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Breed and Reproductive Status Effects on Some Blood Parameters Dryland Goats (Algeria)

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ABSTRACT

Background: The Damascus breed, known for its prolificacy and milking ability, is recently imported in Algeria. The current investigation aimed to study the effects of physiological status on blood progesterone and some biochemical parameters in Shami goats and their crosses with local breeds in arid conditions of Algeria.

Methods: Ten female goats, aged 1.5 to 3 years, were divided into two equal groups: Damascus and Crossbred (Damascus × Arbia). Does were estrus synchronized and naturally mated. Blood samples were collected before intravaginal sponge insertion (non-pregnant), in early (30 days after sponge removal), mid (90 days), late pregnancy (130 days) and 30 days after kidding.

Result: The results showed a significant effect of the reproductive stage on progesterone levels in both groups, on glycemia and cholesterolemia in Crossbred does ($p<0.05$) and uremia in the Damascus group. Concentrations of triglycerides and creatinine revealed no significant difference between physiological phases in both groups. Breed effect was detected in early and mid-pregnancy for P4. Changes in assessed parameters of both groups reflect the goat's adaptation to the increased requirement of pregnancy and lactation in the arid conditions of Algeria.

Key words: Biochemical metabolites, Crossbred, Damascus, Goat, Progesterone, Reproductive status.

INTRODUCTION

The Algerian Arbia goat has moderate prolificacy and low milk yield (Kouri *et al*., 2018). The prolific Damascus breed can be used in pure or crossbreeding programs to improve milk yields in local populations or dual-purpose production systems (Mavrogenis, 2006). Therefore, Algerian farmers tend to improve the local native herds by crossbreeding with imported Damascus bucks.

The reproductive performance of goats is affected by genetic, environmental and physiological factors (Hussain, 2015). The progesterone assay at various physiological phases is essential in determining their fertility status (Talebi *et al*., 2012). The blood biochemical parameters provide useful data for evaluating animal physiological, metabolic, nutritional, health status, welfare and productivity. Nevertheless, results depend on many factors including breed, gender, age, nutrition, physiological status (pregnancy and lactation), stress, disease, season, farming system. Additionally, the adaptability of native goat breeds to specific environmental conditions compared to worldwide distributed goat breeds may be indicated by variations in blood metabolites (Manuelian *et al.*, 2020). The present study aimed to investigate the variations in blood progesterone and some biochemical indices at different reproductive stages in Damascus and Crossbred does (Damascus × Arbia) raised under Algerian arid conditions.

MATERIALS AND METHODS

The Ethical Committee of the Institute of Veterinary and Agronomic Sciences of Batna-1 University (Algeria) approved all procedures.

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Experimental location

The experiment was conducted, in a private farm located at El-Doucen, Ouled Djellal, an arid region of southeastern Algeria (latitude 34°06′N; longitude 5°01′E) characterized by a dry climate, low rainfall and dry pastures. The study extended from July 2022 until January 2023 and involved the period before estrus synchronization, the entire pregnancy period and 30 days after kidding.

Animals and experimental design

Ten clinically healthy female goats, aged 1.5 to 3 years with BSC ranging between 2.5 and 3.5, were divided into equal groups as Group 1: Damascus, Group 2: Crossbred (Damascus × Arbia).

Estrous cycles were synchronized by intravaginal impregnated sponges of 20 mg Flurogestone acetate (Chronogest, Intervet) for 11 days. Twenty-four hours before sponge removal, 400 IU eCG (Folligon, Intervet)/doe was injected intramuscularly. After device withdrawal, the goats were exposed to fertile Damascus bucks for natural mating. The day of mating was considered as day 0 of pregnancy. Gestation was confirmed ultrasonographically 45 days after mating.

The flock was bred under a semi-extensive farming system. Animals were grazed on natural pasture and received barley grain, wheat bran and barley straw. Water was distributed once a day.

Blood sampling, Progesterone and biochemical metabolites assays

Samples were collected aseptically from animals *via* jugular venipuncture in vacutainers without anticoagulant before morning feeding, at five times: before estrus synchronization, in early (30 days after sponge removal), mid (90 days), late pregnancy (130 days) and 30 days after kidding. The serum was separated by centrifugation at 3000 rpm for 15 minutes and stored at -20°C till assayed for progesterone and biochemical parameters.

Quantitative estimation of progesterone concentration (P4) was performed using a chemiluminescence immunoassay kit (Progesterone II kit, Cobas®, Roche). The intra- and interassay CV values were 0,02 et 0,1. Concentrations of biochemical metabolites (glucose GLU, cholesterol CHOL, triglycerides TG, urea, creatinine CRE) were measured by enzymatic colorimetric tests using commercial kits (Spinreact, Spain).

Statistical analyses

Results of progesterone and biochemical parameters at different reproductive stages in Damascus and Crossbred goats were presented as means ± standard deviation (SD). The Shapiro-Wilk test was performed to assess the normal distribution of the data. Two-way Analysis of Variance (ANOVA) was applied to evaluate the effects of the breed and reproductive status on the concentration of progesterone and biochemical indicators, Tukey's post-hoc test was used for detection of significant differences between means concentrations of assessed parameters. All statistical analyses were carried out using the Graph Pad Prism program (version 7.00). The results were considered statistically significant when $P<0.05$.

Results and Discussion

The mean values (±SD) of P4 and biochemical metabolites concentrations measured during different physiological phases (premating, pregnancy and lactation) in Damascus and crossbred goats are shown in Table 1, 2 and 3.

The P4 concentration (Table 1) increased as gestation progressed and dropped to basal levels after kidding in both groups. The highest levels were registered in late gestation in crossbred does. The significant influence of physiological status ($p<0.01$, $p<0.001$) was noted between

Table 1: Effect of physiological stages on progesteronemia (mean±SD) in damascus and crossbred goats.

Parameter	Group	Physiological stages				
		S1	S2	S3	S4	S5
P4 (ng/ml)	G1	0.29±0.15 a***b***	9.20±0.64 e***f***A**	14.84±1.50 h*** i***A***	22.04±0.46 c***j***	0.56±0.27 g***
	G2	0.40±0.16 a***b***	11.74±1.12 e***f***	20.26±0.36 h** i***	22.38±1.89 c***j***	0.49±0.15 g***

P4: Progesterone; G1: Damascus(n=5); G2: Crossbred (n=5); S1: Premating; S2: Early pregnancy; S: Mid-pregnancy; S4: Late pregnancy; S5: Early lactation; a: Premating vs early pregnancy. b: Premating vs Mid-pregnancy, c: Premating vs late pregnancy, d: Premating vs early lactation, e: Early pregnancy vs mid-pregnancy, f: early pregnancy vs late pregnancy, g: early pregnancy vs early lactation, h: Mid-pregnancy vs late-pregnancy, i: Mid-pregnancy vs early lactation, j: Late pregnancy vs early lactation, A: Damascus vs Crossbred, **p<0.01, ***p<0.001.

Table 2: Effect of physiological stages on serum energetic metabolite levels (mean±SD) in damascus and crossbred goats.

Bloodindices	Group	Physiological stages				
		S1	S2	S3	S4	S5
Glu (g/l)	G1	0.53±0.05	0.42±0.07	0.47±0.07	0.46±0.04	0.51±0.07
	G2	0.49±0.05	0.52±0.07	0.43±0.05 h*	0.56±0.03	0.49±0.09
Cho (g/l)	G1	0.88±0.22	0.85±0.30	0.79±0.16	0.74±0.15	0.73±0.13
	G2	1.12±0.14 d*	0.89±0.13	0.91±0.11	0.90±0.14	0.76±0.06
TG (g/l)	G1	0.13±0.04	0.09±0.01	0.08±0.02	0.12±0.03	0.12±0.02
	G2	0.18±0.08	0.12±0.04	0.11±0.03	0.16±0.05	0.14±0.04

G1: Damascus (n= 5); G2: Crossbred (n= 5); Glu: Glucose; Cho: Cholesterol, TG: Triglycerides; S1: Premating; S2: Early pregnancy; S3: Mid-pregnancy; S4: Late pregnancy; S5: Early lactation; d: Premating vs early lactation, h: Mid-pregnancy vs late-pregnancy; *p<0.05.

the premating period and early lactation and stages of pregnancy (early, mid, late) in both groups, while significant differences between goat breeds were observed in early ($p<0.01$) and mid-gestation ($p<0.001$).

No significant differences in glycemia were present among the different samples in Damascus goats (Table 2) while it increased significantly in the crossbred group, in late pregnancy compared to mid-gestation. A significantly lower cholesterolemia ($p<0.05$) was noted at early lactation compared to the premating sample in crossbred goats. For uremia, a significant decrease (Table 3) was recorded in the Damascus group at early lactation compared to pregnancy stages. Triglycerides and creatinine profiles showed no differences between physiological stages. No significant breed effect was noted for all considered biochemical parameters.

Mean serum P4 concentrations were at basal levels (<1 ng ml^{-1}) in both groups before sponge insertion in accordance with earlier studies (Talebi *et al.,* 2012; Yede *et al*., 2023), suggesting that goats were in an anestrous period or early estrus (Pineda, 2003). The significant increase after mating indicated that estrus was efficiently induced in females. The rising trend with gestation advance observed in both groups and the decline to basal levels after kidding were reported earlier (Kadzere *et al*., 1996). Since the main site of production of P4 in pregnant goats is the ovary, the irregular increase of progesteronemia observed in literature during gestation may be attributed to the possible differences in corpus luteum composition and activity (El-Tarabany *et al.,* 2020). On the other hand, the highly significant effect of gestation stage observed on circulatory P4 was previously described by Sousa *et al.* (1999). After parturition, P4 dropped to its basal level as a result of corpus luteum regression (Talebi *et al.,* 2012).

In the current experiment, the significant variation in P4 levels between Damascus and crossbred females at early and mid-gestation may be related to breed in agreement with Mmbengwa *et al.* (2009) who referred large variations in P4 concentrations within and between goat breeds and nutritional regimens. The investigations conducted by Abd El-Hamid *et al.* (2017) disagreed with these findings. The difference between groups could also be attributed to age, parity, or litter size (Hussain, 2015; Madan *et al*., 2020). According to Jarrell and Dziuk (1991), progesterone levels seem to be adjusted to the needs of gestation progress rather than the number of corpus luteum or fetuses suggesting great individual variation between females during different reproductive stages.

No significant effect of reproductive status on glycemia was recorded in Damascus does in agreement with Allaoua *et al*. (2021). The increasing trend during late pregnancy in crossbred does, also reported in sheep by Kandiel *et al.* (2010), indicates increased metabolic needs with advanced pregnancy. Additionally, rising levels noted in early lactating Damascus females compared to high pregnant ones were described earlier but with significant variation (Cepeda-Palacios *et al*., 2018). This rise may be related to the elevation of thyroid hormone during lactation which represents an adjustment to mobilize glucose for lactogenesis (Mbassa and Poulsen,1991), as glucose is the principal precursor of lactose synthesis by mammary epithelial cells (Kaniamuthan *et al*., 2022). It may also be ascribed to the recovery of feed intake and the improvement in the energetic status of females after kidding (Mohammed *et al.,* 2016).

No statistical difference exists between goat breeds' glycemia during different reproductive stages. In contrast, great variation was reported by Cepeda-Palacios *et al*., 2018). The difference could be attributed to age, feed intake, differences in the animal's metabolism, litter size, season, or region (Gamit *et al*., 2019; Khan *et al*., 2020).

Cholesterol concentrations were not significantly affected by physiological status in Damascus goats which conforms with earlier reports (Allaoua *et al*., 2021). On the contrary, crossbred does show lower values in the lactation period ($p<0.05$) compared to the premating period in line with the findings of Liotta *et al.* (2021) and Berrani *et al.* (2021). Variations may be due to the direct involvement of cholesterol in reproductive processes and its intensive utilization by the mammary glands for milk synthesis. The difference between both groups may also be explained by the age of the female goats (Karaşahin *et al*., 2019). Additionally, there was no significant breed effect on blood cholesterol concentrations which is supported by the results of Al-Bulushi *et al.* (2017).

The comparison among the different physiological periods revealed no significant change in TG content in Damascus and Crossbred does. Similar finding was

Table 3: Effect of physiological stages on serum protein metabolite levels (mean±SD) in damascus and crossbred goats.

Bloodindices	Group	Physiological stages				
		S1	S2	S3	S4	S5
URE (g/l)	G1	0.40±0.08	0.48±0.04 g**	0.49±0.06 i**	0.45±0.03 j*	0.31±0.06
	G2	0.38±0.10	0.45±0.08	0.46±0.08	0.42±0.07	0.40±0.08
CRE (mg/l)	G1	7.92±0.48	7.68±0.62	7.16±0.63	7.14±0.41	8.10±0.80
	G2	7.08±0.84	7.02±0.81	7.36±0.79	7.52±1.15	7.88±1.05

G1: Damascus (n= 5); G2: Crossbred (n= 5); URE: Urea; CRE: Creatinine; S1: Premating; S2: Early pregnancy; S3: Mid-pregnancy; S4: Late pregnancy; S5: Early lactation, g: Early pregnancy vs early lactation, i: Mid-pregnancy vs early lactation, j: Late pregnancy vs early lactation, *p<0.05, **p<0.01.

reported by Jimoh *et al*. (2019). In contrast, Abdul-Rahaman *et al.* (2019) described an increasing profile in pregnant goats compared to non-pregnant ones related to elevated hepatic synthesis or deficient energy intake. No such differences were registered throughout the current experiment suggesting adequate nutrient intake in both groups.

No significant impact of reproductive status on uremia was registered in Crossbred females in support to observations of Waziri *et al*. (2010). The marked decline ($P<0.05$) in early lactating Damascus goats compared to pregnant ones, is compatible with their significantly higher nitrogen requirements (Madan *et al*., 2020). However, the results are in contradiction to those previously observed by Idamokoro *et al*. (2019), who noted increased levels ($P<0.05$) in lactating goats, attributed to an altered protein metabolism during the lactation period, or enhanced muscle protein catabolism during the mobilization of body reserves. In addition, the non-significant effect of the breed is consistent with the findings of Castagnino *et al*. (2015).

The creatinine results concur with those of Berrani *et al.* (2021), who found no significant variation related to the reproductive status. In contrast, Soares *et al.* (2018) recorded higher values in pregnant than lactating goats due to increased energy requirement, to maternal mobilization of protein for fetal muscle development and the elimination of the fetal organic residues in maternal circulation. Increased CRE could also be observed in goats after water deprivation (Abdelatif *et al.,* 2010). This evolution was not shown in the present study suggesting the absence of maternal muscle protein catabolism or water restriction and indicative of the renal health of animals. On the other hand, results demonstrated no significant difference in CRE levels across all the reproductive stages between crossbred and Damascus does. A similar finding was reported by Abd El-Hamid *et al.* (2017) in Damascus and Baladi does. On the contrary, reports by Mohammed *et al*. (2016) confirmed that creatininemia differs significantly ($p\leq0.01$ respectively) among breeds.

Conclusion

Damascus and Crossbred females presented similar patterns of change of P4. Due to increased metabolic activities, gestation and lactation markedly influenced some biochemical indices, suggesting an individual metabolic adaptation of females to the higher energetic and protein requirements of these critical phases. Further investigations on a greater number of goats are needed to explore the productive and reproductive performances of Damascus goats and their crosses in Algeria. More studies on other hormonal and biochemical parameters including potential sources of variability such as body condition, age, parity, litter size, genotype, season, management systems and nutrition, to elucidate physiological adaptation mechanisms in this breed, are suggested. In addition, the performance of the local Arbia goats in terms of production and reproduction needs to be improved.

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Conflict of interest

The authors have no conflicts of interest to declare.

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