MOLASSES AND SUGAR CANE JUICE AS ENERGY SUPPLEMENTS FOR MILK PRODUCTION[1]

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Two experiments are described. In experiment 1 two groups each of three crossbred (Holstein x Zebu) cows and their calves received ad libitum molasses or cane juice with pasture and/or chopped sugar cane during 6 consecutive periods each of about 15 d. In the first, second and last periods the diets were identical for both treatments, and were molasses, pasture and chopped sugar cane during period 1; molasses and chopped sugar cane during period 2 and molasses and grazing during period 6. All molasses and sugar cane juice contained urea at 2.5 and 0.8% w/v respectively. Wheat bran (2 kg/d) was fed throughout the experiment. Milking was once daily, calves suckling their dams for a few minutes before milking to stimulate milk let-town and for 30 minutes after milking.

Juice was given instead of molasses to 3 cows during the 3rd period the forage consisting of chopped sugar cane. In period 4 both group. were allowed a period of restricted grazing as well as chopped cane, while during period 5 the chopped cane was removed from the diet and pasture was the only source of forage.

Milk yield was reduced on both the molasses and juice rations when pasture was substituted wholly or partly by sugar cane. The reduction in yield was greater on the cane juice than the molasses-based diet.

In experiment 2 the most promising diets (restricted grazing plus 2 kg/d of wheat bran plus sugar cane juice or molasses) were studied measuring daily intake of juice or molasses, the milk consumed by the calf and saleable milk yield. There were no significant differences between the sugar cane juice or molasses diets in terms of milk yield, calf growth rate, persistency of milk yield or dry matter intake.

Key words: Cattle, milk production, molasses, sugar cane juice, forage quality

Dry season supply of energy and protein to cattle in the Tropics presents problems both in terms of availability and cost of possible nutrient sources.

The proposal to separate sugar cane into energy rich juice and low digestibility fibre, with the latter being used as fuel (Preston 1980), would appear to provide an energy-rich supplement capable of maintaining high levels of production in dairy cows, Gains of up to 1.3 kg/d were reported in fattening bulls by Sanchez and Preston (1980).

In CEAGANA, molasses is used as the energy source in dry season rations for the dairy herd The experiments to be reported-here were designed to compare sugar cane juice with molasses in various feeding systems.

Materials and Methods

Experiment 1: Six Holstein cross Zebu cows were selected from the herd on the basis of stage of lactation and milk yield. The herd is managed on a restricted suckling system with once daily milking. The cows were tied in individual stalls. They were milked by hand between 0700 and 0800 hr and milk weight was recorded daily. The calves were allowed access to their mothers before milking to stimulate milk letdown and after milking were suckled until milk flow stopped. Milk intake by the calves was

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estimated by weighing the calves before and after suckling. All six calves were kept in one pen with free access to molasses (2.5% urea), chopped sugar cane and wheat bran.

The composition of the ration given to the cows was changed at approximately fortnightly intervals (see Table 1). During the 4 periods when grazing was practised (periods 1, 4, 5 and 6) the cows were at pasture (mainly *Brachiaria decumbens*) from 0730 to 1430 hr On returning to their individual stalls, molasses or cane juice and chopped whole sugar cane were freely available in separate feeding troughs except for the final month (periods 5 and 6) when sugar cane was withdrawn from the diet. 2 kg/d wheat bran was fed throughout the trial.

Table 1:

Experimental rations per period

Period	Duration (d)	Designated Treatment	
		Molasses	Juice
I	15	Molasses Chopped sugar-cane Grazing	
II	17	Molasses Chopped sugar-cane	
III	12	Molasses Chopped sugar-cane	Cane juice Chopped sugar-cane
IV	15	Molasses Chopped sugar-cane Grazing	Cane juice Chopped sugar-cane Grazing
V	15	Molasses Grazing	Cane juice Grazing
VI	14	Molasses Grazing	

Three cows received molasses (2,5% urea) throughout the trial while three received molasses for the first four weeks, subsequently changing to cane juice (0.8% urea w/v) for six weeks, followed by a final control period of two weeks on molasses.

Weight gains of the calves were determined by linear regression of weight with time.

The cane juice was obtained by passing sugar cane stalks through a 3 roller mill (McKinnon, Aberdeen, Scotland). The Brix° (% dissolved solids) ranged from 15 to 20. Chopping of the whole sugar cane (including the tops) was done with a Hesston 2000 forage harvester.

Experiment 2: The aim of this experiment was to study in more detail the most promising diets from Experiment 1. Daily intake of juice and molasses were measured in addition to milk yield.

The procedure was the same as in Experiment 1 but with six different Holstein cross Zebu cows. After receiving molasses (2.5% urea w/v) for the first two weeks three of the cows were changed to sugar-cane juice (0.8% urea) for the remainder of the experiment. Grazing was from 0730 to 1530 hr after which the cows returned to their stalls where molasses or juice was available ad libitum together with 2 kg/d of wheat bran.

Results

Experiment 1: The milk yields and persistencies for each period are shown in Table 2 and Figure 1. One cow in the molasses group became lame and had to be removed from the experiment.

Table 2:

Milk yield and persistency of yield of two groups of three crossbred cows given combinations of pasture, chopped sugar cane and molasses or cane juice (Experiment 1)

Days	Forage Source	Milk Yield (kg)		Persistency[1]			
				Molasses[2]	Juice[2]	$SE_{\bar{x}}$	Prob
Standard:		Molasses	Molasses				
0 - 15	Sugar cane Pasture	7.9	7.3	-	-	-	-
16 - 32	Sugar cane	7.6	6.4	.99	.99	± .06	NS
Experimental:		Molasses[2]	Juice[2]				
33 - 44	Sugar cane	6.2	4.4	.82	.64	± .03	.01
45 - 59	Sugar cane Pasture	7.0	5.5	.92	.82	± .03	.06
60 - 79	Pasture	7.5	6.7	.99	.99	± .04	NS
Standard:		Molasses	Molasses				
77 - 88	Pasture	7.4	6.1		-	-	-

[1] Milk yield per period as fraction of average yield in the first (0 - 15d) and last (75 - 88d) periods

[2] Designated treatments

The most important findings from this experiment were:

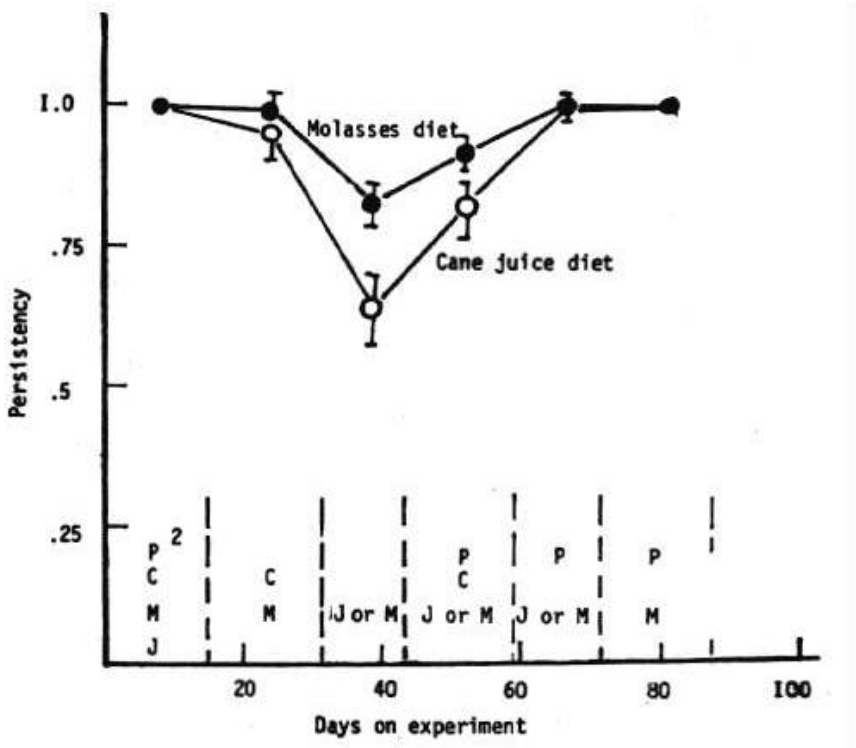
(i) The reduction in milk yield when grazing was substituted wholly or partly by chopped whole sugar cane.

(ii The inferiority of cane juice compared with molasses when whole sugar cane was also present in the diet.

The liveweight gains of the calves for the 41 days when their mothers received juice or molasses are compared in Figure 2. The rate of gain for the calves suckled by cows receiving cane-juice was greater than for those suckled by cows receiving molasses ($P < .05$).

Experiment 2: The intakes of molasses and cane juice and milk yields during the 41 days experiment are shown in Table 3. There were no significant differences in milk yield nor were there any significant differences in the rate of growth of the calves (520 g/d for calves with dams receiving juice and 480 g/d for calves with dams receiving molasses). There were no significant differences in persistency values for milk yield or dry matter intake for cows consuming sugar cane juice or molasses (Table 4).

Figure 1:
Persistency[1] of milk yield according to composition of diet



[1] Persistency is the yield during the experimental period x as fraction of mean yield during first and last periods
[2] P = pasture, C = cane, M = molasses, J = juice

Table 3:

Comparison of intake and milk yield on cane juice and molasses diets (Experiment 2)

	Period I		Period II		Period III	
	Molasses	Molasses	Juice	Molasses	Juice	Molasses
Daily intake of juice/molasses						
Litres	7.6	7.6	37.2	6.7	40.1	6.9
Dry matter, kg	7.5	7.3	6.3	6.4	6.8	6.6
Sugars, kg[1]	5.6	5.5	5.7	4.8	6.4	4.9
Daily milk yield, kg						
Saleable	4.2	5.9	4.2	6.1	3.6	6.4
Drunk by calf	1.6	1.7	2.3	2.7	1.9	2.4
Total	5,8	7.6	6.4	8.8	5.5	8.8

[1] Estimated assuming 75% sugars in DM of molasses and 90% sugafs in DM of juice (Sanchez and Preston 1980)

Figure 2:
*Change in liveweight of calves when their dams received cane juice (**!**) at or molasses (**"**) (Experiment 1)*

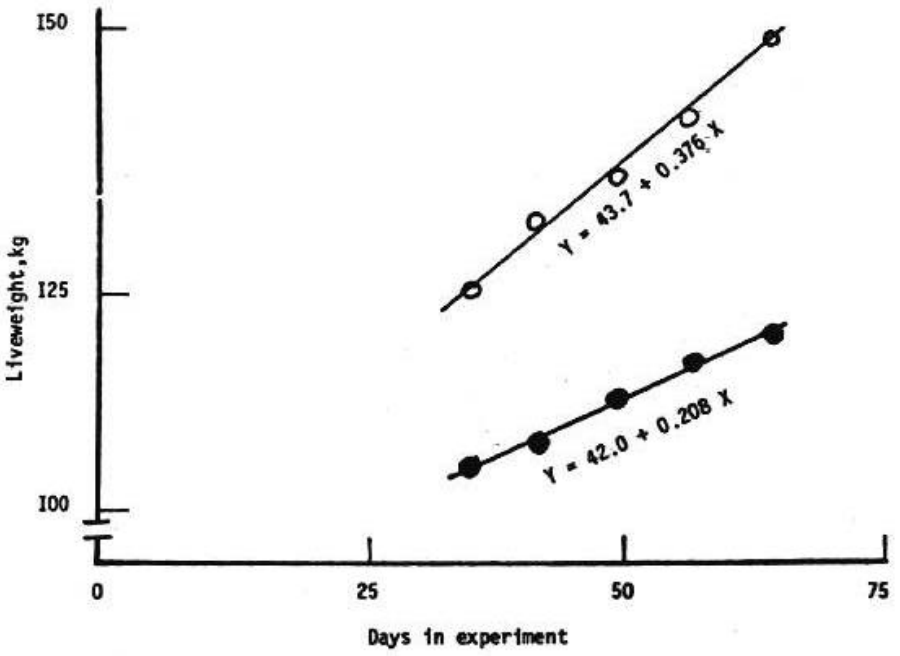


Table 4:
Persistency[1] values for milk yield and dry matter intake of juice/molasses (Experiment 2)

	Individual Periods			Periods II and III Combined		
	I	II	III	Mean	$SE_{\bar{x}}$	Prob
Milk yield						
Molasses	1.00	1.15	1.14	1.15	± .07	.20
Juice	1.00	1.09	.94	1.01		
Dry matter intake						
Molasses	1.00	.88	.90	.89	± .026	.12
Juice	1.00	.85	.81	.83		

[1]Persistency calculated as yield (or intake) in periods II and III expressed as as fraction of yield (intake) in period I

Discussion

The reduction in milk yield when sugar cane was included in the diet was presumably a manifestation of the low rumen degradability of cane fibre (Fernandez and Hovell 1978) which presented a physical limitation to the intake of grass, thus lowering total intake of digestible nutrients. The more marked effect on cows receiving juice is likely to be because of the lower rumen pH in cattle consuming juice compared to molasses based rations (Fernandez et al 1980) and low rumen pH is known to have a negative relationship with cellulose digestion (Hughes-Jones and Peralta 1981) which could result in increased accumulation of fibre in the rumen and thus physically limit voluntary intake. Additional evidence as to the deleterious effects of combining chopped cane with juice is shown by the lower intakes of juice when chopped cane rather than grass provided the fibre source for growing cattle offered sugar cane juice (Gill et al 1981).

The better growth rates of the calves suckled by cows which consumed juice rather than molasses in Experiment 1, implies that either the energy content of the milk was higher or milk consumption was different. There were no differences in calf growth rate in Experiment 2.

Conclusions

The results of these experiments suggest that when grazing is freely avail able, sugar cane should not be fed to milking cows as this will decrease total feed intake and hence production.

In the dry season when pasture availability is low but sugar cane is avail able, then it will be advantageous to provide some grazing, even if very restricted in combination with the sugar cane.

It would appear that the response in terms of milk yield is more sensitive to the type of forage present in the diet, when cane juice as-opposed to molasses is used as an energy source.

Similar responses in terms of feed intake, milk yield and calf growth rate were obtained when ad libitum molasses (with 2,5% urea) was replaced by sugar cane juice (with 0.8% urea) in a restricted grazing system.

References

Fernandez Angela L Hovell FD DeB 1978 The rumen degradation of rice and cane fibre in animals eating sugar cane or molasses Tropical Animal Production 3:169 abstract

Fernandez Angela, Gill Margaret, Done F and Preston T R (1980) Studies on the rumen fermentation pattern in cattle receiving diets based on chopped whole sugar cane or sugar cane juice Tropical Animal Production 5:288 Abstract

Gill Margaret, Done E', Berry S & Preston T R 1981 The effect of forage on voluntary intake and liveweight gain in cattle receiving auger cane juice Tropical Animal Production (in press)

Hughes-Jones H R & Peralta G 1981 Observations on the degradabilities of feedstuff in situ in cattle on diets with or without molasses Tropical Animal Production 6:174-177

Preston T R (1980) A model for converting biomass (sugar cane) into animal feed and fuel 1 Animal Production Systems for the Tropics Meeting organized by IFS and PNAC Aborlan, Palawan, Phillipines, May 19-21, 1980

Sanchez M & Preston T R 1980 Sugar cane juice as cattle feed: comparison with molasses the presence or absence of protein supplement Tropical Animal Production 5:117 124

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