



Growth dynamics and altitude effect on growth performance of Ouled Djellal lambs during the pre-weaning period

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Abstract. *This study evaluates the growth dynamics and the effect of altitude on different growth phases of pre-weaned Ouled Djellal lambs in northeastern Algeria. Forty-nine lambs born in the spring to multiparous ewes were weighed, and their average daily gain was calculated at different ages (at birth, D 30, 60, 90 and 120). The results show that maximum growth occurs during the lamb's first month of life at 200 g/day. Highly positive and significant correlations were recorded between D 90 and D 120 (0.94), D 60 and D 120 (0.88), D 60 and D 90 (0.87) and D 30 and D 90 (0.77). Concerning the altitude effect, lambs born in low altitude regions show a better growth performance than lambs born in high altitude regions, with a significant difference ($P < 0.05$) noticed for D 90 and D 120, which confirms that the Ouled Djellal breed is a typical breed of the steppe and the high plains.*

Keywords: Ouled Djellal lamb, birth weight, growth performance, altitude, North-east Algeria

Introduction

In Algeria, sheep and lambs account for 79% of all national livestock (Ziani and Khaled, 2016). This livestock consists of at least 9 breeds (Ouled-Djellal, D'man, Hamra, Rembi, Taâdmit, Sidaoun, Tazegzawt, Berber and Barbarine) (Djaout et al., 2017). Ouled Djellal breed, known for its good adaptation to harsh environmental conditions and great growth performance, represents 61% of the national sheep population (Zidane et al., 2015). The Ouled Djellal breed is exploited for meat production and appreciated for its maternal aptitudes and prolificacy. This breed is subjected to the farmers' clear preference, which puts the other breeds in a very sensitive situation (Harkat et al., 2015).

Sheep farming is considered the main provider of red meat in Algeria. However, sheep meat is still inaccessible to many middle- and low-income Algerian households (Deghnouche et al., 2018). The reason behind this inaccessibility is the low production of red meat, mainly due to the poor control of feeding and breeding practices (Bencherif, 2011).

Sheep productivity is influenced by body weight and

growth. A high birth weight gives the animal a good start in life and allows it to grow rapidly before and after weaning, predisposing it to better resistance to disease and to reach puberty and maturity quickly (Suliman et al., 1985; Zidane et al., 2015). Several factors can influence lamb growth, whether genetic or non-genetic such as multiple births, age and parity of the ewe and the sex of the lamb (Khama et al., 2022). However, to improve red meat production, it is necessary to understand and optimize these factors. This study investigates the growth dynamic of pre-weaned Ouled Djellal lambs in two different regions (high-altitude and low-altitude regions) and indicates, for the first time, the effect of altitude on their growth performance.

Material and methods

Study area

The study was carried out in the northeast of Algeria, covering four provinces: Biskra, Ouled Djellal, Batna and M'Sila. Seven sites were selected: three sites (Tafrent, Tkout 1 and Tkout 2), located in a high-altitude region (Aurès Mountains) and belonging to the lower semi-arid bioclimatic stage and four sites (Barika, M'Sila, ITDAS and

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Ouled Djellal) located in a low altitude region belonging to the upper Saharan bioclimatic stage. The study was carried out on a private and institutional farm (ITDAS:

Institut Technique pour le Développement de l'Agronomie Saharienne - Technical Institute for the Development of Saharan Agronomy).

Table 1. Altitude and geographical coordinates of the sites studied

Province	Site	Altitude (Km)	Geographic coordinate	
			Latitude	Longitude
Batna	Tafrent	1400	35°15'48"N	6°30'13"E
	Tkout 1	1000	35°08'02"N	6°18'05"E
	Tkout 2	1200	35°10'45"N	6°21'58"E
	Barika	450	35°20'06"N	5°17'17"E
Msila	Msila	500	35°44'53"N	4°31'07"E
Ouled Djellal	Ouled Djellal	250	34°21'15"N	5°06'33"E
Biskra	ITIDAS	120	34°48'07"N	5°37'59"E

Sheep sampling

The study was conducted on forty-nine Ouled Djellal breed lambs, twenty-one from the high-altitude region (Tafrent, Tkout 1 and Tkout 2) and twenty-eight from low-altitude region (Barika, M'Sila, ITDAS and Ouled Djellal). These lambs were born single from multiparous ewes (aged from 2 to 6 years) during the spring seasons. Lambs were weighed at typical ages: birth weight (WB), D 30 (W1), D 60 (W2), D 90 (W3) and D 120 (W4) using a 30 kg portable scale. Average daily gains between these weights were calculated: ADG1 (birth-D 30), ADG2 (D 30-60), ADG3 (D 60-90) and ADG4 (D 90-120). During the first month of the lamb's life, the mother's milk represents the main source of nutrition. From the second month, the lambs follow their mothers to the pasture until 4 months, when they will be weaned. All studied animals were taken to the pasture twice a day and had access to fresh, clean water twice daily (one in the morning, the second in the evening). The natural pastures consisted of a mixture of *Stipa tenacissima*, *Amplelodesma tenax* and *Artemisia herba alba*, and annual meadows composed of various types of grass (predominance of *Cynodon dactylon*, *Melilotus sulcata* and *Vicia monantha*). The animals received supplementation of commercial grain concentrate and good quality hay.

Statistical analyses

Data were analyzed statistically for Min, Max, Mean, Standard Error and Standard Deviation. Pearson's correlation coefficient was calculated to assess the relationship between birth weight and weight at typical ages on hand and between the values of average daily gain on the other hand. In addition, an ANOVA test was applied to evaluate the effect of altitude on the different growth phases of lambs. The statistical analyses were performed with the SPSS software, version 25.

Results and discussion

The studied lambs were born with an average weight of 3.56 kg, reaching 9.53 kg at D 30, 13.76 kg at D 60, 17.26 kg at D 90 and 21.95 kg at D 120 (Table 2). The result obtained for the weight at birth in this study was almost similar to those obtained by Chellig (1992) for the lamb of the same breed (3.5 kg), Benyounes et al. (2013) for the lamb of the Ouled Djellal and Taadmit breed (3.64 and 3.55 kg, respectively) and Ziani and Khaled (2016) for Hamra breed (3.57 kg). Several studies reported superior birth weight values for lambs of the Ouled Djellal breed born in autumn. Deghnouche et al. (2018), Djellal et al. (2018), Smaali and Boukazoula (2019), and Boussena et al. (2020) recorded values of 4.19, 5.54, 4.38 and 4.5 kg, respectively. The same results were found by Benchohra et al. (2013), who registered a value of 4.20 kg at birth for the lamb of the Rembi breed.

The birth weight obtained was higher than the value reported by Zidane et al. (2015) for the Ouled Djellal breed lamb and Kerfal et al. (2005) for the D'man breed lamb (3.04 and 2.6 kg, respectively).

The difference in the weight at birth observed, whether within the same sheep breed or between different breeds, can be explained by the ability of WB to be influenced by genotypic factors (Khama et al., 2022) and productive factors such as the sex of the lamb, type of birth, age and parity of the ewe, season and year of birth. Research done on this subject has shown that male lambs and lambs born single are considerably heavier than female lambs and lambs born doubles (Chniter et al., 2011; Zidane et al., 2015; Deghnouche et al., 2018; Baa et al., 2021; Sveinbjörnsson et al., 2021; Tesema et al., 2022). Older ewes give birth to heavier lambs than younger ewes (Dekhili, 2003; Chniter et al., 2011; Zidane et al., 2015; Sveinbjörnsson et al., 2021). Lambs born

from multiparous ewes are heavier at birth than lambs from primiparous ewes (Baa et al., 2021). Moreover, the weight at birth can differ according to the year of birth (Dekhili, 2003; Djellal et al., 2015; Tesema et al., 2022). For the season of birth, Chniter et al. (2011) found that lambs born in spring were heavier than those born in autumn, whereas Dekhili (2003) found the opposite.

The average daily gain recorded in this study was 200 g/d for ADG1, 140 g/d for ADG2, 120 g/d for ADG3 and 160 g/d for ADG4 (Table 2). This result indicates that the maximum growth occurred in the first 30 days of lamb life, which could be explained by the sufficient milk supply

given by ewes to lambs. The high decrease in average daily gain noted after the first month of lamb's life was closely related to the transitional phase from suckling to grazing, which enters the lambs in a competition situation for feed. The slight increase in average daily gain remarked after 90 days of age might be due to the adaptation of lambs to feeding practice. This finding is in concordance with those reported by Zidane et al. (2015) and Baa et al. (2021) for Ouled Djellal breed lamb and Chniter et al. (2011) and Boubekeur et al. (2019) for the D'man breed lamb. However, Boujenane and Kerfal (1992) reported a low daily gain during 10 to 30 days of age.

Table 2. Descriptive statistics of body weight (WB, W1, W2, W3 and W4) on kg and average daily gain (ADG, g/d)

Variable	Minimum	Maximum	Mean	Std. Error	Std. Deviation
WB	3.19	3.90	3.56	0.10	0.27
W1	8.13	10.79	9.53	0.34	0.91
W2	10.66	16.01	13.76	0.68	1.81
W3	13.71	19.10	17.26	0.77	2.03
W4	16.79	25.71	21.95	1.11	2.95
ADG1	150	230	200	0.01	0.03
ADG2	90	220	140	0.02	0.04
ADG3	60	160	120	0.01	0.03
ADG4	100	230	160	0.02	0.04

(WB)- Weight at Birth, (W1)- Weight at D 30, (W2)- Weight at D 60, (W3)- Weight at D 90, (W4)- Weight at D 120, (ADG1)- birth-D 30, (ADG2)- D 30-60, (ADG3)- D 60-90, (ADG4)- D 90-120

Correlation coefficients among birth weight and weight at D 30, 60, 90 and 120 ranged between -0.002 and 0.94 (Table 3). Highly positive and significant correlations can be noted between weight at D 90 and 120 (0.94), between weight at D 60 and 120 (0.88), between weight at D 60 and 90 (0.87) and between weight at D 30 and 90 (0.77).

Moreover, correlation coefficients are low but positive between birth weight with weight at D 30, weight at D 90, and weight at D 120 (0.38, 0.24 and 0.31), respectively. In contrast, Deghnouche et al. (2018) reported a significant correlation between weight at birth and the mean weights

observed at D 10, 20, 30 and 90 (0.56, 0.57, 0.54 and 0.63), respectively.

The correlation coefficients among ADG1, ADG2, ADG3 and ADG4 ranged between -0.21 and 0.63 (Table 4). A moderate correlation was found between ADG1 and ADG2 (0.41) and ADG2 and ADG4 (0.63). The rest of the correlations were weak to negligible except for ADG2 and ADG3, which was negative (-0.21). Compared to the study of Deghnouche et al. (2018) on the same breed of lamb, a significant correlation ($P= 0.002$) was found between ADG at D 30 and ADG at D 90 (0.64).

Table 3. Pearson correlations of body weights of Ouled Djellal breed lambs

	WB	W1	W2	W3	W4
WB	1	0.382	-0.002	0.243	0.314
W1		1	0.719	0.773*	0.710
W2			1	0.873*	0.886**
W3				1	0.943**
W4					1

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

(WB)- Weight at Birth, (W1)- Weight at D 30, (W2)- Weight at D 60, (W3)- Weight at D 90, (W4)- Weight at D 120

Table 4. Pearson correlation among the values of the average daily gain

	ADG1	ADG2	ADG3	ADG4
ADG1	1	0.417	0.081	0.362
ADG2		1	-0.213	0.631
ADG3			1	0.072
ADG4				1

(ADG1)- birth-D 30, (ADG2)- D 30-60, (ADG3)- D 60-90, (ADG4)- D 90-120

Figures 1 and 2 show the effect of altitude on the growth performance of Ouled Djellal lambs in the pre-weaning period. Lambs born in low-altitude regions have bigger body weights and average daily gain values than those born in high-altitude. Lenfant (1973) reported that the reduction in birth weight observed in high-altitude regions might be explained by intrauterine growth retardation caused by hypoxia. A significant ($p < 0.05$) difference can be noted in W3 and W4, which confirms the description of several authors for the Ouled Djellal breed, who were unanimous in classifying it as a real steppe sheep and the most adapted to nomadism (Kerboua et al., 2003).

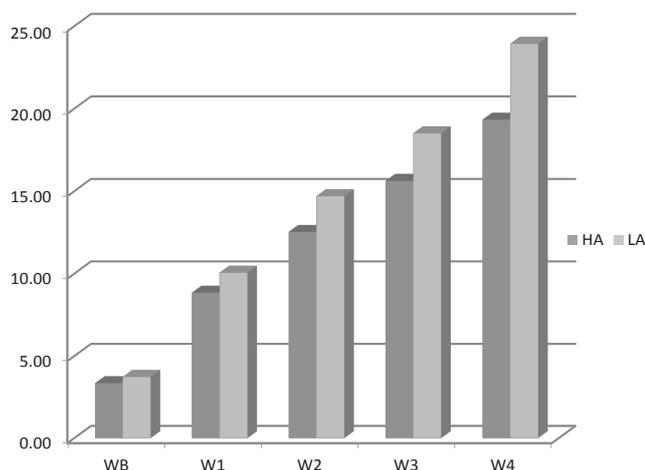


Figure 1. Difference of lambs' weights at typical ages (kg) between high altitude and low altitude regions, (HA)- High Altitude, (LA)- Law Altitude, (WB)- Weight at Birth, (W1)- Weight at D 30, (W2)- Weight at D 60, (W3)- Weight at D 90, (W4)- Weight at D 120

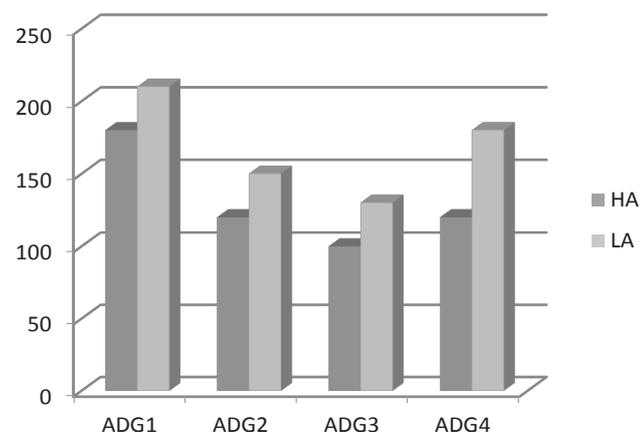


Figure 2. Difference in Average Daily Gain (ADG, g/d) between high altitude and low altitude region, (HA)- High Altitude, (LA)- Law Altitude, (ADG1)- birth-D 30, (ADG2)- D 30-60, (ADG3)- D 60-90, (ADG4)- D 90-120

Conclusion

This paper studied the growth dynamics and the effect of altitude on different growth phases of pre-weaned Ouled Djellal lambs from northeastern Algeria. The findings indicate that in:

- the pre-weaning period, the maximum gain weight of the Ouled Djellal lamb occurred in the first 30 days;
- the highest and most significant correlation coefficients were recorded between W3 and W4, W2 and W4, W2 and W3 and W1 and W3;
- a lamb born in low altitude regions has a better growth performance than a lamb born in high altitude regions, with a significant difference in W3 and W4.

Therefore, the Oulad Djellal breed is a steppe and high plain breed par excellence. To have a good knowledge of the growth performance of this breed, it is necessary to study the other factors, genetic or not, which can influence the growth dynamics.

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