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Minero-Biochemical Profiles of Arbia Goats Reared Traditionally Under the Semi-Arid Environment of North–Eastern Algeria During Peri-Parturient Period

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ABSTRACT

Mineral and biochemical profiles are good indicators of health status in goats. They can be influenced by various factors, such as environ¬ment, methods of manage¬ment, gender, season, age, breed and physiological periods of reproduction. Therefore, the aim of this research was to study the effect of peri-parturient period on certain blood parameters and their interrelationship and correlation, in Arbia goats, reared under the traditional system in semi-arid environment of Algeria. Seventeen clinically healthy Arbia goats aged 1-4 years and weighed 29.09 ± 6.45 kg were chosen from a family farm, located in North-Eastern Algeria. This area has been considered as a semi-arid zone, and its climate has been characterized by hot summer and cold dry winter. Blood samples were collected during the late pregnancy (1Week Pre-Partum=1WPrP) and early lactation (3Week Post-Partum=3WPP). Plasma glucose (Glu), cholesterol (CHO), Urea, creatinine (Creat), triglycerides (TG), total protein (TP), albumin (Alb), Ca, P, Na and K were assayed. At 3WPP, plasma Creat and TG levels decreased significantly (p<0,001; p<0,000 respectively), and TP levels increased (p< 0,05) compared to those measured during 1WPrP. However, Glu, CHO, Alb, Urea, Ca, P, Na and K plasma levels showed non- significant changes between the two studied periods. Additionally, significant correlations (p< 0.05, p< 0,01) were found between some studied blood parameters during pre and post-partum period. In conclusion, the obtained results would certainly help breeders and clinical veterinarians in order to control health and nutritional status of Arbia goats in semi-arid zones of Algeria during this critical period of reproduction. Moreover, the study indicated that the Arbia goats have been well adapted to their environment.

Keywords: *Arbia Goats, Pre-Partum, Post-Partum, Plasma Biochemical and Mineral Parameters, Semi-Arid, North Eastern Algeria.*

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1. INTRODUCTION

In Algeria, there have been about 4.9 of goats out of 35 million heading all types of ruminants (Faostat, 2017). They have been reared mainly in mountainous areas, but the largest number has been distributed in the steppe and Sub-Saharan zones (Moustaria, 2008). Arbia goat has been one of the most popular breeds which have been well appreciated by farmers for milk and meat production because they have been well adapted to their harsh semi-arid environment. Additionally, the nutritional importance of milk has been well known (Park, 2007); milk from goats is more digestible and has longer shelf life compared to cow milk. Nagura (2004) found that goat milk is very beneficial for diabetic patients, people that have some diseases or intolerance to cow milk (Haenlein, 2004). Also, the nutritional importance of kid's meat is proved (Webb et al., 2005; Vladimir et al., 2016).
Therefore, controlling the health and nutritional status of the animals is necessary in order to increase animal production.

Metabolic profile is being used in dairy animals to predict the occurrence of some metabolic disorders, the diagnosis of metabolic diseases, the productivity of animals, and appreciate their nutritional status (Radostits et al., 2000; Balikci et al., 2007; Karapehlivan et al., 2007; Tanritanir et al., 2009; Bagnicka et al., 2014; Doré et al., 2015; Vasava et al., 2016). However, determining blood levels of the various biochemical parameters in goats can be influenced by various factors, such as the different environmental factors and the different methods of management (Sharma & Kataria, 2012), the geographical location with different climates (Elzein at al., 2016; Abd El-Hamid et al., 2017), the gender, season, age, breed (Mbassa & Poulsen, 1991; Antunović et al., 2017; Azab & Abdel-Maksoud, 1999; Anwar et al., 2012; Donia et al., 2014; Bagnicka et al., 2014; Ribeiro et al., 2016; Abd El-Hamid et al., 2017) and the physiological periods of reproduction (Azab & Abdel-Maksoud, 1999; Iriadam, 2007; Sadjadian et al., 2013; Donia et al., 2014; Manat et al., 2016; Soares et al., 2018).
Pregnancy and lactation are the physiological stages which have been considered to modify the metabolism in animals (Krajnicakova et al., 2003; Iriadam, 2007) because of the increase of their nutritional requirements especially during late pregnancy and early lactation (Goff & Horst, 1997). Moreover, during late pregnancy, eighty percent of the foetal growth resulted in a significant increase in nutrient

requirements (Bell, 1995; Dawson et al., 1999). There is also a high demand for protein for udder growth and colostrum production, a decline in voluntary feed intake despite this higher demand for nutrients (Bell, 1995). On the other hand, minerals are important as essential nutrients in the diet of animals. They play a significant role in regulating the physiological function of the puerperal period. That is, the physiological stage can change animals' requirements to these elements (Ahmed et al., 2000).

So, in response to these critical situations, changes in animal's metabolic profile can appear and affect the concentration of biochemical parameters of small ruminants (Sobiech et al., 2008).

The interaction between the animals and the environment, the ability of each species and breed to adapt have been essential characteristics. Therefore, many researchers have studied their breeds of animals under local conditions, in order to establish appropriate physiological baseline values for different blood parameters (Vojta et al., 2011; Šimpraga et al., 2013; Radin et al., 2017) and thereby to make decisions on the best farming system and the best management strategy to increase animals' productions (Mirkena et al., 2010).

The present research aimed to evaluate some plasma biochemical and mineral data in Arbia goats raised in Algerian semi-arid zone and investigate their variations during pre and post-partum period.

2. MATERIALS AND METHODS

2.1 Animals and experimental area

The present research was conducted on seventeen clinically healthy Arab goats aged between 1 and 4 years and weighing 29.09 ± 6.45 kg at the beginning of the research. Goat farm has been located in Touzeline region, 20 km from Oum El Bouaghi province (35° 52' 39″ N, 7°6' 49″E) at an altitude of 902 m. This area from Algeria has been considered as a semi-arid-zone, and its climate has been characterized by hot summer and cold dry winter. The average annual temperature in Oum El Bouaghi has been 13.4 °C, and the average rainfall has been 475 mm per year. Goats were reared in a traditional production system and kept under natural photoperiod and temperature. The animals were grazing on pasture whole day, while in the evening; they were fed straw or hay according to what was available in the farm. During extreme weather conditions in winter, animals were kept indoors, and were given once a day a mixture (500-1000 g/goat/day) of barley and wheat bran especially during the last month of pregnancy and during lactation. In addition to the food mixture, 8-9 kg/day/ ten goats of high quality of hay was also given, salt licks and water ad libitum.

2.2 Sampling and analyses

Blood samples were collected from goats during peri-parturient period: 1 Week Pre-Partum (1WPrP) and 3Week Post-Partum (3WPP). In the morning before feeding, the blood was taken from the jugular vein (5 mL) into Venoject® sterile vacuum tubes (Lithium Heparin, Italy) containing Li-heparin as the anticoagulants. Immediately, the blood samples were centrifuged at 3000 revolutions/min for 15min, and the plasma samples obtained were stored at -20°C until analyzed.

Blood biochemical parameters (glucose (Glu), cholesterol (CHO), triglycerides (TG), total protein (TP), albumin (Alb), urea, creatinine (Creat), calcium (Ca) and phosphorus (P)) were done using a Siemens, ADVIA 1800 Chemistry system (Germany 2007), and corresponding commercially available kits for each studied plasma parameter. Sodium (Na) and potassium (K) were assayed by Dimension RxL Max Integrated Chemistry System (Germany, 2007).

2.3 Statistical analysis

The results were expressed as mean ± standard error of the mean (SEM). Statistical analysis was done using Student t- test. Pearson's correlation test was used to investigate the relationship between the blood parameters. All obtained data were analysed using the Statistical software program (SPPS, version 20). The results were considered significant when $p<0.05$.

3. RESULTS AND DISCUSSION

Tables 1 and 2 show the values (mean ± SEM) of biochemical and mineral parameters in blood of Arbia goats aged between 1 and 4 years. Values of coefficient of correlation (r) between plasma biochemical and mineral parameters have been presented in Table 3 and 4.

Blood Glu level was used as an index of nutritional status (Morant-Fehr et al., 1977). In Arbia goats, plasma level Glu didn't change ($p>0.05$) between 1WPrP and 3WPP (Table 1). Some studies have shown the same observations (Chávez et al., 2009; Samardžija et al., 2013). Significant positive correlation ($p<0.05$) was observed between plasma Glu and TG concentrations ($r=0.575$) at 1WPrP; but it was significantly ($P<0.05$) negative with CHO ($r=0.556$) and with Alb ($r=0.599$) concentrations at 3WPP. The average value of the concentration of the Glu noted in 3WPP was very similar to that found by Mahmoud & Azab (2014) during the same period in Baladi goat; but the one registered at 1WPrP was higher. Manat et al. (2016) were found in Surti goats, that glucose concentration decreased from 0 day of parturition until 14th day post-partum and then started increasing from 21st day onward. The obtained results indicated that during the studied periods, animals were in a positive energy balance, and Arbia goats had a strong homeostatic regulation for glucose. However, the results of the current study disagreed with those of Elzein et al. (2016) who reported a significantly decrease of Glu level during post- partum period compared with that during pre-partum in Desert goats.

Table 1. Plasma biochemical levels during peri-partum period in Arbia goats aged between 1 and 4 years

	Peri-partum period		
Parameter	1Week Pre-Partum	3Week Post-Partum	*p-value*
Glu (g/l)	0,58 ± 0,21	0,59 ± 0,01	0,741
Creat (mg/l)	10,09 ± 0,96 [a]	5,92 ± 0,18 [b]	0,001

Urea (g/l)	0,31 ± 0,021	0,33 ± 0,02	0,496
CHO (g/l)	0,81 ± 0,041	0,77 ± 0,03	0,267
TG (g/l)	0,43 ± 0,053 [a]	0,13 ± 0,01[b]	<0,000
TP (g/l)	70,47 ± 0,93 [a]	73,59 ± 1,06[b]	0,039
Alb (g/l)	32,75 ± 1,08	33,69 ± 0,54	0,267

Means in the same row with different superscript letters are significantly different (P< 0.05).
Results are expresses as mean ± SEM

The significant decrease in Creat concentration (p=0,001) observed in Arbia goats during post- partum period compared to pre-partum one, was also reported by many authors like: Soares et al. (2018) who carried out a study on goats in semi-arid region and Elzein et al. (2016) who conducted a research on Desert goats. The increase during pregnancy was due to an increase breakdown in skeletal muscles and development of foetal musculature during the late gestation (Kaneko et al., 2008). On the contrary, Tharwat et al. (2013) found no-significant differences in blood Creat concentration during the peri-parturient period (-3, -2, -1, parturition, +1, +2 and +3 weeks) in goats. Additionally, in the current research and during 1WPrP, plasma Creat was positively correlated with P (r=0.642, p<0.01) and negatively with Alb (r=0.665, p<0.01).

In the present work, in Arbia goats, a stability in CHO level during the studied periods was noted (1WPrP and 3WPP) which was in accordance with the findings obtained by Soares et al. (2018) in semi arid area but this study disagreed with the results of Bamerny (2013) who noted a significant reduction in CHO concentration during the 1st week pre-partum compared to 3WPP in Meriz goats. Also the mean values obtained in the current research were very higher than those noted in Meriz goats (Bamerny, 2013) during the same periods.

Plasma TG concentration decreased significantly (p<0,000) at 3WPP compared to 1WPrP. These results were consistent with those of previous studies (Sadjadian et al., 2013 and Soares et al., 2018). This decrease was due to triglyceride uptake by mammary gland for milk fat synthesis. The lactation period has been characterised by physiological changes for the adaptation to the requirements such as: the reduction of lipogenesis and esterification, and the stimulation of free fatty acid mobilization. On the contrary, Samardžija et al. (2013) reported that the concentration of TG in German Improved Fawn goats' blood sera did not vary in the peri-parturient period.

The mean value of TP concentration noted during 1WPrP in Arbia goats was significantly lower (p<0, 05) compared to that at 3WPP. This result was similar to those of Sadjadian et al. (2013) and Elzein et al. (2016), but Bamerny (2013) noted a significant decrease in blood TP level 3WPP compared to 1WPrP. The decrease in blood TP level observed in 1WPrP might be due to the fact that maternal amino acids have been used for foetus proteins synthesises, and fetal growth was in his maximum, especially in muscles, during the late pregnancy. Moreover, it could attribute to the rapid extraction of immunoglobulin from plasma during the same period, when colostrum was formed in the mammary gland.

The positive correlation (r=0.491, p<0, 05) observed between TP and Ca at 3WPP in Arbia goats can be explained by the fact that non-ionised portion of total calcium was bound to serum proteins, mainly albumin (47%) and this fraction was not excreted in the urine because it was not filtered at the glomerulus (Payne and Payne, 1987). The mean value of plasma TP level obtained at 3WPP was similar to that found by Antunović et al. (2017) in Alpine goats at 20th day post-partum. On the contrary, Badawy & Youssef (2008) demonstrated non-significant changes for plasma TP during the lactation compared to the pregnancy. On the other hand, Bamerny et al. (2013) found a significant decrease (P<0.05) of TP from its highest value at 2nd week pre-partum to attain the lowest value at 3rd week post-partum in Meriz goats.

Plasma Alb levels tended to increase at 3WPP compared to 1WPrP but in a non-significant way (P>0.05). This result agreed well with those of Bamerny et al. (2013) but it was different from that reported by the previous studies (Badawy & Youssef, 2008; Sadjadian et al., 2013) who noted a significant increase of plasma Alb concentrations during post-partum as compared to the pre-partum period. Tharwat et al. (2013) noted also non- significant decrease in Alb blood level during week −2 until week +3. Albumin is an indicator of liver function. It is the main plasma protein synthesized in the liver, representing 50 to 65% of the total blood protein (Wittwer, 2000). Albumin decreases in the peri-partum period, and its reduction could be associated with hepatocellular liver diseases and fatty liver (Nehra et al., 2001). Therefore, in the present study, it could be deduced that the liver function in Arbia goats was maintained.

Table 2. Plasma mineral levels during peri-partum period in Arbia goats aged between 1-4 years

	Peri-partum period		
Parameter	1Week Pre-Partum	3Week Post-Partum	*p-value*
Ca (mg/l)	89,84 ± 1,31	86,35 ± 2,75	0,243
P (mg/l)	53,77 ± 5,14	47,75 ± 5,58	0,107
Na (mmol/l)	148,59 ± 0,33	147,11 ± 0,93	0,125
K (mmol/l)	4,15 ± 0,11	4,26 ± 0,10	0,593

Means in the same row with different superscript letters are significantly different (P< 0.05).
Results are expresses as mean ± SEM

Table 3. Pearson's correlation coefficient between the studied plasma parameter concentrations for Arbia goats aged between 1 and 4 years during 1WPrP

		Glu	Creat	Urea	CHO	TG	TP	Alb	Ca	P	Na	K
Glu		1										
Creat	r	-0,317	1									
	p	0,215										
Urea	r	-0,373	0,463	1								
	p	0,141	0,061									
CHO	r	-0,231	0,082	0,435	1							
	p	0,372	0,754	0,081								
TG	r	0,575*	-0,252	0,125	-0,057	1						
	p	0,016	0,329	0,632	0,829							
TP	r	-0,037	-0,086	0,258	0,445	-0,026	1					
	p	0,888	0,742	0,317	0,073	0,921						
Alb	r	-0,063	-0,665**	-0,223	0,095	-0,134	0,301	1				
	p	0,810	0,004	0,390	0,718	0,608	0,240					
Ca	r	-0,225	-0,032	-0,133	0,118	-0,406	0,303	0,211	1			
	p	0,386	0,904	0,610	0,651	0,106	0,238	0,416				
P	r	-0,355	0,642**	0,112	0,386	-0,315	-0,143	-0,349	-0,133	1		
	p	0,161	0,005	0,669	0,126	0,218	0,584	0,170	0,612			
Na	r	0,154	-0,295	-0,240	-0,236	-0,036	0,051	0,416	0,200	-0,359	1	
	p	0,555	0,250	0,354	0,363	0,890	0,847	0,097	0,441	0,157		
K	r	-0,023	0,086	-0,169	0,022	-0,283	0,277	-0,065	0,275	0,260	-0,023	1
	p	0,931	0,742	0,517	0,933	0,271	0,281	0,803	0,285	0,313	0,930	

r: Pearson's correlation coefficient, p: p-value, *: Significant correlation at $p < 0,05$, **: significant at $p < 0.01$ and NS: not significant.

Blood concentration of urea directly reflects the amount of protein ingested through the diet (Wittwer, 2000). The observed variations of Urea concentration in Arbia goats were similar to those reported by Soares et al. (2018) who indicated no-significant changes in urea during the transition period (on the 30th, 20th and 10th day ante-partum (dap), at the parturition and on the 10th, 20th and 30th day post-partum). The values of plasma Urea levels noted at 1WPrP in Arbia goats were higher than those reported by Waziri et al. (2010) in Sahel goats. Besides this result, it could be deduced that during peri-parturient period (1WPrP and 3WPP), there were no disorders in protein metabolism in Arbia goats, and the protein intake of the diet was assured.

During lactation, the animals had higher salt requirements (Underwood & Suttle, 1999). Plasma concentrations of Ca, P, Na and K did not vary during peri-parturient period ($p>0.05$). Significant positive correlations were observed between plasma P concentration and Na ($r=0.527$, $p<0,05$) and P and K ($r=0.617$, $p<0.01$) at 3WPP.

Blood Ca, P and Na concentrations had the same evolutions during the same period (1WPrP and 3WPP) in Meriz goats, on the contrary, plasma K level increased significantly at 3WPP (Bamerny, 2013). In this study, the observations for Ca and K were in agreement with those of Donia et al. (2014) but not for Na where they noted a sharp drop of serum Na concentration during the lactation period compared to the late gestation. Soares et al. (2018) also did not report significant variations of Na, P and K in dairy goats, reared in the Brazilian Semi-arid region, during the period of transition. Additionally, they observed that Ca concentration decreased at parturition, then it increased at 20th post-partum day when the mean values were similar to those at 10th pre-partum. Similarly, non-significant variations of Ca, Na and K before and after the parturition were reported by Tanritanir (2009), but they indicated a significant increase of P after parturition. Therefore, even though there was increased demand during these critical periods, it could be concluded that the metabolic needs of Arbia goats were covered.

Table 4. Pearson's correlation coefficient between the studied plasma parameter concentrations for Arbia goats aged between 1 and 4 years during 3WPP

		Glu	Creat	Urea	CHO	TG	TP	Alb	Ca	P	Na	K
Glu	r	1										
	p											

Creat	r	0,367	1									
	p	0,147										
Urea	r	0,034	-0,166	1								
	p	0,896	0,523									
CHO	r	-0,556*	-0,347	-0,227	1							
	p	0,020	0,173	0,381								
TG	r	0,065	0,388	0,200	0,101	1						
	p	0,805	0,124	0,440	0,698							
TP	r	0,286	0,397	0,122	-0,410	-0,233	1					
	p	0,267	0,114	0,642	0,102	0,368						
Alb	r	-0,599*	0,056	-0,057	0,088	-0,124	0,065	1				
	p	0,014	0,837	0,835	0,745	0,647	0,812					
Ca	r	0,033	0,336	0,051	-0,058	-0,134	0,491*	0,373	1			
	p	0,901	0,188	0,845	0,826	0,608	0,045	0,155				
P	r	0,007	-0,329	0,284	0,091	-0,144	-0,098	-0,272	-0,297	1		
	p	0,979	0,197	0,269	0,729	0,580	0,708	0,309	0,247			
Na	r	0,086	0,206	-0,163	-0,074	-0,322	0,404	0,093	0,300	0,527*	1	
	p	0,742	0,428	0,533	0,777	0,207	0,108	0,731	0,243	0,030		
K	r	0,210	-0,290	0,478	-0,086	-0,070	-0,003	-0,139	-0,027	0,617**	0,258	1
	p	0,419	0,259	0,052	0,743	0,789	0,991	0,607	0,917	0,008	0,317	

r: Pearson's correlation coefficient, p: p-value, *: Significant correlation at $p < 0,05$, **: significant at $p < 0.01$ and NS: not significant.

4. CONCLUSION

In Arbia goats reared in semi-arid zone, the peri-parturient period affected blood concentrations of Creat and TG which decreased significantly, and TP concentration increased after parturition. Additionally, Glu, Urea, Alb, Ca, P, Na and K concentrations didn't vary during the study periods. On the other hand, Creat correlated highly with Alb and P during 1WPrP but at 3WPP, P correlated highly with K.

The obtained results would certainly help breeders and clinical veterinarians in order to control health and nutritional status of Arbia goats in semi-arid zones of Algeria to increase the animal production. Moreover, the study indicated that the Arbia goats have been well adapted to their semi-arid environment.

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