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USE OF ULTRASONOGRAPHY IN THE EVALUATION AND INTERACTION OF BODY CONDITION AND OVARIAN ACTIVITY IN TRIHYBRID FEMALE SHEEP FROM THE F.U.J.D.C. SHEEPFOLD. IN THE MUNICIPALITY OF SORACÁ

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Abstract: Sheep farming is one of the agricultural productions with the greatest possibilities for development in Colombia. To improve the reproductive efficiency of herds, it is necessary to study body condition (BC) and how it affects reproductive physiology; Because in our region there were no studies on this topic with our environmental and productive conditions, this research work was carried out at the FUJDC Soracá sheepfold facilities at an altitude of 2799 meters above sea level, an average temperature of 13° Celsius, for this 25 female sheep were used, of which 68% had one birth and 32% had two or more births, with ages between 19 and 62 months and an average live weight of 38.6 ± 6 kg, CC between 2 and 5, classified by the Jefferies method, (1961, classification 1 to 5), transrectal and dorsal ultrasonography was performed at the level of the thirteenth rib to evaluate their ovarian activity, the width and depth of the Longissimus dorsi muscle and the thickness of fat. dorsal (EGD), the preovulatory follicles were classified as small (22%), medium (62%) and large (16%), the EGD varied between 0.2 and 1.1 mm, with a high correlation coefficient with the CC (r=0.8799), like the EGD with the follicular activity which had a low and positive correlation coefficient (r=0.6414), the activity at metestrus determined by ultrasonography 6 days after ovulation determined that 51.28% of the females presented corpora lutea, they had an ovulatory rate of 1.81, through Chi-square tests it was determined that there is a dependence between the EGD and ovarian activity at 6 days post estrus for the right ovary. (p=0.0026) and the left ovary (p=0.00098)
Keywords: ovarian activity, body condition, estrus, sheep culture, transrectal, ultrasonography.

INTRODUCTION

The objective of the study is to determine the interaction between body condition and ovarian activity in trihybrid sheep females from one or more lambs belonging to the Juan de Castellanos University Foundation sheepfold. The aim is to establish the relationship between the traditionally measured body condition and the measurements obtained by ultrasonography of the Longissimus dorsi muscle and the thickness of the back fat in these sheep. In addition, ovarian activity was monitored by ultrasonography in estrus and metaestrus, looking for correlations between the thickness of back fat and ovarian activity.

Body condition has a significant impact on the reproductive function of sheep, affecting the synthesis of hormones and the development of physiological structures related to reproduction. Low body condition may be associated with delayed or suppressed estrus, as well as fewer developing follicles (Scaramuzzi et al., 2011; Kenyon et al., 2014). Body condition is assessed using the body condition score by measuring subcutaneous and muscle tissue along the spine.

The use of ultrasonography in the sheep industry has been fundamental for the diagnosis of pregnancy and the monitoring of anatomical changes in ovarian structures. This technology has also been used in the prediction of carcass composition in beef sheep, showing promising results (Menzies, 2011). In Colombia, the use of technologies such as ultrasonography in sheep production is limited, despite its potential to improve the reproductive efficiency and profitability of farms (Viñoles et al., 2012). Transrectal ultrasonography is a technique widely used to confirm pregnancies in other species, although in sheep the use of transabdominal ultrasonography is more common (Medan et al., 2015).

In the Department of Boyacá, sheep production is of great importance because it represents one of the few viable agricultural economic activities in smallholdings, hillside areas, dry areas or areas of low fertility. Livestock producers with limited resources prefer the sheep species since their feed and capital requirements are low compared to those of other animal species (Martínez-González et al., 2020). The sheep population nationwide has decreased more than 50% in 17 years, which highlights the need to improve reproduction to increase the sustainability and efficiency of the production chain.

Puberty in sheep is influenced by factors such as age, time of birth, breed, weight, diet and photoperiod. During reproductive activity, sheep manifest estrous cycles with an average duration of 17 days, of which approximately 30-36 hours correspond to the period of sexual receptivity (Viñoles et al., 2012). The reproductive physiology of sheep is determined by exogenous and endogenous factors that stimulate or inhibit the control capacity of the endocrine system over the production of fundamental gametes and gestation capacity. Folliculogenesis is a complex process controlled by the relationships between intrafollicular steroids, growth factors and the feedback system of the hypothalamic-pituitary-ovarian axis (Scaramuzzi et al., 2011). Ultrasonography has allowed the identification and elimination of wombs with uterine and ovarian alterations, which has resulted in an increase in fertility and pregnancy rates. However, the twinning rate in some biotypes is low due to limited selection capacity. There are alternatives to improve the twin rate, such as genetic improvement, nutritional optimization, or a combination of both strategies (Oliveira et al., 2017). Ultrasonography is also an important tool for the diagnosis and monitoring of the reproductive physiology of sheep, allowing

direct observation of the follicles and corpora lutea in the ovary. The measurement of the Longissimus dorsi muscle using ultrasonography can be incorporated into sheep genetic improvement programs (Berg & Jacobsen, 2020).

MATERIALS AND METHODS

Study Area: The study was carried out in Soracá, a region suitable for agricultural and livestock production, located in the central area of the department of Boyacá, Colombia. Soracá is located in the central mountain range of the Andes and has an altitude of 2,799 meters above sea level, with an average temperature of 12°C.

Type of Study: The study was descriptive in nature and focused on evaluating body characteristics and ovarian activity in 25 empty trihybrid sheep with one or more lambs, using dorsal and transrectal ultrasonography. The sheep were selected during the period of high reproductive activity (August to November) and managed under controlled conditions, including uniform feeding and semi-stable management. The influence of back fat thickness and the characteristics of the Longissimus dorsi muscle on follicular activity was evaluated. Transrectal ultrasonography was performed to monitor the number and size of antral follicles and corpora lutea in each ovary. Additionally, back fat thickness and Longissimus dorsi muscle dimensions were measured at the beginning of estrus and six days after ovulation.

Data Analysis: Summary measures such as mean, mode, median, range, variance and standard deviation were used to analyze the quantitative variables. The data obtained were subjected to the Chi-square test (X^2) to evaluate the relationship between the categorical variables, contrasting the hypothesis of independence with that of dependence.

RESULTS AND DISCUSSION

In this research, various physiological and reproductive parameters of 25 female sheep between 19 and 62 months old, with a live weight between 30 and 58 kg, were analyzed. The study sought to correlate these characteristics with body condition, number of births, ovarian activity and back fat thickness.

WEIGHT AND BODY CONDITION

The sampled sheep had an average weight of 38.6 kg with a standard deviation of 6 kg, and the mode was 40 kg. More than 50% of the sheep weighed 38 kg or more. Body condition, evaluated according to the Jefferies (1961) technique, showed that the majority of animals had a body condition of 3 or 4. These results coincide with previous studies that suggest that body condition is a reliable indicator of nutritional status and of general animal health (Russel et al., 1969). The analysis of the weight and body condition of the female sheep revealed a significant variability in the studied population. The observed relationship between weight and body condition, as well as the positive correlation between backfat thickness and body condition, underlines the importance of these metrics as indicators of the nutritional and health status of the animals.

NUMBER OF BIRTHS

The majority of females (68%) had given birth only once. Body conditions varied depending on the number of parities, with animals from one parity having body conditions between 2 and 4, and animals with two or more parities showing body conditions between 3 and 5. Previous studies have shown that the number of parities can influence body condition and reproductive capacity of sheep (Ewbank, 1967).

OVARIAN ACTIVITY AND TRANSRECTAL ULTRASOUNDS

Using transrectal ultrasounds, the follicles present in the ovaries were measured. 50 follicles were identified, classified as small (0-1 mm), medium (1-2.9 mm) and large (≥3 mm). Silva, et al., (2016) demonstrated that there is a greater capacity of the measurements obtained through the use of ultrasonography to estimate the absolute values of different components of the body such as back fat, than to estimate the proportion of these components as is the case of the measurement of body condition by palpation, as a result of this it was evident that the measurements of subcutaneous fat taken by ultrasonography explained the great variation observed in the total value of body fat of the animals studied, these results demonstrate that the predictive models are specific to the breed and the environment of the study in which they were carried out so that they can have a practical application.

Villar & Zimerman (2010) found a positive correlation between pre-slaughter body condition and the proportion of renal pelvic fat and carcass coverage in Merino sheep, which presented a low level of carcass fattening (< 3mm), characteristic of wool genotype breeds, such as the results obtained in this study finding a high positive correlation (r=0.8799) between body condition and back fat thickness, with the highest value for back fat thickness 1.1mm.

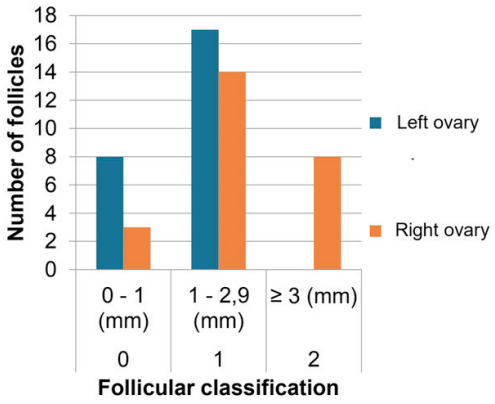

Figure 1: Follicle classification observed when the animals showed signs of heat

Females with one calving had a higher proportion of medium and large follicles compared to those with two or more calvings. Furthermore, it was observed that animals with higher body condition tended to have more large follicles (≥3 mm). Ultrasound has been widely used to monitor follicular dynamics in sheep, proving to be an effective tool to evaluate reproductive activity (Bartlewski et al., 1999). Ovarian activity during estrus showed variations similar to previous studies in other sheep breeds, confirming the reliability of ultrasonography to detect ovarian follicles (Bartlewski et al., 1999; Contreras Solís et al., 2007).

The measurement of the Longissimus dorsi muscle also showed significant correlations with body condition, supporting its use as an indicator of nutritional status and energy reserves in sheep (Khanal et al., 2016).

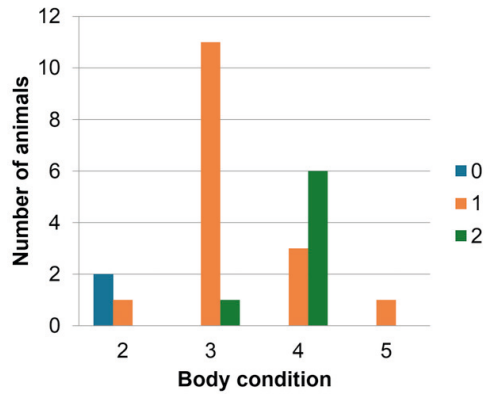

Figure 2: Follicular activity versus body condition

Data on ovarian activity and ovulatory rate highlighted important differences related to the number of births. Females with more births tended to show better body condition and a greater thickness of back fat, which could positively influence their reproductive capacity (Ulutas et al., 2012). However, ovulatory efficiency, measured by the rate of conversion of follicles to corpora lutea, was relatively low, especially in multiparous females. These findings are consistent with previous studies that suggest that better nutritional management can improve reproductive efficiency in sheep (Schoenian, 2010).

BACK FAT THICKNESS

The average backfat thickness was 0.584 cm, with a standard deviation of 0.306 cm. For females with one calving, the average thickness was 0.55 cm, while for females with two or more calvings it was 0.66 cm. A high correlation (r=0.8799) was found between body condition and back fat thickness, indicating that measuring back fat is a good indicator of energy reserves in these animals. This finding is in line with studies that suggest that backfat thickness can be used as a reliable proxy for the evaluation of energy status in sheep (Gunn et al., 1969).

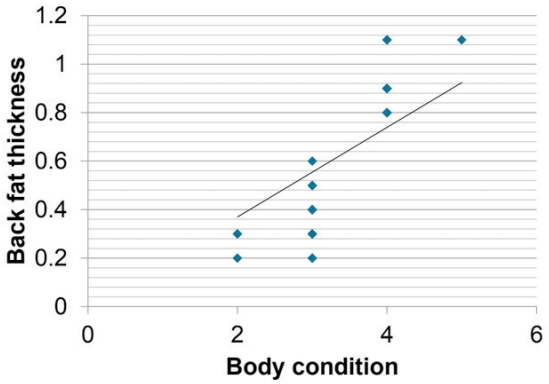

Figure 3: Correlation coefficient of back fat thickness versus body condition

Backfat thickness was shown to be a good indicator of energy reserves and correlates better with body condition than traditional lumbar palpation, especially in unshorn sheep. This method has been validated in several studies, suggesting its usefulness in veterinary practice and in the management of sheep flocks (Russel et al., 1969; Keinprecht et al., 2016).

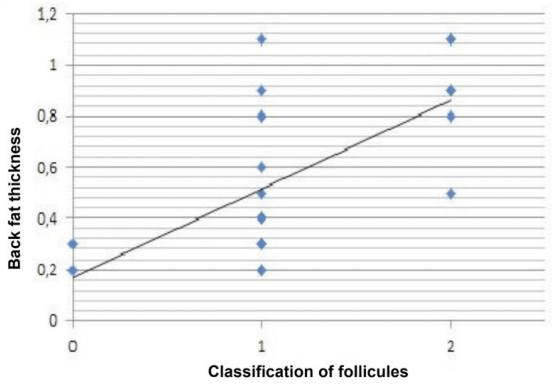

Figure 4: Correlation coefficient of back fat thickness versus follicular classification.

MUSCLE MEASUREMENTS: LONGISSIMUS DORSI

During estrus, the depth and width of the Longissimus dorsi muscle were measured, finding averages of 1.72 cm and 1.79 cm respectively. Correlations between body condition and these measures were positive and significant, suggesting that better body condition is associated with greater muscle development. Similar studies have shown that measurement of the Longissimus dorsi muscle is useful for assessing nutritional status and body reserves in ruminants (Khanal et al., 2016).

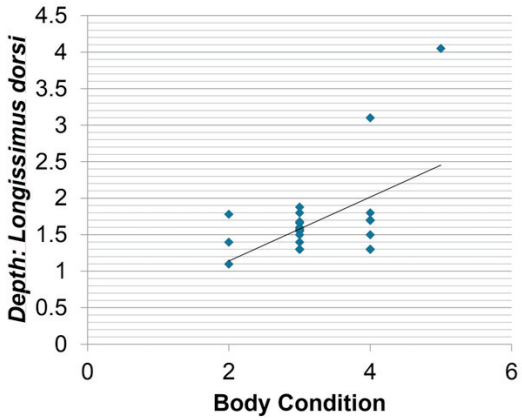

Figure 5: Correlation coefficient Muscle depth: *Longissimus dorsi* versus body condition.

When comparing the total number of follicles observed at estrus with the number of corpora lutea observed 6 days after estrus, it was evident that only 51.28% of the follicles observed at estrus produced a corpus luteum, for the animals with a birth on 44.1% of the follicles observed at estrus produced a corpus luteum and for animals with two or more births 31.25% of the follicles observed at estrus produced a corpus luteum, the ovulatory rate of the animals was estimated by dividing the number of corpora lutea measured by ultrasonography, among sheep with at least one corpus luteum (Banchero, Vázquez, Quintans, & Ciappesoni, 2014), for this study the ovulatory rate was 1.81 with a standard deviation of 0.49.

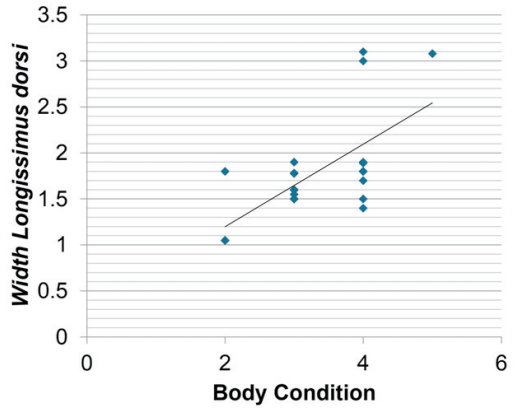

Figure 6: Muscle width correlation coefficient: *Longissimus dorsi* versus body condition.

The presence of corpora lutea was correlated with back fat thickness, but not with body condition. The presence and number of corpora lutea are critical indicators of reproductive function and fertility in sheep (Viñoles et al., 2004).

Chi-Square tests were performed to evaluate the independence between the various variables. It was found that the presence of corpora lutea in the ovaries at 6 days post-estrus depended on the thickness of back fat, but not on body condition. This result suggests that backfat thickness may be a better predictor of reproductive activity in sheep than body condition alone (Keinprecht et al., 2016). This suggests that backfat thickness may be a more reliable indicator of reproductive fitness than body condition alone (Koyuncu et al., 2013). These results highlight the need for a combination of traditional and technological methods for a comprehensive and accurate assessment of reproductive health and efficiency in sheep.

CONCLUSIONS

Traditionally measured body condition showed a strong correlation with backfat thickness assessed by ultrasonography of the Longissimus dorsi muscle. This latter objective measure might be preferable due to subjective variability in body condition assessment between different observers. Implementing backfat thickness as an objective method to determine body reserves in sheep could improve the precision of nutritional evaluation.

The use of ultrasonography equipment made it possible to effectively monitor ovarian activity in sheep, identifying structures such as follicles and corpora lutea throughout the estrous cycle. This approach provided detailed data on ovarian activity, suggesting the possibility of exploring even more details, such as the number of follicular waves in different

cross breeds in the studied environment. This exhaustive monitoring could be crucial to optimize reproductive management in the region.

The study highlighted the significant influence of back fat thickness on follicular activity and the presence of corpora lutea during the estrous cycle of sheep. These findings highlight the importance of properly preparing and selecting animals before the breeding process, demonstrating to producers the usefulness of incorporating advanced technologies to improve both productivity and reproductive efficiency in their operations. Furthermore, they coincide with previous studies that indicate that back fat thickness not only influences follicular activity, but also the synthesis of key reproductive hormones.

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