

## SEASONAL VARIATIONS OF THE REPRODUCTIVE ACTIVITY IN LOCAL BREED'S EWES RAISED IN THE SOUTH-WEST OF ALGERIA

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### ABSTRACT

The objective of this study was to determine the characteristics of variations in sexual activity of ewes taken in a saharian environment in the southwest of Algeria. Two experiments were conducted in this study. In the first one, a monthly monitoring was carried out on a population of 1430 ewes dominated by the Ouled Djellal breed, aged between 1 and 7 years, and belonging to 12 livestock farms distributed in different zones of the study area. In the second experiment, 63 healthy Ouled Djellal ewes, assumed non-pregnant and aged from 1 to 5 years, were involved to determine the hormonal profiles of progesterone, oestradiol, FSH, and LH during the four seasons (autumn, winter, spring, and summer). Hormonal assays were measured by using the chemiluminescent immunoenzymatic technique (CLIA). The monthly distribution of lambing in ewes has allowed us to deduce that sexual activity is continuous throughout the year with a maximum of lambing in autumn. The results of the hormone assays also revealed the existence of a hormonal activity during the four seasons with a decrease in winter and spring for progesterone and in summer for LH. This permit us to conclude that Ouled Djellal ewes raised under difficult climatic conditions of the south-west of Algeria are relatively non-seasonal with sometimes only a slight decrease in reproductive activity.

Keywords: FSH; LH; non-seasonal; oestradiol; progesterone; saharian environment; sexual activity.

### INTRODUCTION

In sheep, the existence of seasonal variation in sexual activity has often been reported. Indeed, this reproductive character is generally associated with the seasonality of neuroendocrine activity [1-3]. Moreover, there are considerable racial differences in the period and duration of sexual activity [4]. However, it should be noted that some breeds are naturally more non-seasonal than others. In addition, there are significant individual variations within the same breed [5].

The influence of the environment on the determination of the length of the sexual season has been widely studied. Indeed, many researchers have clearly established that this duration is essentially controlled by photoperiodic variations [6-8]. Other environmental signals that are no less important may also influence sheep reproductive activity such as temperature, food availability and quality, social interactions, and the geographical location of the animal [9-11].

In Algeria, sheep farming is characterized by its economic interest and

the very valuable qualities of local breeds which show exceptional adaptations under extreme environmental conditions. The seasonal character of breeding in ewes raised in southern Algeria is still poorly studied. This article reports the monthly distribution of lambing as well as the changes in pituitary (FSH and LH) and gonadal (progesterone and oestradiol) secretions in ewes during the four seasons of the year in the region of Béchar (Southwest of Algeria).

## MATERIALS AND METHODS

### Study Area

The study area concerns the wilaya of Béchar, which is located in the southwest of Algeria between latitudes 28°15'N and 32°20'N and longitudes 0°20'E and 5°17'W. The climate is a continental desert type with hot summers (+45°C) and a cold winter (2°C to 3°C). The precipitations are irregular and low with about 90 mm/year. Sandstorms are very frequent and violent reaching speeds of up to 100 kilometers per hour. The day length varies from 09 hours 56 minutes in December to 14 hours 04 minutes in June.

### Animals

The investigations were carried out among the breeders of the study area. Livestock systems were generally conducted in extensive or semi-intensive. The feeding of most herds was based on grazing throughout the day, with a concentrated feed supplement which varies from 200 to 500 g per head and per day depending on the actual status of the pastures. The rest of the herds were kept in stalls during all over the year feeding with rations based on hay, concentrates, and on-farm crop residues.

Furthermore, all animals were subject to natural conditions of lighting.

## Experimental Design

This study is divided into two parts:

**Experiment 1:** The study was conducted over a one-year period from December 2016 to November 2017. It was carried out on a population of 1430 ewes dominated by the Ouled Djellal breed (Fig. 1), which is an excellent meat breed and adapted to arid areas [12]. These ewes were primiparous or multiparous, aged 1 to 7 years, and belonging to 12 livestock farms. The information about lambing was recorded every month during a regular and systematic passage.

**Experiment 2:** To determine the hormonal profiles of progesterone, oestradiol, FSH, and LH during the four seasons of the year (autumn, winter, spring, and summer), 63 Ouled Djellal ewes were involved in this experiment. The choice of animals was made based on the following elements: healthy ewes, supposed to be non-pregnant, and 1 to 5 years old.

Blood samples were taken from the jugular vein in vacutainer heparin-tubes, and immediately placed in a bath of ice until centrifuged and maintained at 0-4°C during manipulation. All plasma samples were frozen and stored at -20°C until the time of assay.

Hormone assays of progesterone (ng/ml), Estradiol (pg/ml), FSH (mIU/ml) and, LH (mIU/ml) were performed with the chemiluminescent enzyme immunoassay technique (CLEIA) using the automated Beckman Coulter Access.



**Fig. 1. A sheep flock dominated by the Ouled Djellal breed in the Béchar area**

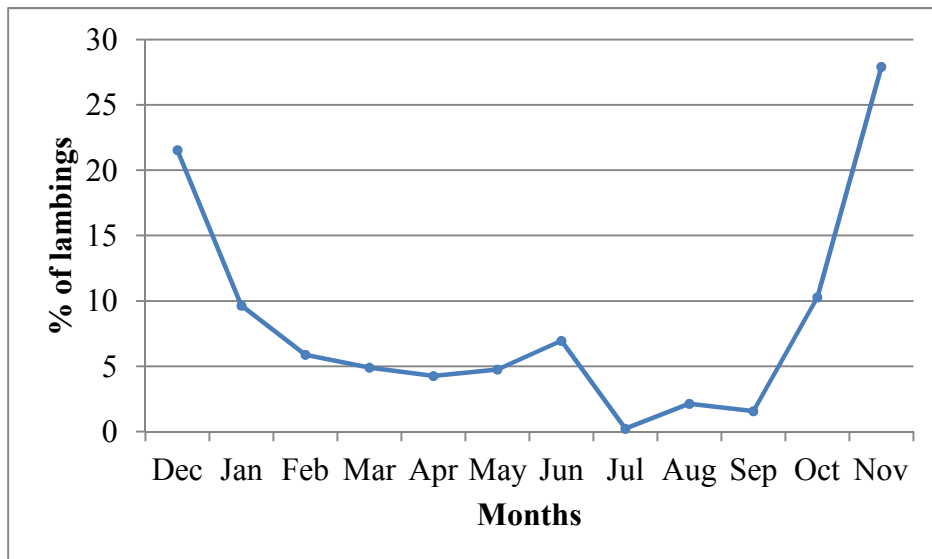
**Statistical Analyses**

Differences in hormone measurements between seasons were assessed by analysis of variance (ANOVA) followed by Duncan's post hoc test. Data analysis was performed using the statistical software SPSS version 22 [13]. A value of  $P < ,05$  was considered statistically significant.

**RESULTS**

**Monthly Distribution of Lambing**

For a total of 1411 lambing throughout the year, Fig. 2 shows the lambing distribution per month in the observed population.



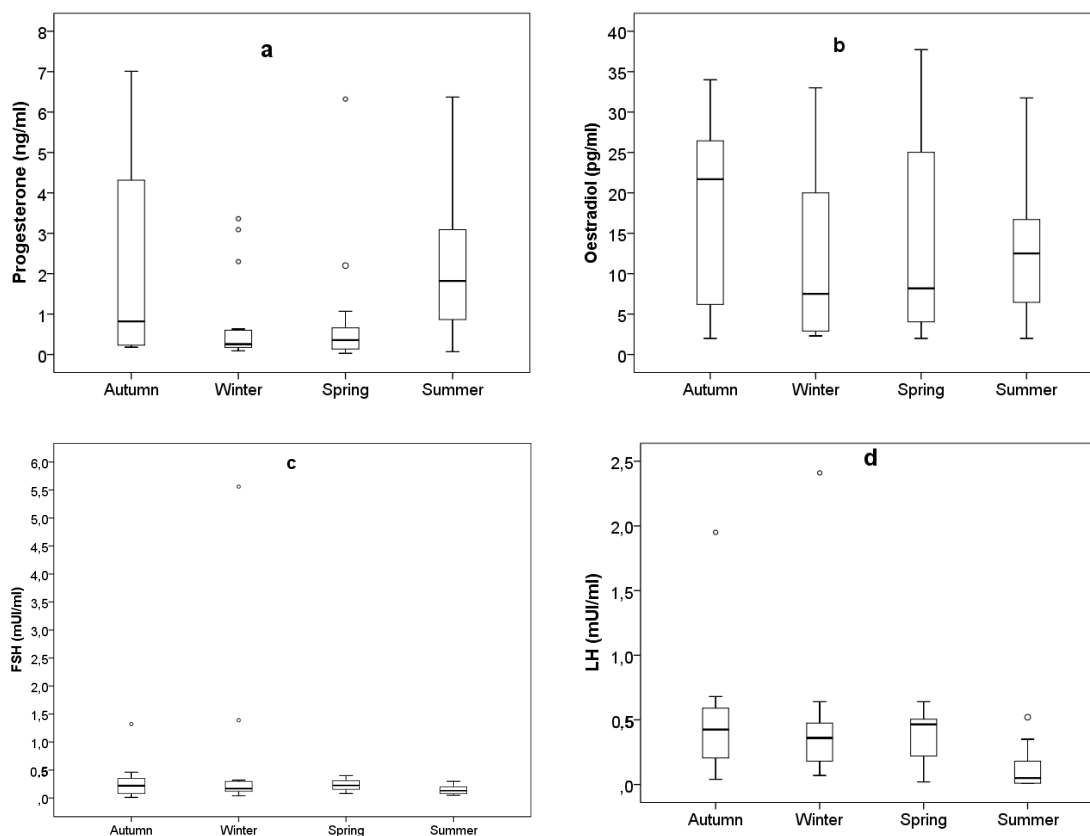
**Fig. 2. Monthly distribution of sheep births in Béchar region**

The distribution of lambing periods over the year shows that there is no total cessation of sexual activity, but it is more frequent at certain times of the year. The maximum number of births is concentrated in the period from October to January, which represents 69, 38% of lambing, with a peak in November. In contrast, the minimum births are recorded in July, August, and

September with lambing rates of 0,21%, 2,13% and 1,56%, respectively.

### Hormonal Plasma Profiles

The results obtained by the hormonal assay of progesterone, oestradiol, FSH, and LH are reported in Fig. 3 (medians and dispersions) and Table 1 (means).



**Fig. 3. Variations in plasma levels of progesterone (a), oestradiol (b), FSH (c), and LH (d) in ewes over the four seasons: autumn (n = 16), winter (n = 16), spring (n = 16), and summer (n = 15). The box plots show the median (horizontal line across the box), interquartile range (vertical ends of the box), and range (whiskers)**

**Table 1. Plasma concentrations (mean  $\pm$  SEM) of progesterone, oestradiol, FSH and LH in ewes according to seasons**

Variable	Season			
	Autumn	Winter	Spring	Summer
Plasma concentration of progesterone (ng/ml)	2,30 $\pm$ 0,62	0,77 $\pm$ 0,27	0,83 $\pm$ 0,39	2,22 $\pm$ 0,49
Plasma concentration of oestradiol (pg/ml)	18,43 $\pm$ 2,73	11,30 $\pm$ 2,58	12,97 $\pm$ 2,86	12,45 $\pm$ 2,13
Plasma concentration of FSH (mIU/ml)	0,29 $\pm$ 0,77	0,58 $\pm$ 0,34	0,23 $\pm$ 0,02	0,14 $\pm$ 0,02
Plasma concentration of LH (mIU/ml)	0,47 $\pm$ 0,11	0,45 $\pm$ 0,14	0,37 $\pm$ 0,05	0,12 $\pm$ 0,04

Plasma progesterone levels show significant variation between the four seasons ( $P < .05$ ). The maximum concentration is recorded in autumn with a value of about 7,01 ng/ml (Fig. 3a). On the other hand, the lowest concentrations are recorded during winter and spring.

Plasma oestradiol levels did not differ significantly between the four seasons ( $P > .05$ ). Indeed, depression seems more diversified (Fig. 3b). Mean oestradiol concentrations range from 11,30 pg/ml in winter to 18,43 pg/ml in autumn (Table 1).

The median values of FSH levels in different seasons appear to be fairly close (Fig. 3c). However, there is no difference between seasons ( $P > .05$ ). Overall, FSH levels range from 0,1 to 5,56 mIU/ml.

Maximum LH concentrations are marked in winter and autumn with values of the order of 2,41 and 1,95 mIU/ml, respectively. Analysis of variance shows that there is a significant difference between seasonal averages ( $P < .05$ ). According to Duncan's test, the concentrations in the summer season were significantly low with an mean value of 0,12 mIU/ml. On the other hand, mean values in autumn, winter, and spring are close varying from 0,37 to 0,47 mIU/ml (Fig. 3d, Table 1).

## DISCUSSION

It is known that latitudes levels affect annual variations in photoperiod and ambient temperature. Indeed, animals adapted to high latitude climates have short and well-defined breeding seasons, while tropical latitudes, where photoperiod and temperature vary little during the year, are inhabited by many animals with long breeding seasons [14]. Moreover, according to Baril et al. [15], lambing occurs throughout the year in many tropical and subtropical sheep breeds. This is the case of ewes raised in the region of Béchar (located in subtropical zone) with a variable number of lambing from one month to another.

Our results are in agreement with those obtained by Niar et al. [16], who reported that Algerian ewes are able to reproduce throughout the year. In fact, ewes grazing the coastal grasslands of extreme northeast of Algeria and the Ouled Djellal sheep raised in northwest of Algeria are characterized by their ability to lamb naturally at any time of the year [17-19].

Similar results have been observed in various other areas, in "D'man sheep" breed in southern Morocco [20], sheep raised in the northwest of Tunisia [21], "Sahel sheep

under transhumant management” in northern Burkina Faso [22], the “Marwari breed” of the Rajasthan desert in India [23], and in “Djallonke sheep” in a village environment in Togo [24] and in the Guinean zone of Benin [25]. Furthermore, Lassoued and Khaldi [26] observed that the “Queue fine de l'Ouest” and “Noire de Thibar” breeds in the south-west of Tunisia show seasonal variation, ovarian and estrous activities not very marked, but with the possibility of breeding during the off-season.

Our result reports that the majorities of fecund mating are in mid-spring to late summer, coinciding with long days in the study area, unlike other breeds originating from mid and high latitudes that enter a period of sexual rest or anoestrus more or less long when the days lengthen [27, 28]. Thus, Thimonier et al. [5], for their part, observed a cessation of cyclical estrus behavior in the “Ile-de-France” and “Préalpes” ewes, but the resumption of ovarian activity occurred in the second half of June which corresponds to the longest days.

As regards the hormonal assays, Thimonier [29] determined that, on the one hand, progesterone levels of cycled females are characterized by alternating low values (less than 0,5 ng/ml) during the preovulatory period and high values (more than 0,5 ng/ml) during most of the luteal phase, on the other hand, peripheral plasma progesterone remains less than 0,5 ng/ml during the anoestrus. The results presented in this work have shown that the concentrations expressing progesterone were very different during the seasons with averages higher than 0,5 ng/ml for each season (Table 1). This indicates that the hormonal activity continued throughout the year without anoestrus. These results are in agreement with those obtained by Zidane

and Abadou [18] with a maximum value of the order of 6,6 ng/ml and Arsoy and Sağmanlıgil [30] during their studies on the “White Karaman sheep” with rates ranging from 0,02 to 6,17 ng/ml. In contrast, Balaro et al. [31] noted that some “Santa Inês” ewes had a seasonal anoestrus in the spring.

In addition, oestradiol values are variable within each season. According to Driancourt et al. [32], the oestradiol concentration decreased around the eighth day of the cycle and increased during dioestrus. It decreased to its minimum level at the end of the cycle. The oestradiol peak is responsible for initiation of oestrus and induction of the preovulatory LH surge, and concentrations produced by the preovulatory follicle can reach 15 to 30 pg/ml.

Both FSH and LH levels are characterized by the existence of extreme values in autumn and summer. These maximum values indicate that they are preovulatory peaks. According to Souza et al. [33], the concentration of FSH decreased during the follicular phase and reached a peak synchronously with the LH surge. In addition, FSH and LH concentrations are similar to the concentrations obtained by Grazul-Bilska et al. [34], in control ewes in autumn, with mean values ranging from 0,05 to 0,12 mIU/ml for FSH and from 0,08 to 0,11 mIU/ml for LH and appeared lower than the values described by Zidane and Abadou [18]. This difference may be justified by the hormonal assay methods used in both studies.

## CONCLUSIONS

The present study has shown that the monthly distribution of lambing has allowed us to deduce that sexual activity is continuous throughout the year with a peak

of lambing in autumn. The results of the hormonal assays also revealed the existence of hormonal activity during the four seasons with a lowering in winter and spring for progesterone and in summer for LH.

This leads to the conclusion that the Ouled Djellal ewes reared under difficult climatic conditions of the southwest or Algeria are relatively nonseasonal with sometimes a slight decrease in reproductive activity.

Further works are needed to complete this study, including the determination of the characteristics of the estrous cycle of ewes reared in the southwest of Algeria, and the study of the influence of the status of natural grazing lands in the Saharian areas on reproductive performance to improve the productivity of sheep farming in these areas.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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