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PRELIMINARY STUDIES ON THE UTILIZATION OF THE NATURAL VEGETATION IN THE HENEQUEN ZONE OF YUCATAN FOR THE PRODUCTION OF GOATS II. THE EFFECT OF SUPPLEMENTATION WITH PROTEIN AND/OR ENERGY

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Twenty four crossbred Criolla-Nubian female goats, 6-7 months of age and with a mean initial live weight of 18.8±0.6 kg, were used to study the effect of the supplementation of diets based on browse in low secondary bush with energy and/or protein during the dry season. The experiment lasted 140 days. Fifteen goats, 4-5 months of age and with a mean initial live weight of 16.3±0.5 kg, were added for the last 42 days, as nine of the original goats were removed from the experiment. The animals of the original group were housed in four groups of six in 4 x 4 m pens. The additional animals were divided into two groups of four and one group of three and were housed in similar pens. The experimental design was a 2 x 2 factorial, in which the factors were: with and without an energy supplement (molasses; 0.5 kg/animal/day) and with and without a protein supplement (soya bean meal; 0.15 kg/animal/day). All the animals were allowed to graze in low bush between 7:00 am and 11:00 am, each day.
The daily live weight gain of the animals in the original group which received molasses was significantly higher ($P < 0.001$) than that of those which did not receive this supplement (54 vs 17 g/day). Although gains tended to be improved with the soya supplement (43 vs 28 g/day), this effect was not significant ($P > 0.05$). On the other hand, the rate of gain of the animals of the additional group was not significantly affected ($P > 0.05$) by the energy supplement; 52 and 51 g/day with and without molasses, respectively. Soya, however, did improve ($P < 0.05$) the daily gain of this group (70 vs 33 g/day). Significant interactions between the two supplements were not observed in either of the experimental groups.
The difference between the two groups of animals in the response to the protein and energy supplements is discussed in terms of the availability and the quality of forage in the low bush.

Key Words: Goats, low bush, supplementation, growth.

In the preceding article (Ríos and Riley, 1985) the production of goats is proposed as a means of utilizing the growing areas of secondary vegetation (low bush) in the henequen zone of the State of Yucatán. The preference of goats for diets based on bushy vegetation (browse) is well recognized (Devendra, 1978).

At present, the population of small ruminants in Yucatán is low and in the absence of production data from goats grazing in low bush, it is difficult to identify the principal factors which limit animal productivity with such diets. An experiment was therefore carried out to study the growth rate of young goats with a diet based on grazing in low bush and the response of these animals to supplementation with energy (molasses) and/or protein (soya bean meal) during the dry season.

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Materials and Method

In an experiment which lasted 140 days (January to May, 1983), 24 crossbred Criolla/Nubian female goats were used. They were 6-7 months of age and weighed 17.5 ± 0.6 kg at the beginning of the experiment. The animals were selected from the herd of the Centro Demostrativo Caprino, Teya, of FIRA, Bank of México, which has been described by Ríos and Riley (1985). Fifteen goats of 4-5 months of age and with a mean live weight of 16.3 ± 0.5 kg were added for the last 42 days of the experiment (16 April-29 May). The animals of the original group were housed in four 4 x 4 m pens in groups of six. The additional goats were divided into three groups of four and one of three (control) and housed in similar pens.

The experimental animals were allowed to graze in low bush with the rest of the herd between 7:00 am and 11:00 am, in the care of two shepherds (see Ríos and Riley, 1985). The supplements were administered daily, when the goats returned from the bush.

A 2 x 2 factorial experimental design was used, the factors being: with and without an energy supplement (molasses) and with and without a protein supplement (soya bean meal). The individual treatments were:

i) Control (C) - basal diet of grazing in low bush.

ii) Molasses (M) - basal diet plus 0.5 kg molasses/animal/day.

iii) Soya (S) - basal diet plus 0.15 kg soya/animal/day.

vi) Molasses/soya (M/S) - basal diet plus 0.5 kg molasses and 0.15 kg soya/animal/day.

Water and a commercial mineral mix were available ad libitum. The animals were weighed every two weeks and the daily live weight gain was calculated by linear regression of live weight against time (Snedecor and Cochran, 1981). Analysis of variance was carried out on the daily gains of each group of animals and Duncans multiple range test was used to separate the means of each treatment (Snedecor and Cochran, 1981).

Nine of the goats in the original group became pregnant: the results of these animals were not included in the statistical analysis.

Results

Figure 1 shows the changes in mean live weight of the original group of animals during the 140 days of study. All the treatment groups gained weight for the first 70 days, the faster rates of gain being seen in groups M and M/S. After this time, the animals of groups C and M began to lose weight, but body weight was maintained in those which received soya in the supplement.

The mean daily live weight gains of the original group are shown in Table 1. Animals receiving molasses had a significantly ($P < 0.001$) higher rate of gain than those which did not receive this supplement (54 vs 17 g/day, respectively). Live weight gains tended to be improved by the presence of soya in the supplement but this effect was not significant ($P > 0.05$). Comparing the treatments individually, only the group M/S had a

rate of gain significantly higher ($P < 0.05$) than that of the control group. No significant ($P > 0.05$) interaction between soya and molasses was observed.

Table 1

The effect of supplementation of diets based on browse in low bush with energy (molasses) and/or protein (soya bean meal) on the performance of growing goats during 140 days of the dry season (original group)

	Treatments				
	T	M	S	M/S	SED [1]
Live weight (kg)					
Initial	16.6 ± 0.8	19.3±1.7	16.5±1.2	17.6±1.2	-
Final	18.6 ± 1.4	27:2±1.3	20.5±1.0	26.1±1.8	-
Mean daily gain (g)	7.0[a]	49.0[a,b]	27.0[a,b]	59.0[b]	15.65

Means without common superscripts are significantly different ($P < 0.05$)

[1] SED - Standard error of the difference

The mean live weight changes of the additional animals are shown in Figure 2. This group entered the experiment during the most severe part of the dry season (April-May), and therefore, the animals which did not receive supplementation (group C) lost weight during the first four weeks of the study. In this same period, the animals receiving only molasses (M) maintained their live weight, whereas those consuming soya (S and M/S) gained about 30 g/day. If Figures 1 and 2 are compared, it can be seen that the pattern of live weight changes in both the original and the additional groups of animals during the last 42 days of the experiment is very similar.

Table 2

The effect of the supplementation of diets based on browse in low bush with energy (molasses) and/or protein (soya bean meal) on the performance of growing goats during 42 days of the dry season . (additional group)

	Treatments				
	T	M	S	M/S	SED [1]
Live weight (kg)					
Initial	16.7±0.7	16.7±1.0	16.2±0.8	16.0±0.8	-
Final	17.9±1.2	18.7±0.7	19.2±0.9	19.9±0.6	-
Mean daily gain (g)	29.0	37.7	72.7	66.4	29.73

Table 2 shows the mean daily live weight gains of the animals in the additional group. The daily gain of animals receiving soya (70 g) was significantly ($P < 0.05$) higher than that of those which did not receive this supplement (33 g). There was no effect of molasses on the rate of gain and no significant interaction between the two supplements.

All the experimental animals gained weight rapidly during the final two weeks of the study, these coincided with the beginning of the rainy season.

Figure 1

Effect of supplementation with molasses and/or soya on changes in liveweight of goats grazing in low bush during the dry season (original group).

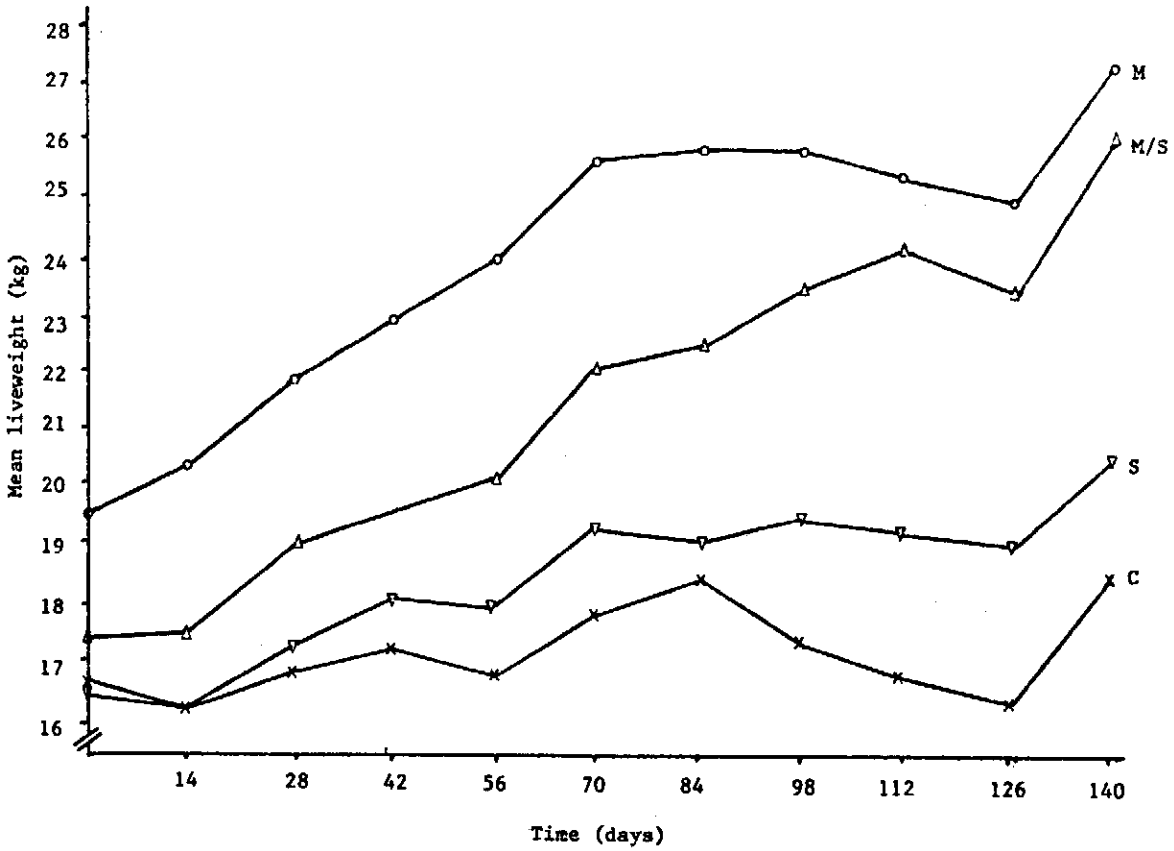
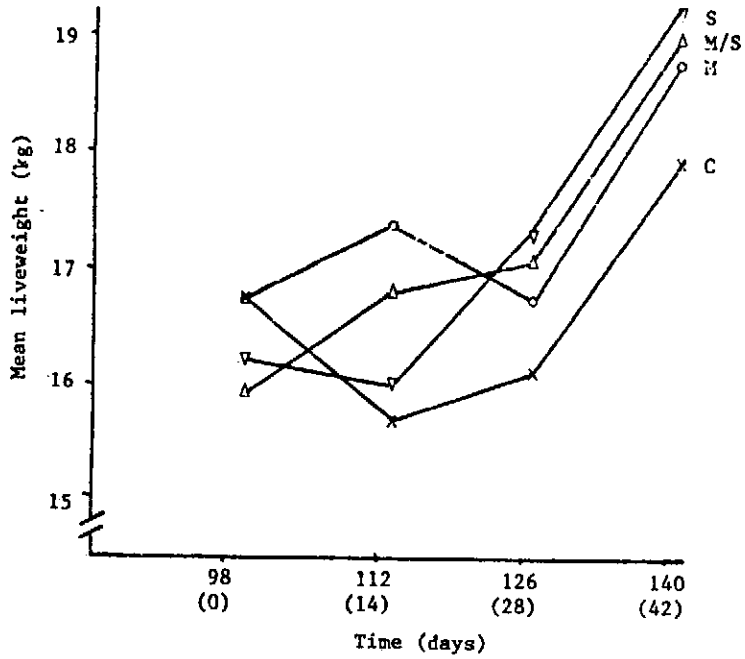


Figure 2

Effect of supplementation with molasses and/or soya on changes in liveweight of goats grazing in low bush during the dry season (addicional group).



Discussion

It is interesting to note the different response to the two types of supplement (molasses and soya) in the two groups of animals (see Tables 1 and 2). The better mean daily live weight gain in the animals of the original group which received molasses was due to a faster growth rate for treatments M and M/S during the first 70 days of the experiment. This, together with the high quality of the forage available in the bush at this time (see Ríos and Riley 1985), suggests that the limiting factor in the goats' diet early in the dry season was the availability of forage, and therefore, energy. The response to the soya supplement in the first two months of the study may have been due to its use as an energy source, which is in agreement with the concept of Clanton (1980); when the intake of energy is limited as a result of low forage availability, a protein supplement will be used as an energy source.

The growth rate of the additional group of animals responded to the soya supplement and not to molasses. This observation was reflected in the live weight changes of the original goats during the final months of the experiment (Figure 1). At this time goats grazing with the experimental animals of the present study spent a large part of their total grazing time consuming a poor quality grass (*Bouteloua filiformis*) and the quantity of forage available in the bush was very low (Ríos and Riley 1985).

The response to the protein supplement during the more critical part of the dry season can be discussed in terms of two possibilities:

i) During this time protein became the limiting factor in the available forage.

Twenty kg goats of medium activity, such as grazing in semi-arid areas, require 83 g crude protein (CP)/day and a DM intake of 1.08 kg dry matter (DM) to obtain a daily gain of 100 g, this represents 7.7% CP in the diet DM (N.R.C. 1981). In April and May, although a high intake of a grass of poor nutritional quality was observed, the goats spent 50% of the total eating time consuming plants with more than 12% CP (Ríos and Riley 1985). While this type of observation does not necessarily indicate how much of each plant species is eaten, it is not considered unlikely that the concentration of protein in the goats diet was limiting. However it is probable that the low availability of forage and the short time for which the goats were allowed to graze each day limited the intake of both protein and energy during the final months of the experiment.

ii) The presence of soya in the supplement increased the DM intake of the grazing goats.

It is well accepted that sources of true protein can influence the intake of poor quality forages. Van Soest (1982) considers the relationship between intake and the concentration of nitrogen in the diet. At levels below 8% CP, the requirements of the rumen bacteria for nitrogen are not filled, this inhibits rumen fermentation and results in reduced forage intake. Clanton (1980) supplied a soya bean meal supplement to young cows fed brome grass hay. A response in forage intake to the supplement was only seen when the hay had a CP content below 8.4%. This author suggests that protein supplements will not increase intake in grazing animals, even when the forage is of low quality, since the animals are free to select the most palatable forage available. In this respect, Pratchett et al (1977) observed that the CP content of forage samples from cattle with oesophageal fistulae, grazing in different ecological zones of Botswana, was higher than that in cut samples of the same forage.

It has been mentioned that it is not thought probable that the diet selected by the goats in the final months of this study was low in CP. The response to the soya at this time, therefore, was associated more with its contribution to the tissue requirements of the animal than with an increase in the intake or the digestibility of the forage.

The lack of response to molasses in the additional group of animals and the observation that this supplement was not as effective as soya in preventing the weight losses experienced by the control animals of the original group, could be related to a reduction in the intake of the basal diet. Several authors have observed a reduction in fibre digestion in animals receiving high energy supplements (Henning et al 1980). This may apply to the groups of goats which received molasses in the final months of the study, when the consumed forage was higher in fibre than in previous months (see Ríos and Riley 1985).

Some or all of the factors discussed above may have contributed to the different responses to the two supplements in the final stages of the study.

Conclusions

The results of this experiment, together with those of the accompanying study (Ríos and Riley 1985), indicate that the primary factor limiting the growth of young goats grazing in low bush during the dry season is the availability and not the quality of the forage. It is important to emphasize that this conclusion applies to an area of bush which has suffered a high stocking rate for a number of years. On the basis of this study, in which the groups of animals which received no supplementation did not suffer large weight losses during the dry season, it seems that goat production with diets based on browse in the low bush of the henequen zone of Yucatán is feasable. Further long-term studies are required, however, as varying climatic conditions from year to year will affect the availability and the quality of forage and therefore, the ability of the bush to maintain animals during the dry season. Careful control of the stocking rate and rational management of the bush would minimize the need to provide the animals with supplements during the dry season.

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