FATTENING CATTLE WITH SUGAR CANE: EFFECT OF SUPPLEMENTATION WITH FINAL MOLASSES[3]

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Two growth trials are reported. In the first (of 141 days) , 42 bulls of initially about 220 kg and 2 years of age were given: (A) chopped whole sugar cane ad libitum plus 300 g/d extracted soya bean meal; (B), © and (D) as (A), but with 100, 200 or 300 g molasses/urea (2.5%) per kg fresh cape mixed into the cane; (E) as (D) , but with 600 g soya/d; (F) , chopped whole cane plus 1 kg/d wheat bran; or (G), as (F) plus 150 g soya/d. All animals received 9 g urea and 2.5 g ammonium sulphate/kg fresh cane. Two pens of three animals were allocated to each treatment. Growth rates and cane intakes were (± SEx): 61, 172, 190, 239, 122 148, 166 ± 39 g/d and 3.2, 3.2, 3.6, 3.3, 3.2, 3.4 and 3.6 ± 0.15kg DM/d for treatments (A; to (G) respectively. Molasses intakes were 0.9, 1.8, 2.6 and 2.6 kg DM/d for treatments (B) to (E) respectively. The growth response to the additional molasses was thus very poor and this was not rectified by additional protein (E). The response to wheat bran (F) and (G) was also poor (less than half that expected).

In the second experiment (of 135 days), 24 bulls of initially about 170 kg and 2 years old were given chopped whole sugar cane plus 300 g/d soya (plus minerals, urea and ammonium sulphate as above) and molasses/urea (5%) in separate feeders (H) or mixed into the cane (I), or molasses/urea (10%) in separate feeders (J) or mixed into the cane (R) . The amount of molasses mixed into the cane was defined by the voluntary intake when given separately. Two pens of 3 animals were allocated to each treatment. Growth rates and food intakes (± SEx) were: 457, 446, 475 and 554 ± 42 g/d, 2.3, 2.7, 3.1 and 3.3 ± 0.12 kg cane DM/d; and 1.2, 1.6, 0.8 and 0.9 ± 0.03 kg molasses DM/d for treatments (H) to (K) respectively. Differences in growth rates or total DMI were not significant although at the higher level of urea, the animals eat less molasses (P - 0.003) , and more cane (P - 0.007) .

It is concluded that the method of presenting the molasses (mixed or separate) was not important, and that the partition of the voluntary consumption of cane and molasses/urea can be trolled by varying the urea content of the molasses. No explanation can be offered for the very poor responses in Expt One, although it is suggested that the reason may be due to inefficiencies within the animal|microbial complex of the ruminant.

Key Words: Cattle, sugar cane, molasses, growth

The growth of cattle given unsupplemented sugar cane is generally low (Preston 1977). It has been shown that digestible organic matter intake can be increased by mixing final molasses with sugar cane (Paulino et al 1977; Montpellier and Preston 1976; Marte et al 1978). The objective of the first experiment reported here was to see whether such mixtures would also give greater growth. As will be shown, very poor responses were obtained, and a second experiment was carried out in order to test whether the method of giving the molasses was important (mixed with the cane or separately). Provisional accounts of these two experiments have already been given (Silvestre and Hovell 1978, 1978a).

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Materials and Methods

Animals, Treatments and Design:

Experiment One: Forty-two Zebu type crossbred bulls of initially about 220 kg and two years old, were ranked according to liveweight and allocated to one of seven dietary treatments. Six animals were allocated to each treatment as two pens of three animals. The treatments were thus replicated twice in a randomised block design. The dietary treatments were as follows:

A. Control. Chopped whole sugar cane plus 9 g urea and 2.5 g ammonium sulphate/kg cane (given as a solution in water mixed into the cane), plus 80 g of a 1:1 mixture of dicalcium phosphate and salt, plus 300 g soya daily.

B. As A, but with 100 g molasses/urea (2.5%) per kg fresh cane mixed into the cane.

C. As B, but with 200 g molasses/urea per kg fresh cane.

D. As B, but with 300 g molasses/urea per kg fresh cane.

E. As D, but with 600 g soya daily.

F. As A, but supplemented with 1 kg wheat bran daily (no soya).

G. As A, but supplemented with 1 kg wheat bran and 150 g soya daily.

Experiment Two: Twenty four Zebu type and crossbred bulls of about 170 kg initial weight, and 2 years old, were ranked according to liveweight and allocated to one of four treatments as two pens of three animals. The experimental design was a 2 x 2 factorial replicated twice and the dietary treatments were as follows:

H. 5% molasses/urea and cane, separate: Chopped whole sugar cane and final molasses containing 5% (w/w) urea offered in separate troughs and ad libitum. Plus 300 g soya and 80 g/d of a 1:1 mixture of salt and calcium diphosphate.

I. 5% molasses/urea and cane, mixed: As H. above, but the sugar cane and molasses mixed together in the same proportion as the voluntary consumption of sugar cane and molasses in the preceding week when offered separately. The mixture was offered ad libitum.

J. 10% molasses/urea and cane, separate: As H. above, but with 10% urea in the final molasses.

K. 10% molasses/urea and cane, mixed: As I. above, but with 10% urea in the final molasses, and the proportions of cane:molasses/urea dictated by the voluntary consumption for J. above in the preceding week.

Management and Measurements:

Experiment One: The cattle were housed in groups of three animals in covered slatted floor pens. They were fed once daily on freshly chopped whole cane, the previous days refusal being recorded. The molasses/ urea (treatments B, C, D and E) wee thoroughly mixed into the cane at feeding, the other supplements were sprinkled on top. The molasses/urea was prepared by mixing 95 parts (by weight) with 2.5 parts urea and 2.5 parts of water, the urea being mixed first into the water, and the solution then mixed with the molasses. The urea/ammonium sulphate mixture was prepared as a mixture (by weight) of 18 urea : 5 ammonium sulphate : 77 water. This wee mixed into the cane at the rate of 50 g solution per 1 kg fresh chopped cane. The cane was chopped using a Gehl forage harvester, which produced pieces of up to 2-3 cm in length. All cattle were weighed every two weeks and their growth calculated as the linear regression of liveweight on time (from day 14). Cane dry matter (DM) and ! Brix (refractometer) were measured 5 days a week, and the weekly DM intakes calculated on the weekly average. The molasses/urea wee assumed to contain 70% DM throughout, which is our normal experience. The experiment lasted 141 days.

Experiment Two: Methods were essentially those of Experiment One, with the following differences:

The cane and molasses/urea when fed separately were offered in separate troughs,

The 5 and 10% solutions were prepared by mixing 2.5% molasses/urea with a 50:50 solution (w/v) of urea and water,

The relative proportions of cane:molasses/urea when given mixed were adjusted weekly and were defined by the voluntary intakes in the preceding week of the groups given their cane and molasses/urea in separate troughs.

The experiment lasted 135 days.

Results and Discussion

Experiment One: The growth and food intake of the bulls is given in Table 1. As was reported by Marte et al (1978), there was no effect of the addition of the molasses/urea on cane intake, and thus DM intake was substantially increased (by 68%) by the addition of 300 g molasses/urea/kg cane. Since this increase wee due to the molasses, digestible DM intake should have been increased by at least this amount, and probably rather more (given that molasses is more digestible than sugar cane). Molasses additions to this level do not seem to alter the digestibility of the cane (Marte et al 1978). It wee therefore surprising that the growth response was only 180 g/d, or about 70 g/kg molasses DM added.

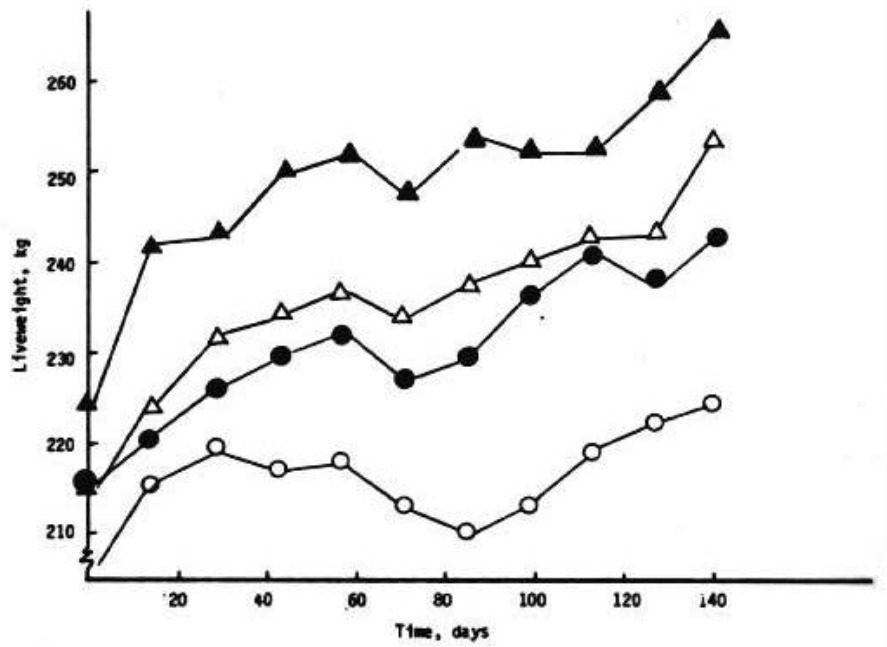
Table 1:
Food consumption and growth of Zebu and Brahman bulls given chopped whole sugar cane supplemented with molasses or wheat bran for 141 days {Expt 1)

Diet	A	B	C	D	E	F	G	
Supplement								
Molasses, g/kg cane	0	100	200	300	300	0	0	SEx
Wheat bran, kg/d	0	0	0	0	0	1	1	
Soya, g/d	300	300	300	300	600	0	150	
Liveweight								
Initial, kg	204	215	214	224	222	213	227	-
Gain, g/d[6]	61	172	190	239	122	148	166	39
Food consumption, kg/d								
Chopped whole cane[7]	12.6	12.2	12.8	12.5	12.2	13.1	13.8	0.56
Molasses/urea (2.5%)	-	1.2	2.6	3.8	3.7	-	-	-
Dry matter intake, kg/d[1]								
Chopped whole cane	3.22	3.20	3.35	3.28	3.20	3.44	3.63	0.15
Molasses/urea (2.5%)	-	0.85	1.79	2.63	2.56	-	-	-
Soya	0.28	0.28	0.28	0.28	0.56	-	0.14	-
Wheat bran	-	-	-	-	-	0.87	0.87	-
Minerals[2]	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-
N/S supplement	0.14	0.14	0.15	0.14	0.14	0.15	0.16	-
Total DMI	3 82	4.55	5.65	6.41	6.54	4.54	4.74	-
Molasses/urea %DM	-	19	32	41	39	-	-	-
Nitrogen intake, g/d[3]								
As protein	19	19	19	19	38	19	30	-
As NPN	86	97	118	129	126	90	95	-
Total	105	116	137	148	164	109	125	-
Consumption Index[4]	1.78	1.94	2.31	2.51	2.87	1.99	1.93	0.15
Feed Conversion Ratio[5]	63	26	49	26	55	31	30	5.8

[1] Molasses/urea taken as 70% DM
[2] 1:1 mixture of salt and dicalcium phosphate
[3] Calculated assuming soya to be 40% CP, wheat bran 12% CP and urea 46% N kg
[4] DMI/100 kg liveweight
[5] kg DMI/kg gain
[6] Calculated on individual animals, mean of 6
[7] Average composition (± SD) 26.1 ± 1.9% DM and 12.4 ± 1.6 Brix (40.1 ± 3.6± sugar in DM)

It was apparent early in the trial that the response was poor (Figures 1 and 2), and we conducted a thorough check of the feeding procedures, as we were worried that the correct amount of molasses was not being added. We could find no obvious errors in this, the weighing of the food or the feed refusals. We did however discover that in the treatments in which molasses/urea was mixed into the cane (diets B, C, D and E), the urea/ ammonium sulphate solution wee not being added to the cane (it was in treatments A, F and G). This mistake was rectified after the first eight weeks of the trial. For this reason the data were reanalysed from day 71 with the result shown in Table 2. Growth rates on all treatments were better in this period. However the response to the molasses remained poor.

Figure 1:
Growth of bulls given chopped sugar cane plus 300 g soya/d 0 (○), 100 (●), 200 (△) or 300 (▲) 9 2.5% molasses/urea per kg fresh cane (Expt 1)



Thus the first and obvious explanation - namely an error in the procedures - cannot be invoked. The lack of response to additional soya (diet E) makes it unlikely that insufficient protein was the reason. It is interesting that the response to wheat bran was also poor. The average response of 91 g/kg wheat bran does not compare with the 231 ± 21 g/kg reported before (Silvestre and Hovell 1978b). A second possible explanation is that the animals were in poor health and had high burdens of intestinal parasites. Although we did not do egg counts of the faeces, the bulls had in fact been wormed earlier. There were no obvious manifestations of poor health (other than the poor growth rate) and our feeling is that high parasite burdens do not provide the explanation.

Thus there is no obvious explanation for the poor response observed. We therefore conducted a second experiment in order to compare the response to molasses given with the cane, or separately.

Figure 2:
Growth of bulls given chopped sugar cane with 500 9 molasses/urea per kg fresh cane plus 300 (▲) or 600 (△) g soya/d, or cane plus 1 kg wheat bran alone (■) or plus 150 g soya/d (□) (Expt 1)

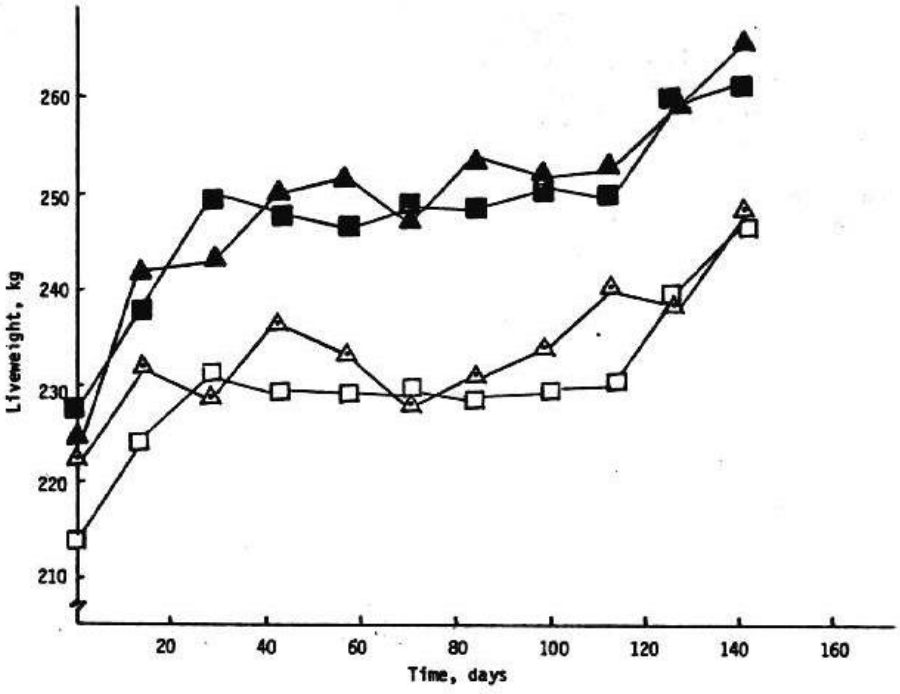
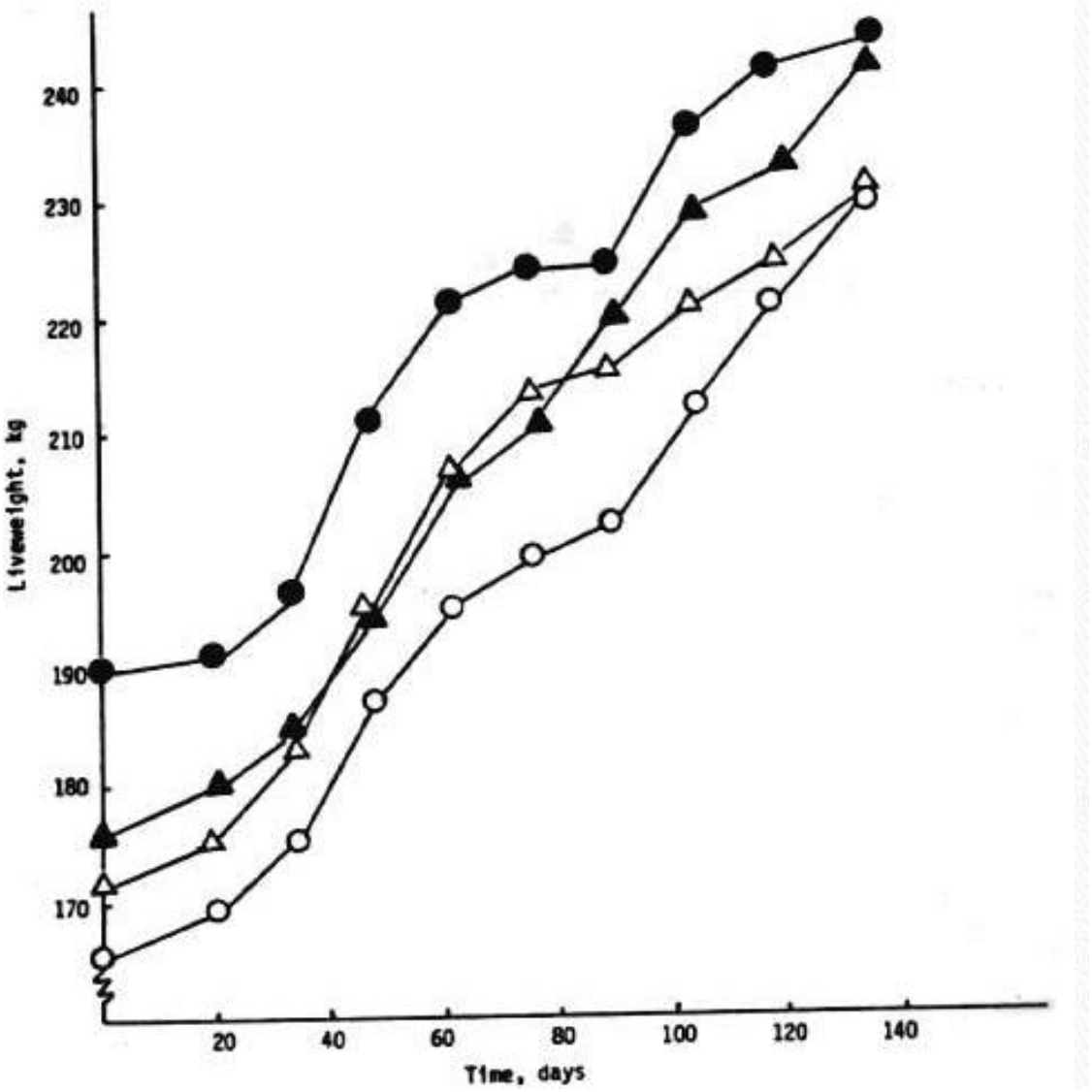


Table 2:
Food consumption and growth of Zebu and Brahman bulls from days 11 to 141 (Expt 1)

Diet	A	B	C	D	E	F	G	
Supplement								
Molasses, g/kg	0	100	200	300	300	0	0	SEx
Wheat bran, kg/d	0	0	0	0	0	1	1	
Soya, g/d	300	300	300	300	600	0	150	
Liveweight gain, g/d	182	217	246	233	262	254	176	37
Food consumption, kg/d								
Chopped whole	14.4	13.4	13.8	13 5	13.3	14.6	15.0	0.38
Molasses/urea	-	1.3	2.8	4.0	4.0	-	-	-
Chopped whole cane (DM)	3.84	3.61	3.68	3.60	3.51	3.88	4.00	0.11
Molasses/urea (DM)	-	0.91	1.96	2.80	2.80	-	-	-

Figure 3:
Growth of bulls (Expt 2) given chopped sugar cane plus 5% molasses /urea separate (•) or mixed (○) or plus 10% molasses/urea separate (△) or mixed (▲) with the cane (Expt 2)



Experiment Two: The feed consumption and growth of the animals is presented in Table 3 and Figure 3. In this experiment, the growth of all groups was substantially better than in Experiment One. There were no significant differences between individual treatments.

The combined effect of mixing, and that of the level of urea, are given in Table 4. Total try matter intake (DMI) was greater (P =0.009) when the cane and molasses were mixed than when they were given separated. However, the tendency towards improved growth, and that towards improved feed conversion efficiency, were not significant statistically.

Table 3:
Food consumption and growth of Zebu and cross-bred bulls given chopped whole sugar cane supplemented with molasses /urea (mixed or separately) for 135 day. (Expt 2) (means of 2 pens each with three animals)

Diet	H	I	J	K	
Level of urea	5%	5%	10%	10%	SEx
Feeding system	separate	mixed	separate	mixed	
Liveweight gain					
Initial, kg	166	189	171	176	4
Gain, g/d	457	446	475	554	42[5]
Food consumption kg/d					
Chopped whole cane[1]	18.8	10.4	11.9	12.6	0.46
Molasses/urea	1.9	2.5	1.4	1.6	0.09
Dry matter intake (DMI), kg/d					
Chopped whole cane	2.32	2.74	3.13	3.31	0.12
Molasses[2]	1.19	1.55	0.79	0.94	0.03
Soya	0.26	0.26	0.26	0.26	-
Minerals	0.08	0.08	0.08	0.08	-
Urea	0.10	0.12	0.14	0.16	-
Total DMI	3.95	4.75	4.40	4.75	0.11
Molasses:cane (DM)	0.51	0.56	0.25	0.28	0.04
Molasses,% DMI	.30	33	18	20	-
Consumption Index[3]	1.94	2.20	2.20	2.26	0.08
Feed Conversion Ratio[4]	8.9	10.5	8.0	10.0	1.1

[1] Average composition26.6% DM, 13.2°Brix, 42% sugar in DM
[2] Molasses DM without urea
[3] kg DMI/100 kg live weight
[4] kg DMI/kg gain
[5] Animals treated as replicates

Table 4:
The effect of level of urea and form of presentation (mixed or separately) on the food consumption and growth of Zebu and cross-bred bulls given chopped whole sugar cane and molasses/urea (Expt 2)

Molasses/urea	Separate	Mixed	P[6]	5%	10%	P[6]	SEx
Liveweight							
Initial, kg	168	182	0.025	178	174	0.25	3
Gain, g/d	466	500	0.44	452	515	0.18	305
Food consumption, kg/d							
Chopped whole cane[1]	10.4	11.5	0.055	9.6	12.2	0.007	0.33
Molasses/urea	1.6	2.0	0.013	2.2	1.5	0.003	0.06
Dry matter intake (DMI), kg/d							
Chopped whole cane	2.73	3.03	0.055	2.53	3.22	0.007	0.09
Molasses[2]	0.99	1.25	0.073	1.37	0.87	0.003	0.02
Total DMI	4.18	4.75	0.009	4.35	4.57	0.23	0.08
Molasses:cane (DM)	0.38	0.42	0.25	0.54	0.27	0.004	0.03
Consumption Index[3]	2.07	2.23	0.088	2.07	2.23	0.088	0.06
Feed Conversion Ratio[4]	8.4	10.2	0.13	9.7	9.0	0.37	0.78

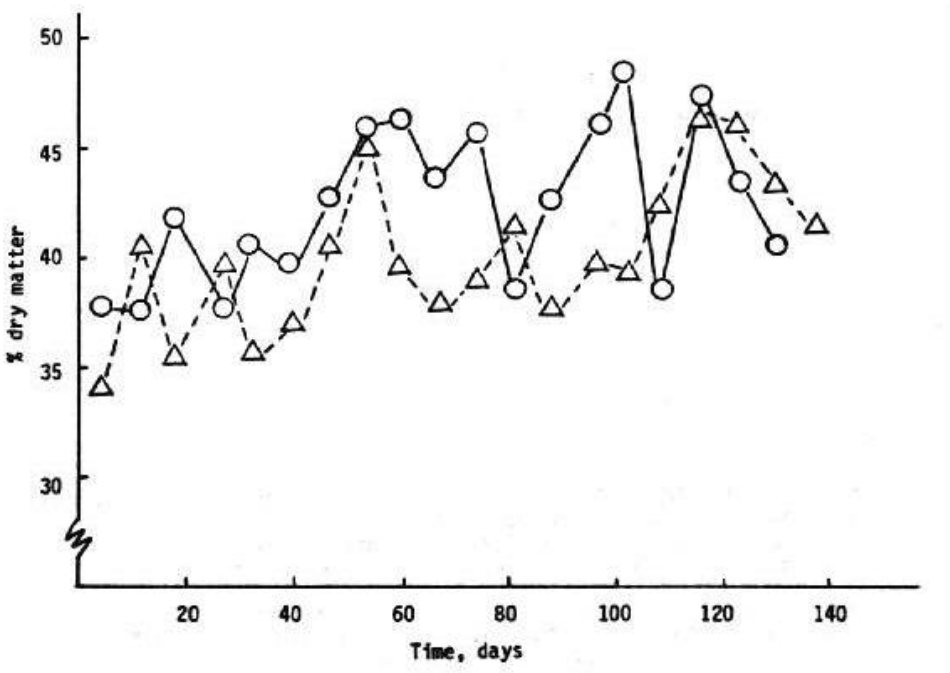
[1] Average composition 26.6% DM, 13.2° Brix, 42% sugar in DM
[2] Molasses DM without urea
[3] kg DMI/100 kg liveweight
[4] kg DMI/kg gain
[5] Animals treated as replicates
[6] Probability of t test

The effect of increasing the urea concentration in the molasses was to cause the animals to reduce their intake of molasses/urea by 36% (P = 0.003). They compensated by eating 27% more cane (P = 0.007) with the effect that total DMI was little changed. The molasses is likely to have been more digestible than the cane, and expressed as digestible DMI when calculated from the data of Marte et al (1978), the digestible dry matter (DDM) intakes become 2.82 and 2.86 kg DDM/day. The effect of urea concentration on controlling molasses intake is useful, and in agreement with previous work (Silvestre et al 1977), in which it was also found that overall growth rates were very similar at different ratios of cane to molasses.

The reason for the very poor response to supplementation (both with wheat bran, and with molasses/urea) and the overall poor growth in the first experiment is not clear. The very different growth rates and feed conversions were obtained with animals from the same background in the same building and of similar initial weights. The cane was of poor quality in both experiments (26.1% DM, 12.4° Brix, 40% sugar

in DM, and 26.6% DM, 13.2° Brix and 42% sugar in DM respectively). Thus there were no obvious differences in cane quality between experiments as is emphasised by Figure 4, in which the average sugar content (% DM) is plotted on a weekly basis. As we stated above, we could find no reason to fault the care of the animals or their health. We are therefore forced to conclude that the explanation may lie in a real inefficiency within the complex animal/microbial system of the ruminant.

Figure 4:
Sugar content of cane (% dry matter) with time on Expt 1 (△) Expt 2 (○)



Conclusions

The second experiment confirmed that animals given chopped whole sugar cane and molasses/urea plus a protein supplement can generally be expected to make gains of 400-500 g/d. The first experiment suggested that with sugar cane diets, in some circumstances responses to supplementation with protein and molasses may be below expectation.

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