

SHORT NOTE [NOTA CORTA]

INTAKE OF TROPICAL TANNINIFEROUS PLANTS BY GOATS AND SHEEP WHEN OFFERED AS A SOLE FED

[CONSUMO DE PLANTAS TANINIFERAS TROPICALES POR CAPRINOS Y OVINOS CUANDO SE OFERTAN COMO ÚNICO ALIMENTO]

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SUMMARY

The intake of tropical tanniniferous plants (TTP) (*Lysiloma latisiliquum*, *Piscidia piscipula* and *Acacia pennatula*) when offered as a single feed to small ruminants could help to design a supplementation strategy looking for an anthelmintic effect. The objectives of the current study were: i) to determine the chemical composition of TTP offered to goats and sheep, ii) to determine and compare the total intake of TTP when offered as a single feed to goats and sheep. Adult sheep and goats, with experience in the intake of TTP, were allocated to individual pens. Three consecutive experimental period (15 d) separated by seven days were used. Each period consisted of 10 d adaptation and 5 days of experiment. During adaptation animals received 40 g of leaves of each TTP plant, fresh grass and concentrate feed on a daily basis. During the experimental period animals were fed *ad libitum* only with the fodder of a sole TTP. Between each period, animals were fed with fresh grass (*ad libitum*) and concentrate (200 g⁻¹ day). Crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (L) were determined from each TTP. Total polyphenols (TP), total tannins (TT) and condensed tannins (CT) were also determined. During each experimental period, refused fodder and intake were measured every 24 h. A multivariate analysis was used in order to determine the effect of factors (animal species, plant species and individual animal within specie) on the dry matter intake. Factors with statistical effect (P<0.05) were analyzed by ANOVA (one way). The experiment with *A. pennatula* was suspended because animals refused to eat the plant. *Piscidia piscipula* and *L. latisiliquum* had similar quantities of CP. *Lysiloma latisiliquum* had

the highest levels of polyphenolic compounds (TP, TT and CT) and lowest quantities of fibre components (NDF, ADF and L). The intake of *P. piscipula* was higher in goats than in sheep (P<0.01). However, the intake of *L. latisiliquum* was similar between both species. It was concluded that, when small ruminants eat a TTP as a single feed, the intake is mainly regulated by the fiber compounds.

Keywords: Tropical forages, small ruminants, intake, chemical composition,

INTRODUCTION

Tannins contained on tropical plants have been proposed as an alternative method for the control of gastrointestinal nematodes (GIN) in small ruminant production systems. In veterinary medicine, two ways of use tropical tanniniferous plants (TTP) has been identified (Hoste et al., 2008): 1) as medicinal plants or phytotherapeutic drugs, which consist on the administration of plants portions or extracts to animals during short periods of time, 2) as nutraceuticals, which imply that by means of voluntary intake animals might obtain enough quantities of bioactive compounds. In the latter approach, a key question is whether animals are able to eat enough quantities of dry matter and tannins to obtain the AH effect, without negative effects.

The TTP could be an important source of nutrients to small ruminants. However, the complex profile of plant secondary metabolites (PSM) and fibre components (lignin) might limit their use. In fact the idea that TTP are toxic remains through the world.

Recent experimental work has shown that TTP consumption and use can be affected by the nutritional background of animals (energy, protein) (Villalba *et al.*, 2002), the way animals are fed the TTP (diversity of plants) (Rogosic *et al.*, 2006) and the experience of animals to TTP (Provenza, 2006).

Under this context, it has been recently reported that, when TTP (*L. latisiliquum*, *P. piscipula* and *A. pennatula*) were offered simultaneously to experienced goats and sheep, animals do not seem to select against tannins (Alonso-Díaz *et al.* 2008a, 2009). It was also reported that low quantities of TTP extracts (1200 µg/ml) affected the biology of *Haemonchus contortus* and *Trichostrongylus colubriformis* infective larvae (L3) (Alonso -Díaz *et al.*, 2008b, 2008c). Indeed, a recent *in vivo* study showed that the intake of 1.4 mg of CT/kg body weight (BW) from *L. latisiliquum* negatively affected the establishment of *T. colubriformis* and *H. contortus* (Brunet *et al.*, 2008). In all previous *in vivo* studies, animals were supplemented with concentrate feed (200 g⁻¹ day) and grass *ad libitum*.

In this study we hypothesized that when animals are offered TTP fodder as a sole feed, without any supplementation, sheep and goats are able to ingest enough quantities of plant material showing a similar threshold as in previous cafeteria studies. The objectives of the current study were: i) to determine the chemical composition of TTP offered to goats and sheep, ii) to determine and compare the total intake of TTP when offered as a single feed to goats and sheep

MATERIAL AND METHODS

Study area.

This study was conducted at the Faculty of Veterinary Medicine and Animal Science, University of Yucatan, Mexico. The climate is AW₀ (tropical warm sub-humid with rains during summer). The mean annual temperature is 26 °C and rainfall ranges from and from 940 to 1100 mm per year.

Forages and experimental animals.

During July and August, fresh leaves of *P. piscipula*, *A. pennatula* and *L. latisiliquum* were harvested daily in the mornings. These plants were chosen because they are predominant within the native vegetation of the region (Flores-Guido, 2001). Indeed, previous *in vitro* (Alonso-Díaz *et al.*, 2008b, 2008c) and *in vivo* (Brunet *et al.*, 2008) studies demonstrated an AH effect against GIN relating its tannin content as a bioactive component against nematodes. Four, one-year-old growing female hair sheep and goats (17.9±1.1 kg BW and 17.1±1.3 kg BW, respectively) were used. All the

animals had browsing experience in the native vegetation of the study area for at least 8 months before the start of this study.

Chemical analysis.

Feed samples were analyzed using official procedures for dry matter (DM) (7.007), nitrogen (2.057), and ash (7.009) according to AOAC (1980). Both NDF and ADF were not corrected for residual ash. The NDF was determined using sodium sulfite and without alpha amylase. Lignin (sa) was also determined (Van Soest *et al.*, 1991). Total polyphenols (TP) (Folin-ciocalteu), total tannins (TT) (Folin-ciocalteu) and CT (Butanol-HCl) were also analyzed according with the methodology described by Makkar (2003).

Intake studies.

Each goat and sheep was allocated to individual 3 x 3 m pens with concrete floor and tinned roof. Three consecutive experimental period (15 d) separated by seven days were used. Each period consisted of 10 d of adaptation, where 40 g of leaves of each plant (*P. piscipula*, *L. latisiliquum* or *A. pennatula*), fresh grass *ad libitum* and 200 g of concentrate (wheat bran, soybean meal and sorghum grain; 155 g CP/kg DM and 11.0 MJ/ME/kg DM) were offered on a daily basis. Then, fresh grass and concentrate was suspended and TTP was offered *ad libitum* as a sole feed during five days.

The refusals were collected every 24 h to obtain an intake pattern during the study period. Quantity of plant material in the feeders was monitored constantly (four times per day) and more leafs were added to the feeder when needed to enable *ad libitum* consumption of each plant material. Daily feed samples were collected, air-dried, milled and kept in airtight containers for later analysis.

Statistical analysis.

Multivariate analysis was used in order to determine the effect of factors (animal species, plant species and individual animal within species) on the dry matter intake. Then, factors with statistical effect (P<0.05) were analyzed by ANOVA (one way).

RESULTS AND DISCUSSION

Data of *A. pennatula* is not reported as it was not ingested by both species when offered as single feed. Both, goats and sheep were losing weight during the experiment the *A. pennatula*.

Lysiloma latisiliquum and *P. piscipula* leaves had similar concentrations of CP. The fodder of *L. latisiliquum* had the highest levels of polyphenolic compounds (TP, TT and CT) and lowest quantities of fibre components (NDF, ADF and L) (Table 1).

The intake of *L. latisiliquum* was similar between goats and sheep (17.10 g DM / kg WL and 18.8 g DM / kg BW, respectively) ($P>0.01$). However, the intake of *P. piscipula* was greater in goats than in sheep (25.25 g DM/kg LW vs. 16.14 g DM / kg LW, respectively) ($P<0.01$). For each experimental period no effect was found among individual animals within species. These results suggest that when small ruminants eat a TTP as a single feed, the intake is mainly regulated by the fiber compounds and not the polyphenolic compounds. This is consistent with previous results obtained in cafeteria trials using the same plants (Alonso et al., 2008a, 2009). These results suggest that, when both small ruminant species are confronted with plants with low quality in terms of digestibility, goats showed the capability to ingest more quantities of such material. This is possibly due to differences in the physiology of digestion between both species.

The cumulative intake pattern of each animal species is presented in the figures 1 and 2. A consistent trend can be observed for both species. No apparent toxicity effect was observed after the experimental periods. However, offering single forages resulted in lower total DM intake than when the same material was offered in cafeteria trials (Alonso et al., 2008a, 2009). Similar results have been reported previously (Rogosic et al., 2006). The contrasting intakes of goat and sheep when the same feeds are offered either as cafeteria or as single feeds must be taken into account to design feeding strategies for nutritional or nutraceutical purposes.

Table 1. Chemical composition (g / kg of DM) of *Piscidia piscipula* (A) and *Lysiloma latisiliquum* (B) offered to goats and sheep

	CP	Ash	EE	NDF	ADF	L	FT	TT	CT
A	194	124	48	477	275	116	11	10	11
B	199	52	27	424	229	98	43	29	19

CP= crude protein; EE= ether extract; NDF= neutral detergent fibre; ADF= acid detergent fibre; L= lignin; TP; total phenols; TT= total tannins; CT= condensed tannins

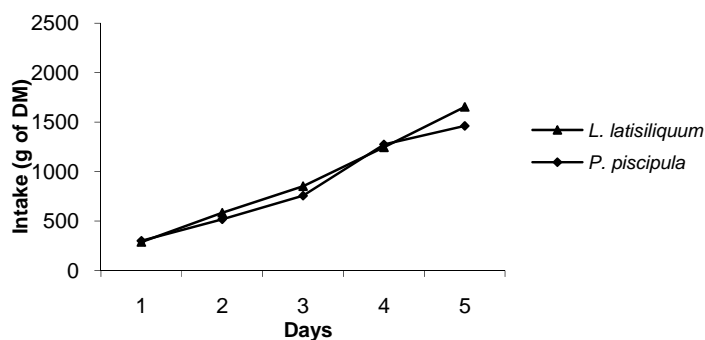


Figure 1. Cumulative intake pattern of tannin-rich plants *Lysiloma latisiliquum* and *Piscidia piscipula* by sheep.

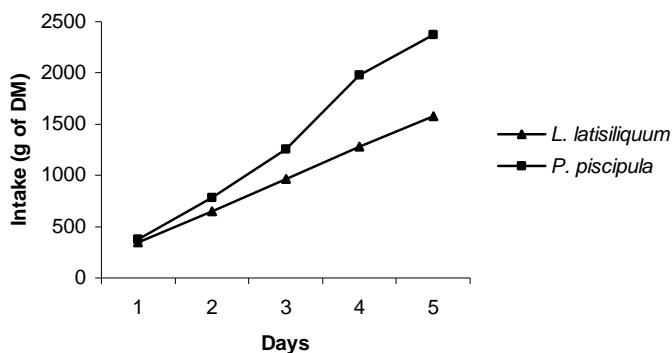


Figure 2. Cumulative intake pattern of tannin-rich plants *Lysiloma latisiliquum* and *Piscidia piscipula* by goats.

CONCLUSIONS

When TTP fodders are offered as single feeds, goats and sheep have different intakes of *P. piscipula*, ingest similar amounts of *L. latisiliquum* and both refused *A. pennatula*. Intake does not seem to be strongly related with tannin content. This information suggests that when small ruminants eat a TTP as a single feed, the intake is mainly regulated by the fiber compounds.

ACKNOWLEDGMENTS.

This work was supported by project CONACYT-SAGARPA-COFUPRO No. 12441 M.A. Alonso-Díaz acknowledges receiving a scholarship from Consejo Nacional de Ciencia y Tecnología (CONACYT, México) to undertake his Ph.D studies.

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