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Original article

Morphological Evaluation of the Ovary in Relation to Estrogen and Progesterone Production in Ewe Lambs in Western Libya

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ABSTRACT

Ovarian development and the onset of puberty have a significant impact on sheep reproductive efficiency. It is essential to comprehend the connection between steroidogenesis and ovarian activity in order to enhance breeding. In local ewe lambs (Ovis aries) bred in western Libya, this study aimed to assess the morphological features of the ovary in relation to serum concentrations of progesterone and estrogen. Ovaries and matched blood samples were collected from healthy ewe lambs (n = 50) slaughtered at local abattoirs across western Libya. Ovarian length, width, and thickness were measured. Serum estrogen and progesterone levels were quantified using a chemiluminescence immunoassay. Data were analysed using the Statistical Package for the Social Sciences for Windows version 26. All parameters were reported as mean ± standard deviation (M ± SD). The results showed that the dimensions between the right ovaries were not significantly different from those of the left. The comparative analysis of progesterone and estrogen hormonal profiles across the three weight groups showed a positive correlation but no statistically meaningful variation. The overall ovarian activation rates across right (RT) and left (LT) ovaries differ between the three different weight groups. clearly show an increased trend as weight increases, with no statistically significant association between body weight category and ovarian activity. Ovarian morphometric parameters serve as reliable macroscopic indicators of systemic estrogen and progesterone output in Libyan ewe lambs. These baseline morphological and endocrine data give valuable insights into early reproductive maturity and can inform selective breeding programs to optimise reproductive throughput in small ruminants in western Libya.

Introduction

Small ruminants, such as sheep and goats, are crucial to Libya's animal agriculture industry. Sheep production is the primary source of meat, exceeding that of cattle, and a significant source of income for farmers. According to the Food and Agriculture Organisation's [14] estimate, there are one billion sheep worldwide. Approximately 25% of sheep worldwide are fat-tailed Barbary sheep. About 95% of Libya's sheep population is of the Libyan Barbary breed (7,546,321 head) [1]. This breed is distinguished by its capacity to endure harsh conditions like protracted drought and intense heat, which also allows it to achieve significantly higher productivity in high-resource environments. Live weight ranges from 21 to 23 kg for lambs, 28 to 65 kg for ewes, and 45 to 85 kg for rams, depending on the area and feeding conditions [5, 10]. The functioning ability of ewes' ovaries essentially determines their reproductive potential [30]. A coordinated sequence of folliculogenesis, ovulation, and luteal formation is necessary for ovarian development, pubertal maturity, and the creation of regular oestrous cycles [28, 30].

Antral follicle count (AFC), corpus luteum (CL) volume, ovarian weight, dimensions, and volume are examples of morphometric characteristics that are significant physical markers of reproductive state [17, 21]. The ovary's endocrine activity, which is mainly fueled by the steroid hormones progesterone (P4) and 17β-estradiol (E2), occurs concurrently with these structural changes [25]. The change from pre-pubertal quiescence to functional cyclicity in young ewe lambs is indicated by changes in systemic steroid concentrations and histological folliculogenesis [28]. Evaluating the relationship between ovarian morphology and hormone secretion is crucial for identifying early reproductive markers in young females. Although ovarian biometry and hormonal profiles have been assessed in foreign sheep breeds in controlled environments, baseline reproductive parameters for native Mediterranean and North African breeds are still not well documented, especially in localised Mediterranean coastal and sub-Saharan ecosystems. This study aims to evaluate ovarian activity, ovarian size, and blood levels of estradiol-17β and progesterone in relation to body weight in ewes and lambs in western Libya.

Methods

A total of fifty clinically healthy ovaries of ewe lambs were collected from the slaughterhouse of Sabratha City during the period of December 2025 to July 2026. The animals were slaughtered by Islamic methods at an age of less than one year;

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age was estimated by dentition before slaughter [31]. Before slaughter, blood samples were collected from the jugular vein of animals in the morning. One sample was collected into a plain tube without an anticoagulant agent for hormonal analysis. Samples were transported in an ice pack for analysis. Post-slaughter, the carcass was dressed, and all of its organs were taken, except the heart, lungs, and liver. A scale was then used to weigh the body (Figure 1). The ovaries were transported in an ice pack for examination.
Ovaries were cleaned and freed from adhering tissues, and biometric parameters were measured. The length, width, and thickness of ovaries were measured using a vernier calliper (Figure 2) in centimetres, as described by [22, 29]. Ovarian length is measured from the cranial to caudal surface, and width is measured from the lateral to medial surface [9, 18]. Plasma was obtained by centrifugation (4,000 rpm, 10 minutes) and stored at -20°C until analysis was performed. All plasma samples were analysed for estrogen and progesterone levels using a Chemiluminescence Immunoassay Analyzer (iFlash, China).

Figure 1. A scale used to weigh the carcass

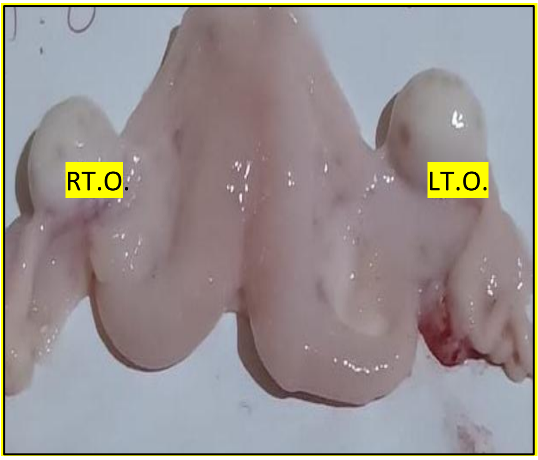

Figure 2. Right and left ovaries of ewe lamb.

Statistical Analysis
Data were analysed using Statistical Package for the Social Sciences for Windows version 26 (2019). All parameters were reported as mean ± standard deviation (M ± SD). Continuous variables were summarised as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Differences in activation frequencies across weight categories were evaluated using Fisher's Exact Test, which is suitable for small and uneven cell counts. To assess whether activation differed between the right and left ovary within the same animal, McNemar's Test was applied to paired ovarian measurements.

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Ethical Considerations

Ethical approval for the study was obtained from the Libyan Medical Research Centre Bioethics Committee (Approval No. NBC: 018.A.26.130). All animals were handled with care and patience, with no harm or violence. All samples were taken using professional methods, correctly and easily cooled.

Results

Data presented in (Table 1), showed that the mean weight of the carcass of ewe lambs (15.891± 3.304 Kg), and the mean levels of progesterone (0.66± 0.854ng/ml) and estrogen (27.16± 19.18 pg/ml).

Table 1. Mean and Standard deviation of body weight and reproductive hormone profiles in ewe lambs

Predictors	Body weight (Kg)	Progesterone (ng/ml)	Estrogen (pg/ml)
Mean ± SD	15.89± 3.30	0.66± 0.85	27.16± 19.18

(Table 2) presented the biometrics of ovaries in ewe lambs; the length, width, and thickness of right ovaries (0.83± 0.18 cm, 0.64± 0.16cm, and 0.44±0.09 cm, respectively), which did not significant differed compared to that of left ovaries (0.82± 0.18 cm, 0.62± 0.15 cm, and 0.45±0.10 cm, respectively).

Table 2. Mean and Standard deviation of Biometrics of ovaries in ewe lambs

Predictors	Length (cm)	Width (cm)	Thickness(cm)
Right ovary	0.83± 0.18	0.64± 0.16	0.44±0.09
Left ovary	0.82± 0.18	0.62± 0.15	0.45±0.10

Table3. Comparison of serum progesterone and estrogen levels across different weight groups in Ewe Lambs

Body weight (Kg)	Progesterone (ng/ml)	Estrogen (pg/ml)
10 -14 kg	0.38 ± 0.63	24.63 ±17.92
15 -19 kg	0.70 ±0.67	24.46 ±20.29
20 -24 kg	0.96 ±1.28	35.36 ± 15.89
P-value	0.17	0.33

The comparative analysis of hormonal profiles across the three weight groups showed a positive correlation but no statistically meaningful variation in either progesterone or estrogen hormone concentrations (Table 3). Progesterone levels demonstrated modest numerical increases from 0.38 ± 0.63 ng/mL in the 10–14 kg group to 0.96 ± 1.28 ng/mL in the 20–24 kg group; however, the associated p-value (0.17) indicates that these differences are not statistically significant. Similarly, Estrogen concentrations showed a slight elevation in the highest weight category (35.36 ± 15.89 pg/mL) compared with the lower groups (24.63 ± 17.92 and 24.46 ± 20.29 pg/mL), yet the p-value of 0.33 confirms the absence of a significant association between weight and Estrogen levels. These findings suggest that body weight within the examined range does not exert a measurable influence on circulating Estrogen or Progesterone concentrations.

Table 4. Ovarian Activity rate and frequencies across weight group

Body Weight (Kg)	Total Activity Rate	Activities %	Frequencies Activity (RT)	Frequencies Activity (LT)
10 -14 Kg	12/20	60.0%	3	3
15- 19 kg	15/22	68.18%	3	2
20- 24 kg	7/8	87.5%	3	3

Table 4 exhibits measured activity levels across Right (RT) and Left (LT) characteristics to three different weight groups. The overall activation rates clearly show an increasing trend as weight increases. The success/ active ration rises gradually from 60% (10-14 Kg) to 68.18% (15-19 Kg) and to 87.5% (20-24Kg). Across all analyses, Fisher's Exact Test showed no statistically significant association between bodyweight category and ovarian activity. The test for any ovarian activation produced a p-value of 0.507, indicating that activation frequency does not differ meaningfully across weight groups. Furthermore, the paired comparison between right and left ovary activation using McNemar's Test showed no statistically significant difference in activities within individual animals. The test produced a chi-square value of 0.055 with a corresponding p-value of 0.813, indicating that the likelihood of ovarian activation is essentially the same for the right and left ovary. This result demonstrates that ovarian side does not influence activation status, and that any observed

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differences between right and left ovary activation are attributable to random variation rather than a systematic biological effect.

Discussion

In the current study, the mean carcass weight of 15.89 ± 3.30 kg was observed in the ewe lambs that were slaughtered, while the length, width, and thickness of the right and left ovaries were not significantly different compared to the weight of the carcass. Our results were in accordance with [8, 16,22,29], who observed insignificant differences between the length and width of the right and left ovaries (Table 1). Other researchers [2,23] found significant variation. Mean levels of progesterone and estrogen were found within the normal ranges through hormonal analysis, although levels of steroid hormones are variable due to phases of the oestrous cycle, age, weight, seasonal impacts, breed, and environmental conditions, which are examples of physiological and extrinsic factors that frequently drive such endocrine variance in small ruminants [19].

Our study's analysis of the hormonal profiles found a positive correlation between body weight and circulating progesterone and estrogen concentrations, alongside the absence of statistically significant variation across weight groups. Similar results demonstrated a positive correlation between body weight and progesterone and estrogen concentrations [7,12,13]. The presence of a positive correlation proves that increasing body weight can improve reproductive performance [6]. The investigation assessed the impact of body weight on ovarian activation. A positive numerical trend in ovarian activation rates across weight groups is consistent with research on reproductive physiology that highlights the connection between follicular growth and body weight [27].

Additionally, studies by [11] showed a strong positive correlation between the body weight of ewe lambs and their reproductive performance, which aligns with the current findings. Although activation rates clearly increased numerically throughout weight classes, this trend was not statistically significant. This lack of significance suggests that baseline energetic requirements for ovarian responsiveness were met across all weight tiers or that the sample size within subgroups limited the statistical power needed to detect a statistically meaningful difference. In terms of ovarian laterality, there is no significant functional difference between the right and left ovaries, indicating functional bilateral symmetry within individual animals [15]. Under steady-state endocrine conditions, both ovaries have equal potential for follicular activation and luteal development [3,26]. However, classical literature in small ruminants occasionally notes a slight right-side bias in ovulation rate [4,20].

Conclusion

The study confirms that ewe lambs exhibit bilateral ovarian symmetry, with no significant differences in ovarian dimensions or laterality. Hormonal analysis showed progesterone and estrogen levels within normal ranges, positively correlated with body weight, suggesting that increased body mass supports reproductive potential. Although ovarian activation rates rose numerically across weight groups, statistical significance was not achieved, likely due to adequate baseline energy levels across all groups or limited sample size. Overall, the findings indicate that body weight contributes to improved reproductive performance, while fundamental ovarian functionality remains consistent across carcass weight categories.

Conflict of interest. Nil

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