Supplementation of Grazing Cattle with Molasses-Urea or Molasses-Poultry Litter During the Dry Season

Juan Carlos Ku Vera* and Jose Roberto Salcedo Meza*

Abstract

Zebu cattle grazing guinea grass received supplements of molasses-urea or molases-poultry litter during the dry season in a cattle ranch in Mexico.

Thirty male Zebu cattle with an average liveweight of 175 kg were used. The experimental treatments were as follows: grazing of guinea grass without supplements (T1); grazing of guinea grass plus 2 kg/head/day of molasses-urea (3% urea) (T2) and grazing of guinea grass plus 2 kg molasses mixed with 1 kg poultry litter/head/day (T3). Supplements were offered to the cattle only during the dry season. During the rainy season the three experimental groups were only grazing guinea grass.

Liveweight gains during the dry season for the T1, T2 and T3 groups were 235, 433 and 503 g/head/day, respectively. Liveweight gains during the rainy season for the T1, T2 and T3 groups were 687, 685 and 632 g/head/day, respectively. The combined liveweight gains during the dry and rainy seasons were 523, 594 and 586 g/head/day for the T1, T2 and T3 groups, respectively.

There were differences in the liveweight gain during the dry season between the groups of cattle which received or did not receive supplements. However these differences disappeared during the rainy season when the group of cattle which did not receive supplements compensated the liveweight gain.

Introduction

Cattle production in Mexico shows marked contrasts. One can find both intensive-type cattle farms along with traditional subsistence-type farms. This is largely due to the peculiar systems of land ownership prevailing in the country.

Beef cattle production is located mainly in the tropical rangelands of South Mexico and in the arid and semi-arid areas in North Mexico. In the tropical areas the main cattle type available is *Bos indicus*, whereas in the North the main cattle type is *Bos taurus*.

Dairy cattle production is located mainly in the temperate areas of central Mexico and in very localized dairy zones towards the West and North of the country. One of the most popular breeds of dairy cattle in Mexico is Holstein-Friesian, although there are many herds of Brown Swiss cattle which are found mainly in the grazing areas.

Mexico is self-sufficient in the production of beef meat, but it imports large amounts of powder-milk (e.g. 250,000 tons in 1989) from industrialized countries to meet the domestic demand. Beef cattle production is generally extensive with very limited technical inputs. Milk production is mainly specialized and intensive although there are many farms with the double-purpose system mainly in the tropical areas. Beef cattle are also exported alive to the USA by cattle farmers in North Mexico to be fattened in the Southern feedlots of the USA.

Even when most of the medium/large private beef cattle farmers are well-off economi-

* Facultad de Medicina Veterinaria Zootecnia, Universidad Autonoma de Yucatan, Apartado Postal 116-D, 97100 Merida, Yucatan, Mexico.

cally, the main problem facing animal production at present in Mexico is that it does not fulfill its very fundamental purpose namely : to provide the Mexican people with a source of animal protein of good quality and at a low price. Thus the fundamental problem for animal scientists in Mexico is how to increase the low intake of animal protein by large strata of the Mexican population (mainly low income groups). This problem is obviously not a strictly technical one but it is rather a problem which requires sound economical and social considerations.

Alternative sources of feed for ruminant animals must be found to reduce the imports of concentrate feeds for dairy cattle. The development of feeding systems based on agricultural by-products (straw) and organic wastes (animal excreta) must be encouraged.

There is a strong need to increase significantly the research funds available to animal scientists in Mexico to solve the numerous technical problems which limit an increase in animal productivity. The development of rational, efficient and ecologically-oriented systems of cattle production must be a first priority for the Mexican Government at present.

Cattle production in the tropical rangelands of Mexico is seasonal due to the irregular pattern of rainfall throughout the year which determines changes in the amount and nutritive value of the herbage available for the grazing stock. Tropical pastures are characterized by a low dry matter digestibility and a low voluntary feed intake (Minson, 1990 ; Leng, 1990).

During the dry season, the nutritive value (dry matter digestibility, % crude protein) of the herbage available is low and frequently grazing cattle cannot meet even their energy requirements for maintenance.

Supplementation of grazing cattle with energy-nitrogen sources during the dry season may provide the necessary nutrients required to maintain an efficient rumen fermentation of the low quality herbage consumed.

Only a few studies have been carried out in Mexico (Butterworth *et al*., 1973) to evaluate the potential of molasses-non-protein nitrogen supplements to improve the liveweight performance of grazing cattle during the dry season.

Materials and methods

Expt. 1 was carried out in a cattle ranch located in Yucatan's Peninsula in Southeast Mexico. The herd was composed exclusively of various crosses of *Bos indicus* (Zebu) cattle. The region in which the ranch is located is characterized by a dry tropical environment and rainfall is very seasonal, with most of the rain falling between late May and early October.

Animals : Thirty entire male cattle with an average liveweight of 175±29 kg at the start of the experiment were used. The cattle were allocated at random to three different treatments of ten cattle each:

T1 : Grazing guinea grass (*Panicum maximum*) without supplement.

T2 : Grazing guinea grass plus supplementation with 2 kg/head/day of a mixture of molasses-urea (3% urea in molasses).

T3 : Grazing guinea grass plus supplementation with a mixture of 2 kg molasses (without urea) plus 1 kg of poultry-litter/head/day.

The molasses-non-protein nitrogen supplements were offered only during the dry season (83 days) from mid-February to mid-May. The administration of the supplements was discontinued at the onset of the rainy season (mid-May) when the three experimental groups of cattle were kept only on the grazed pasture. All the experimental bulls were weighed approximately every month after a 16 hour fast.

Grazing management : The pasture crop available at the ranch was guinea grass (*Panicum maximum*). The experimental bulls were taken daily from the central corrals of the ranch to the grazing paddocks at 16 : 00 h and they remained there overnight. They were taken back to the corrals at 07 : 00 h the next day. At 07 : 00 h every morning, the bulls were separated according to the treatment and the different supplements were offered. Drinking water and a mineral block were available only in the morning and early afternoon while the bulls were kept in the corrals.

Data on liveweight changes were subjected to an analysis of variance and the treatment means were tested by using the least significant difference procedure (Snedecor and Cochran, 1967).

Expt. 2 Dry matter digestibility of sun-dried pig excreta (SDPE). Four zebu entire male cattle were used. Cattle were given twenty-five days for adjustment to the eating of SDPE.

Initially cattle were given a ration consisting of elephant grass (*Pennisetum purpureum*) and SDPE mixed with molasses. The amount of elephant grass and molasses given was gradually reduced while the amount of SDPE was gradually increased through the twenty-five day period and by that time the cattle were eating exclusively SDPE without any molasses.

The cattle were then held in metabolism crates during six days for adaptation to the crates. *In vivo* dry matter digestibility was determined as described by Schneider and Flatt (1975). Complete fecal collections were carried out during eight days while the cattle were held in metabolism crates and fed exclusively SDPE. The pig excreta were offered at 8 : 30 h every day and feed refusals were weighed the next morning just before feeding. Water was freely available and 50 g of a commercial mineral supplement was given daily to the cattle. In a separate trial the ruminal dry matter degradability of SDPE with or without treatment with NaOH was investigated by incubating nylon bags containing SDPE in the rumen of four entire male Zebu cattle fitted with permanent rumen cannulas and fed star grass (*Cynodon nlemfuensis*). Duration of incubation in the rumen was 24, 36, 48, 72 and 84 hours. Two nylon bags were incubated in each animal for each period of incubation. Three gram of SDPE was introduced into each bag. After incubation the bags were washed with tap water and put to dry in an oven at 60℃ during 48 hours. Ruminal dry matter degradability was estimated by weight difference.

Results

Expt. 1 The average liveweight gains during the dry season (83 days) for the T1, T2 and T3 groups were 235, 433 and 503 g/head/day, respectively. The cattle supplemented during the dry season (T2/T3 groups) consumed the full amount of supplement offered and no refused feed was observed. Average liveweight gains during the rainy season (146 days) for the T1, T2 and T3 groups were 687, 685 and 632 g/head/day (Table 1). During the rainy season, the three experimental groups of cattle did not receive any supplementary feeding and they only grazed on the pasture.

In the cattle of the T1 group the rates of weight gain were significantly ($P<0.05$) lower than in the cattle of the T2 and T3 groups during the dry season. However, when the availability and quality of the herbage improved during the rainy season, cattle in the T1 group showed higher rates of weight gain than cattle in the T2 and T3 groups. This phenomenon can be interpreted as a typical compensatory growth response.

The overall average liveweight gains throughout the 229 days of the experiment amounted to 523, 594 and 586 g/head/day for the T1, T2 and T3 groups, respectively. The above values were not found to be significantly different. These small advantages (for the T2/T3 groups) in terms of daily liveweight gain would presumably cancel any potential economical benefit arising from offering to grazing beef cattle supplements consisting of molasses-non-protein nitrogen mixtures during the dry season in tropical Mexico.

Expt. 2 The chemical composition of SDPE is given in Table 2. There was a large variation in the dry matter and organic matter intakes of SDPE between animals. DM and OM intakes ranged from 2.9 to 5.3 kg and from 2.7 to 4.9 kg per animal per day, respectively.

Table 1 Effect of supplementing grazing cattle with molasses-urea or molasses-poultry litter during the dry season on liveweight performance

Treatment	T1	T2	T3
No. of animals	10	10	7
Initial LW (kg)	174.4± 9	179.2± 9	174.4±12
LW at the end of the dry season (kg)	193.9±10	215.2± 9	214.2±10
Final LW (end of rainy season) (kg)	294.3±11	315.3±11	306.7±13
Mean LW gain through the dry season (g/day)	235 ±45	433 ±43	503 ±99
Mean LW gain through rainy season (g/day)	687 ±26	685 ±41	632 ±32
Pooled LW gain through the dry and rainy seasons (g/day)	523 ±25	594 ±33	586 ±45

Note : Mean ± SE.

Table 2 Chemical composition of sun-dried pig excreta

Item	% ± SE
DM	87.7±0.9
CP	14.7±0.3
EE	2.9±0.2
NDF	56.8±1.8
ADF	30.5±1.4
Lignin	9.4±1.2
Ash	7.5±0.4

The dry matter and organic matter digestibilities of the SDPE ranged from 50.2% to 63.4% and from 48.1% to 59.9%, respectively. The ruminal dry matter degradability of the SDPE was clearly increased when the materials were treated with NaOH (4% dry basis). Table 3 shows the ruminal dry matter degradability of SDPE with or without treatment with NaOH.

Discussion

Expt. 1 In the experiment reported here, the group of cattle (T1) which did not receive any supplementary feeding during the dry season showed low rates of weight gain (235 g/head/day) during this period. Thus, it is likely that the dietary energy intake of the T1 group exceeded its maintenance energy requirement during this critical period of the year.

The higher rates of weight gain of the cattle in the T2 and T3 groups than in the cattle in the T1 group during the dry season may be interpreted as an improvement of the rumen nitrogen status of the supplemented cattle which probably resulted in an increase in dry matter digestibility of the pasture crop consumed and thus in an enhancement of animal performance.

Hennessy and Williamson (1990) observed that in Hereford cattle fed sub-tropical native pasture plants, urea supplements increased the rumen ammonia concentration and liveweight gain of cattle. Similarly, Iwuanyanwu, Umunna and Dim (1990) reported that supplementation with molasses-urea mixtures in White-Fulani heifers fed native hay increased dramatically the dry matter digestibility and the liveweight gain of the supplemented cattle was greater than that of the group which did not receive supplements. Butterworth *et al.* (1973) found small increases in liveweight gain when they supplemented beef cattle grazing pangola grass with molasses alone or molasses-urea (3% urea) during the dry season in North Mexico.

Gulbransen (1985) showed that in Hereford heifers losing weight and supplemented with molasses-urea mixtures the weight loss was lower than in the cattle which did not receive supplements. Gulbransen (1985) concluded that the molasses supplement requires the inclusion of a nitrogen source (urea/uric acid) to supply the most deficient nutrient (nitrogen) in the rumen during the dry season.

Supplementation of grazing cattle in the tropics must be considered in the context of actual production and demand of beef in the areas concerned, since it would be more practical (and economical) under some conditions to let cattle lose some weight during the dry season and aim at a compensatory growth response in the following rainy season when the availability and quality of the pasture increase.

During the rainy season, cattle in the T1 group showed higher rates of weight gain than cattle in the T2 and T3 groups. The higher rates of weight gain for the T1 group during the rainy season can be best interpreted as a compensatory growth response (Wilson and Osbourn, 1960 ; O' Donovan, 1984 ; Ryan, 1990). O' Donovan *et al.* (1978) also observed that even cattle not severely restricted in nutrient intake during the dry season (as the T1 group in the present study) showed a compensatory growth response during the following rainy season.

Similarly, Winks *et al.* (1979) reported that cattle which did not receive supplements during the dry season showed a compensatory growth response during the rainy season, thus casting doubts on the advantages derived from supplementation to cattle during the dry season in the liveweight gain. Furthermore, Wright and Russell (1991) have demonstrated that cattle showing a compensatory growth response initially deposit more protein and water in the empty body weight gain than unrestricted cattle. This would obviously benefit the consumer.

From the above results, it can be suggested that on economical and practical grounds, it may not be advisable to give supplements to grazing cattle showing small liveweight gains during the dry season, since even cattle subjected to a relatively lower level of feeding during the dry season will catch up the rate of growth of their well-nourished (supplemented) counterparts during the following rainy season.

Cattle feeding strategies must be devised in tropical Mexico to take advantage of compensatory growth as an alternative to the use of costly and frequently imported dry season supplements.

Expt. 2 There is very little information regarding the dry matter digestibility of dehydrated pig excreta fed as the only source of nutrients to cattle. However, Stanogias and Pearce (1978) using regression techniques estimated the dry matter digestibility of pig excreta in cattle at 29%, which is a considerably lower value than that obtained in the present study. The main problem regarding the feeding of dehydrated pig excreta to cattle is the long period of adaptation required to induce the cattle to eat pig excreta only. The increase observed in the ruminal dry matter degradability of the SDPE treated with NaOH (Table 3) is in agreement with the results obtained by Flachowsky and Ørskov (1986) who reported similar increases in the ruminal dry matter degradability of pig excreta treated with sodium hydroxide in sheep. The results obtained in the present experiment would tend to suggest that by treating the SDPE with NaOH, an increase in dry matter digestibility and probably

Table 3 Ruminal dry matter degradability (%) of sun-dried pig excreta (SDPE) with or without treatment with sodium hydroxide

Rumen incubation time (hr)	SDPE	SDPE+NaOH (4% dry basis)
24	23.0±5	48.6±7
36	32.2±1	54.9±2
48	35.4±2	59.8±2
72	39.8±3	65.0±2
84	45.6±7	71.0±3

Note : Each value is the mean ± SE of eight determinations.

in the voluntary feed intake of the SDPE may be expected. More research work is needed to develop a feeding system for cattle based on the use of high levels of pig excreta in the ration.

The problems facing beef and dairy cattle producers in Mexico are mainly related to the amount and quality of the feed resources available to them. Traditional beef cattle producers face every year a dry season period when cattle tend to lose weight. Feeding and management strategies have to be developed to reduce the adverse effects of the dry season on animal performance.

Milk producers are confronted with the constant increase in the price of concentrate feeds which are imported to a great extent. Thus alternative sources of feed must be found to try to reduce the cost of the ration of dairy cows and then to decrease the price of milk for the consumer.

In the final analysis, cattle producers, animal scientists and government officials should attempt to develop more efficient systems of animal production to reduce the price of beef meat and milk with the final objective of improving the diet of the poor people of Mexico who are presently unable to buy both sources of nutrients.

References

1) Butterworth, M. H., Aguirre, E. L., Aragon, A. C. and Huss, D. L. (1973) : Use of molasses containing urea as a supplement to pangola grass pastures in Northeast Mexico. Journal of Range Management, 26, 269-271.
2) Flachowsky, G. and Ørskov, E. R. (1986) : Rumen dry matter degradability of various pig faeces and chemically treated pig slurry solids. Archives of Animal Nutrition, Berlin, 36, 905-913.
3) Gulbransen, B. (1985) : Survival feeding of cattle with molasses. 1. Feeding non-pregnant heifers with molasses plus urea and roughage. Australian Journal of Experimental Agriculture, 25, 1-3.
4) Hennessy, D. W. and Williamson, P. J. (1990) : Feed intake and liveweight of cattle on subtropical native pasture hays. I. The effect of urea. Australian Journal of Agricultural Research, 41, 1169-1177.
5) Iwuanyanwu, I. E. J., Umunna, N. N. and Dim, N. I. (1990) : Effects of urea supplement with or without molasses on the intake, digestibility and liveweight changes of beef heifers fed native hay. Animal Feed Science and Technology, 31, 227-284.
6) Leng. R. A. (1990) : Factors affecting the utilization of "poor quality" forages by ruminants particularly under tropical conditions. Nutrition Research Reviews, 3, 277-303.

7) Minson, D. J. (1990) : Forage in Ruminant Nutrition. Academic Press, San Diego, USA.
8) O' Donovan, P. B., Woldgebriel, A., Taylor, M. S. and Gebrewolde, A. (1978) : Liveweight performance of crossbred and zebu cattle grazing on native Rhodes grass pastures. Tropical Animal Health and Production, 10, 243-249.
9) O' Donovan, P. B. (1984) : Compensatory growth in cattle and sheep. Nutrition Abstracts and Reviews. Series B, Livestock Feeds and Feeding, 60, 653-664.
10) Ryan, W. J. (1990) : Compensatory growth in cattle and sheep. Nutrition Abstracts and Reviews. Series B, Livestock Feeds and Feeding, 60, 653-664.
11) Schneider, B. H. and Flatt, W. P. (1975) : The Evaluation of Feeds through Digestibility Experiments. The University of Georgia Press, Athens, USA.
12) Snedecor, G. W. and Cochran, W. G. (1967) : Statistical Methods. Sixth Edition, The Iowa State University Press, Ames, Iowa, USA.
13) Stanogias, G. and Pearce, G. R. (1978) : Digestibility by cattle of diets containing dried pig faeces. Animal Feed Science and Technology, 3, 155-161.
14) Wilson, P. N. and Osbourn, D. F. (1960) : Compensatory growth after undernutrition in mammals and birds. Biological Reviews, 35, 324-363.
15) Winks, L., Laing, A. R., O' Rourke, P. K. and Wright, G. S. (1979) : Factors affecting response to urea-molasses supplements by yearling cattle in tropical Queensland. Australian Journal of Experimental Agriculture and Animal Husbandry, 19, 522-529.
16) Wright, I. A. and Russell, A. J. F. (1991) : Changes in the body composition of beef cattle during compensatory growth. Animal Production, 52, 105-113.

Discussion

Tsuda, T. (Japan) : Would you comment on the palatability for cattle of NaOH-treated pig excreta and molasses poultry litter.

Answer : Clearly the palatability of pig excreta was one of the main problems in our experiments, since the intake of excreta was very variable and it was difficult to induce cattle to eat a 100% pig excreta ration. To overcome this problem, we mixed the excreta with molasses to stimulate the intake. It actually took 25 days for the animals to absorb a 100% ration (4-4.5 kg DM of excreta intake). Pelleting may be desirable to shorten the adaptation period.

Pradhan, K. (India) : Do you have any data on the meat quality of the animals raised under two different nutritional conditions (lower level followed by better level and compensatory growth). Indeed it appears that along with compensatory growth, the meat quality tends to decrease unlike in dairy cattle.

Answer : We did not analyse the meat quality in our experiments. However some data on compensatory growth in ruminants suggest that body protein accretion may increase after a period of undernutrition.