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PHYSICAL AND ECONOMIC PERFORMANCE OF BRAHMAN STEERS ON THREE DRY SEASON FEEDING REGIMES UNDER COMMERCIAL CONDITIONS IN COSTA RICA

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Although published work concerning the use of sugar cane and molasses to beef animals is plentiful, little attempt is made in Costa Rica to supplement the dry season nutrition of grazing cattle with these feeds. This work evaluated the use of sugar cane and molasses diets under commercial conditions. Sixty Brahman steers of two ages (10 and 22 months) were used to evaluate physical and economic responses to 3 nutritional treatments based on molasses and restricted grazing (T_1), chopped whole sugar cane (T_2) and unsupplemented dry season grazing (T_3). During an 88 day observation period the mean daily live weight change for the older steers was 0.6 0.66 and - 0.11 kg/d and for the younger animals 0.39, 0.44 and - 0.01 kg/d for treatments T_1, T_2 and T_3 respectively. Within treatments T_1 and T_2 the older animals grew faster than the younger ones ($P < 0.01$) and in T_3 all animals lost weight with no significant difference between age groups. A financial analysis showed that older animals are best suited to receive supplementary feeding whereas the younger animals may be maintained at pasture during the dry season.

Key words: Cattle, dry season supplementation, molasses, sugar cane

One of the principal problems of production from natural pastures in the tropics is the occurrence of extended dry seasons when pasture growth ceases and the nutritive value of pasture dry matter declines markedly (Osbourn 1976).

Over recent years much work has been conducted to evaluate the feeding value of alternative sources of energy and protein for ruminants in the tropics. A notable source is sugar cane (Preston and Leng 1978 a, 1978 b) and its industrial by-product molasses (Preston 1972) These feed stuffs are of particular relevance since they allow the use of high inclusions of non protein nitrogen (NPN) in the diet to substitute natural proteins which are generally scarce in the tropics (Preston and Willis 1969).

The need to include energy and protein supplements in diets based on sugar cane or molasses has produced published work covering a wide variety of different alternatives. Supplements for use with sugar cane have included rice polishings (Preston et al 1976), cassava forage (Meyreles and Preston 1977), meat meal and groundnut oil (Silvestre et al 1977) sweet potato forage (Meyreles and Preston 1978), wheat bran (Silvestre and Hovell 1978) and *Leucaena leucocephala* (Hulman and Preston 1981). Molasses and urea diets have been supplemented with poultry litter (Meyreles and Preston 1980), *Leucaena leucocephala* (Alvarez et al 1977), rice polishings maize grain, fish meal, soybean meal and maize oil (Ferreiro et al 1977), meat meal, cassava root and groundnut oil (Silvestre et al 1977), sweet potato (Ffoulkes and Preston 1978) and banana forage (Rowe et al 1979). On the basis of information available it would be thought possible to formulate

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diets for dry season feeding of beef animals, based on available feeds in almost any sub tropical situation. In the case of Costa Rica where sugar cane and beef make up a large proportion of total agricultural production the use of sugar cane and tis by-products does not play a significant part in commercial beef production. Beef production in Costa Rica is carried out extensively using, in the main, unimproved pastures (Anon 1980), with little or no dry season feeding practised.

The work presented here was carried out principally to investigate the commercial feasibility of using diets based on either sugar cane or molasses for dry season feeding as an alternative to the traditional use of pasture only. The effect of age of animal on physical and economic response to feeding was also investigated in order to evaluate strategies of feed use in complete animal production systems.

Materials and Methods

Animals and Treatments: A total of 60 Brahman steers was used to measure live weight changes on three different dry season feeding regimes. Thirty steers with an average live weight of 324 (± 5.3 SE) kg and age 22 (±0.2 SE) months and 30 recently weaned steers with live weight 198 (± 3.6 SE) kg and 10 (± 0.15 SE) months of age were distributed randomly between 3 feeding treatments. The experimental design was a 2 x 3 factorial with 10 replications. The trial took place between January and May 1982 (dry season) at the Escuela Centroamericana de Ganadería, Costa Rica,located at an altitude of 400 metres in the sub-humid tropics. There is a pronounced wet season between May and November with a mean annual rainfall of 1,700mm. All measurements were made during the observation period of 88 days which followed a period of 21 days to allow adaptation to the treatment diets.

All animals had spent the 7 month wet season prior to the start of the of the trial grazing pastures of *Hyparrhenia rufa* (Jaragua). The younger animals had been weaned form their dams 2-3 months previously and were in noticeably poorer body condition than the older more mature steers. Throughout the trial animals of both ages were managed as a single group within each feeding treatment.

Diets: The molasses based diet (T_1) consisted of molasses + 3% urea and poultry litter offered ad libitum in separate feeders. The poultry litter was obtained from a broiler unit and contained wood shavings. In order to provide natural protein,meat meal was fed at 0.5 kg/animal/d. In addition, steers were allowed to graze a paddock of *Hyparrhenia rufa* for 4 hours daily between 7:00 am and 11:00 am. This area had not been grazed for 5 weeks before the start of the experiment and was grazed throughout the observation period at a stocking density of 4 livestock units/ha (LSU equivalent to 450 kg liveweight). No artificial fertilizer was applied.

Animals on the sugar cane treatment (T_2) were fed 15 kg chopped sugar cane + 1% ura and 1 kg rice polishings/animal/d. The sugar cane used had a regrowth of approximately 12 months at cutting. The whole plant was chopped and fed to the animals.

Grazing animals (T_3) composed a control group which followed the traditional practice of leaving steers at pasture throughout the dry season without supplementation. This group grazed 5 paddocks of *Hyparrhenia rufa*

at a stocking rate of 0.5 LSU/ha. Prior to the experiment, these pastures had received the same management as the grazing area used in T_1.

All animals were allowed constant free access to a mineral supplement which comprised 50% bone meal and 50% common slat. Fresh water was available at all times.

Management of Feeding: Animals fed the molasses based diet (T_1) were confined within a corral for 20 h each day and only released for their restricted grazing period of 4 h. During this time the corral gate remained open to allow animals access to water and the ad lib feeds. Molasses and poultry litter feeders were replenished every alternate day. The meat meal was spread on the surface of the molasses daily.

The sugar cane group (T_2) were confined within a corral during the entire experimental period. Sugar cane was cut by hand and chopped on a daily basis using a 7 hp petrol driven stationaty cane chopper. The urea was dissolved in 5 litres of water before being applied to the chopped cane by watering can. Rice polishings were evenly spread over the cane/urea mix.

Within treatment groups the feeding trough space was arranged so as to minimize competition and harassment between animals of different ages. All steers were treated to control internal parasites before starting the experiment and sprayed every three weeks during the period to control ticks.

Measurements: All animals were weighed individually on two consecutive days at the start and finish of the observation period and at 21 day intervals during the experiment.

Feeds were weighed and recorded when fed with the exception of the sugar cane for which daily consumption was calculated every 2 weeks. The rationing of sugar cane to group T_2 was necessary as a means of minimizing waste of chopped cane. The quantity fed was adequate for consumption in one day which resulted in feed refusals being less than 1% of total feed offered.

Results and Discussions

i) Feed intake: Intake of diet components and characteristics of diets consumed by animals in T_1 and T2 are shown in Table 1. Although the energy concentration of the diet consumed in T_1 is apparently higher than that of T_2 (Table 1), animals in T_1 were allowed to graze for a restricted period daily and as a consequence the apsture intake may have had the effect of diluting the energy concentration of the T_1 diet, such that the overall energy concentration of T_1 and T_2 diets would be similar. Also, for the same reason, the apparent difference in percentage crude protein between T_1 and T_2 (Table 1) would be reduced. The proportion of the total crude protein consumed in the form of non protein nitrogen (NPN) was almost identical in both treatments. In T_2 the NPN was urea whilst in T_1 24% of the NPN intake was from the poultry litter and the rest from the urea. The mean daily consumption of poultry litter was low due to a period of three weeks when it was not offered to T_1 animals. This occurred as a result of a change in management practice by the supplier. At 0.23% (Table 1) the amount of poultry litter consumed is well within the maximum of 0.6% body weight as suggested by Meyreles and Preston (1982).

Table 1:

Mean daily dry matter intake and diet composition of animals in supplementary feeding treatments.

Consumption of diet components (kg Dry Matter/100 kg Body Weight/Day)		
Component	Treatment T_1	T_2
Molasses	1.1	
Urea	0.047	0.063
Meat Meal	0.14	-
Poultry Litter	0.23	-
Pasture	NR[1]	-
Sugar cane	--	1.45
Rice Polishings	-	0.306
Total Consumption	1.517	1.819

Diet Composition +		
	T_1	T_2
Energy Concentration (MJ ME/kg DM)	11.0	9.8
Crude Protein (% DM)	18.0	15.4
Crude Protein as NPN (%)	63.0	65.0

NR[1]

+ Calculated using book values.

ii) Live weight changes: Mean daily live weight changes for each age and treatment group were calculated by linear regression (Table 2). Live weight gains of the older animals were similar to those observed by other workers under less commercial conditions. T_1 steers grew at 0.69 kg/d (Table 2) whereas Meyreles and Preston (1980) report gains of 0.78 kg/d on a similar diet with 1.0 kg cotton seed using crossbred bulls. Steers on the sugar cane diet (T_2) had a growth rate of 0.66 kg/d (Table 2) compared with 0.73 kg/d reported by Ferreiro et al (1977) although the latter animals also consumed 1.25 kg of molasses:urea per day.

Animals in T_1 and T_2 grew significantly faster than grazing animals, T_3 ($P < 0.01$) which lost weight over the period (Table 2). In terms of absolute gain it would be expected that heavier older animals exhibit higher liveweight gains than lighter animals. The analysis of variance showed this to be the case with significant age ($P < 0.01$) and age x treatment interaction effects ($P < 0.001$). Hence the absolute gain resutls (Table 2) are considered as six discrete groups with a SE of the difference between any two comparisons. Within T_3, no significant age effect exists in contrast T_1 and T_2 where the older, heavier animals grew faster ($P < 0.01$) than the younger steers.

To assess relative growth rates between age groups, liveweight changes have also been expressed in terms of animal liveweight (Table 2). In the analysis of variance there were no age or age x treatment interaction although there was a difference.

The effects of age on live weight gain between nutritional treatment may be accounted for by differences in maturity and body composition of two age groups. When offered a medium quality diet (T_1 and T_2) both ages showed the same relative potential for trowth (Table 2). However, when

Table 2:

Mean live weight gain per day for steers of two ages on three different dry season feeding regimes

	ABSOLUTE GAIN (g/animal/day)			RELATIVE GAIN (g/100 kg Body wt/day)			
Feeding Regime	T_1	T_2	T_3	T_1	T_2	T_3	$SE_{\bar{x}}$
Age (months)	Molasses	Sugar Cane	Pasture	Molasses	Sugar Cane	Pasture	
22	690^a	660^a	-111^b	190^x	190^x	-40^y	
							± 15
10	390^c	440^c	-10^b	170^x	210^x	-5^y	
	... SE diff $\pm$ 75 ...			... $SE_{\bar{x}}$ Treatment $\pm$ 19 ...			

Values with different superscripts within same block are significantly different $P < 0.01$

restricted to poor quality dry season feeding the older steers in good body condition suffered marginally more relative live weight loss than the younger recently weaned animals which were in poorer condition. The latter group demonstrated the ability to maintain body weight during the dry season.

(iii) Economic considerations: To assess the financial implications of the effects of nutrition and age on performance an economic analysis was carried out using the data in Table 3. Feed costs for animals of different ages were apportioned in accordance with mean metabolic body weight (Body Weight$^{0.75}$). All costs were calculated at Current Costa Rica prices and converted to $US with the exception of the sugar cane where the farm gate price was used in order to take account of the opportunity cost of selling to a sugar mill. Capital costs for T_1 and T_2 were calculated as the interest foregone by investing capital in machinery, corrals and feed troughs. The value of animals was not taken into account since this is the same regardless of nutritional regime.

Table 3 illustrates the financial advantage of older animals in both supplementary feeding regimes. Furthermore, the use of the molasses based diet (T_1) was the most profitable principally because poultry litter was a cheaper form of NPN than urea, capital and labour costs were lower and growth rates were marginally better than for the sugar cane diet (T_2). In locations where the possibility of selling cane does not exist, its opportunity cost is likely to be much reduced and consequently the comparative financial advantage of the molasses diet may be reduced.

The financial losses incurred by grazing animals during the dry season were added to the net financial gain of supplemented animals to express the economic advantage of feeding over grazing (Table 3). Under both feeding regimes (T_1 and T_2) the older steers had more than twice the economic advantage compared with the recently weaned steers.

Table 3:-

Comparative costs and benefits of feeding steers at two ages over 88 day trial period in the dry season.

FEEDING REGIME	MOLASSES		SUGAR CANE		GRAZING	
Age (months)	10	22	10	22	10	22
Live weight (kg)						
At Start	200	328	188	322	207	322
At Finish	234	396	227	381	206	312
COSTS AND BENEFITS						
(Cents $US/Animal /Day)						
Molasses	10.1	14.5	-	-	-	-
Urea	1.9	2.8	2.5	3.6	-	-
Meat Meal	6.0	8.6	-	-	-	-
Poultry Litter	0.3	0.4	-	-	-	-
Grazing Land	0.5	0.7	-	-	4.0	6.0
Sugar Cane	-	-	6.8	9.7	-	-
Rice Polishings	-	-	9.1	13.1	-	-
TOTAL FEEDS	18.8	27.0	18.4	26.4	4.0	6.0
Additional Labour[1]	0.4	0.6	1.7	2.7	-	-
Capital Costs [2]	0.2	0.2	1.2	1.2	-	-
Gasoline	-	-	0.7	1.1	-	-
TOTAL COSTS	19.4	27.8	22.0	31.4	4.0	6.0
Benefit From Live weight Gain [3]	24.2	42.8	27.3	40.9	-0.6	-7.0
Net Benefit[4]	4.8	15.0	5.3	9.5	-4.6	-13.0
Advantage over Grazing only	9.4	28.0	9.9	22.5	-	-

1 Assuming routine labour equal for all treatments.

2 Cost of investment in machinery, feed troughs and corrals.

3 1 kg live weight = 62 cents US.

4 For comparison of treatment. Assumes all other fixed and variable costs equal between treatments.

Conclusions

Some caution should be exercised in the interpretation of the feed intake data since animals of different ages were managed as a single group within feeding treatments. However, one of the principal objectives was to attempt to assess the practical and economic validity of the feeding regimes in a commercial context. In view of the extremely large differences in

economic performance between age groups any over estimation of feed intake by younger animals would not significantly affect the financial advantage of older animals.

The use of poultry litter to provide 24% of the NPN was shown to be a cost effective method of replacing urea.

It was demonstrated that sugar cane or molasses based diets can be used commercially with little need for costly or specialist equipment as a profitable way of growing steers during the dry season. This may be particularly beneficial in systems producing animals of sufficient live weight at the end of the wet season to allow dry season "finishing".

When dry season feeding is in short supply it is beneficial to supplement older animals (22 months) whilst maintaining younger animals on pasture only where the latter type of animal seems to have a relative advantage. Since both ages had the same growth rates/100 kg body weight in the supplemented treatments the advantage of younger animals lies in their ability to maintain themselves at grass rather than a disadvantage when offered supplementation.

In comparison with traditional practices this analysis suggests that allowing 22 month old animals access to a molasses and restricted grazing diet during a 100 d dry period would result in an additional £28 profit per steer over this period.

The effect of compensatory growth on the conclusions presented above cannot be discounted should a period of dry season feeding be followed by wet season grazing. Work is currently in progress to evaluate these effects. It should be noted however that the use of dry season feeding in corrals which reduces stocking rate at this time of year may be of positive benefit to pasture growth in the subsequent wet season. Consequently any evaluation of dry season feeding should take into consideration the many different factors acting within the entire farm system.

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