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## Growth Performance of Goat Local Breed Reared in Southeastern Algeria

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#### ABSTRACT

The autochthonous goat Arbia breed is the most widespread in Algeria, however, little work has been done to evaluate its performance and improve its production. The objective of this study was to evaluate the pre-weaning growth performance of Arbia breed kids and determine the factors that can influence it. The performance control was performed on 120 kids by determining the weights at typical ages and average daily gain (ADG). The main factors studied were birth weight, litter size, and kid sex. The results obtained showed that kids weighed 2.29kg at birth, 4.87kg at 10 days, 6.64kg at 20 days, 8.69kg at 30 days, 11.08kg at 60 days, and 14.01kg at 90 days. The average daily gain rate was 257.84 g / day between birth and 10 days, 177.21g / day between 10-20 days, 205.12 g / day between 20-30 days, 79.58 g / day between 30-60 days, and 97.61g / day between 60-90 days. Birth weight was very strongly related to weights at typical ages of (30, 60, 90) days. Litter size had a very significant effect on birth weight, weight at 90 days, and on the average daily gain between 60-90 days (P>0.05). Sex showed a significant influence on birth weight, and weights at typical ages of 30 and 90j, as well as on the average daily gain between 60-90 days (P>0.05). It is necessary to set up programs to characterize and improve the performance of Algerian goat populations in order to give this species the place it deserves in Algerian livestock farming.

Keywords: Goats, Local Breed (Arbia), Growth Performance, Litter Size, Sex.

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#### 1. INTRODUCTION

Goat farming in Algeria is characterized by a population of more than four million head (MADR 2016), located in difficult areas, mainly mountainous regions in the north and steppe and sub-desert areas in the south (Moustaria 2008), where it is an important economic activity, and is conducted mainly in an extensive mode (Mouhous and al 2015). This breeding is among the most traditional agricultural activities associated with sheep farming (Fantazi 2004). Currently, there has been a radical change in goat farming given by the recent evolution of the price and the nutritional importance of kids' meat (Vladimir and al. 2016), which has had new advantages that can allow it to evolve towards a less extensive mode; while the demand for milk and enthusiasm for its quality, which is more digestible and has longer shelf life compared to cow milk, foresees its extension in agricultural areas with intensification of its breeding, diversification of its mode of conduct and orientation of its production (Madani and al. 2015). Algerian goat herd is very heterogeneous and composed of animals from local populations; Kabyle breed, occupying the mountains of Kabylie and Aurès; Makatia breed, located in the highlands and in North areas; and M'Zabia breed, located in the northern part of the Sahara. The most important of these Algerian local populations is Arbia breed. It is located in steppe zone, semisteppic areas and in highlands. It is especially appreciated for meat production (J'dey) (Belaid 2016). It is characterized by a

low waist of 50-70cm, a hornless head with long ears, wide and pendulous. Its coat is multicolored (black, gray, brown) with hair length of 12-15 cm. The Arabia goat has an average milk production of 1.5 liters per day (Madani and al., 2003). Algerian goat herd has an extraordinary genetic diversity but has so far been the subject of little description of its population or evaluation of its performance in order to improve it. This work aimed to determine the pre-weaning growth performance of Arbia breed kids in an arid region of South-East Algeria, and analyze the impact of different parameters (birth weight, litter size, and sex) on measurable criteria (weight at typical age, average daily gain ADG) from birth to weaning in order to provide the breeder an assistance in managing the herd on growth criteria on the one hand and to allow goats' genetic evaluation, and reasoned selection of future breeders on the other hand.

#### 2. MATERIAL AND METHODS

#### 2.1. Presentation of the study area

Biskra region is located in the south-east of Algeria, south of Aurès mountains, it appears as a real buffer zone between North and South, its surface is 21 509,80 km<sup>2</sup>, its altitude is 125 meters from sea level. The relief of study region consisted of four large geomorphological sets: plains, mountains, plateaus and depressions (Farhi, 2014).

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#### 2.2. Animals

The study involved a population of 120 goats (male and female) of Arbia local breed from multiparous goats naturally fought; they were born in autumn 2018, reared by their mothers, and conducted extensively. The kids were identified beforehand with numbered earrings. Table 1 shows the number of kids by sex and litter size.

	breed	5	sex	Litter size			
Number	Arbia	Male	Female	Simple	Double	triple	
		64	56	24	80	16	

#### 2.3. Methods

Kids' Weighing was done using a scale with a maximum capacity of  $50 \text{kg} \pm 100 \text{g}$ , and all information from birth to weaning was recorded on individual growth charts for each kid.

#### Studied variables:

Control of the evolution of kids growth from birth to weaning was represented by live weight (LW), and the average daily gain (ADG) was performed as follows: live weight in (kg) at d0 (at birth), d10, d20, d30 and d90 (weaning). - ADG in (g) between: d0-d10; d10-d20; d20-J30 and d30-d90.

#### Variation factors :

- Sex of the product (male, female)
- Litter size (single, double and triple)

#### 2.4. Statistical analysis:

The descriptive statistics were carried out with the Excel Stat software 2016, for live weight (LW) and average daily gain (ADG) analysis, expressed respectively in kg and g / days. The correlation results were calculated by Pearson test for the evaluation of the relationship between live weights at different growth phases. All parameters' averages were calculated and presented by their mean standard errors (mean  $\pm$  SEM). The statistical difference was reported at (P<0.05). The generalized linear model (GLM) was used to test the effects of factors on the variables, by applying the independent sample T test to estimate the significance or homogeneity between different sets of data (comparison test between the averages).

#### 3. RESULTS

# 3.1. Growth performance by litter size 3.1.1. Birth weight:

The mean live weight at birth of the kids was  $2.292 \pm 0.45$  kg. Single kids tended to have higher birth weights compared to doubles and triples (2.75 ± kg vs. 2.37 ± kg vs. 1.47 ± kg); respectively. Birth weight differed significantly with litter size (p = 0.001 < 0.05) (Figure 01).



Figure 01: Birth weight in single, double and triple Arbia breed kids

**3.1.2.** Weight at typical ages (10, 20, 30, 60, 90d): Figure below shows the evolution of weight at typical ages (10, 20, 30, 60, 90d) by litter size. Mean weights at typical ages did not differ significantly with litter size except weight at 90 days (P = 0.010). Single kids tended to have greater weights than doubles and triples during all the experimentation (Figure 02).



Figure 02: Change in weights at different typical ages (kg) by litter size in Arbia breed kids.

#### 3.1.3. Average daily gain:

Figure 03 shows the results of average daily gain from birth to weaning. It was appeared that singles tended to have higher ADG compared to doubles and triples. The average daily gain was not significantly different from litter size, except the average daily gain between 60 days to 90 days (P = 0.007), where a significant difference was noted.



Figure 03: Variation of daily average gain (g) by litter size in local kids (Arbia).

#### 3.1.4. Weight evolution: "Growth curve"

The live weight in single, double and triple kids in this study evolved according to a polynomial order regression curve, the equations were y = 2.4983x + 0.0838; y = 2.3288x - 0.0847; and y = 1.7114x+0.03743 where (x is the age and y is the weight); respectively. Single birth kids always grew more than double and triple ones (Figure 04). They tended to have higher live weights than doubles and triples from births to weaning.



Figure 04: Evolution of weight by litter size in Arbia breed kids.

# 3.2. Growth performance by sex of kids3.2.1. Birth weight:Male kids were born heavier than females (2.62 and 1.97 kg);

respectively (Figure 05). Birth weight was significantly different considering the sex of the kids (P < 0.05 / P = 0.002).



Figure 05: Change in birth weight (kg) by kids sex in Arbia local breed.

#### 3.2.2. Weight at typical ages

The figure below shows the evolution of weight at Day 0 and at 5 typical ages (10, 20, 30, 60, 90 days) according to the sex of the kids. Females tended to be light compared to males throughout the study duration (Figure 06). Weights at the different typical ages did not vary significantly with the kids' sex except at ages of 30 and 90 days where significant differences between the two sexes were observed, with respective P values of (p = 0.029, p = 0.007).



Figure 06: Variation of weight (kg) at typical ages by sex kids of Arbia local breed.

#### 3.2.3. Average daily gain

Figure below (Figure 07) shows the results of average daily gain (ADG) from birth to weaning. It was appeared that females had the average daily growth higher than males from birth until 10 day, then the opposite. It was also noted that ADG at typical ages did not differ significantly with the sex of the kids. However, a significant difference was noted for the average daily gain obtained between 60 and 90 days (p = 0.019).



Figure 07: Change in average daily gains (g) by sex kids in Arbia local breed.

#### 3.2.4. Evolution of weight "growth curve"

Live weight in male and female goats in this study evolved according to a first order polynomial regression curve; the equations were: y = 2.5241 x + 0.2629 and y = 2.056 x + 0.2727, where (x is the age and y is the weight); respectively. The male kids were still growing faster than the females (Figure 08). They had the superiority from birth to weaning.



Figure 08: Evolution of weight by sex in Arbia breed kids.

#### 3.3. Correlations between growth parameters

Mean values of growth parameters were analyzed and reported in Table 02. Pearson correlation test at two levels of significance (0.05 and 0.01) showed significant correlations, mostly positive, and linking growth parameters (r > 0.5). Significant correlations were noted between weights at different typical ages with the corresponding ADGs. Weights at birth and at 20 days were positively correlated with the weights at 30, 60 and 90 days, with the average daily gain between 60- 90 days for birth weight. The correlation matrix also revealed very strong positive inter-correlations between weaning weight (90j), and birth weights and typical ages at 20, 30, and 60 days. Also, positive correlations linking ADG 10-20d to weights at 30 and 60d were found.

Variables	d0	d10	d20	d30	d60	d90	ADG 0-10	ADG 10-20	ADG 20-30	GMQ3430-60	ADG 60-90
d0	1										
d10	0,477	1									
d20	0,447	0,454	1								
d30	0,599	0,350	0,802	1							
d60	0,543	0,460	0,858	0,820	1						
d90	0,833	0,400	0,674	0,630	0,768	1					
ADG 0-10	0,143	0,802	0,207	0,014	0,149	0,115	1				
ADG 10-20	0,181	0,156	0,810	0,658	0,649	0,483	0,298	1			
ADG 20-30	0,228	0,176	-0,339	0, <b>890</b>	0,084	0,086	0,353	-0,260	1		
ADG 30-60	0,024	0,231	0,194	0,188	0,528	0,313	0,277	0,063	-0,607	1	
ADG 60-90	0,799	0,231	0,323	0,290	0,353	0,870	0,284	0,206	-0,061	0,143	1

**Table 02:** Correlations between pre-weaning growth parameters of Arbia breed.

#### 4. DISCUSSION

The average birth weight of the local Arbia kids in this study was (2.29 kg), it was similar to the reported birth weights in SAHEL kids in Senegal (2.24kg) (Djakba 2007). However, it

was higher than the birth weight recorded in the Creole goats of Guadeloupe (1.64kg) (Chemineau & Grude, 1985), as well as in goats of Maradi breed in Niger (1.85kg) (DJIBRILLOU, 1986). In addition, the average weight obtained in this study was lower than the birth weights described in local breed in Morocco (3.80kg) by Chentouf and al. (2006); also in Alpine and Saanen breeds, which recorded birth weights of (3.62 and 3.43 kg); respectively (Doizé and al. 2013). This weight was still lower than that reported in Pyrenean breed (3.7kg) (Thuault & Tisseur, 2017), Damascus breed in Turkey (Keskin & Bicer, 2000), local Egyptian breeds Barki and Zaraibi (Abdelsalam and al. 2000), Cashmere breed (Kuchtik & Hosek 2000), and Alpine and Nubian breeds (Gebrelul and al 1994). Birth weight can be influenced by several factors that may be genetic or environmental (Meza-Herrera and al. 2014; Parajuli and al. 2014; Protas and al. 2014).

Boussena and al. (2013), recorded a birth weight of (4.25kg) in Ouled Djellal lambs (main sheep breed in Algeria). Chafri & Mahoachi (2011), Djellal and al. (2016) reported average weights of (3.99kg, and 5.30kg) in lambs of the D'man and Ouled Djellal breeds; respectively. Except for the weights recorded at the typical ages of 10 and 20 days, birth weight showed significant positive correlations with all weights obtained until weaning. Birth weighing made it possible to better understand the difference in weight between animals, and was a good indicator of mothers' diets in the last weeks of gestation (Reveau and al. 1998), during which the fetus would acquire 75% of his birth weight (Nadon 2017). The mother must therefore receive sufficient inputs to ensure her own physiological functions, but also to provide the energy and nutrients necessary for the growth of the fetus.

Males have always been born heavier than females, and they also grew faster. Similar results have been published by Ba Diao and al (1996), Madani (2000). The results of this study were consistent with those reported by Hagan and al (2012) who found that males were heavier at birth than females with respective weights of 1.25 and 1.15 kg. In Mexico, the same findings have been made by Meza-Herrera and al. (2014), who found a significant difference in mean birth weight, by sex, which was 3 kg for males, and 2.77 kg for females. The difference in growth between the sexes lay in conformation and metabolism; according to Benevent et al. (1971), each sex evolved under the control of its own endocrine balance, which favored a more or less important organ development.

For Alpine and Saanens females' growth, the weight objectives were 17kg at weaning (2 months), 27 kg at 4 months, and 37 kg at breeding (7 months) (Thuault & Tisseur, 2017). These references were very interesting, but for the most part nontransposable to the Arbia breed. The breed hardiness led to slower growth, with specific farming practices to local breeds, such as leaving kids under the mother and more generally extensive management based on the exploitation of the free feed supply which was illustrated by a very uncertain level of food availability, linked to rangelands, fallows and by-products of cereals, with, in general, a pronounced food deficit in an unfavorable rainfall year (Commission Nationale AnGR, 2003). Single born kids tended to have higher birth weights compared to double and triple (Chemineau & Grude 1985), this result was confirmed in the Arbia kids in this study. The type of birth had a significant effect on birth weight; a similar result was reported in Burundi kids (DJIBRILLOU, 1986). It was appeared that competition between fetuses for nutrients and uterine space increased with fetus' number during gestation, reducing their weights (Lawrence and al. 2012). In a study conducted in

the United States by Amoah and al. (1996) on several goat breeds including Alpine and Saanen, it was found that each increase of one fetus per litter was associated with a weight decrease of 0.45 kg per kid. As a result, single kids were significantly heavier than kids born from twin or triple births, as reported in Doizé and al. (2013), and Meza-Herrera and al. (2014), cited by Nadon (2017). In addition, it has been reported that litter size was influenced by breed. Indeed, some breeds were more prolific than the others, which could have an impact on litter size and indirectly on birth weight (Hrbud and al., 2014).

The results for the weights of kids in 30 days (8.69 kg) obtained in this study were very close to those reported by Thuault & Tisseur (2017), for Pyrenean breed (8.30 kg), whereas they were superior to those recorded in the Sahelian goat kids (5.67 kg) (Djakba 2007), in local breed kids of Morocco (Chentouf and al. 2006); and those of the Maradi breed in Niger (Djibrillou 1986), Compared to 30 day weight of lambs of different breeds, it was noted that this result was comparable to that reported by Deghnouche and al. (2018), in Oulad Djellal lambs in Algeria (8.44 kg), and that was reported by Chikhi (2002) in Boujaàd lambs in Morocco (8.75kg). The growth of kids was closely related to mothers' milk production especially during the first 40 days, during which the correlation coefficients between these two characters were the highest (0.7 to 0.9).

The weight obtained at 60 days of age (11.19 kg) was lower than that observed in Sahel breed kids (Djakba 2007), and Pyrenean ones (13.30 kg) (Thuault & Tisseur 2017). Early weaning had a negative impact on goat kids' growth and mortality during the period from birth to 60 days of age (Luparia and al. 2009). The weight at 90 days (14.16 kg) obtained in this experiment was significantly high compared to that noted in Maradi breed (Djibrillou, 1986); however, it was lower than the weight observed in young Pyrenean breed (18kg) (Thuault & Weaver, 2017). The significance of sex effect on birth weight and on typical age weights (30 and 90 days) was confirmed in the present study, this result did not correspond to that described in Ouled Djellal lambs (Boussena and al. 2013; Deghnouche and al. 2018). The correlation between birth weight and weaning weight was found to be significant (P<0.05); it was also described by DJIBRILLOU (1986); and Djakba (2007). The live weight varied significantly (P<0.05) with litter size throughout the experiment, the same result was reported in Ouled Djellal lambs (Belmili and al. 2014); however, a contradictory result was underlined by Meza-Herrera and al. (2014), who found that litter size did not have a significant effect on weaning weight. On the other hand, it has been concluded that the intensification of herd management slightly improved the growth performance of young goats, suggesting that this parameter was more conditioned by the genetic potential of young kids than by rearing mode (Chentouf and al., 2006).

Growth performance during breastfeeding has been important to consider. The ADG 10-30d is an indicator of mother's milk production. On the basis of the obtained results, it appeared that ADGs of singles (males and females) mounted to 213 g. Doubles had an average daily growth of 205 g and triples had an average daily growth of 192 g. The differences between males and females were insignificant. In this study, the sex factor did not have a significant effect on all average daily gain except for the ADG between 60-90 days. this result was consistent with that of Bendiab & Dekhili (2012), examining Ouled Diellal. lambs. The ADG between 60-90 days (weaning), was an indicator of the earliness. An examination of the overall results showed that, except the significant differences recorded during this period, there were no important differences between the average growth performances in different animal categories: there was approximately 132 g of average daily gain for males and 62 g for females. Considering the average weaning weights, they reached to about 15 kg for males, and about 12 kg for females. Thus, at first glance, it seemed that the individual factor influenced more on weight and performance variations than sex, or even the litter size (Leimbacher & Tatareau 1991). Comparing these performances with ADGs obtained between 10-30 days, a considerable drop was noted. The time between these weighings was long, so it was necessary to specify when the important stall occurred, to better understand the individuals' growth potential, but also to develop the breeding techniques that could minimize this phenomenon.

Growth curve is the graphical representation of a mathematical equation that predicts weight by age (Nadon 2017). In the present study, weight evolution by litter size, or sex, was done according to a regression curve of first order polynomial, and different equations were obtained to predict the weight of single, double, and triple kids , as well as male and female kids in different ages. The control of live weight, and its variations, in indigenous goat has been an important element often raised in goat herd management (Najari and al. 2007). Gaddour and al. (2007), have confirmed that animal weight and body reserves the management of constituting parameters in tight relation with local genetic resources adaptation.

In 2014, Piedhault and al. published the most recent improved version of the growth curve for Livestock Institute. Indeed, the authors linked dairy production objectives according to the growth curve. It seemed that weight reached at 7 months age, would have an impact on milk production. Goats that maintained the highest growth curve could aim for 850 liters, while the lighter ones had an average projection of only 650 liters per year, or nearly 24% less milk than their heavy counterparts. In ducks that maintained a low growth curve, a delay of nearly 3 months could be observed at breeding (Nadon 2017).

#### 5. CONCLUSION

Growth performances obtained, demonstrated the potential for satisfactory growth of the local breed Arbia comparable to the other native breeds in the world. At the end of this study, it appeared that litter size and sex significantly affected the growth performance.

The variation in the growth performance of the local kids (Arbia) would certainly help to better understand the production characteristics of this breed, which could have a great contribution for goats breeders in choosing the breed on the one hand, and on the other hand, to facilitate the choice of future breeders who can be put in a genetic breeding program in order to achieve the best performances to obtain the best production rates.

Finally, this work should be completed by the identification and study of other factors' effects that can induce the growth of young breeds, namely the future of Arbia local breed.

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