Use of leucaena meal (*Leucaena leucocephala*) on the post-weaning lamb feeding during dry season

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Abstract

With the aim of evaluating the lambs performance on dry seasons and feeding with *Leucaena leucocephala* (LM), a trial was carried out in CENIAP experimental area, in Maracay, Aragua state, Venezuela. The treatments were: T1: hay + concentrated food (CF), T2: hay + 50% CF + 50% LM, T3: hay + LM. Seven lambs by treatments were used with an initial average weight 15.2 kg and supply with hay by 5% of their live weight (LW) and 200 g/animal/day of supplementary food. The studied variables were: protein (PC), calcium and phosphorous of the diet, hay consumption and total dry matter, daily weight gain (DWG), food conversion and conversion efficiency (CE). The used design was randomized. The diet content of PC (P<0.01) was between 3.6 and 21.7% for hay and CF, respectively. The hay consumption for the three treatments were between 292 and 583 g/lamb/day, which was 2.6% of the LW, without significance between treatments. There were not significant differences (P>0.05) for DWG and CE and the final daily gain was 48, 32 and 43 g/lamb/day for T1, T2 and T3, respectively. The conclusion is that LM may be a substitute for CF when the lambs are fed with a low quality forage at dry seasons.

Key words: Leucaena flour, lambs, daily weight increase, consumption, conversion efficiency

Introduction

According to diverse studies made about total expenses in systems of animal production, between 55 and 70% are attributable to the inadequate nourishment, being one of the causes of low productive efficiency, therefore is necessary the introduction of balanced portions taking as base regional products (3). In this sense, one of the strategies that might be implemented in diverse production units is the sow of bushy species as
leucacena (Leucacena leucocephala (Lam.) of Wit), which can be used as an association with gramineae or in a protein bank. This last modality can be used as browse or cut, to provide it in a dry way or in flour for the animals feeding.

*L. leucocephala* since is a legume, has an important role due to the nitrogen contribution to the fodder, besides the adaptation capacity to certain edaphoclimatic conditions, all this makes of this legume a forage producer specie with a great nutritive value (2, 25). In Venezuela, have been obtained values of raw protein that oscillate between 19 and 32% (7).

On the other hand, the daily gain of post-weaning weight of lambs reduces between 40 and 70%, compare to the pre-weaning gain, so is necessary to improve the feeding conditions of animals in the stage, with the purpose of reducing these differences and improve the productive indexes of the system (27).

The purpose of this research was to evaluate the productive behavior of post-weaning of the sheep, during the critical dry season, feed with a diet that has leucacena flour.

### Materials and methods

The essay took place in the sheep experimental unit of the National Center of Farming Research (CENIAP), Maracay, Aragua state, geographically located at 10°17'N of latitude and 67°37'0 of longitude and a height of 463 msnm. The mean annual temperature is of 25.1°C and a mean annual precipitation that oscillates between 900 and 1000 mm, with a well defined dry period that is around January to April. The annual average relative humidity is 64%.

Soils belong to the Mollisoles order, from loamy to loamy-sandy, neutral pH with a high content of calcium, a little in phosphorus and potassium. Besides, the lot where was sowed the hay present on this research was manure with goat dung, with a dungy machine, of 600 kg/ha during the rainy period (July) of 1997.

The evaluated treatments were:

- $T_1$: Hay + concentrated feeding (200 g/animal/day)
- $T_2$: Hay + 50% concentrated feeding (100 g/animal/day) + 50% leucaena meal (100 g/animal/day)
- $T_3$: Hay + leucaena (200 g/animal/day)

The leucaena meal was obtained from an established plantation in the experimental field of CENIAP, sowed at 45 cm of the soil, and with cuts every 120 days, drying them in an open space under shadow in a shed. Flowers, rachis, stalks lower of 6 mm were detached, which were finely grinded in a grinder-hammer and storage in bags. Samples were taken to determine the content of raw protein, calcium and phosphorus in the evaluated treatments as well as in the provided hay to the animals, through the proximal analysis (1), spectrophotometry of anatomical absorption and colorimetric (9), respectively.

Seven post-weaning lambs/
treatment were used with the West African and Barbados black stomach breeds with an initial weight between 16.1 ± 2.4; 15.1 ± 2.3 y 14.4 ± 1.3 kg/animal for T1, T2 and T3 respectively. These were accommodated on individual places, type horizontal ship under roof, in spaces of 2 m² each (1 x 2 m). The evaluation period was during 50 of dry period (March- April) of 1998, including 5 days to get used.

The base diet consisted on the daily provision of low quality hay of guinea grass (*Panicum maximum*), harvested in unfertilized paddock in the post-flowering period. The supplied quantity was in reason of 5% of the weekly alive weight, in a sense of evaluating the repealed hay quantity and estimate the consumption.

The used portion for the treatment provision is showed in table 1. This feeding was administered one hour after put the hay.

The hay and concentrated feeding consumption was estimated, with the aim of evaluating the conversion and efficiency of animals conversion. Besides, hay consumption and total consumption (hay more supplement) was evaluated in function of the alive weight of animal. Likewise, the daily weight gain was estimated, through the weekly weight of lambs.

A randomized design was used, where each animal represented a treatment (7 repetitions/treatment), using as a covariable the initial weight and the animal breed. Analysis were made through the correspondent ANAVAR and the Tukey test was used to compare means. In the percentage values case, these were transformed through the angular transformation.

### Results and discussion

**Raw protein, calcium and phosphorus**

In table 2 is showed the protein content, which varied between 3.6 and 21.7% (P<0.01). In this, can be appreciated the low protean quality of the supplied hay, which does not cover the minimum necessary requirements of sheep and ruminants in general (21).

The concentrated feeding had more elevated elements of raw protein, calcium and phosphorus (P<0.01);

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Concentrated</th>
<th>Concentrated + meal</th>
<th>Meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish flour (g)</td>
<td>40.0</td>
<td>20.0</td>
<td>0</td>
</tr>
<tr>
<td>Corn flour (g)</td>
<td>137.0</td>
<td>68.5</td>
<td>0</td>
</tr>
<tr>
<td>Molasses (g)</td>
<td>19.0</td>
<td>9.5</td>
<td>0</td>
</tr>
<tr>
<td>Minerals (g)</td>
<td>4.0</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>Leucaena meal (g)</td>
<td>0</td>
<td>100.0</td>
<td>200.0</td>
</tr>
<tr>
<td>Total (g)</td>
<td>200.0</td>
<td>200.0</td>
<td>200.0</td>
</tr>
</tbody>
</table>
however, Ca content of this raw matter did not differ (P>0.05) for the leucaena meal and the mix of this last with concentrated feeding (table 2).

In relation to phosphorus in the diet (P<0.01), is appreciated the low content of this in the leucaena meal, which does not cover the sheep necessities, proving that even though leucaena is a legume, although it is efficient in the phosphorus collection supply to the plant, is not enough available for animals, neither in grazing or in cut to the flour obtaining (5, 6, 16, 26). Espinoza (7), found concentration levels of phosphorus in the plant under the necessary for animals, even in early ages (6 weeks), recommending deeper research with this element to determine the most adequate fertilizing level. However, it is observed a good content of this macro-element in the supplied hay, maybe due to the absorption capacity and pasture supply, therefore it is possible that phosphorus content in the plant might be a product of the organic fertilization of the land. In this sense, Garcia (11) mentions that 50% of nutrients as phosphorus come from the animal lees that accumulate in the stalks, in a sense that through the harvest can be optimized the use of this product.

On the other hand, once analyzed the hay consumption and supplied supplement to each treatment (tables 3 and 4), could be observed that there was not a significant difference (P>0.05) for the content of raw protein and calcium between the different consumed diet and where the protein quantity was near 9% (table 2). This value is much under the just ablactated lamb and yearling lamb requirements in their firsts growing phases, due that they need a minimum of 15 to 16% of raw proteins (17, 20, 21). Therefore, for

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**Table 2. Raw protein, calcium, and phosphorus content of the fodder and supplied supplement to the post-ablactation sheep.**

<table>
<thead>
<tr>
<th>Feeding</th>
<th>Raw protein</th>
<th>Calcium</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated (Conc)</td>
<td>21.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.05&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Leucaena meal (HL)</td>
<td>19.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.32&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.15&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Conc + HL</td>
<td>19.84&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.54&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.58&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hay</td>
<td>3.55&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.42&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.41&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diet:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay + Conc</td>
<td>8.9&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.35&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.68&lt;sup&gt;A&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hay + Conc + HL</td>
<td>9.0&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.23&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.47&lt;sup&gt;A&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hay + HL</td>
<td>8.9&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.06&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.32&lt;sup&gt;B&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a,b,c,d</sup>Different small letters in a same column, between raw matter, presented significant differences (Tukey, P<0.05).

<sup>A,B</sup>Different capital letters in a same column, between diets, presented significant differences (Tukey, P<0.05).
the growing phase of these animals, are required grass and fodder as a base diet with excellent nutritive values.

It was observed a lower phosphorus content in the diet on the hay treatment plus leucaena flour (P<0.05). However, the phosphorus content that lambs and yearling lambs require oscillates between 0.16 and 0.38%, meanwhile calcium must be between 0.2 and 0.82% (17, 20, 21), being in the normal values in relation to Ca:P indicated by Mc Dowell et al. (19).

**Hay consumption**

There were not found significant differences (P>0.05) for hay consumption between treatment and subsequent weeks. However, it was observed a highly significant difference (P<0.01) in the last week respect to the beginning of the experiment (first week). This consumption oscillated between 423 and 532, 317 and 417, 292 and 380 g MS/animal/day for T1, T2 y T3, respectively, where the hay consumption incremented in the order of 26, 32 and 30% between the beginning and last day of the essay, for T1, T2 y T3 treatments, respectively, for an average increment of all treatments of 136 g MS/animal/day.

In table 3 is showed that the average hay consumption was of 474, 424 and 395 g/animal/day, which is equal to 2.7; 2.7; and 2.5 of alive weight

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hay consumption (g/animal/day)</th>
<th>% PV/day</th>
<th>Total % PV/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated</td>
<td>474&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>2.7&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>3.8&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Conc. + HL</td>
<td>424</td>
<td>2.7</td>
<td>3.9</td>
</tr>
<tr>
<td>Leucaena meal</td>
<td>395</td>
<td>2.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

<sup>ns</sup>There was not found a significant difference between treatments

Table 3. Hay consumption and total dry matter in function of the animal (g/day) and the alive weight (%) for each treatment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hay consumption (g/animal/day)</th>
<th>% PV/day</th>
<th>Total % PV/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated</td>
<td>674&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>48&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>14.0&lt;sup&gt;ns&lt;/sup&gt;</td>
</tr>
<tr>
<td>Conc. + leucaena meal</td>
<td>624</td>
<td>32</td>
<td>19.5</td>
</tr>
<tr>
<td>Leucaena meal</td>
<td>595</td>
<td>43</td>
<td>13.8</td>
</tr>
</tbody>
</table>

<sup>ns</sup>Not significant

Table 4. Conversion and efficiency of post-weaning lambs conversion consuming low quality hay with concentrated, leucaena flour and the mix of both.
for animals which average was of 17.8; 16 and 15.7 of animal/weight for T₁, T₂ y T₃, respectively. In relation to the total consumption of dry matter (hay + supplement) was of 3.8; 3.9; and 3.8 for treatments and in the same order previously mentioned (P>0.05). These results are inferior to those reported in an experiment done with 30 sheep, divided in two groups of 15 each, where were supplied hay (group 1) and more concentrated hay with 42% of raw protein (group 2) obtaining an average of consumption values of 4.1 and 4.5 of alive weight in animals with an average weight of 23.2 and 26.3 kg in group 1 and 2 respectively (18).

Hay consumption for all treatments in function of alive weight of the animal varied between 1.9 and 3.4% (P>0.05), with a general mean of 2.2.6%; while for the total consumption during all the experiment varied between 3.2 and 4.6% (P>0.05) with a general average of 3.8%.

Martinez et al. (15) using a protean supplementation in green grass of low quality did not report significant differences in the daily fodder consumption in dry base, because as well as Clavero et al. (4), considerer that in a low protean diet, the fermentation ruminal estimate is limited. On the other hand, when observing table 2, where is evidenced that the protein consumption in the diet was of 9%, it is probably that the nutritive request of the ruminal microbiota has not been satisfied, to guarantee the catalytic effect (22). In experiments done in Mexico (12), using yearling lamb and nourished with a hay basal portion of star grass (Cynodon nlemfuensis, 4.3% PC) and other of guinea (Panicum maximum, 5.6% PC) incorporating dry fodder of “mata raton” (Gliricidia sepium) and B. Alicastrum, respectively; found an increment in the volunteer consumption of dry matter due to a high ruminal digestion of the organic matter of the supplied arboreal species. Likewise, these authors indicated that due to a low quality of the basal portion there was not a positive effect on the ruminal extension of the grass dry matter; which corroborates what said by Obispo et al. (22), in the sense that resulted difficult to catalyze the ruminal digestion of gramineae of very low quality. It is probably that the high content of cellular walls of grass with low quality, join to the lignifications of this wall, are severe limitations to ruminal digestion improvement of the basal portion (12).

**Daily gain weight**

Figure 1 shows daily gain weight of animals during all the experimental phase. It was observed a significant difference (P<0.05) for this variable in the second week (20/3) and highly significant (P<0.01) for the third (26/3). For the rest dates and for the daily gain of final weight was not observed significance (P>0.05). In the same figure, is observed that weight gain oscillated between 14 and 122 g/animal/day for the witness treatment (hay plus concentrate), 0 and 167 g/animal/day for T₂ (hay plus concentrated and leucaena flour) and from 1 to 133 g/animal/day in T₃ (hay plus leucaena flour). The daily gain of final weight of animals was of 48, 32 and 43 g/animal/day for T₁, T₂ y T₃, respectively (P>0.05).
Superior values have been obtained with animals of the same flock (8, 13, 14, 18). Despite, was found a higher accumulated gain with treatments using leucaena (396 g/animal) and 50% of each mixtures (T2; 391 g/animal), compare to the witness (308 g/animal) (P<0.05).

Though of having in some cases, weekly weight gain over 100 g/animal/day, the obtained daily gain of final weight, can be attributable by two factors. The first of them, might be due to the low quality of base fodder for the lambs feedings, which did not cover animals necessities (table 2), in a part corroborating the previously generated discussion, based on the fact that there was not a catalyzation of the ruminal digestion of the supplied hay, which occasioned a scarce productive response of yearling lambs.

Secondly, may be also explained by the possible consanguinity of the flock, because when this experiment took place, besides it kept closed, it was not considered the weight feature for the selection of animals. The additive genetic potential is measured by the heredity index, which if it is zero for a determine feature on a specific population, this feature does not response to the selection (24). On a research done in a period of 15 years, on genetic improvement in sheep, that took place on the Experimental station of Maipu, Chile University, where centered the studies in Suffolk flocks with low weight, which objective was to increment the height and development (corporal weight), at the end of the period obtained increases of more of 10 kg in sheep, besides it was induced to an increment in the...
apparition, prolificity and lambs quantity.

On the other hand, could be observed in the behavioral pattern of animals, that as well as weight gain and consumption are related between them, because at the same time that there was a reduction in the consumption, GDP reduced and incremented when consumption was higher. This is showed in figure 2, where is seen the existent regression between the animal weight and the consumption of dry matter (R=0.83).

In table 4, is seen the conversion and efficiency of conversion, related between consumption and daily gain of final weight, where can be seen that there was not a significant difference (P>0.05) between the evaluated treatments, which allows to suggest the substitution of the concentrated feeding by the leucaena flour, thus the obtained values showed it so.

The conversion values obtained on this essay were superior than those obtained in other experiment with lamb and using a fodder millet (*Sorghum vulgare*) with 6.1% of PC and 400 g/animal/day of isoprotean supplement (13).

Between the factors that influence the conversion index are found the animal genetic, sex, animal handling and the feeding programs, and others (23), which if considering the consanguinity hypothesis and the low protean quality of the base feeding, will explain the behavior of the conversion efficiency. However, it is observed that only with leucaena flour the conversion efficiency resulted to be the same of the witness treatment
The feeding of post-weaning lambs and yearling lambs in their first growing phase, requires a base diet of elevated protean quality, due to this research proved that with grass of low nutritive quality does not exist a satisfactory animal response. However, leucaena meal (*Leucaena leucocephala*) can substitutes the concentrated feeding with base of fish and corn flour in the lamb feeding, constituting a choice when the supplied fodder be of low nutritive quality.

**Conclusions**

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