Tropical Animal Production 1982 7:169-173

FATTENING CATTLE WITH SUGARCANE JUICE: EFFECT OF THE CONSERVATION OF JUICE WITH AMMONIA AND THE USE OF LEUCAENA LEUCOCEPHALA AS A SOURCE OF PROTEIN AND FORAGE[1,2]

F Duarte[3], R Elliott[3,4] & T R Preston[3]

Facultad de Medicina Veterinaria y Zootecnia, Universidad de Yucatán, Apartado 116-D, Mérida, Yucatán, México

20 young bulls (initial liveweight 130-230 kg) were distributed between 5 groups , each group containing 4 animals. One group received fresh cane juice/urea ad libitum with 400g / animal/d fishmeal and fresh *Leucaena leucocephala* forage at 2% liveweight (control). The other four groups received sugarcane juice conserved with aqueous ammonia (4.3 g NH_3/ 1 of juice), with the same level of supplementation of leucaena. Two of the groups received fish meal (400 g/d) and two groups did not.

Mean liveweight gains (kg/d) were : 1.05 for the fresh juice treatment, and 1.02 and 0.85 for the groups receiving conserved juice with and without fishmeal respectively. Respective conversions were 4.8, 5.7 and 5.8

Key words: cattle, sugarcane, sugarcane juice, leucaena, ammonia

One of the more viable alternatives for achieving a greater production of food of animal origin is through the intensification of production (Preston and Willis 1975). In some areas of the tropics this has been achieved through the utilization of sugarcane and by-products of the sugar industry (Preston 1972, 1977). A recent work reported much higher animal performance on sugarcane juice diets (Sanchez and Preston 1980) than from molasses (Preston 1972) or sugarcane (Preston 1977) based diets. This use of sugarcane, through its fractionation into the two components, juice and fibre (the latter still retains residual sugars), would appear to offer an important alternative for the utilization of this plant for animal nutrition and the production of fuel (Preston 1980).

Due to the very high content of soluble sugars found in sugarcane juice, it is necessary to give, together with this energy source,a source of non-protein nitrogen for efficient use of the sugars by the rumen micro-organisms. Aqueous ammonia, as well as being a source of non- protein nitrogen, has been shown to be an excellent sugar preservative in cane silage (Alvarez and Preston 1976) and of other by-products such as hene - quen pulp (Godoy et al 1979). Recently it was also reported that aqueous ammonia is equally as efficient in preventing spontaneous fermention in sugarcane juice (Bobadilla and Preston 1981; Duarte et al 1981).

[1] *This work forms part of a thesis submitted to the University of Yucatán as partial requirement for an MSc in Tropical Animal Science*

[2] *The financial support of the International Foundation for Science is gratefully acknowledged as is the support of Srs. Adolfo Peniche and Luis Hurbe of the Compañia Nutrisur de Merida, Yucatan, whose financial contribution allowed the purchase and reconstruction of the sugar - cane mill.*

[3] *Present addresses:* F.Duarte, Universidad Autónoma de Chapingo, Chapingo, Estado de Mexico ; R.Elliott, University of Queensland, St Lucia, Brisbane, Australia T.R.Preston, James Cook University, Townsville, Queensland 4811, Australia

[4] *Technical Cooperation Officer, Overseas Development Administration. London, UK*

Other important factors for efficient use of high sugar, liquid diets for ruminants are sources of forage and by-pass proteins (Preston and Leng 1980). It has been shown that for diets based on molasses/urea, forages of high quality such as those of *Leucaena leucocephala* (Hulman et al 1978), cassava (Fernandez and Preston 1978) and sweet potato (Ffoulkes and Preston 1978) are capable of supplying both the forage and protein requirements and give a good level of animal performance.

The objectives of the present work were to evaluate sugarcane juice preserved with aqueous ammonia as the basal diet for fattening cattle , when the forage of *Leucaena leucocephala* is used as the only source of forage in the diet.

Materials and Methods

Treatments and experimental design: A randomized block design was used with the following treatments:

(A) Fresh sugarcane juice, containing urea and supplemented with leucaena and fishmeal (control).

(B) Sugarcane juice preserved with aqueous ammonia and supplemented with leucaena and fishmeal.

(C) Sugarcane juice preserved with aqueous ammonia and supplemented with leucaena, but without fishmeal.

20 young bulls were used, divided uniformly between 5 groups, assigning one group to diet (A) (control) and two groups to each of the treatments (B) and (C).

Animals: The young bulls used were of the Zebu breed, and had a mean initial weight of 136 kg (between the limits 130-230 kg). All the animals were vaccinated and deparitisised before the start of the trial , which lasted 120 days, of which the first 30 days were the adaptation period.

Housing: The 5 groups were housed in separate, open corrals (approximately $40m^2$/animal), equipped with covered troughs and waterers, and a slatted roof.

Diets: In treatment (A) the level of urea in the juice was 5 g/l. The concentration of aqueous ammonia in the juice used in the treatments (B) and (C) was the equivalent of 4.3 g of NH_3/l. The aqueous ammonia was poured into the recipients before filling these with the sugarcane juice which came directly from the sugar mill.

The sugarcane was brought from the Ejido Justicia Social, which is situated in Santa Rosa, some 200 km from the experimental farm of the Facultad de Medicina Veterinaria y Zootecnia of the University of Yucatan where the trial was carried out. The cane was brought twice a week and stored in the open before being milled. The juice was extracted from the stalks by passing these through a 3-roller crusher. The mean extraction rate was in the range 45-50%. The mean degrees Brix value for the juice during the trial was 16°.

The animals in treatment (A) received fresh juice twice a day, at 0900 and 1500 h, usually within 60 minutes after having extracted it from

the cane.

The preserved juice was given once a day, in the morning, usually after 4 or 5 days preservation. The leucaena was chopped and fed, also in one feed/day in the morning. All animals received a commercial mineral mix at the level 60 g/animal/day.

The fishmeal was of local manufacture and contained approximately 45% protein . The leucaena forage was harvested from the roadsides around the faculty, and was given fresh to the animals at a level of 2% of their live weight. The dry matter was 35.4 ± 1.4% and had a mean content of 8.71 ± 0.94% of mimosine.

Measurements: Liveweights of the animals were recorded at intervals of 14 days, and rate of liveweight gain was calculated by linear regress - ion, using the mean weight of the animals in each groups as the dependant variable.

Intake was measured by daily weighing of feed refusals and determin - ing the dry matter content of all dietary components.

Results

At the start of the trial two of the four animals receiving the con - trol treatment (fresh juice with urea) presented symptoms of intoxication characterised by poor coordination and progressive weakening. They recovered after 4 days of grazing without sugarcane juice. Three of the eight animals receiving treatment (C) (juice preserved with ammonia and leucaena forage, but without fishmeal), suffered from bloat.

Table 1:

Mean values for performance parameters of Zebu bulls fattened on a sugarcane juice diet

	Fresh juice	Juice conserved with NH_3		
	With fish meal	With fish meal	Without fish meal	$SE_{\bar{x}}$ (P)[3]
Liveweight, kg				
Initial	179	186	182	
Final	275	280	257	
Daily gain;	1.05	1.02	0.85	± .12 (.42)
Intake, kg/d				
Fresh juice	17.2	19.7	18.8	± 2.4 (>.5)
Leucaena	4.1	4.25	4.45	
Fishmeal	0.40	0.40	-	
Minerals	0.06	0.06	0.06	
Total DM	4.50	4.90	4.35	± .10 (.18)
Consumption Index[1]	1.98	2.11	1.99	± .08 (.37)
DM conversion[2]	4.28	4.83	5.57	± .69 (>.5)

[1] kg DM/100 kg LW/d

[2] kg DM consumed/kg liveweight gain

[3] Probability of significance according to the ANOVA of the 4 groups which received conserved juice

It was not possible to determine whether this condition was related to the dietary treatments or not.

Mean values for animal performance parameters for the different treatments are presented in Table 1. The liveweight gains of all animals that survived to the end of the trial were very uniform (the r^2 value for all groups being above 0.99).

Discussion

It was not possible to determine the exact cause of the intoxification observed in animals fed fresh sugarcane juice. The symptoms and manner in which they recuperated indicated a condition similar to that reported for molasses (Verdura and Zamora 1970). It was noted that animals receiving preserved juice with ammonia showed an intake pattern in which they consumed small quantities at frequent intervals, in comparison with those receiving fresh juice which consumed relatively greater quantities in the morning immediately after having been given the sugarcane juice . It is possible that such a difference in the pattern of consumption could have been related to the incidence of toxicity, this being observed only in the fresh juice treatment. In addition to its obvious value as a preservative, it would therefore seem that the ammonia also contributed to regulate consumption.

On the other hand the high pH of the juice, caused by the ammonia could be a disadvantage as alkaline conditions tend to favour the growth of micro-organisms such as *Leuconostoc* and *Mesenteroides*. The incidence of bloat, which was observed only in the conserved juice treatment, without fishmeal, became apparent at a time when the juice was showing signs of thickening, probably due to the presence of dextrose, which substance is produced by the bacteria *Leuconostoc*.

Both types of illness were apparently caused by factors which related to the management of the juice, and it should be possible to control this.

The most interesting aspect of the results is the high animal performance in terms of daily liveweight gain and feed conversion for all treatments. The importance of these results is even more apparent when one takes into account the breed used (Zebu) for which the genetic potential , even for diets of cereal concentrates, does not exceed 0.9 kg/d (Willis and Preston 1968). The results obtained here with the juice are similar to those reported by Sanchez and Preston(1980) in which a diet based on sugarcane juice supported daily liveweight gains in crossbred cattle (Holstein x Zebu) of around 1.2 kg/d, this value being very similar to that obtained with concentrate diets in Cuba (Preston and Willis 1975). It would seem to be possible, with diets based on sugarcane juice,to achieve animal performances in the tropics comparable to those obtained in temperate countries where feeding and management are near optimum.

Conculsions

The utilization of sugarcane juice opens new and promising alternatives for the fattening of cattle in the tropics. It is worth noting that in Mexico during 1981, 2,000,000 t of sugarcane were not utilized for various reasons. The use of sugarcane juice for animal feed would result in

a better overall utilization of the total production of sugarcane. Moreover there exist large extensions of suitable land for the cultivation of sugarcane which have not been exploited because they are a long way from the sugar mills, and which at present support low animal production/ unit of land area. However, the yield of biomass/unit of land area could be raised by the culitvation of sugarcane with a consequent improvement in the yield of animal products.

References

Alvarez J F & Preston T R 1976 Ammonia/molasses and urea/molasses as additives for ensiled sugarcane Tropical Animal Production 1:98-105

Bobadilla Milagros & Preston T R 1981 The use of Sodium Benzoate and Ammonium Hydroxide (aqueous - NH_3) as preservative for sugarcane juice Tropical Animal Production 6:345-349

Duarte E, Mena A, Elliott R & Preston T R 1981 A note on the utilization of aqueous ammonia as a preservative for sugarcane juice in ruminant diets Tropical Animal Production 6: 257-260

Fernandez Angela & Preston T R Cassava forage as a fibre and protein supplement in molasses based diets : effect of level of forage and supplementation with soybean Tropical Animal Production 3:109-113

Ffoulkes D & Preston T R 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

Godoy R, Herrera F, Carcaño R, Elliott R & Preston T R 1979 Preliminary observations on the use of anhydrous ammonia with and without molasses for the preservation and utilization of ensiled sisal pulp Tropical Animal Production 4:276-280

Hulman B, Owen E & Preston T R 1978 Comparison of *Leucaena leucocephala* and groundnut 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 a feed for cattle World Review of Nutrition and Dietetics (Ed G H Bourne) Karge:Basle

Preston T R 1977 Nutritive value of sugarcane for ruminants Tropical Animal Production 2: 125-142

Preston T R 1980 A model for converting biomass (sugarcane) into animal feed and fuel In: Animal Production Systems for the Tropics Provisional report No. 8 IFS Stockholm

Preston T R & Leng R A 1980 Utilisation of tropical feeds by ruminants In Ruckebusch and Thivend (eds) Digestive Physiology and Metabolism in Ruminants MTP Press Lancaster UK

Preston T R & Willis M B 1975 Intensive beef production Pergamon Press Oxford UK

Sanchez M & Preston T R 1980 Sugarcane juice as cattle feed ; comparisons with molasses in the presence or absence of a protein supplement Tropical Animal Production 5:117-124

Verdura T & Zamora F 1970 Necrosis cerebro-cortical en ganado bovino alimentado con niveles altos de melaza Revista Cubana Ciencia Agrícola 4:209-214

Willis M B & Preston T R 1968 The performance of different breeds of cattle in Cuba Animal Production 10:77-84

Received 23 July 1982

Translated from the Spanish