Original Article

Biometrical Changes in Reproductive Tract of Arbia Goats According to Age, Body Condition, and Pregnancy

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ABSTRACT

Background: Improved reproduction requires understanding the biometry of goats' female reproductive system.

Objectives: The present study was conducted to record the biometry of the female genital organs of the Arabia (Arbia) goats in Algeria according to age, body condition score, and pregnancy.

Methods: A total of 149 reproductive tracts (from 80.54% non-pregnant and 19.46% pregnant goats) from three slaughterhouses were collected and measured. Each organ's length, width, thickness, and weight were measured using slide calipers and an electric weighing balance. The ages of the fetuses in pregnant goats were determined by measuring their crown-rump length. Analysis was carried out using SPSS software, version 21.

Results: The reproductive tract dimensions increase with age, body condition score, and stages of pregnancy. The left ovary's weight, length, and width showed very significant ($P<0.001$) increases across age. The measurements of the uterine horn (except thickness) increased significantly ($P<0.001$) with age. The fallopian tube, the uterine body, and the cervix measures showed significant increases ($P<0.001$) between the first and third age groups. The ovary and the uterine body dimensions showed highly significant ($P<0.001$) increases across body condition scores. Pregnancy had no significant effect on the ovary and cervix dimensions. The uterine horn measurements showed significant increases ($P<0.05$) throughout gestation, and those of the uterine body showed highly significant increases ($P<0.001$) along the pregnancy stages.

Conclusion: This study will provide baseline information on the morphology of the female Arbia breed reproductive system.

Keywords: Age, Arbia, Goat, Morphometry, Pregnancy

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Introduction

According to Food and Agriculture Organization (FAO) 2017 statistics, Algeria had about 5 million head of goats (FAOSTAT, 2018). Small ruminants are essential for food security for livestock-keeping households (Wodajo et al., 2020). Goats provide milk, meat, fiber, and skin. It offers rural residents both animal protein and a source of income, especially in developing countries (Escareño et al., 2013). Additionally, goat milk is a potential source of various macro- and micro-nutrients that help promote nutritional and desirable health benefits (Nayik et al., 2021).

To meet the growing demand for meat and milk, goat breeds adapted to specific regions should be examined for their reproductive performances and maturity level.

Currently, four local breeds in Algeria have been identified phenotypically and genetically: Arbia, Mekatia, Naine de Kabyle, and M'zabite (Tefiel et al., 2018).

The Arabia (Arbia) goat is the dominant breed, located especially in the steppe regions and high plateau (Ouchene-Khelif et al., 2021); subject to extensive breeding conditions, the Arbia breed is characterized phenotypically by a multicolored coat, long hair, and a low waist of 50-70 cm, a head devoid of horns with pendulous ears (Laouadi et al., 2020). It is raised for its meat, the quality and quantity of its hair (Ouchene-Khelif et al., 2021), and acceptable milk production capacity (Djouza & Chehma, 2018). Additionally, this native goat is very good at adapting to environmental changes.

To maintain excellent reproductive performance and serve as an economic resource, it is important to have a firm understanding of the breed's reproductive anatomy. The female animals' genitalia anatomy provides information about their general health. Also, for pregnancy diagnosis, treatment, and dealing with issues related to infertility, knowledge of the biometrical status of the female genital tract is necessary (Bhat et al., 2011). In addition, modern methods of population growth like artificial insemination (AI) and in vitro fertilization (IVF) require a thorough understanding of female reproductive biometry. Compared to cattle, buffaloes, ewes, and pigs, the reproductive anatomy of these animals is poorly known; the description of a goat's reproductive organ is usually made as if it is identical to sheep (Smith & Saunders, 1986).

Animal morphology shows considerable variation with respect to breed, age, sex, nutritional condition, pregnancy, and environmental factors, among others (Alpak et al., 2009). Thus, measurements are essential tools for comparison. To achieve a more objective assessment, numerous metrical measurements need to be carried out (Brombin et al., 2009).

To our knowledge, biometric parameters of different segments of the reproductive tract of the Arbia goat have never been reported. Therefore, this is the first study undertaken to determine the biometry of the female genital organs of the Arbia goat kept in Algeria according to age, BCS and pregnancy. Small ruminants' reproductive biology and biotechnology will significantly benefit from the insights gained from the current study.

Materials and Methods

Study area and sample collection

This investigation was conducted at the Laboratory of Veterinary Sciences, Ibn-KhaldounUniversity, from June 2021 to November 2022. One hundred and forty-eight genital tracts from 80.54% non-pregnant and 19.46% pregnant Arbia goat were collected from three slaughterhouses located in the Tiaret region of Algeria. Tiaret is a major agricultural center on the Sersou Plateau, dealing in wheat and livestock. According to the Köppen classification, the climate in the Tiaret region is CWa, characterized as a hot, summer Mediterranean climate. The average rainfall is 472 mm/y and the mean temperature is 15.5°C.

Study animals

Non-pregnant goats were grouped according to age (based on the dental pattern, 6-12, 12-36, and >36 months) and the BCS (emaciated, thin, average), as reported by Ghosh et al. (2019).

Crown-rump length measurements of the fetus were used to estimate the fetus age in pregnant goats, which were grouped according to the stage of gestation (first trimester: 21-49 days [n=18], second trimester: 42-77 days [n=10]), as described by Sivachelvan et al. (1996) and Martinez et al. (1998).

Sample collection

After slaughter, the genital tract was removed from the pelvic viscera and transferred immediately in a plastic bag to the laboratory of the Institute of Veterinary Sciences of Tiaret.

Measurements

To examine the organs better, extra fat was first carefully removed through dissection, and the organs were washed and positioned normally on a table. Different segments' length, width, and thickness were measured by a measuring scale and recorded in mm (Figure 1). The weight of each organ was determined using an electric balance (Ohaus®; USA), recorded in g (Figure 2).

Statistical analysis

The data obtained was recorded in Microsoft Excel software, version 2016. The descriptive analysis was performed with IBM SPSS, version 21, and the results were expressed as Mean±SE. Before analyzing the data based on age, body condition score (BCS), and pregnancy groups, the normality of the data was tested using the Kolmogorov-Smirnova test. The Kruskal-Wallis test and one-way analysis of variance test were used. The Mann-Whitney and Tukey tests were used to determine the significance between groups. The data from the pregnancy samples were subjected to t-test and Mann-Whitney test. The level of significance was set at 5%.

Results

The genital tract of the Arbia goat is composed of a pair of ovaries, a pair of fallopian tubes, a pair of uterine horns, the body of the uterus, the cervix, the vagina and the vulva (Figures 3 and 4). A comparison of the size of the Arbia goat's reproductive tract based on age is presented in Table 1.

Compared to the left ovary, the right ovary was heavier and longer. In contrast, the left side of the fallopian tube and the uterine horn were heavier and longer than the right ones.

There was no significant difference ($P>0.05$) in dimensions between the left and right ovaries in the first and second groups. Still, there was a very significant difference ($P<0.001$) in weight and length of the ovary across ages.

The length and weight between left and right fallopian tubes in each age group show no significant differences ($P>0.05$), while there was a very highly significant difference ($P<0.001$) in weight across ages.

In terms of uterine horns, the length, width, and thickness of the right and left horns differ significantly in the first and second groups, while the measurements (weight, length, and width) of the uterine horns differ highly significantly across ages ($P<0.001$).

The uterine body weight, width, and thickness revealed significant differences between age groups ($P<0.001$).

There were no significant differences ($P>0.05$) between the second and third groups in the cervical weight, length, and thickness. The dimensions of the ovary, uterine body, and cervix showed a statistically significant difference ($P<0.001$) between the first and third groups. Biometry of the reproductive tract according to BCS is indicated in Table 2.

All ovarian measurements showed highly significant differences ($P<0.001$) between groups for the body condition score. Except for weight, there were differences between the left and right ovaries in terms of their length, width, and thickness.

There were no appreciable changes in length or weight between the left and the right fallopian tubes in the second and third groups ($P>0.05$). However, the length of the fallopian tube varied significantly ($P<0.001$) between the first and third groups across the BCS.

Right and left uterine horns in the first and second groups differed significantly ($P<0.05$) in length, width, and thickness, while there were highly significant differences ($P<0.001$) in weight, length, and width of uterine horns across the BCS. There were significant differences ($P<0.001$) in the measurements and weight of the uterine body between all BCS groups.

Cervical measures and weight varied significantly ($P<0.001$) between the first and second groups and between the first and third groups. The reproductive tract's biometry according to gestation stages is presented in Table 3.

There was no significant difference ($P>0.05$) in measurements between the left and right of the ovaries, oviducts, and uterine horns in the first and second trimesters of pregnancy.

The length of the fallopian tube showed no significant increases throughout pregnancy, while the weight showed highly significant increases ($P<0.001$) along the stages of gestation.

There were very significant differences ($P<0.001$) in all measurements and weights of the uterine horn and the uterine body along the stages of pregnancy.

Table 1. Arbia goat's reproductive tract measurements according to age (n=40)

Organ	Side	Parameter	Mean±SE		
			Months		
			6-12	12-36	>36
Ovary	Right	Weight (g)	0.79±0.05[a]	1.03±0.07[b]	1.68±0.12[c]
		Length (mm)	15.50±0.47[a]	17.20±0.41[b]	20.08±0.49[c]
		Width (mm)	10.98±0.29[a]	11.83±0.40[bc]	13.65±0.52[ac]
		Thickness (mm)	6.78±0.24[a]	8.18±0.31[ab]	8.98±0.38[ac]
	Left	Weight (g)	0.75±0.03[a]	1.06±0.11[b]	1.60±0.10[c]
		Length (mm)	15.35±0.33[a]	16.40±0.38[b]	19.08±0.39[c]
		Width (mm)	10.73±0.28[a]	12.18±0.47[b]	13.88±0.36[c]
		Thickness (mm)	7.10±0.23[a]	8.10±0.31[ab]	8.80±0.35[ac]
Oviduct	Right	Weight (g)	0.36±0.01[a]	0.45±0.02[b]	0.56±0.03[c]
		Length (mm)	165.55±4.35[a]	170.80±4.38[a]	175.85±4.51[a]
	Left	Weight (g)	0.40±0.02[a]	0.46±0.02[b]	0.60±0.03[c]
		Length (mm)	176.88±4.35[a]	178.70±4.18[b]	190.65±4.02[c]
Uterine horn	Right	Weight (g)	2.38±0.21[a]	4.41±0.35[b]	6.52±0.51[c]
		Length (mm)	62.05±1.88[a]	79.70±2.85[b]	93.28±4.43[c]
		Width (mm)	9.63±0.41[a]	11.35±0.38[b]	13.58±0.53[c]
		Thickness (mm)	7.13±0.29[a]	8.80±0.35[ab]	9.73±0.40[ac]
	Left	Weight (g)	2.44±0.17[a]	4.67±0.34[b]	6.82±0.53[c]
		Length (mm)	66.80±2.00[a]	84.83±2.76[b]	101.70±4.45[c]
		Width (mm)	9.25±0.39[a]	11.30±0.43[b]	12.68±0.48[c]
		Thickness (mm)	6.80±0.31[a]	8.25±0.32[ab]	9.13±0.33[ac]
Body of uterus		Weight (g)	5.51±0.65[a]	8.84±0.95[b]	14.41±1.11[c]
		Length (mm)	32.83±1.53[a]	39.35±1.51[ab]	43.25±1.68[ac]
		Width (mm)	19.30±0.70[a]	22.30±0.89[b]	27.88±1.02[c]
		Thickness (mm)	7.55±0.32[a]	10.03±0.43[b]	11.73±0.41[c]
Cervix		Weight (g)	2.99±0.30[a]	5.76±0.46[ab]	5.76±0.46[ab]
		Length (mm)	25.50±1.90[a]	35.30±1.53[ab]	35.30±1.53[ab]
		Width (mm)	13.63±0.59[a]	16.85±0.61[b]	16.85±0.61[b]
		Thickness (mm)	8.20±0.49[a]	11.03±0.42[ab]	11.03±0.42[ab]

[a, b, c, ab, ac, bc]Significant differences (P<0.001).

Table 2. Arbia goat's reproductive tract measurements according to body condition score

Organ	Side	Parameter	Mean±SE		
			Body Condition		
			Emaciated (n=50)	Thin (n=47)	Average (n=23)
Ovary	Right	Weight (g)	0.76±0.03[a]	1.25±0.08[b]	1.90±0.17[c]
		Length (mm)	15.72±0.40[a]	18.23±0.42[b]	20.74±0.65[c]
		Width (mm)	10.62±0.24[a]	12.60±0.35[b]	14.65±0.74[c]
		Thickness (mm)	6.70±0.21[a]	8.38±0.26[b]	9.96±0.50[c]
	Left	Weight (g)	0.78±0.03[a]	1.26±0.10[b]	1.66±0.16[c]
		Length (mm)	15.62±0.30[a]	17.34±0.40[b]	19.09±0.56[c]
		Width (mm)	10.80±0.23[a]	13.04±0.42[b]	13.87±0.56[c]
		Thickness (mm)	7.08±0.21[a]	8.19±0.27[b]	9.57±0.49[c]
Oviduct	Right	Weight (g)	0.37±0.01[a]	0.46±0.01[ab]	0.64±0.05[ac]
		Length (mm)	162.96±3.76[a]	170.64±3.92[b]	188.00±5.46[ac, bc]
	Left	Weight (g)	0.40±0.02[a]	0.51±0.02[ab]	0.62±0.05[ac]
		Length (mm)	174.84±3.67[a]	181.87±3.73	196.57±5.87[ac]
Uterine horn	Right	Weight (g)	2.40±0.19[a]	5.19±0.41[b]	7.34±0.50[c]
		Length (mm)	63.94±1.77[a]	85.21±3.89[b]	95.61±4.11[c]
		Width (mm)	9.46±0.32[a]	12.17±0.37[b]	14.74±0.63[c]
		Thickness (mm)	7.08±0.28[a]	9.28±0.29[ab]	10.26±0.51[ac]
	Left	Weight (g)	2.51±0.17[a]	5.34±0.38[b]	7.86±0.60[c]
		Length (mm)	69.26±1.87[a]	90.94±3.90[b]	104.17±4.31[c]
		Width (mm)	9.18±0.35[a]	11.98±0.39[ab]	13.35±0.58[ac]
		Thickness (mm)	6.84±0.30[a]	8.66±0.25[ab]	9.52±0.41[ac]
Body of uterus		Weight (g)	5.33±0.56[a]	10.27±0.85[b]	17.44±1.37[c]
		Length (mm)	31.66±1.21[a]	41.13±1.26[b]	47.43±2.17[c]
		Width (mm)	19.32±0.67[a]	23.87±0.69[b]	30.52±1.30[c]
		Thickness (mm)	7.66±0.31[a]	10.87±0.43[b]	12.04±0.48[c]
Cervix		Weight (g)	2.93±0.29[a]	6.51±0.39[ab]	9.21±0.99[ac]
		Length (mm)	24.38±1.61[a]	37.66±1.20[ab]	38.87±2.54[ac]
		Width (mm)	14.06±0.62[a]	17.81±0.51[c]	20.48±0.75[b]
		Thickness (mm)	8.18±0.40[a]	11.38±0.28[ab]	11.48±0.45[ac]

[a, b, c, ac, bc]Significant differences (P<0.001).

Table 3. Arbia goat reproductive tract measurements according to stages of gestation

Organ	Side	Parameter	Mean±SE	
			Days	
			21-29 (n=18)	42-77 (n=10)
Ovary	Right	Weight (g)	1.44±0.11[a]	1.57±0.15[a]
		Length (mm)	17.83±0.50[a]	19.80±1.17[a]
		Width (mm)	13.56±0.58[a]	15.50±0.98[a]
		Thickness (mm)	10.00±0.55[a]	9.90±0.45[a]
	Left	Weight (g)	1.31±0.11[a]	1.54±0.42[a]
		Length (mm)	17.00±0.65[a]	19.50±1.63[a]
		Width (mm)	14.11±0.67[a]	13.30±1.28[a]
		Thickness (mm)	9.17±0.32[a]	8.80±0.77[a]
Oviduct	Right	Weight (g)	0.39±0.03[a]	0.53±0.03[b]
		Length (mm)	162.17±4.93[a]	178.80±10.22[a]
	Left	Weight (g)	0.41±0.03[a]	0.54±0.03[b]
		Length (mm)	167.83±5.30[a]	190.70±12.99[a]
Uterine horn	Right	Length (mm)	109.44±7.20[a]	163.50±16.19[b]
		Width (mm)	21.83±2.29[a]	39.40±6.24[b]
		Thickness (mm)	16.44±1.47[a]	22.70±1.82[b]
	Left	Length (mm)	110.44±7.72[a]	173.50±9.57[b]
		Width (mm)	20.11±1.90[a]	41.00±3.22[b]
		Thickness (mm)	15.33±1.22[a]	23.50±1.67[b]
Body of uterus		Length (mm)	77.56±4.81[a]	155.00±8.94[b]
		Width (mm)	48.39±4.17[a]	121.00±7.70[b]
		Thickness (mm)	22.83±1.11[a]	34.40±2.29[b]
Cervix		Weight (g)	5.71±0.60[a]	8.37±1.21[b]
		Length (mm)	32.22±2.16[a]	40.40±5.66[a]
		Width (mm)	16.72±0.74[a]	17.40±1.16[a]
		Thickness (mm)	12.39±0.70[a]	13.90±1.14[a]

[a, b]Significant differences (P<0.05).

Table 4. Number and age fetal wastage of the slaughtered Arbia goat

Number of Pregnant Slaughtered Goats	Number of Fetal Loss	Crown-rump Length (mm)	Estimated Age (d)
6	8	7-11	21-28
8	10	15-20	29-33
4	4	24-52	33-49
8	9	65-135	42-56
2	2	131-320	63-77

A total of 33 fetal losses occurred as a result of the 18.9% (28/148) slaughter of pregnant goats. The first trimester of pregnancy showed the highest prevalence (64.3%), followed by the second trimester (35.7%) (Table 4).

Discussion

The biometrical measurements were conducted on 149 reproductive tracts (80.54% non-pregnant and 19.46% pregnant). The Mean±SE of length, width, thickness, and weight of different segments are presented according to age in Table 1 and body condition scores in Table 2.

In the present study, the mean weight, length, and width of the right ovary in Arbia goat at 6-12 months were 0.79±0.05 g, 15.50±0.47 mm, and 10.98±0.29 mm, respectively, and those of the left were 0.75±0.03 g, 15.35±0.33 mm, and 10.73±0.28 mm, respectively. The mean values for the weight of the right and left ovaries were lower than those given by Uddin et al. (2021) at

Figure 1. Measuring the length of right salpinx

Figure 2. Measuring the weight of ovary

7-12 months, but the mean length and width of the right and left ovaries were higher than those reported by Uddin et al. (2021) at 7-12 months in Black Bangle goats.

The average measures (weight, length, width, and thickness) of the right and left ovary at 12-36 m in this study were higher than the results of Kirbas Dogan et al. (2019) in the Anatolian wild goat and those of Haque et al. (2016) in the black Bengal goat. However, these results were lower than those in Iranian native goats (Mohammadpour, 2007).

The weight and width between left and right ovaries in this study did not reveal a significant difference; these findings were similar to those reported by Aliyu et al. (2016) in the Sahel breed of Nigeria.

There was a very significant difference ($P<0.001$) regarding the weight of the ovary across ages. However, Aliyu et al. (2016) reported no significant difference. The weight of the ovary is influenced by the number and size of follicles and the corpus luteum it contains. Kouamo et al. (2015) stated that a good nutritional status positively influenced the follicular population. Moreover, the animal's age impacts the ovary's weight, which increases during the pubertal stage and more so during the post-pubertal stage than during the pre-pubertal stage, according to Sahu et al. (2017).

Based on our results, the right ovary was heavier than the left one according to age, body condition score, and pregnancy, indicating that the right ovary is more active than the left, as supported by previous studies (Gupta et al., 2011; Reasul et al., 2018; Kirbas Dogan et al., 2019).

In this study, the lengths of the right and left fallopian tubes at 6-12 months were 165.55±4.35 mm and 176.88±4.35 mm, respectively. These findings were significantly higher than the results of Uddin et al. (2021), which were 93±0.57 mm and 90±0.54 mm, respectively, at 7-12 months in black Bengal goats.

The mean lengths of the right and left fallopian tubes in Arbia goat at 12-36 months were 170.80±4.38 mm and 178.70±4.18 mm, respectively, which were longer compared to the salpinx's length in red Sokoto goat, black Bengal goat and Anatolian goat, reported by Adigwe & Fayemi (2005), Gupta et al. (2011), and Kirbas Dogan et al. (2019).

The mean weights of the right and left fallopian tubes at 12-36 months were 0.45±0.02 and 0.46±0.02 g, re-

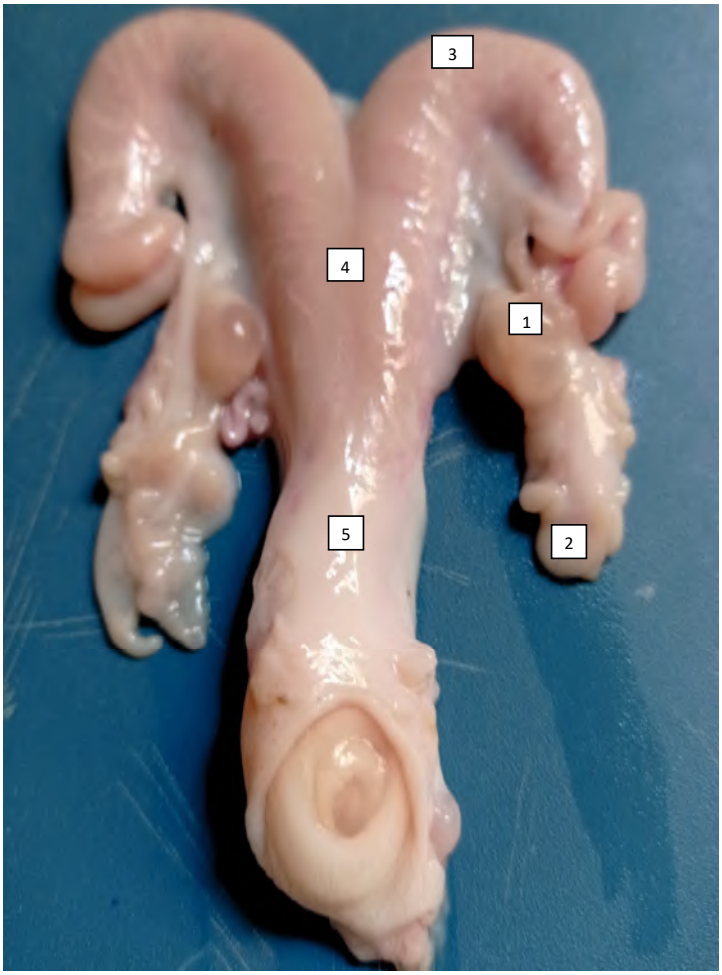

Figure 3. The reproductive system of the female Arbia goat

1) Ovary, 2) Oviduct, 3) Uterine horn, 4) The body of the uterus, 5) Cervix

spectively; these results were higher than those recorded in Anatolian goat by Kirbas Dogan et al. (2019). The salpinx of the Arbia goat is longer than that of other breeds; this may be related to the breed of goat studied.

At 6–12 months, the right uterine horn's length and width were 62.05±1.88 mm and 9.63±0.41 mm, respectively. The left uterine horn's length and width were 66.80±2.00 mm and 9.25±0.39 mm, respectively. However, Uddin et al. (2021) reported greater length and width for both the right and left uterine horns of black Bengal goats at 7-12 months.

The right and left uterine horns measured 79.70±2.85 and 84.83±2.76 mm in length, respectively, at 12-36 months. Comparatively, Adigwe & Fayemi (2005) and Gupta et al. (2011) reported relatively longer lengths for red Sokoto goats and black Bengal goats. However, Kirbas Dogan et al. (2020) found a shorter length for Anatolian goats.

The width of the right and left uterine horns at 12-36 months in this study was less than that measured in red Sokoto, black Bengal, and Anatolian goats by Adigwe & Fayemi (2005), Gupta et al. (2011), and Kirbas Dogan et al. (2020), respectively.

In this study, the average measures (weight, thickness) for the uterine horn at 12-36 months were higher than those mentioned by Kirbas Dogan et al. (2020).

There was a significant difference in weight and length of the uterine horn across ages, which agrees with the results of Abiaezute et al. (2017) in the West African dwarf goat of Nigeria.

The mean length of the body of the uterus was 32.83±1.53 mm at 6–12 months; comparatively, a lower length was obtained in black Bengal goats at 7–12 months (22.7±0.16 mm) (Uddin et al., 2021). The increase in the length of the body of the uterus may be due to repeated cycles (Shalini et al., 2013). On the other

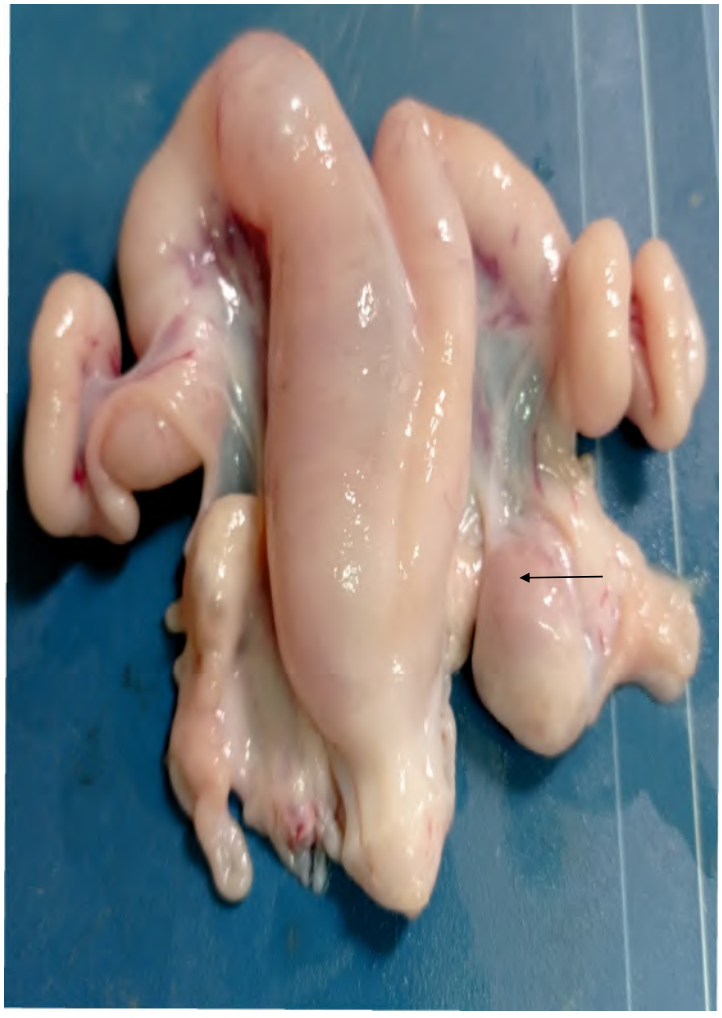

Figure 4. Early pregnancy in the left uterine horn

Note: The presence of the corpus luteum in the right ovary (arrow)

hand, a higher width was recorded in the black Bengal goat (29.5±0.31 mm) at 7–12 months of age (Uddin et al., 2021) compared to the current study.

The mean values for weight, length, width, and thickness of the body of the uterus at 12-36 months were higher than those given by Kirbas Dogan et al. (2020) in the Anatolian wild goat. However, Adigwe & Fayemi (2005) reported a higher length of the body of the uterus in the red Sokoto goat.

There was a significant difference in the weight of the uterine body across ages, which is in accordance with the report of Abiaezute et al. (2017).

The cervix length in this study at 6-12 months was 25.50±1.80 mm, whereas it was 27.8±0.31 mm in black Bengal goats reported by Uddin et al. (2021) at 7-12 months. The length of the cervix is influenced by factors including age, species, physiological conditions, and the number of births (Abiaezute et al., 2017).

The width of the cervix in Arbia goats at 6–12 months (13.63±0.59 mm) was slightly higher than that obtained by Uddin et al. (2021) in black Bengal goats at 7-12 months.

The average size (weight, length, width, and thickness) of the cervix at 12-36 m was higher than those reported by Adigwe & Fayemi (2005) and Kirbas Dogan et al. (2020).

The reproductive tract measurements of the Arbia goat increased with age; this finding is consistent with the findings of Shah et al. (2015), Fernandez et al. (2020), and Uddin et al. (2021). According to Holm et al. (2016), both age and live weight impact the reproductive system's development.

In the current study, the biometry of all reproductive tract organs increased with BCS, and the third group (2.5–3) had the highest values. Therefore, breeders and producers must consider these results and feed their herds well for better productivity because a good BCS directly affects hypothalamic activity and GnRH secretion (Rhind et al., 1989).

The difference between the results of the current study and those of other researchers may be explained by differences in breed, age, height, and weight of the animals in the study. These differences may also be due to climatic effects, as young goats in the tropics have to contend with the impact of the first dry season, when growth may be seriously retarded.

In the present study, the prevalence of slaughtered pregnant goats was 18.9%. This finding was higher than Anup Kumar et al. (2015) and Pagamici & Stephan (2022), which were 15.3% in goats and 7.6% in sheep, respectively. However, higher incidences of 25.82% and 29.1% were reported in the Sahel goats of Nigeria (Bokko, 2011) and in cows of Tanzania (Swai et al., 2015), respectively.

The highest pregnancy loss rate was in the first trimester; this finding agrees with those reported by Anup Kumar et al. (2015) and Bokko (2011) in goats. On the contrary, Swai et al. (2015) found that the most wasted fetuses in cows occurred in the second trimester of pregnancy. Less practiced pregnancy diagnosis could be the cause of this high percentage.

In this study, pregnancy did not significantly impact the measurements and weight of both the left and right ovaries (Jaji et al., 2012).

The dimensions of the uterine horns and body of the uterus increase significantly during pregnancy, which is consistent with the findings of Jaji et al. in goats (Jaji et al., 2012), sheep (Jaji et al., 2012), and cows (Jaji et al., 2012). These increases may be linked to fetal growth and the accompanying fluids and membranes during pregnancy (Jaji et al., 2012).

In conclusion, according to the results of the current study, measurements of the different parts of female genitalia in Algerian Arbia goats are either distinct from or less comparable to those in earlier reports for goats of other breeds.

Conclusion

These findings have established the baseline measurements of the female reproductive tract in Arbia goats according to age, BCS and stages of gestation, all of which impact the biometry of the female genital organ. This knowledge will facilitate the identification of various organ anomalies and serve as a manual for AI procedures and pregnancy detection in this animal species.

Ethical Considerations

Compliance with ethical guidelines

The European Communities Council directive (2010/63/EU) for animal experiments was followed in this study. The genitals that were the subject of the research came from animals slaughtered at the slaughterhouses and were destined for incineration.

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Authors' contributions

Conceptualization and supervision: Mira Chikhaoui and Khedidja Rennak; Methodology and data collection: Khedidja Rennak; Data analysis: Fatima Mahouz; Writing the original draft: All authors; Review and editing: Mira Chikhaoui and Khedidja Rennak.

Conflict of interest

The authors declared no conflict of interest.

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