Tropical and Subtropical Agroecosystems, 1 (2003): 93-96

Tropical and Subtropical Agroecosystems

IMPACT OF *MUCUNA* BEAN (*Mucuna* spp.) SUPPLEMENTATION ON MILK PRODUCTION OF GOATS

H. Mendoza-Castillo[1]*, J.B. Castillo-Caamal[2] and A. Ayala-Burgos[2]

[1]University of Chapingo, Mérida, Yucatán, México. E-mail:hmen12@hotmail.com

[2]Faculty of Veterinary Medicine and Animal Production, University of Yucatan, México

**Corresponding author*

SUMMARY

The objective of the trial was to determine the impact of supplementation with *Mucuna* bean (*Mucuna* spp.) on milk production of goats during a 28-day period. Experimental goats were in their third and fourth month of lactation and on average weighed 36.00 ± 5.15 kg. Supplements offered were ramon (*Brosimum alicastrum*) or *Mucuna* bean. Basal diet was chopped Napier grass. Both forage and supplements were offered *ad libitum*. Each treatment had five replications (i.e., animals). The forage and supplement consumption and milk production were recorded on a daily basis. At the end of the trial, a sample of milk was taken to determine total solids, protein, fat and lactose. Regressions between supplement consumption and total dry matter intake and milk production were carried out. At the start of the trial, total dry matter intake was high, but declined with time in both treatments. *Mucuna* bean intake was 872 ± 361 g DM a^{-1} d^{-1} and that of ramon foliage was 1144 ± 38 g DM a^{-1} d^{-1}. *Mucuna* bean supplementation increased the total dry matter intake in a linear fashion (DMI = 402 + 1.228X, $R^2 = 0.72$). The supplementation with ramon foliage also increased the total DM intake, but in a quadratic fashion (DMI = 64531 - 113.83x - 0.0489X^2, $R^2 = 0.74$). Contents of protein, fat, total solids and lactose in milk were very similar between the treatments. No signs of detrimental effects were observed in the animals supplemented with *Mucuna* bean.

Key words: *Mucuna* bean, goats, dry matter intake, milk production, milk quality.

INTRODUCTION

In Yucatan, Mexico, increasing land pressure has endangered the traditional agricultural *milpa* system, which depends on the fallow period to improve and maintain soil fertility. Lately, the duration of fallow has diminished, resulting in increased weed pressure, low fertility and poor yields of maize, the most common main crop (Mariaca, 1992).

The low output of the traditional agriculture is also affecting animal production of the smallholder farmer. Smallholders may have to sell their animals, leading to a situation where they have to buy meat and milk to satisfy the family's necessities, which often is not possible due to the scarcity of economic resources. The consequent shortage in animal protein consumption has led to a chronic and prevalent malnutrition which has been reported in up to 63% of the children (Balam, 1996). Therefore, the production of animal protein is important. Goats, which have the ability to transform fibrous feed into human food of high nutritional value, are not widely raised in Yucatan, but could greatly improve nutrition of the region's inhabitants through milk (Devendra and Burns, 1970).

Efforts have been made to improve the *milpa* system with practices that maintain or improve production and promote rural development (PROTROPICO, 1997). An agroecological approach has been suggested which is based on the use of local inputs and synergies to stimulate a sustainable agricultural system (Gliessman, 1998). In this context, *Mucuna* bean has been incorporated in the milpa system as a green manure and cover crop. In addition, efforts have been undertaken to take advantage of the grain, foliage and stubble in animal feeding. The *Mucuna* beans have a promising nutritional quality (Duke, 1981; Josephine and Janardhanan, 1992; Templeton and Ferguson, 1917; Eilittä and Sollenberger, 2002). However, some anti-nutritional substances could limit their use (Duke, 1981; Josephine and Janardhanan, 1992). On the other hand, foliage of ramon tree (*Brosimum alicastrum*) has been traditionally used in the region as an animal feed, and no reports have been made of negative impacts. The objective of the study was to determine the impact of supplementation with *Mucuna* bean and ramon foliage on the intake and milk production of goats feeding on a basal diet of Napier forage (*Pennisetum purpureum*).

MATERIALS AND METHODS

The trial was carried out in Xmatkuil, near Merida city, which is located in 20°51'N and 89°37'W. The climate is classified as Aw_o, and is warm and sub-humid, with an annual rainfall of 984 mm, annual average temperature of 26.8°C, and a relative humidity

of 72 % (Duch, 1991). The work was carried out in on-farm conditions, and both farm workers and researchers managed the experiment (e.g., cutting of forage and foliage of ramon, grinding of *Mucuna* bean, registering of feed consumption and milking and weighing of animals).

Trial duration was 28 d, which was preceded by an adaptation period of 7 d. Animals used in the study were Creole goats with regular body condition averaging 36.00 ± 5.15 kg of body weight, and were beginning the fourth month of suckling, with three or four kids each.

Treatments included: A. foliage of ramon + Napier grass and, B. pods of *Mucuna* bean + Napier grass. Both treatments were offered *ad libitum,* adjusting their quantity according to the quantity rejected in the previous day. Napier grass and ramon foliage were harvested one day before their consumption.

Each goat was an experimental unit and each treatment consisted of 5 replications. Goats were weighed at the beginning and at the end of the experiment. They were milked every afternoon, when their individual intake was also registered. Other variables registered were change of weight, feed intake, production of milk, and content of milk protein, total solids, fats and lactose. Data were analyzed through the Student's t-test and through regression analysis.

RESULTS AND DISCUSSION

Statistical differences between the two supplements were not observed in any of the variables studied (Table 1). However, goats that ate *Mucuna* bean had a trend for weight loss (P = 0.14). Supplement intake also tended to be lower for *Mucuna* (P = 0.13). Inexplicably, one goat first reduced its *Mucuna* bean consumption and, after a few days, rejected it completely. These results are in accordance with previous work on dairy cows where variability in consumption, and a subsequent impact on weight and milk production, were high (Templeton and Ferguson, 1917). Protein, total solids, fats and lactose concentration in milk were similar among treatments (Table 1). Apparently, both feeds successfully substituted the low quality Napier forage. There were no evident detrimental impacts associated with *Mucuna* bean consumption and the general behavior of goats feeding on *Mucuna* bean was similar to those fed with ramon foliage. However, future investigations should focus on residual antinutritional factors in animal tissues.

Table 1 Effect of supplementation with *Mucuna* bean and ramon foliage on goat performance and milk quality.

Variable	Treatment		P-value
	Mucuna Bean	Ramon	
Supplement intake (g d^{-1})	872 ± 361	1144 ± 38	0.13
Forage intake (g d^{-1})	602 ± 291	500 ± 50	0.46
Total intake (g d^{-1})	1474 ± 525	1644 ± 72	0.49
Change of weight (kg)	-1.6 ± 2.88	0.7 ± 1.15	0.14
Milk production (g d^{-1})	597 ± 404	610 ± 285	0.96
Protein (g 100 g^{-1})	3.37	3.28	n.a.
Fat (g 100 g^{-1})	2.5	2.5	n.a.
Total solids (g 100 g^{-1})	11.78	11.18	n.a.
Lactose (g 100 g^{-1})	4.54	4.44	n.a.

n.a.=not analyzed.

Increasing consumption of *Mucuna* bean increased total dry matter intake in a linear fashion (DMI=402+1.228X, R^2=0.72; Figure 1). The ramon intake also increased total dry matter intake, but in a quadratic fashion (DMI= 64531-113.83X-0.0489X^2, R^2=0.74). Importantly, it seems that animals which were fed with ramon foliage reached their full digestive capacity because ramon, although highly nutritious, is also a voluminous nutrient source. Higher total dry matter consumption resulted in higher milk production. However, the milk production of goats fed with ramon foliage was seemingly reduced at highest consumption levels (Figure 2).

In the *ad libitum* feeding situation, we always made sure that rejections were left at levels that are common in conventional feeding trials. On average, 45% of the *Mucuna* bean and 31% of the ramon was rejected. At

the end of the experimental period, intake of *Mucuna* bean by the goats was slightly superior to that previously reported with Pelibuey sheep (Castillo-Caamal *et al.,* this volume).

Intake of *Mucuna* bean is in accordance with the early 20th century research on dairy cows (Tracy and Coe, 1918). The *Mucuna* bean consumption was 1688 ± 318 g a^{-1} d^{-1} at the beginning of the trial but by the end of it, intake was 780 ± 134 g a^{-1} d^{-1} (Figure 3). Individual variability in daily intake was less with *Mucuna* bean than with ramon (Figure 3). At these levels of consumption, goats did not show any signs of intoxication.

Compensatory feed ingestion was observed in both treatments, with high consumption at the beginning, followed by a progressive reduction, until apparently a period of stabilization was achieved (Figure 3). Similar trends were found for milk production.

Intake of *Mucuna* bean and ramon supplements affected milk production in a linear fashion. This relationship was clearer with ramon (y=7159.7+6.789X, R^2=0.83) than with *Mucuna* bean (y=0.8187+0.686X, R^2=0.38).

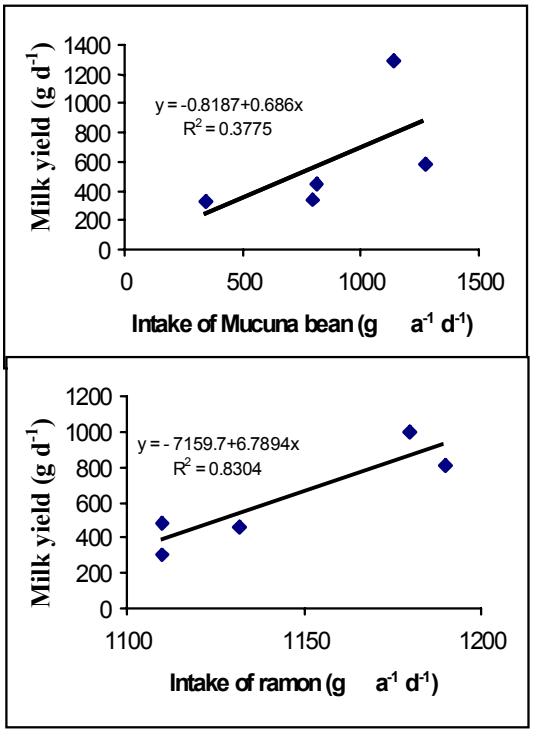

Figure 2. Impact of supplement intake on milk production in goats feeding on Napier grass supplemented with (a) *Mucuna* bean and (b) ramon foliage.

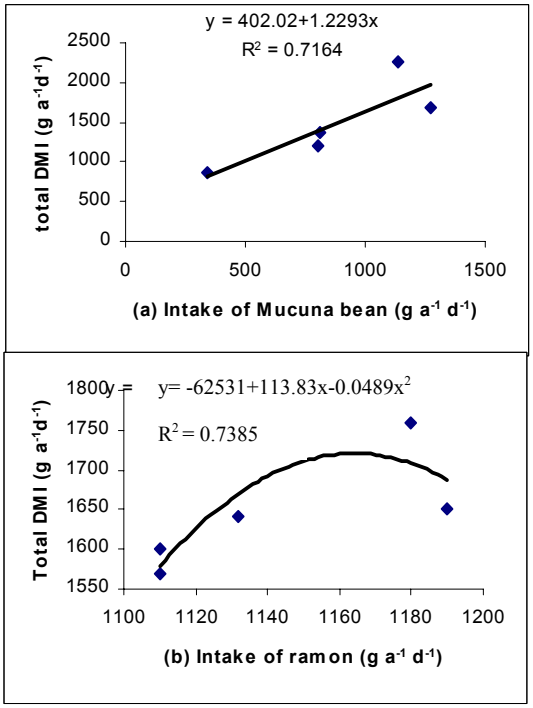

Figure 1. Impact of supplement intake on total dry matter intake of goats feeding on Napier grass supplemented with (a) *Mucuna* bean and (b) ramon foliage.

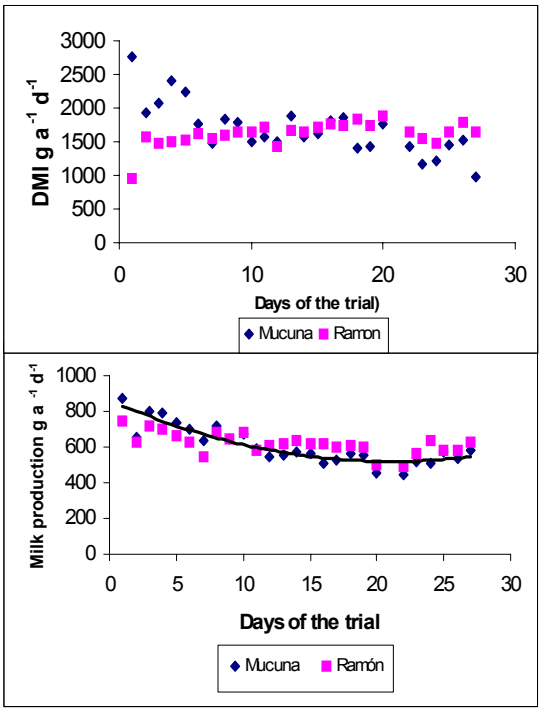

Figure 3. Consumption of the supplements and milk production of the goats through the trial period.

ACKNOWLEDGMENT

The authors wish to acknowledge partial funding from the Rockefeller Foundation through the Agricultural Cover Group (GAC-RED) with the project "Uso Forrajero de los Abonos Verdes y Cultivos de Cobertura."

REFERENCES

Balam, G. 1996. La frecuencia de la desnutrición y sus factores socioeconómicos en Yucatán. Mérida, Yucatán, México. Centro de Investigaciones y Estudios Avanzados, Unidad Mérida.

Castillo-Caamal AM, Castillo-Caamal JB, Ayala-Burgos A. This volume. *Mucuna* bean (*Mucuna spp.)* supplementation of growing sheep fed with a basal diet of Napier grass (*Pennisetum purpureum).*

Devendra, C, Burns, M. 1970. Goat production in the Tropics. CAB. Farnham Royal, Bucks, England.

Duke, JA. 1981. Handbook of Legume of World Economic Importance. Plenum Press. New York.

Duch, GJ. 1991. Fisiografía del estado de Yucatán (Su relación con la Agricultura). Universidad Autónoma de Chapingo. México.

Eilittä M, Sollenberger L. 2002. The "Many Uses of *Mucuna*": Velvet Bean in the Southern United States in the Early 20th Century. In Food and Feed from *Mucuna*: Current Uses and the Way Forward: Proceedings of an International Worshop, April 26-29, 2000. CIDICCO, CIEPCA and Judson College, Illinois. Tegucigalpa, Honduras. Pp. 73-110.

Gliessman, SR. 1998. Agroecology. Ecological processes in sustainable agriculture. Ann Arbor Press. Michigan, USA.

Josephine, MR, Janardhanan, K. 1992. Studies on Chemical Composition and Antinutritrional Factors in Three Germplams Seed Materials of the Tribal Pulse, *Mucuna pruriens* (L.) DC. Food Chemistry. 43:13-18.

Mariaca, MR. 1992. El papel de la fertilidad del suelo en el sistema roza-tumba-quema. In Zizumbo VD, Rsamussen CH, Arias RML, Terán CS (Ed.). La modernización de la milpa en Yucatán: Utopía o Realidad.DANIDA-CICY. Mérida, Yuc. Méx. Pp. 215-226.

PROTROPICO. 1997. Blending traditional and scientific knowledge: The Need for viable alternatives. In Dare to Share. Dare to Share Fair at the 9th Conference of the International Soil Conservation Organisation (ISCO). Bonn, 26-30 August, 1996. Würzburg, Germany. Margraf Verlag.

Templeton, GS, Ferguson, HC. 1917. Velvet Bean Versus Cottonseed Meal as Feed for Dairy Cattle. Agriculture Experiment Station of the Alabama Polytechnic Institute. Bulletin No. 198. November 1917. Opelika, Alabama, USA.

Tracy, SM, Coe, HS. 1918. Velvet Bean. Farmer's Bulletin 962. United States Department of Agriculture. Washington D. C. USA.

Submitted July 2, 2002 - Accepted September 13, 2002