Colegio de Postgraduados

Marafalfa grass (*Pennisetum purpureum* Schum) and mucuna (*Stizolobium pruriens* L. Medik) silage in a semi-confined sheep system in southeastern Mexico

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ABSTRACT

Objective: The objective of this study was to evaluate an alternative for feeding with silage to limit the decrease in productivity in dry seasons for sheep producers.

Design/methodology/approach: Ensilage was made with marafalfa grass (*Pennisetum purpureum* Schum) and endemic mucuna (*Stizolobium pruriens* (L.) Medik). The feeding method evaluated consisted of a semi-confined system, allowing the sheep to graze for a period of five hours per day, to later supplement it with the proposed silage. Studies of bromatological parameters were carried out with the three proposed silage treatments, and the weight of the sheep was measured at the beginning, during and at the end of fattening.

Results: The results suggest that the *P. purpureum* silo demonstrates significant weight gain, which is why it is proposed as an alternative for dry seasons.

Limitations on the study/implications: In the state of Campeche, sheep production is carried out under extensive direct grazing systems on grasslands, with scarce technology and low productivity. In the dry season, the productivity of these systems suffers a significant loss, due to limitations.

Findings/conclusions: Ensilage without the addition of mucuna (*S. pruriens*) obtained better results in sheep growth and this may be due to palatability. It is suggested to include a drying process prior to adding the mucuna (*S. pruriens*).

Keywords: Dry season, grazing, extensive livestock, bromatological analysis, tropical livestock production.

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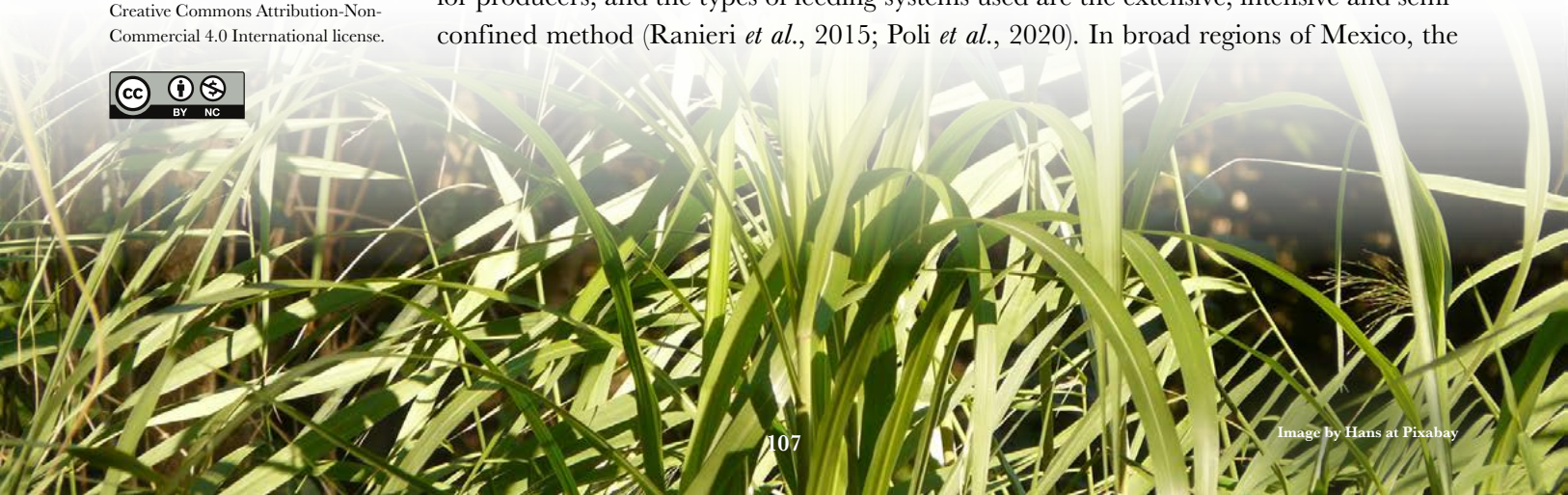
INTRODUCTION

Sheep livestock production in tropical and subtropical regions is conducted under grazing of pasturelands or meadows, since they are sources of feed that entail lower costs for producers, and the types of feeding systems used are the extensive, intensive and semi-confined method (Ranieri *et al.*, 2015; Poli *et al.*, 2020). In broad regions of Mexico, the



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productivity of grazing systems for sheep tends to decrease during the months of March to June (dry period) due to the low productivity of native grasses, significantly affecting the profits of producers (Bobadilla-Soto *et al.*, 2021); it is necessary to resort to the use of hay pasture to complement the diet of the animals in this stage of the year through a semi-confined system (Chávez-Espinoza *et al.*, 2022).

In the state of Campeche, sheep production has had a constant growth during the last 15 years, reaching a state herd of around 200,000 heads (SIAP, 2020). However, the conditions of climate and state vegetation generate problems, such as productive limitations by stages of the year (Candelaria-Martínez *et al.*, 2015), parasite problems in the sheep (Flota-Bañuelos *et al.*, 2019, 2023), and bad selection of grasses for fodder (Pérez, 2017). In this sense, the need to explore alternatives to improve the diet of these animals emerges, not only to combat low productivity during the dry period, but also to limit some of the problems mentioned.

The use of hay pasture to supplement the diet of sheep presents an interesting area of opportunity, since many of the grasses used constitute weeds in other regional agrosystems (Santana *et al.*, 2020). In this sense, Ramírez and Pérez (2006) state that the maralfalfa grass (*Pennisetum* spp.) is of great interest for sheep livestock feed in the tropics, since it generates a good and high biomass production for producers including important characteristics for ensilage in times of scarcity (Ramírez and Pérez, 2006). Maralfalfa grass (*P. purpureum*) has high productivity (Chiquini-Medina *et al.*, 2019), and nutritional values that fulfill the requirements of sheep (Clavero and Razz, 2009; González-Garduño *et al.*, 2011). The objective of this study consisted in evaluating the adequate supplementation of maralfalfa grass (*P. purpureum*) enriched with mucuna (*S. pruriens*) to supplement the sheep with higher protein contribution, in a semi-confined system, and to evaluate the yield in the animal's growth, in Campeche, Mexico; the hypothesis consisted in that the higher protein content contributed by mucuna will increase the weight gain without affecting the amount consumed by the sheep.

MATERIALS AND METHODS

Location of the experimental site

The experiment was carried out in the "La Unión" Agricultural Ranch, located in the agriculture and livestock production colony "Miguel Alemán" Xcampeu, Campeche (19° 47' 53" N; 90° 23' 49" W), located on Km 19 of the Campeche-Holpechén federal highway, with detour to ejido San Antonio Bobolá.

Conducting the experiment

The collection of mucuna (*S. pruriens*) was carried out in different sites of the state of Campeche, because it is common to find it in barren lands and in the ejido San Antonio Bobolá. The cut was made before it had pod and began to dry. The mucuna (*S. pruriens*) collected was ground in a 2000a multi-functional high-speed mill located in the laboratory of the Instituto Tecnológico de Chiná. Cutting the grass *P. purpureum* was done at 90 days with an approximate height of 170 cm, to later be chopped and ensilaged with 10% for T2

and 20% for T3 of mucuna (*S. pruriens*) flour, leaving them to store in a lapse of 21 days. Each bag of silo had an approximate weight of 15 kg, calculating the consumption for one week of feed for the sheep. Confinement pens size 4×4 m were used, which were cleaned adjusting the feeding and drinking troughs.

The selection of sheep was carried out visually with the objective of having a homogeneous weight of the animals. The sheep were dewormed with the anthelmintic Paradex® 10%, at a dose of 0.5 mL/10 kg of live weight orally using disposable syringes of 5 mL. The animals had one week of adaptation, for seven days they were taken out to graze in a period of five hours daily and then their feed was supplemented with the silo. After the week of adaptation, the animals were taken out to graze in a fixed schedule of 8:00 to 13:00 h. During this lapse, cleaning of the pens was done taking out the excrement and urine; likewise, a change in drinking water and cleaning of the feeding trough was carried out. The research was conducted for a period of 6 weeks. During this time in the morning (8:00 am), the sheep were weighed every 7 days and the amount of silo that was given to them was increased once they gained weight and therefore increased the amount that they were fed.

Treatments and experimental design

The weight gain in growing sheep was evaluated using six repetitions per treatment in an experimental design of complete random blocks. In total there were 18 sheep with genetics of the breeds Black Belly and Pelibuey, which were weighed and divided for each treatment to have a total of 6 animals. Three treatments were considered, branding each animal with five different colors to be able to identify what treatment they belonged to. The white and black belts were used for the control treatment fed with *P. purpureum* silage without mucuna (*S. pruriens*) (T1). The black belts were used for the treatment of feed with *P. purpureum* + 10% *S. pruriens* (T2) silage, and the white belts for the treatment with *P. purpureum* + 20% *S. pruriens* (T3) silage.

Bromatological analyses

The bromatological analyses were carried out in the Instituto Tecnológico de Conkal, Yucatán, inside the animal nutrition laboratory. Three silage samples were taken which corresponded to the formulas evaluated in the treatments. The analyses that were conducted on each sample were the following: neutral detergent fiber and acid detergent fiber with the technique of paper bag filter/ANKON, raw protein with the micro-Kjeldahl technique (NOM-F-90-S-1978) (DOF, 1979), ash with the calcination method (NOM-F-066-S-1978) (DOF, 1978), and ethereal extract with the Soxhlet method (NMX-F-615-NORMEX-2018) (DOF, 2019).

Statistical analyses

To evaluate the significant differences, the data obtained were analyzed through Analysis of Variance and Tukey's means comparison test at 5% $\alpha = 0.05$, through the use of the statistical package SAS (Statistical Analysis System) (SAS, 2004).

RESULTS AND DISCUSSION

The results from the bromatological analysis carried out with the three types of feed pointed out that ensilage with marafalfa grass (*P. purpureum*) and the addition of 20% mucuna (*S. pruriens*) presented a higher content of raw protein (8.37%) together with a high percentage of ash (3.84%); the treatment of maralfalfa (*P. purpureum*) with addition of 10% mucuna (*S. pruriens*) presented higher content of ash (4.02%), in addition to 6.91% of raw protein. Finally, the maralfalfa (*P. purpureum*) silage without addition presented lower percentage of protein and ash (3.94 and 3.26%, respectively), but with slightly higher percentages of detergent and acid fiber (Table 1).

In the treatments with maralfalfa (*P. purpureum*) with addition of mucuma (Table 1), similar percentages of proteins were obtained to those reported by other authors with corn ensilage commonly used (Galina *et al.*, 2008; Herrera *et al.*, 2015); however, the percentages were lower than the corn silages added with other grasses with protein percentages higher than 10%, such as those added with alfalfa (Aguirre *et al.*, 2016), or buffel grass (Barros and Silva *et al.*, 2022). Under the conditions of study, although the silages evaluated presented lower protein, they were used as complement to grazing and not as sole source of feed. In the first week of feeding, all the sheep presented observable weight loss with the three treatments, attributed to the period of adaptation of the animals to the conditions of study (González-Garduño *et al.*, 2011; Barros e Silva *et al.*, 2022). When the tests were finished, it was seen that the weight gains were constant week after week in each treatment (Figure 1).

The treatment that showed the best response of sheep weight gain was maralfalfa (*P. purpureum*) silo without addition, followed by the silo with *P. purpureum* + 10% of *S. pruriens*. These results were attributed to the better palatability of the maralfalfa grass (*P. purpureum*). The addition of fresh mucuna (*S. pruriens*) to the ensilage has a fermentation process that affected the consumption of silage per animal and from this the lower weight gain per animal. Maralfalfa (*P. purpureum*) is a soft grass, highly sweet and palatable (González-Garduño *et al.*, 2011; Sevilla-Panchano, 2011), which suggests a higher consumption of silage (Figure 2).

The results obtained showed that the best treatment to obtain sheep weight gain during the dry season is the *P. purpureum* hay pasture silage, which is why the inclusion of mucuna (*S.*

Table 1. Nutritional content of the maralfalfa grass (*P. purpureum*) alone and with the addition of mucuna (*S. pruriens*) and (*S. pruriens*) at 10% and 20%.

Nutritional content	Silage type		
	***Pennisetum purpureum* + 10% de *Stizolobium pruriens* (T1)**	***Pennisetum purpureum* + 20% de *Stizolobium pruriens* (T2)**	***Pennisetum purpureum* (Tc)**
Acid detergent fiber (%)	35.83	41.00	41.81
Neutral detergent fiber (%)	65.80	64.86	66.56
Crude protein (%)	6.91	8.37	3.94
Dry biomass (%)	72.04	70.00	83.31
Ashes (%)	4.02	3.84	3.26
Ethereal extract (%)	1.11	0.75	0.37

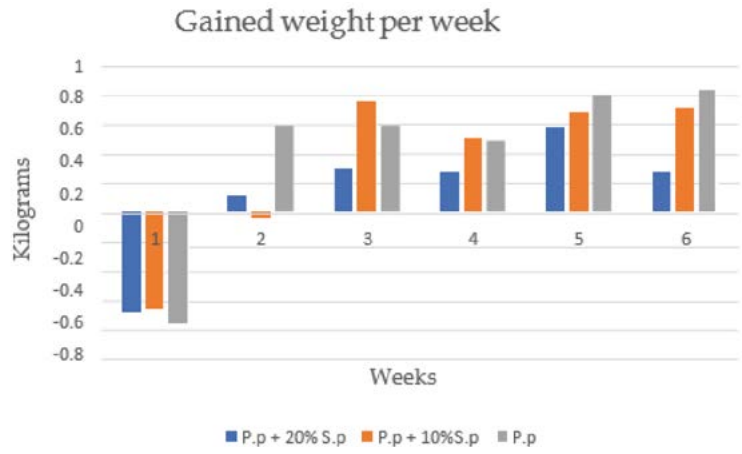

Figure 1. Average individual weight gain trend of the sheep subjected to the three treatments of maralfalfa grass (*P. purpureum*) each week of feeding.

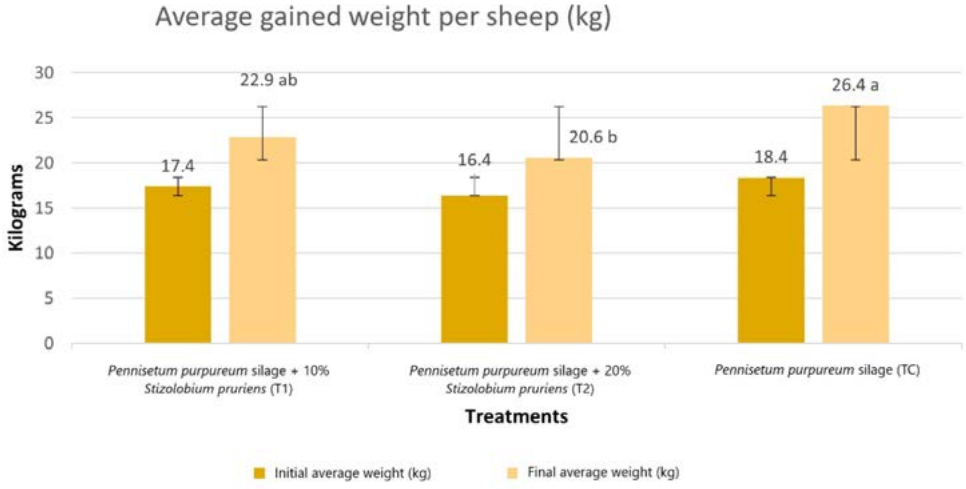

Figure 2. Average weight gain per sheep, as a result of the type of silage. Treatments with the same letter are statistically equal (Tukey, α=0.05).
DMS =3.202

pruriens) to increase the protein content may be unnecessary. The possible low palatability of the silage with mucuna (*S. pruriens*) can be due to the lack of drying and grinding of the legume to avoid a fermentation process during the ensilage with maralfalfa (*P. purpureum*) and its change in flavor. In this regard, Santos Silva *et al.* (2023) mentioned the importance of an adequate drying process in the silages high in nitrogen, since there is an effect on the palatability in tropical sheep with an influence in the decrease of consumption.

In general, the increase in daily weight of treatments Tc (193.1g) and T1(107.56 g) were within an acceptable range reported by different authors (Aguirre *et al.*, 2016; Silva *et al.*, 2021; Barros e Silva *et al.*, 2022; Santos Silva *et al.*, 2023), while not for T2 (53.35 g). Daily average gains between 100 and 150 grams are considered profitable in sheep fattening (Poli *et al.*, 2020; Chávez-Espinoza *et al.*, 2022). In this study, the maralfalfa (*P. purpureum*) silage promoted a better daily weight gain yield when compared to corn (Aguirre *et al.*,

2016) or alfalfa (Reséndiz *et al.*, 2013) silage, which agrees with the previous publications such as Ramírez and Pérez (2006) and González-Garduño *et al.* (2011).

Despite having a significant gain in treatments with the use of *P. purpureum* silage without additive in semi-confined systems for sheep in Campeche, it is recommended to evaluate a drying process and more adequate implementation of mucuna (*S. pruriens*) to increase the percentage of raw protein in the silage, without affecting the palatability.

CONCLUSIONS

Ensilage made with maralfalfa (*P. purpureum*) without mucuna (*S. pruriens*) additive showed a better weight gain yield in the semi-confined grazing system in sheep. The study suggests including a drying process prior to the addition of mucuna (*S. pruriens*) to increase the protein content offered to the sheep without compromising the palatability that could decrease the consumption, since the fermentation process is compromised with the presence of green legumes.

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