the extremely high values, with no difference between treatments for rumen ammonia. These latter data, in particular, indicate that there is very little difference in rate of release of ammonia from urea and from cassava protein since rumen ammonia was equally high on the 45% cassava treatment as on the control despite the fact that supplemental nitrogen in the form of urea was only 53% with the cassava treatment compared with 100% on the control.

Other observations supporting the concept of high solubility of the protein in cassava forage are those of Ravelo et al (1977a). These showed that cassava forage was a more effective buffer than urea, resulting in higher levels of lactic acid in ensiled mixtures of sugar and cassava forage, than sugar cane/urea without cassava. A

rumen fermentation experiment also showed that the concentrations of ammonia increased when cassava forage was left for increasing periods (24, 48 or 72 hr after harvesting) before feeding, in a combined mixture with sugar cane (Ravelo et al 1977b). Comparable levels of rumen ammonia were reached in this latter study (150 mg NH_3/litre) even though no urea was fed and the crude protein in the mixture of cassava (50%) and sugar cane (50%) was only 8.04% in dry matter

Figure 3:
Effect of level of cassava forage on protozoal biomass in rumen fluid

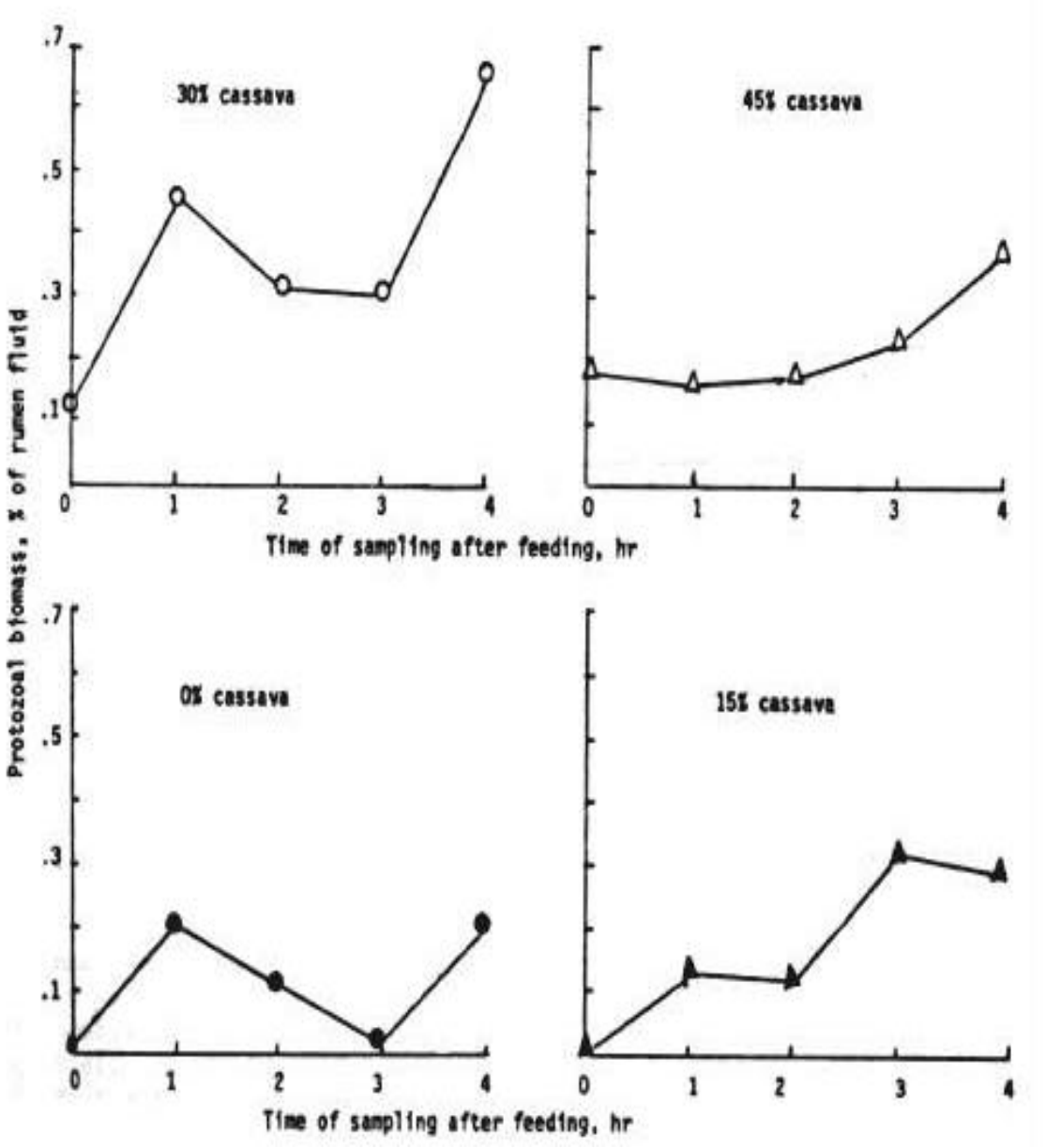
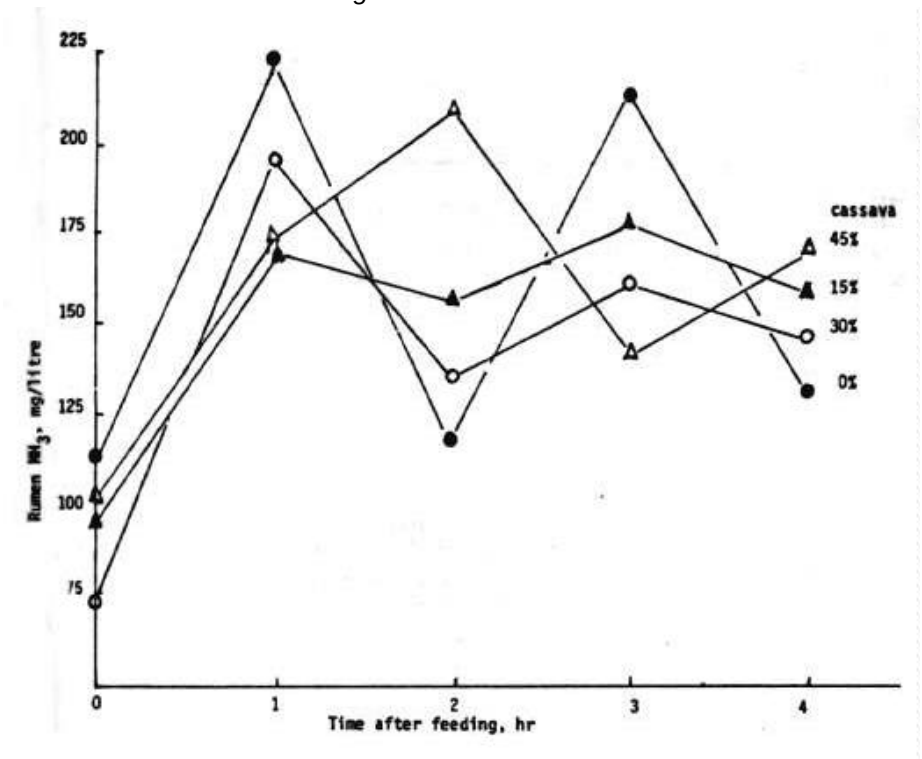


Figure 4:
Effect of level of cassava forage on rumen ammonia



The above findings would suggest that the limitations to the use of cassava forage as a protein source for cattle are related to the high solubility of the protein. This will be less of a problem when the only nitrogen source is the cassava (as in the experiment carried out by Moore), but the situation is likely to be exacerbated by giving supplementary urea, as was the case in the present experiment. The fact that the present trial was carried out in the wet season when the sugar content of the cane was low (120 Brix) would also have contributed to poor utilization of the ammonia produced in the rumen.

Table 2:
Effect of breed/sex on live weight gain and voluntary feed intake

	Zebu x Holstein		Zebu	
	Bulls	Heifers	Bulls	SEx
Live weight, kg				
Initial	222	201	161	
Daily gain	.112	.010	.175	±.050 (P<.14)
Consumption index	1.86	1.79	1.76	±.073 (P <.54)

Although it was not the intention in this experiment to make any breed/sex comparisons it is interesting to compare the relative responses between the different replications (table 2). There was a strong tendency for live weight gain to be higher for Zebu males and lowest for crossbred females with crossbred males in an intermediate position. The data are not sufficiently comprehensive to allow firm conclusions to be drawn as to whether these apparent differences reflect true breed/sex differences or were random effects However, it has been observed in other experiments that Zebu cattle appear to have a higher tolerance to urea toxicity (and therefore to higher ammonia levels) than Holstein cattle (Alvarez and Preston unpublished data).

Conclusion

The results of this experiment show conclusively. that fresh cassava forage has only limited value as a protein source, when used to supplement urea in sugar cane based diets. It would seem that its usefulness would be in substituting for urea until such time as methods can be found to reduce its solubility.

References

Leng R A, Valdez R L, De Gonzalez E & Minor S 1976 A method for assessing protozoal biomass in rumen fluid Trop Anim Prod 1:42

Meyreles L, MacLeod N A & Preston T R 1977a Cassava forage as a Source of forage protein: effect of. population density and age at cutting Trop Anim Prod 2:18-26

Moore C P 1976 El uso de forraje de yuca en la alimentacion de ruminantes Seminario Internacional de Ganaderia Tropical, en Acapulco, Mexico

Preston T R, Carcaño C, Alvarez F J, and Gutierrez D G 1976 Rice polishings as a supplement in a sugar cane diet: effect of level of rice polishings and of processing the sugar cane by derinding or chopping Trop Anim Prod 1:150-161

Ravelo G, MacLeod N A & Preston T R 1977a Ensiling mixtures of sugar cane, cassava forage and urea Trop Anim Prod 2

Ravelo G, MacLeod N A 6 Preston T R 1977b Rumen ammonia production as affected by partial drying of cassava forage given in combination with sugar cane Trop Anim Prod 2: abs

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