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Blood biochemical parameters in *Ouled Djellal* ewes in the peri-parturient period

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ABSTRACT

The aim of this study is to investigate changes in blood biochemical parameters in Ouled Djellal ewes during the peri-partum and dry periods. The study included thirty healthy ewes, blood samples were collected during three periods: one week before parturition, one week after parturition and three weeks after drying off. Results showed that ewes in late pregnancy have the highest blood cholesterol, triglyceride and albumin levels and the lowest glycaemia. Total protein concentration was significantly higher in dry period than on late pregnancy and on early lactation ($p< 0,0001$) whereas, urea concentration was significantly higher ($p< 0,002$) on early lactation compared to dry period. On the other hand, calcium levels increase significantly in late pregnancy and decrease significantly in early lactation. However, phosphorus level was significantly higher in dry period and the highest magnesium levels were recorded in late gestation. Current findings regarding blood parameters in late pregnancy, early lactation and dry period may expand the knowledge for interpretation of the metabolic profile in order to establish a diagnosis and a prognosis of reproductive and metabolic diseases in ewes during these periods.

Keywords: blood parameters, dry period, ewes, lactation, pregnancy.

INTRODUCTION

Ouled Djellal is the most important sheep breed in Algeria; it represents approximately 58 % of the national livestock. This well adapted breed to the Algerian steppe environment is known for its exceptional meat and wool production qualities. The adult body weight lies between 60 and 80 kg and female fertility ranges between 87% and 89% [11]. Most studies on this breed concerned its zootechnic performances, while its metabolic profile is rarely investigated.

During the reproductive cycle of the ewe, late pregnancy and lactation are critical periods; they represent a physiological load to the female body, which activates adaptation mechanisms in order to maintain normal homeostasis during the peri-partum period. Knowing the metabolic profile in this period is very important to specify nutritional status as well as to prevent health disorders which lead to production and reproduction disturbances.

Blood serum biochemical parameters are affected by several factors such as breed, age, under nutrition or season [39]; [42], during pregnancy these levels are naturally affected by the involvement of maternal tissues in providing energy for foetal growth.

Lactation is a very demanding period for females confronted with increased nutritional needs. During this period, especially in its initial phase, characterized by high milk production, it is difficult to satisfy the nutritional requirements of lactating animals. This is due to their increased need for energy and minerals for milk synthesis. As a result, there will be a significant change in animals' metabolism leading to the modification of blood biochemical parameters and minerals concentration. These variations not only affect animal's performances, but also lead to certain metabolic disorders reflecting a real metabolic stress for animals during lactation [6].

The aim of this investigation is to determine changes in some blood parameters of *Ouled Djellal* ewes in the peri-parturient and dry periods.

MATERIALS AND METHODS

Animals

A total of thirty clinically healthy *Ouled Djellal* ewes, aged between 2 and 4 years and weighing 51,3 ± 7,7kg were used. The study was conducted between September 2011 and March 2012 in Constantine region located in north-eastern Algeria. In dry period; ewes were grazing and had free access to hay and water. During pregnancy and lactation periods, besides free access to hay, ewes fed hay (*ad libitum*) in addition to a daily meal composed of 400 g of grain mixture (85% barley and 15% faba beans) once a day (8:00am).

Sampling and analyses

Blood samples were collected during three periods: one week before parturition (late pregnancy), one week after parturition (early lactation) and three weeks after drying off. Blood was taken from jugular vein into heparinazed vacuum tubes Venoject®, the plasma was immediately separated by centrifugation at 3000 rpm/10min, and stored at -20°C until analyzed. The concentrations of biochemical indicators (glucose, cholesterol, triglycerides total proteins, urea and albumin, Calcium, Phosphorus and Magnesium) were analysed by the Random Access Clinical auto Analyzer.

Statistical analysis

All data were expressed as means ± standard deviation (SD). Differences between group means were estimated using a one-way analysis of variance (ANOVA) and a Tukey Multiple Comparison Test was performed to test the significance of differences between all groups using the software STATISTICA (version 99). Results were considered as statistically significant at $P < 0.05$.

RESULTS

Significant differences in biochemical parameters were recorded before and after parturition (Table 1).

Glucose and total protein plasma concentrations were significantly higher in dry period than on late pregnancy and early lactation. Cholesterol, triglyceride and albumin levels on early lactation and dry period were significantly lower than those on late pregnancy. Urea concentration was significantly higher ($p< 0,002$) on early lactation compared to dry period. Calcium plasma levels increase significantly in late pregnancy and decrease significantly in early lactation compared to the dry period. However Phosphorus level was significantly higher in dry period. The most important Magnesium levels were recorded in late gestation. In peri-parturient period, the fluctuation in blood glucose, urea and phosphorus concentration were note significant.

Table 1. Blood biochemical parameters (Mean ± SD) of *Ouled Djellal* ewes during the peri-parturient and dry period

	Mean ± SD			p values		
	Late pregnancy	**Early lactation**	**Dry period**	**a**	**B**	**c**
Glucose g/l	0,55 ± 0,06	0,57 ± 0,17	0,63 ± 0,08	NS	0,0009	NS
Cholesterol g/l	0,81 ± 0,14	0,48 ± 0,15	0,56 ± 0,12	0,0001	0,0001	NS
Triglyceride g/l	0,38 ± 0,11	0,10 ± 0,07	0,12 ± 0,05	0,0001	0,0001	NS
Total proteins g/l	67,67±5,02	61,06±12,37	79,55±7,23	0,01	0,0001	0,0001
Albumine g/l	32,00±6,21	21,68±3,81	26,73±1,48	0,0001	0,0001	0,0001
Urea g/l	0,48±0,06	0,55±0,15	0,45±0,09	NS	NS	0,002
Ca mg/l	101,22±9,97	74,53±12,56	82,77±12,51	0,00001	0,00001	0,04
P mg/l	52,44±13,06	51,18±13,02	64,37±12,08	NS	0,004	0,02
Mg mg/l	21,10±1,72	17,56±6,14	17,74±4,49	0,00001	0,0001	NS

***a** : late pregnancy vs early lactation ; **b** : late pregnancy vs dry period; **c**: early lactation vs dry period*

DISCUSSION

Blood glucose is known as metabolic profile test, thus, it has distinguishable value in pregnancy toxemia, retarted growth, weight loss, production and reproduction defects [17]; [29].

In our study, changes in blood glucose concentrations were not significant during the peri-parturition period, the same results were reported by other researchers [28]. While higher plasma glucose levels were recorded in dry period.

In ewes, some other authors [2]; [10] reported greater blood glucose levels in pregnant ewes. While several studies showed that serum glucose levels were higher during lactation than pregnancy [18]; [40]; [7]; [24]. Thus, low concentrations of blood glucose during late pregnancy and the onset of lactation could be explained by its consumption by foetus and by milk production [36]; [30].

In this investigation significant higher levels of cholesterol and triglycerides in late pregnancy have been reported. In sheep, during late pregnancy, blood serum lipids profile is characterized by an increased concentration of total cholesterol [17]; [25]; [7]; [28] and lipoproteins [35] due to the diminished responsiveness of target tissues towards insulin that, together with an increased mobilization of fatty acids from adipose tissue make available new sources for foetal growth. During pregnancy, it has been found in several species a decrease of lipoprotein lipase activity which could also cause hypertriglyceridemia [22]. Thus, both, secretion and catabolism of triglycerides are altered during gestation.

Furthermore during early lactation, decreased serum cholesterol may be explained by the increased absorption of cholesterol from the tissues involved in the synthesis of milk [25]. However decrease in plasma concentration of triglycerides during lactation is compatible with an increase in energy requirements and a negative energy balance [20]; [5].

It was reported a decrease in blood protein concentrations during the latter stages of gestation, and these low blood protein levels reach normal concentration as the lactation period advances [9]; [7]. In our study, total protein concentration was significantly lower on late gestation and early lactation compared to the dry period; a similar results to ours were reported by other studies [20]; [27]. This decrease in serum total protein during late pregnancy may be attributed to the fact that the foetus synthesises all its proteins from the amino acids derived from the mother, and growth of the foetus increases exponentially reaching a maximum level, in the last third of gestation [3].

In the beginning of lactation the decrease of total proteins is due to the decrease of the rate of globulin which could be explained by the fast extraction of immunoglobulins for the synthesis of the colostrums [4].

In this study, the values of albumin pregnant ewes were significantly higher than those of lactating ewes ($p < 0.0001$). Our results agree with those of [8], [38], [10], who noted a significant influence of the reproductive stage on serum albumin that increases during gestation; they also agree with those of [16] and [27], who described a significant increase in serum albumin during late gestation. [37] also noted a significant increase in serum levels of this parameter in the seventh and eighth month of pregnancy in cows.

Some authors attribute the decrease in albumin in early lactation to a decrease in protein synthesis in the liver, which is due either to fatty infiltration which follows the mobilization of body reserves [37]; Grummer , 1993); or to a decrease in the availability of amino acids used primarily to meet the demand in mammary amino acids and glucose [12].

Plasma urea concentration is considered as a significant indicator of dietary protein supply in both sheep and goats [9]; [25]. The mean level of urea found in our study was greater in periparturition period compared to dry period. Similar results are shared by [3] and [13], who observed high uraemia values during gestation and lactation periods. [14] reported, plasma urea to start increasing in pregnant ewes from 10^{th} week of pregnancy, reaching a maximum level at parturition. [28] indicate that the serum concentration of urea peaked during parturition. This increase could be due to the decrease in glomerular filtration rate and reduced clearance of urea during the late gestation and lactation [32] or as described by [15] during late gestation blood levels of some non- essential amino acids are reduced and free uremia is increased; this reflects an increase in the catabolism of amino acids and the synthesis of glucose from these compounds.

The calcium (Ca) concentration in blood serum of sheep is considered to be deficient when calcium is less than 60mg/l, but above 80mg/l levels are considered adequate [1]. Present results indicate that (Ca) plasma level increase significantly in late pregnancy and decrease significantly in early lactation to reach normal values in dry period. The enlargement of parathyroid gland during pregnancy causes (Ca) mobilisation from the mother bones, maintaining normal (Ca) level in the mother intracellular fluids as the foetus removes (Ca) for ossifying its owns bones. Accordingly, the significant increase in (Ca) concentration in late pregnancy could be related to an increase of (Ca) mobilization from the skeleton. In goats some researchers obtained different results concerning Ca levels during pregnancy and lactation. [19] reported that Ca concentrations in plasma increased as gestation progressed and decreased after kidding while [41] said that no statistical differences between before and after parturition at Ca levels in goats.

Phosphorus (P) is also required in large quantities for skeleton mineralization. The present study indicates that the plasma Phosphorus level was significantly lower during late pregnancy and early lactation compared to dry period wile in peri-parturition period we have not found a significant difference. Some authors attributed such decrease in serum (P) level during late pregnancy to an increased rate of (P) mobilization out of maternal circulation into the foetus, (P) available in circulation is supplied by increasing (P) absorption from the gut or (P) resorption from the bones of dam [16]. Other researchers found that P levels during late gestation and postpartum period significantly increased in ewes and goats [21]; [26]; [41].

Magnesium (Mg) is required for normal skeletal development and one of the most common enzyme activators. Sheep with serum Mg levels less than 15 mg/l are deficient; levels greater than 15 mg/l and less than 18 mg/l are considered marginal; serum levels from 20 mg/l to 35 mg/l are adequate [1]. In our study, the highest Mg levels were found in late pregnancy. The same result was found by [34] that reported a higher concentration of Mg in blood serum in late gestation which decreased in parturition and 3 weeks postpartum. The decline of magnesiemie in early lactation could be explained by the fact that the sheep during this period, in addition to the stress of parturition and lactation , are often in negative energy balance , which implies and lipomobilisation therefore consumption of magnesium circulating [23].

CONCLUSION

The results of this study showed that: plasma, total protein, albumin, cholesterol, triglycerides, Ca and Mg levels were higher in late pregnancy while plasma urea level was higher in lactation compared to dry period. Our results confirm that the peri-parturient period is the period during which the most important biochemical changes were observed related to the maximum fetal growth in late pregnancy and the beginning of lactation.

Current findings may expand the knowledge for the diagnosis and prognosis of reproductive and metabolic diseases in ewes during these periods aimed to avoid a decline of the production performance and consequently of the economic lost.

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