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# Strategic Supplementation and Productive Indicators of Pelibuey Ewes and Their Offspring During Gestation and Lactation

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## ABSTRACT

**Aim**. To evaluate the impact of strategic supplementation on productive indicators of Pelibuey ewes and their offspring during gestation and lactation. **Methods**: The study was conducted at the Experimental Station of Pastures and Forages in Las Tunas province. Twenty-four Pelibuey breeding ewes were used. The variables analyzed were: body condition score, average daily gain, initial weight, weight at lambing, birth weight, and weaning weight. Four treatments were established using a completely randomized design. Means were compared by multiple comparison test (Duncan, 1955). Data were processed with the InfoStat statistical package, version 2.1. **Results**: The provision of supplementation did not fully meet the requirements for dry matter, protein, and energy. The analysis indicated that strategic supplementation alone covered approximately 50% of dry matter and energy requirements, and about 75% and 67% of protein requirements during gestation and lactation, respectively. **Conclusion**: Strategic supplementation improved the productive performance of Pelibuey ewes in the last third of gestation and during the first two thirds of lactation, as evidenced by significant increases in lamb birth weight, lamb weaning weight, and average daily gain of the ewes and their offspring.
**Keywords**: nutritional balance; hair sheep; nutritional requirements (*Source: AGROVOC*)
*AGROVOC*)

# INTRODUCTION

Most sheep (*Ovis aries*) in Cuba are managed in extensive systems dominated by natural pastures, with little use of supplementation technologies (Rodríguez-Cruz, 2021). In this context, there is a pronounced annual fluctuation in the quality and quantity of the feed resource base, which negatively affects the productive performance of animals in these production systems.

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In this context, strategic supplementation is a nutritional strategy that can ameliorate the situation described above. Supplementation should be regarded as the provision of nutrients that, for various reasons, may be deficient or inadequate in the basal diet for the desired level or type of production. It has been shown to affect lamb birth weight, carcass traits, and growth (Rodríguez and Ortiz, 2020).

In Cuba, supplementation for sheep can be implemented using a wide range of feedstuffs, including nutritionally adequate pastures and forages, concentrate feeds, and agro-industrial by-products, among others, depending on local or regional availability.

Moreover, close management of breeding ewes within the flock is essential to achieve satisfactory productive performance. Accordingly, the cyclical reproductive status of females in the production system requires the technician or producer responsible for the herd to implement management and feeding protocols tailored to the specific stage of the reproductive cycle.

The performance of breeding ewes, particularly during the last third of gestation and at the onset of lactation, represents a critical period in the productive cycle of sheep. Rodríguez and Ortiz (2020) proposed that management and nutrition should be adjusted at each of these stages to achieve satisfactory outcomes in weaned and marketable lambs.

Furthermore, the sheep sector in Cuba is among the least supported in terms of the application of scientific and technical practices in production settings; consequently, such practices are infrequently implemented, which substantially contributes to low productivity levels (Rodríguez-Cruz, 2021).

Based on the foregoing, the present study was conducted to evaluate the impact of strategic supplementation on productive indicators of Pelibuey ewes and their offspring during gestation and lactation.

# MATERIALS AND METHODS

Location and edaphic characteristics of the experimental area: The study was carried out at the Experimental Station of Pastures and Forages in Las Tunas province, located at km 1½ La Larga on a grayish-brown soil with level terrain. The experimental period corresponded to May and January of 2018 and 2019, respectively.

Average values of the main climatic variables during the experimental period: During the experimental period, minimum temperatures ranged from 16–22 °C and maximum temperatures from 28.4–32.5 °C. Relative humidity varied between 65–82%. Mean annual precipitation was 700 mm.

Total number of animals and other relevant characteristics: Twenty-four Pelibuey breeding ewes between their third and fourth parity were used; mean body weight was 27.42 kg. The animals exhibited no apparent clinical signs and were in good health.

The basal pasture consisted entirely of jiribilla (*Dichantium caricosum*) under rainfed conditions and without fertilization. Animals grazed 6 hours per day, from 09:00–11:00 and 13:00–17:00, in areas adjacent to the shade shelters.

Body condition scoring: Body condition score (BCS): Diagnosis was performed by visual inspection and individual palpation. Scores were assigned following the methodology of Reinoso and Simón (2000) adapted for sheep. A 1–5 scoring scale was used, and assessments were made by two independent evaluators.

Strategic supplementation Breeding ewes received mineral salt and water *ad libitum* in the shade shelter, and were offered the experimental supplements according to their assigned treatments.

The supplementation consisted of 6 kg *Leucaena leucocephala*, 6 kg *Pennisetum purpureum* (Cuba CT-169), 1 kg honey, and mineral salt and water *ad libitum* per group; therefore, the approximate consumption was 1 kg of each forage and 166 g of honey per animal, as appropriate.

-Treatment I (Control): no supplementation

-Treatment II: supplementation during the last 15 days of gestation and the first 15 days of lactation.

-Treatment III: supplementation during the last 30 days of gestation and the first 30 days of lactation.

-Treatment IV: supplementation during the last 60 days of gestation and the first 60 days of lactation

**Estimation of the nutritional value and the contribution of the strategic supplementation**

The nutritional value of the feeds was estimated using the nutritive value table of García-Trujillo and Pedroso (1989), and all species were considered to be of medium quality. Dry matter intake was assumed to be 2.5% of body weight (30 kg) and requirements were calculated according to NRC (2007); energy requirements were increased by 20% to account for the medium quality of the pasture.

Variables analyzed and Statistical analysis: The following variables were evaluated: birth weight of the lambs, weights of the breeding ewes, body condition score, and average daily gain. A completely randomized design was used, and response variables were compared by ANOVA followed by Duncan's multiple range test (Duncan, 1955). Data were processed with InfoStat

version 2.1 statistical software. Normality was assessed using the Kolmogorov–Smirnov test. For evaluation of the assumptions of homogeneity and normality, Levene's test and the Shapiro–Wilk test were used, respectively. Variables that failed one or both assumptions were log-transformed.

**Table 1. Values of the Levene and Shapiro-Wilk test statistics**

| Original variables | Levene test for homogeneity of variances | Shapiro-Wilk test for normality |
|---|---|---|
| Initial weight of the breeding females (kg) | 0.48 | 0.38 |
| Weight at parturition (kg) | 0.34 | 0.40 |
| Average daily gain of the mothers (g animal$^{-1}$ day$^{-1}$) | 0.26 | 0.35 |
| Birth weight of the offspring (kg) | 0.74 | 0.42 |
| **Transformed variables** | | |
| Weaning weight (kg) | 0.80 | 0.65 |
| Average daily gain of the offspring (g animal$^{-1}$ day$^{-1}$) | 0.68 | 0.50 |

# RESULTS AND DISCUSSION

Table 2 presents the estimation of the partial nutritional balance for the breeding females that received the strategic supplementation, based on the main bromatological components most frequently used in ration formulation and feed analysis (Angulo *et al*., 2022; Navarro *et al*., 2022). In this regard, authors such as Delgado and Arias (2018) have argued that supplementation should be considered as the supply of nutrients that, for various reasons, may be deficient or inadequate in the basal diet for a given level or type of production — a goal that was evidently achieved with this supplementation.

The results indicated that, even with the offered supplementation, the requirements for dry matter, protein, and energy were not likely met one hundred percent, which probably influenced the animals' inability to express their maximum potential. Nevertheless, the contribution from pasture intake — an aspect that was not quantified in the study — should have helped to some extent to mitigate the situation described above.

From a quantitative standpoint, the analysis indicated that the strategic supplementation by itself covered approximately 50% of dry matter, between 75% and 67% of protein for gestation and lactation, respectively—values that could be significant given ruminants' ability to recycle nitrogen at the organismal level (Espinosa *et al*., 2021). In the case of energy, as with dry matter, a little more than 50% of the requirements was covered; from a nutritional perspective this may be the most important shortfall and therefore the highest priority for animal scientists and producers, since this nutrient supports all bodily activities (Hernández *et al*., 2023).

**Table 2. Daily and individual partial nutritional balance of the strategic supplementation in the studied stages**

| Feed contribution | DM (g) | CP (g) | ME (Mcal/kg) | Calcium (g) | Phosphorous (g) |
|---|---|---|---|---|---|
| *Leucaena Leucocephala* | 310.00 | 62.00 | 0.78 | 7.13 | 0.75 |

| | | | | | |
|---|---|---|---|---|---|
| *Pennisetum Cuba CT 169* | 205.00 | 12.91 | 0.42 | 0.88 | 0.35 |
| Final honey yield | 134.80 | 4.95 | 0.36 | 1.83 | 0.13 |
| Common salt | 19.40 | - | - | 2.89 | 2.45 |
| Total | 669.20 | 79.86 | 1.56 | 12.73 | 3.68 |
| **Individual requirement** | **Last quarter of gestation** | | | | |
| | 1300 | 106.00 | 3.00 | 3.90 | 2.90 |
| Partial balance* | -630.80 | -26.14 | -1.44 | + 8.83 | + 0.78 |
| Individual requirement | **Eight first week of lactation** | | | | |
| | 1300 | 118.3 | 3.00 | 4.30 | 3.10 |
| Partial balance* | -630.80 | -38.44 | -1.44 | +8.43 | +0.58 |

**Note: * Balance excluding pasture intake.**

The results of the body condition assessment are shown in Figure 1. Scores ranged from 2.25 to 3.45. Animals that were not supplemented, or that received supplementation only for 15 days before and after parturition, showed body condition scores below 3 during lactation, which highlights the effect that the additional supply of key nutrients had on animal performance. This finding also supports Hernández *et al*. (2023), who reported that this period is the most demanding in terms of a ewe's nutritional requirements. In contrast, animals that received supplementation for 30 and 60 days reached parturition in better physical condition, a factor that, according to Hinojosa-Cuéllar (2019), positively influences offspring development by benefiting birth weight and the milk production of their dams.

From a dynamic perspective, a downward trend in body condition scores was observed from the beginning of gestation through the final days of lactation. This decline was likely caused primarily by the failure to meet the increasing nutritional requirements of the breeding females, which leads animals into a negative energy balance characteristic of this physiological stage. However, greater stability was achieved in the animals that received higher levels of supplementation. It is worth noting that the time of year likely had a marked influence on the drop in body condition during the second and third months of lactation, which coincided with the region's driest and most critical months for the study, January and February. This period has a strong negative correlation with pasture availability and quality.

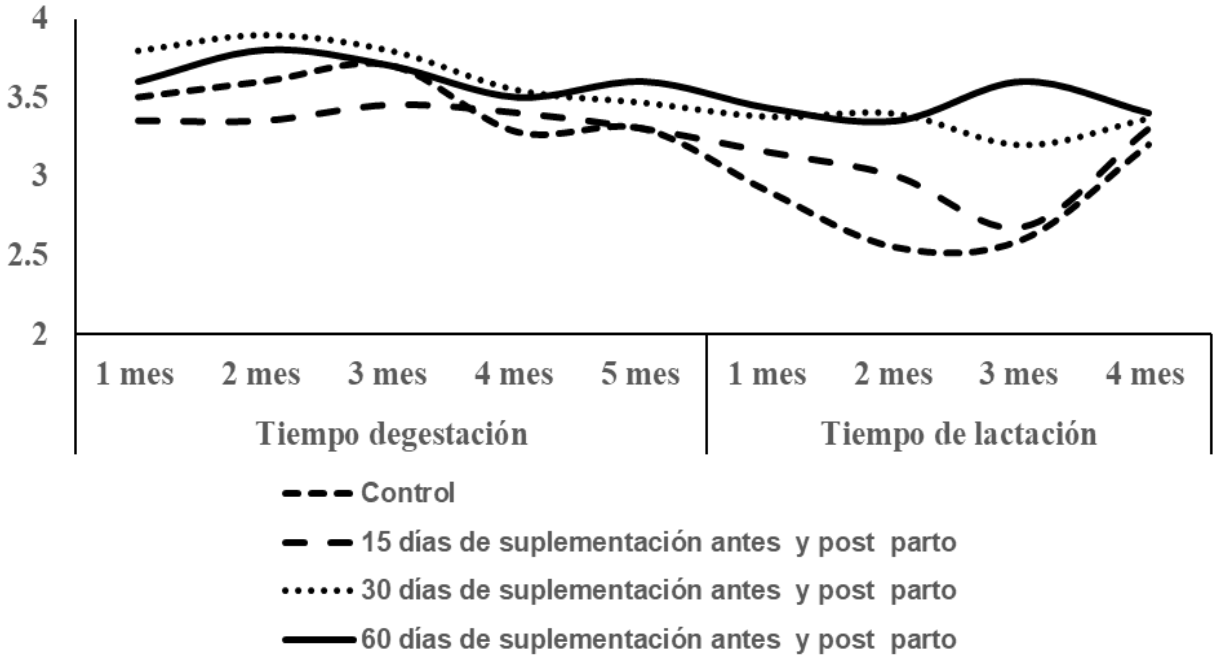


**Figure 1. Body condition behavior**

The average initial weight of the breeding females was 27.42 kg, below the 30 kg considered ideal for ovine producers by Perón (2010), who states that this is when physiological maturity for reproduction is reached. In this regard, Forcada *et al.* (1992) concluded that ovulation rate increases with the animal's live weight, with a consistently positive correlation between the two (Table 3).

Significant statistical differences between treatments were observed in the weight of the breeding females at the time of parturition. In this regard, the control group and the group that received supplementation for 15 days before parturition did not differ from each other. In contrast, significant differences were found for the animals that received supplementation for a longer period, which may be due to their nutritional requirements being met to a greater extent, especially during the last third of gestation, when these requirements reached their highest values in that stage (Chay-Canul *et al*., 2016).

The average daily gain showed no statistical differences between the control group and the group that received supplementation 15 days before parturition, which concluded that when hair sheep consume natural pasture the average daily gain ranges between 40 and 70 g animal$^{-1}$ day$^{-1}$. Likewise, the breeding females that received supplementation for 30 and 60 days before parturition had average daily gains 30–40% higher than the other treatments, which suggests that energy and protein requirements were more fully met during the final stage of gestation, although those values remained far from the breed's maximum potential. These indicators were lower than

the 150 g animal$^{-1}$ day$^{-1}$ reported by Sánchez-Frómeta (2019), who fed developing Pelibuey ewes confined in elevated-floor pens with restricted grazing.

**Table 3. Effects of supplementation on the breeding females during the experimental period**

| Variables | Treatments | | | | SE ± |
|---|---|---|---|---|---|
| | Control | 15 days before parturition | 30 days before parturition | 60 days before parturition | |
| Initial weight (kg) | 27.47 | 27.62 | 27.37 | 27.23 | 0.18 |
| Weight at parturition (kg) | 35.57$^{a}$ | 34.611$^{a}$ | 39.62$^{b}$ | 41.32$^{c}$ | 0.09 |
| Average daily gain (g animal$^{-1}$ day$^{-1}$) | 54.59$^{a}$ | 56.58$^{a}$ | 81.70$^{b}$ | 93.97$^{c}$ | 1.09 |

**Different scripts indicate significant differences ($p < 0.05$).**

The average live weight of the lambs at birth was 2.91 kg, a value that falls within the breed range and can be considered adequate given the feeding system used and the climatic conditions of the area where the experiment was conducted.

The breeding females that did not receive supplementation had offspring weights below the overall average, which confirmed the effects of maternal feeding on birth weight. Authors such as Morantes and Rivas (2022) stated that inadequate feeding management during gestation that causes weight loss and low body condition in ewes favors the birth of low-birth-weight lambs due to placental insufficiencies that limit fetal nutrition, with a consequent increase in mortality rate; it also results in poor mammary development and reduced production and quality of colostrum and total milk.

On the other hand, the breeding females that consumed the diet for a longer period (30 and 60 days of gestation) had weights 12.66% and 15.14% above the overall mean, respectively. These results, in absolute terms, were similar to the 3.15 kg reported by Lenis *et al.* (2022) under a management system during the females' last trimester that consisted of restricted access to a silvopastoral system with *Leucaena leucocephala* and *Cynodon plectostachyus* plus rice-bran supplementation.

Weaning and weight gain, two highly correlated variables, resulted in an average weaning weight of 14.01 kg and an average daily gain of 75.75 g animal$^{-1}$ day$^{-1}$; weaning was carried out at 120 days. The group that received no supplementation or only consumed it for 15 days had a weaning weight well below the overall mean. Therefore, the lambs from dams that consumed the ration for a longer period reported weights above the mean, with significant differences compared with the control and the 15-day group. This was likely directly related to the mothers' milk production, which must have been higher both quantitatively and qualitatively, consequently increasing the growth of the offspring. In this respect, the values were higher than those obtained by Montes *et al.* (2022), although in that study weaning was performed at 90 days, and similar to those of Lenis *et al*. (2022), who reported 15.3–16.2 kg with average daily gains of 101 g/day for males

and 108 g/day for females in a silvopastoral system with *Leucaena leucocephala* and *Cynodon plectostachyus*.

**Table 4. Behavior of offspring weight at birth, weaning, and in average daily gain**

| Variables | Treatments | | | | SE ± |
|---|---|---|---|---|---|
| | Control | Supplementation during 15 days of gestation and lactation | Supplementation during 30 days of gestation and lactation | Supplementation during 60 days of gestation and lactation | |
| Weight at birth (kg) | 2.69[a] | 2.72[a] | 3.08[b] | 3.17[c] | 0.02 |
| Weaning weight (kg) | 11.65[a] | 11.98[a] | 15.62[b] | 16.77[c] | 0.12 |
| Average daily gain (g animal$^{-1}$ day$^{-1}$) | 75.75[a] | 77.29[a] | 104.51[b] | 112.64[c] | 0.98 |

**Different scripts indicate significant differences (p < 0.05).**

# CONCLUSION

Strategic supplementation during the last third of gestation and the first two thirds of lactation significantly improved the productive performance of Pelibuey breeding ewes, as shown by increases in lamb birth weight, lamb weaning weight, and average daily gain (ADG) of both dams and their offspring.

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## AUTHOR CONTRIBUTION STATEMENT

Research conception and design: JAHT; data analysis and interpretation: JAHT; manuscript writing: JAHT

## CONFLICT OF INTEREST STATEMENT

The authors state there are no conflicts of interest whatsoever.