EFFECT OF UREA LEVEL ON THE PERFORMANCE OF CATTLE ON A MOLASSES/UREA AND RESTRICTED FORAGE FEEDING SYSTEM[1]

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50 Creole X Friesian heifers were used to compare five concentrations (0, 1.2S 2.5, 3.75, 5Z) of urea in liquid molasses. The molasses/urea mixture was fed at libitum, fresh forage at 32 of liveweight and fish meal at 400 g head/day. The trial lasted 64 days. Daily liveweight gains were significantly higher for urea levels in molasses, of 1.25. 2.5 and 3.75 compared with 0 and 5%. The response curve was parabolic with the highest liveweight gain (0.556 kg/d) coinciding with 2.5% urea in molasses. Molasses and total DM intake were highest and feed conversion best on the 2.5% urea level, which was therefore considered to be the optimum level.

Key [lords Cattle, molasses, urea, fattening

The use of urea as a non-protein nitrogen supplement for intensive fattening of cattle on molasses-based diets is extensively reported in the literature (Preston 1972). The optimum level of urea in any cattle diet for maximising liveweight gains needs further investigation (Delgado et al 1978). Some data have been reported on the performance of animals at different levels of urea in different feeding rations. For example, working with zebu bulls Ferreiro and Preston (1976),comparing 4 levels of urea in molasses, found the best treatment to be the highest level considered, ie 10% urea in molasses given together with chopped auger cane in separate feeders both on a free-choice basis, and also 1 kg/day of rice polishings as supplement, The rate of liveweight gain was 0,630 kg/day. Also comparing different levels of urea incorporated in a standard sugar cane diet supplemented with 1 kg/day of rice polishings, Alvarez and Preston (1976) reported the optimum concentration of urea to be the highest level considered, ie 15 g/kg of fresh cane or 35 g/kg dry matter of the diet. The daily gain was 0.59 kg for these experimental Zebu bulls. However, when liquid molasses/urea were given ad libitum in combination with restricted quantities of forage and a protein rich meal (500 g/day) to Zebu bulls, the optimum concentration of urea in liquid molasses was found to be 3% by by Silvestre et al (1976b) for a maximum liveweight gain of 0.734 kg/day. In the intensive system of cattle fattening based on molasses, the animals are induced to consume large quantities of molasses by restricting the intake of fresh forage so that maximum energy can be derived from molasses, and this is an advantage in situations like Mauritius where there is an acute shortage of fodder for part of the year (March - June).

The objective of this experiment was to evaluate in the local context, the response of growing cattle to different levels of urea in molasses and to determine the level which would give the best liveweight gains when forage is restricted.

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Materials and Methods

Five dietary treatments were compared in a completely randomised block design with two replicates. The treatments were 0, 1.25, 2.5, 3.75 or 5% of urea in molasses.

50 Creole X Friesian heifers aged from 10 to 26 months and weighing 126 to 217 kg were randomly allocated to each treatment according to their weight. They had free access to the molasses-urea mixture; a mineral mixture (dicalcium phosphate 70%, Sodium Chloride 28.6%) and fresh water were also available at all times. The animals received daily in the morning 400 g/head of local fish meal and afterwards freshly cut grass (*Ischaemum aristatum* but sometimes *Pennisetum purpureum* or *Stenotaphrum dimidiatum* have also been fed) at the level of 3% bodyweight, adjusted at each bi-weekly weighing of animals.

Animals were housed in half-roofed pens with concrete floors (4.2m2 / animal). The molasses and fish meal troughs were on the roofed-side of the shed while fodder and water troughs were on the unroofed side.

After a period of 3 weeks for stabilization of animals on the experimental diets data collection started on 24.5.79 and the trial lasted 84 days. The different concentrations of urea in molasses were obtained by dissolving a weight of urea in an equal weight of lukewarm water, and subsequently adding different amounts of the solution, i.e. 0, 2.5, 5.0, 7.5 or 10.0 kg respectively in 100 kg molasses.

The animals were weighed individually every 14 days with a balance which weighed to the nearest 500 g. The amount of molasses/urea added to the troughs was recorded daily daily intakes of fodder and fish meal supplement were also recorded by measuring left overs every morning. Weekly samples of pure molasses, fish meal and fodder were taken for analysis. Nitrogen was determined by the Kjeldahl method. Fibre and fat were determined by the methods outlined by AOAC (1965). The Brix of molasses was determined by hand refractometer, and its dry matter percentage calculated after 72 hours in an oven at '.70 C. Statistical analyses of data were done according to the method outlined by Snedecor and Cochran (1969).

Results

Chemical Analysis: The nutritive value of the fodder used (Table 1) varied considerably, probably because the fodder was not cut at the same stage of growth

Table 1:
Chemical composition of feeds

	No of Samples	DM %	DM basis, %		
			N	Ether extract	Crude fibre
Forage[1]	10	30.5 ± 9.4	1.15 ± .58	1.97 ± .02	35.9 ± 4.5
Fish meal	8	91.3 ± .43	8.52 ± .25	7.64 ± 1.27	0.15 ± .009
Molasses[2]	6	74.7 ± 1.3	1.04 ± .09	-	-

[1] mainly: *Ischaemum aristatum* (herbe d'argent), *Pennisetum purpureum* (elephant grass)
occasionally: *Stenotaphrum dimidiatum* (herbe bourrique)

[2] Brix value was 84.4 ± 3.9

every time. Also different types of fodder such as Ischaemum aristatum Pennisetum purpureum, Stenotaphrum dimidiatum, were fed to the animals during the trial. The fodder wee of a relatively poor quality (7.2% crude protein and 35.9% crude fibre in the dry matter).

Health: Animals were in good condition during the trial except for two in the treatment 2.5% urea. One of the animals wee removed when the experiment was running its 5th week, because of a general depressed state. The exact cause could not be determined. The other animal died on the 10th week but the exact cause of death could not be determined either. However, it should be pointed out that teeth were not due to the experimental treatment applied, The data from these two animals were excluded from the analysis.

Animal Performance: Intake of molasses, total DM intake and daily liveweight gain were significantly higher on urea levels between 1.25 and 3.75% compared with 0 or

Table 2:
Mean values for changes in liveweight, feed intake and feed conversion of heifers given molasses with different concentration of urea

	Urea concentration in molasses, %					S E of difference
	0	1.25	2.50	3.75	5.00	
No. of animals	10	10	8	10	10	
Liveweight, kg						
Initial	173.2	176.5	179.4	173.8	169.2	
Final	205.2	215.4	221.3	208.2	200.2	
Daily gain[1]	.376^{b}	.476^{a}	.556^{a}	.446^{a}	.379^{b}	.041
Feed intake kg/d						
Fresh fodder	5.42	5.68	5.64	5.53	5.41	
Molasses	5.04^{b}	5.76^{a}	5.91^{a}	5.39^{b}	4.52^{c}	.169
Urea	-	.072	.148	.202	.226	
Fish meal	.400	.400	.400	.400	.400	
Minerals	.060	.060	.060	.060	.060	
Total DM	5.845^{c}	6.532^{a}	6.703^{a}	6.342^{b}	5.676^{c}	.106
Consumption index[2]	3.142	3.3350	3.360	3.347	3.086	.114
Conversion[3]	15.68	13.75	12.21	14.30	15.38	1.5

[1] Determined by linear regression of liveweight on time

[2] Daily intake of dry matter kg /100 kg liveweight/day

[3] Intake on dry matter/gain in liveweight, kg/kg

[abc] Values without superscript in common differ at $P < .05$

5% (Table 2). The plots of these data together with those for feed conversion (Figures

1 and 2), show the parabolic nature of the response curves, from which it can be concluded that the 2.5% urea level is optimum.

Figure 1:
Effect of urea concentration in molasses on rate of intake of urea, molasses and dry matter

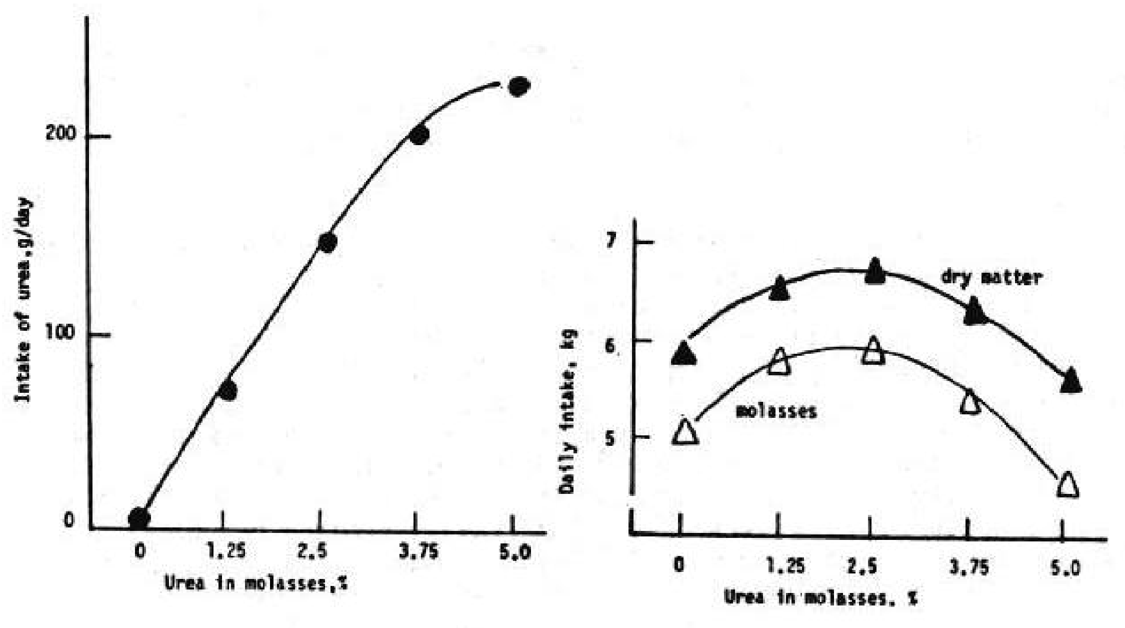
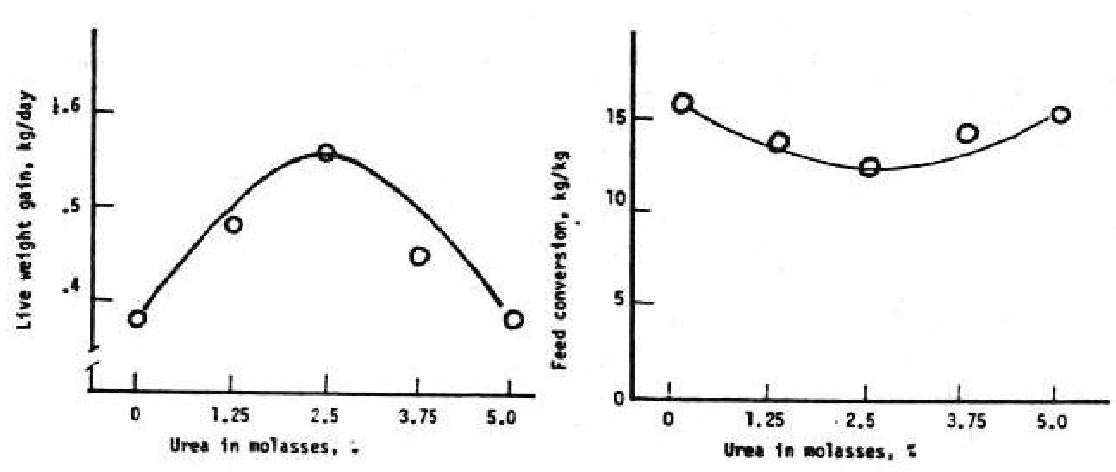


Figure 2:
Effect of urea concentration in molasses on rate of Liveweight gain and feed conversion in fattening bulls



Urea intake rose linearly as its concentration in molasses increased over the range zero to 3.75% urea, At this point daily intake was about 200 g and increased only marginally (to 226 g/d) at the 5% concentration .

Discussion

The results of this experiment indicate that in the feeding system employed here, there exists an optimum concentration of urea in molasses for maximum animal performance, This appeared to be at the level of 2.5% A trial carried out by Silvestre et al (1977b) also showed that the rate of liveweight gain increased with increasing urea concentration in molasses reaching a maximum at 3% urea in the molasses mixture, after which animal performance began to deteriorate, The basal diet was restricted forage (2% DM of liveweight) and 500 g of a protein rich meal, the molasses/urea was on a free choice basis, The average daily gain was 734 gat this 3% urea level in molasses. However, the rate of growth in their experiment was related directly to urea intake as the main factor influencing liveweight gains, In the present experiment, there are indications that both level of urea (up to 150 g/day) and of molasses contribute to better rate of growth (Table 2).

In the interpretation of the results from this experiment, it must be noted that different forages were used, and their nutritive value also varied considerably (Table 1). Salais et al (1977) reported that both the nature of the fibre and the protein content of the forage are important contributing factors in determining the responses to molasses/urea diets. A change from processing cane tops through a grinder, to produce a fine product (consisting of fragments < 10 mm), to chopping by machete into much larger fragments, (about 20 cm long) had a marked improvement on animal performance, from 0.092 to 0.530 kg liveweight/day with Zebu steers fed suger cane stalk or tops as forage sources in a molasses diet. This was attributed to the effect of changing fibre length on rumen motility and intake. Based on the higher nitrogen content of Bermuda Cross I areas and Leucaena leucocephala compared with cane forages, and the poorer growth rates obtained from the latter, the same workers concluded that level of forage protein wee an important contributing factor to the superiority of the diets based on Bermuda grass and leucaena,

It is known that as the concentration of urea in molasses is increased (over the range 0 to 15% urea) the consumption of molasses is reduced apparently due to the low palatability of urea (Silvestre et al 1977a). The average intake of molasses was highest at the 2.5% urea level in this experiment (5.91 kg/d) which was equivalent to about 2.9% of animal liveweight. The maximum total dry matter intake on the 2.55 treatment wee 6.70 kg, which was equivalent to about 3.35% of animal liveweight.

These intakes both of molasses and of total dry matter are higher than that usually observed with molasses based diets in other countries (Preston and Willis 1974 Salais et al 1977; Ffoulkes and Preston 1978); but they are similar to other reports from Mauritius (Hulman et al 1978; Gaya et al 1979).

Similar comparisons can be drawn from these reports concerning the rate of liveweight gain and feed conversion where results from Mauritius have always tended to be inferior compared with those reported elsewhere.

The high intake of molasses per se was hardly the cause of the poorer performance in the present trial since the best results were on the highest level of molasses intake.

More thorough investigation is required in order to understand the reasons for the apparently higher intakes of molasses in Mauritius and if there is a relationship between this high intake and the poorer levels of performance.

References

Alvarez F J & Preston T R 1976 Studies on urea utilisation in sugar cane diets:effect of level Tropical Animal Production 1:194-201

Alvarez F J, Wilson A, Sutherland T M & Preston T R 1976 Studies in urea utilization in sugar cane diets: effect of different methods of incorporating urea in the ration Tropical Animal Production 1:186-192

AOAC 1965 Official methods of analysis Association of-official Agricultural Chemists Washington D C

Delgado A, Veltia J L, Elias A & Dieguez R 1978 The use of pasture for beef production 5 Supplementation with molasses, urea and true protein for yearling calves fed with low quality forage Cuban Journal Agricultural Science 12:143-150

Ferreiro M & Preston T R 1976 Effect of different concentrations of urea in final molasses given as a supplement to chopped sugar cane for fattening cattle Tropical Animal Production 1:66-71

Ffoulkes D & Preston T R 1978 Cassava or sweet potato forage as combined sources of protein and roughage in molasses based diets: effect of supplementation with soybean meal Tropical Animal Production 3:186-192

Gaya H, Nasseeven R, Hulman B & Preston T R 1979 Effect of the level of fish meal on growth and feed conversion of cattle fed molasses/urea and restricted amounts of forage Tropical animal Production 4:148-153

Hulman B, Owen E & Preston T R 1978 Comparison of leucaena leucocephala and groundout cake as protein sources for beef cattle fed ad libitum molasses/urea in Mauritius Tropical Animal Production 3:1-8

Preston T R 1972 Molasses as an energy source for cattle World Review of Nutrition and Dietetics 17:250-311

Preston T R & Willis H B 1974 Intensive Beef Production 2nd Edition Pergamon Press, Oxford, New-York, Toronto, Sydney

Salais F J, Sutherland T M & Wilson A 1977 Effect on animal performance of different sources of forage in diets based on molasses and urea Tropical Animal Production 2:158-162

Silvestre R, MacLeod N A & Preston T R 1977a Voluntary intake and liveweight gain of cattle given chopped sugar cane and solutions of molasses containing different concentrations of urea Tropical Animal Production 2:1-12

Silvestre R, MacLeod N A & Preston T R 1977b Fattening cattle with molasses/ urea: Effect of different urea levels Tropical Animal Production 2: 315-318

Snedecor G W & Cochran W G 1969 Statistical Methods (6th Edition) Iowa State University Press: Iowa USA

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