

Biochemical Blood Parameters and Body Weight Change During Postpartum Period of Ouled Djellal Ewes in Algerian Semi-Arid Area

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Abstract: The objective of this study is to investigate postpartum profiles of biochemical blood constituents and body weight changes in Ouled Djellal ewes (n=10), during four weeks following parturition. Fundamental indices of the protein and energy metabolism, levels of calcium, phosphorus, magnesium, potassium, chloride, sodium were determined. These biochemical indices were evaluated at one week intervals for four week period. Body weight measurements were taken at lambing, at the second and at the fourth week postpartum. Serum glucose, triglyceride, creatinine, Alanine aminotransferase (AST), Aspartate aminotransferase (ALT), calcium levels and body weight were found to vary significantly during postpartum. However, serum cholesterol, urea, albumin, total protein, phosphorus, magnesium, potassium, chloride, sodium levels did not vary significantly during the experiment period. In conclusion, during the first month of postpartum ewe in semi-arid area, there are significant changes in certain blood biochemical indices and body weight, which are attributed to increase metabolic activities due to lactation.

Key words: Biochemical indices • Body weight • Postpartum • Ouled Djellal ewes • Semi-arid region
• Lactation

INTRODUCTION

In Algeria, sheep raising is concentrated in the steppe. The Ouled Djellal (OD) breed is the most dominant in this region representing nearly 60% of the 19.6 million heads [1, 2].

Although all nutrients are ultimately derived from food intake, the pool of disposable nutrients includes those that are stored in body tissues, such as adipose tissue and intramuscular fat that can be mobilized if required [3]. The contribution of body reserves in food balance sheet during difficult time can play an important role in global efficiency of production [4], quite particularly under semi-arid conditions where ewes may be exposed to stressful conditions which influence their metabolism.

Pregnancy and lactation are physiological status considered to modify metabolism in animals and induce stress [5, 6].

Bodily metabolism undergoes several adaptations linked to the physiological phases. In fact in certain periods animal organism is submitted to an intense work to provide nutrients to determinate organs, like during lactation, while in other periods organism store the energy coming from food, as in the dry period. Those metabolic adaptation principally are linked to several hormones effect that causes a major or minor activity of some organs respect to others [7]. During lactation, the mammary gland secretory cells utilize 80% of the blood-circulating metabolites for milk synthesis, depending on the infiltration speed of precursors of milk compounds (i.e. free amino acids, glucose and fatty acids). The strong

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reduction in lipogenesis and the increased fatty acid release, supported by norepinephrine and epinephrine stimulation, induce an increase in lipase activity of mammary gland to provide the substrates for milk fat synthesis [8]. Metabolism of mineral substances, which belongs to the basic components of the inside environment, plays a significant role in the regulation of physiological functions of the puerperal period [9].

It is essential to gain insight into postpartum physiological changes in the female animal if a complete understanding and possible manipulation of the reproductive physiology is desired [10]. In view of this, the objective of this study is to evaluate variations of blood biochemical indices and body weight during postpartum period of Ouled Djellal ewe in semi-arid area.

MATERIALS AND METHODS

Animals: Ten clinically healthy Ouled Djellal ewes were used (3-4 years old/ mean body weight 57.22 ± 6.99 kg), free from internal and external parasites and kept on one farm. During the trial, all animals were kept under natural photoperiod and ambient temperature, in Ras elAïoun town department of Batna (eastern Algeria with a Mediterranean climate type continental semi-arid, latitude $35^{\circ} 66' N$, longitude $5^{\circ} 60' W$ and altitude 973m). Animals were allowed to drink and to feed freely, the ration consisted of hay and concentrate throughout the experiment period.

Blood Sampling, Biochemical Analysis and Body Weight Measurements: The blood samples were taken from all ewes at first, second, third and fourth week after lambing. Jugular blood samples were collected early in the morning before feeding. The time interval between collection and transportation to the laboratory generally took less than 60 min. The blood samples were collected from the jugular vein (4 ml) into heparinized tube. After that, the plasma was separated by centrifugation (10 min) at $3000 \times g$.

Plasma biochemical parameters (total protein, albumin, urea, creatinine, triglycerides, cholesterol and glucose), concentrations of the mineral parameters (Ca-Calcium, P-inorganic Phosphorus, Mg-magnesium, K-Potassium, Na-Sodium, Cl-Chloride) and enzyme activity (ALT-alanine aminotransferase, AST-aspartate aminotransferase) were determined using commercial kits *Spinreact*, Spain.

Body weight measurements were taken at lambing, at the second and at the fourth week postpartum using weighing scale.

Statistical Analysis: All statistical analysis was performed with SPSS 20. Data were presented as the means ($\pm S.D$) and were subjected to statistical analysis using one way ANOVA test. A mean difference of $P < 0.05$ was regarded as significantly different.

RESULTS AND DISCUSSION

The data of the variations of biochemical profile and body weight on postpartum time are set out in Figure 1 and Table 1 respectively.

Biochemical Blood Parameters Changes: Glucose metabolism is unique in ruminants because they absorb essentially no preformed glucose from the gut [11]. In this study, plasma glucose level decreased markedly up to the second week then returned toward the initial level during the third and the fourth week (Figure 1). El-Sherif and Assad, [12] found a marked decrease in plasma glucose until the fourth week of lactation. According to Kaneko, [13] the major portion of the glucose uptake by the mammary gland provides for the biosynthesis of milk. The glucose and galactose moieties of lactose are derived from blood glucose. However, Takarkhede *et al.* [14] and Goff, [15] reported an increase in serum glucose after parturition. The increased glucose levels during early lactation in ruminants ascribed to developed glucose-sparing mechanisms mostly in mammary gland to prevent hypo-glycaemia [15]. On the other hand, Fýrat and Ozpinar, [16]; Karapehlivan *et al.* [17] found no significant change in serum glucose levels during lactation.

Our results showed that there was a significant increase ($P < 0.001$) of plasma triglycerides up to the third week followed by a decrease during the fourth week. Obidike *et al.* [10] found a significant increase in plasma triglycerides until the 10th day then a decrease toward the 30th day of the postpartum ewes. During early lactation, the increase in the level of plasma triglycerides resulted from the decrease of glucose that leads to depletion of glucose to adipose tissue resulting in more release of fatty acids [18]. These fatty acids are used for the synthesis of triglycerides and taken up by the liver where they are either changed to ketone bodies or oxidized to CO_2 , or esterified to triacylglycerols [17]. However, Piccione *et al.* [19] reported a significant decrease of triglycerides during early and mid-lactation.

In the present study, Serum cholesterol levels increased ($P > 0.05$) up to the third week then decreased during the fourth week of postpartum. However, Nazifi *et al.* [20] found a significant decrease in serum

Table 1: Mean (\pm S.D.) body weight changes during postpartum period

Weeks postpartum	0	2	4	P
Mean body weight (kg)	57.22 \pm 6.99	49 \pm 6.23	44.25 \pm 6.07	S ***

S: significative; *** $P < 0.001$

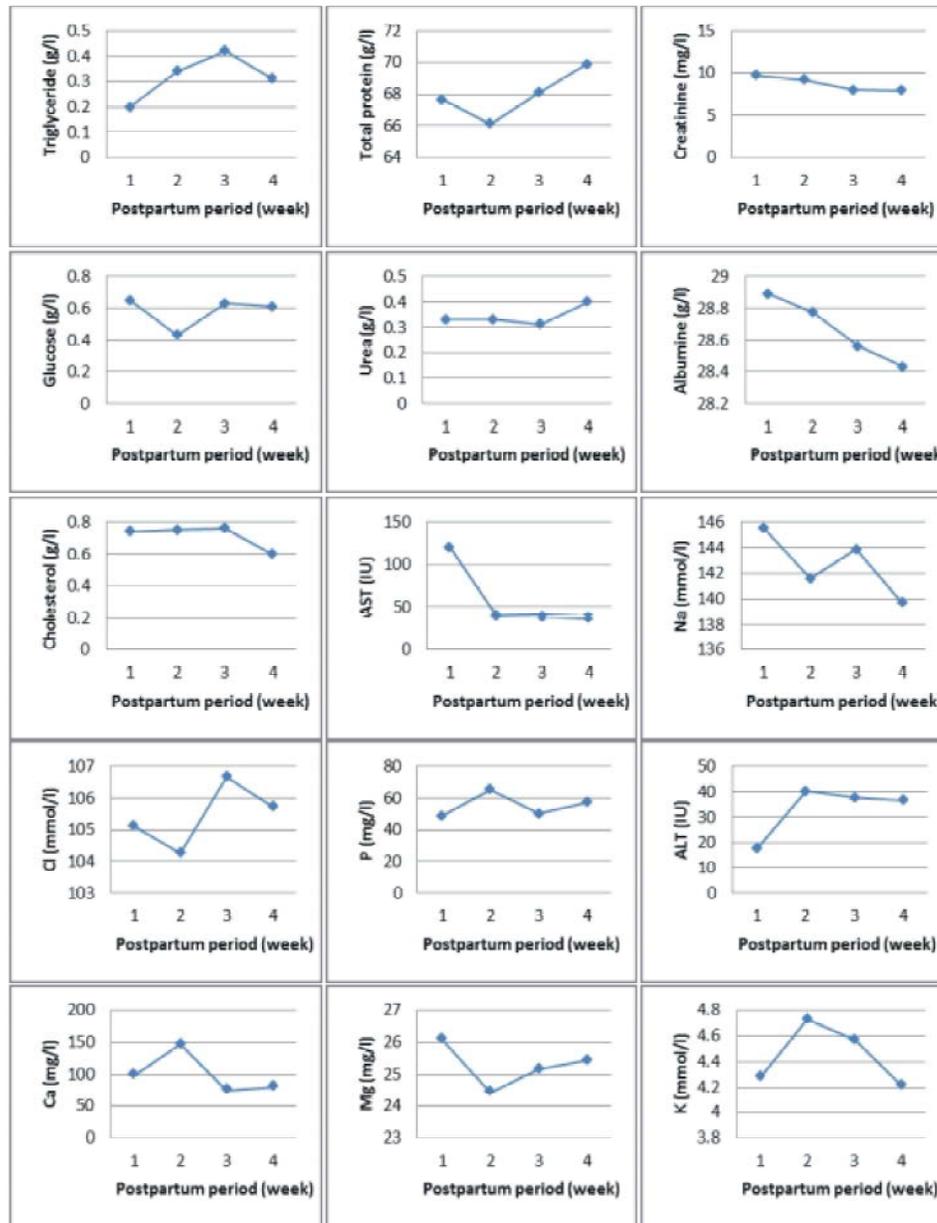


Fig. 1: Mean postpartum blood biochemical parameters change in Ouled Djellal ewes (n = 10)

Ca: Calcium; K: Potassium; P: Phosphorus; Na: Sodium; Cl: Chloride; Mg: Magnesium; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; variations of glucose, triglyceride, calcium, ALT were significant ($P < 0.001$) and for creatinine, AST ($P < 0.01$). However, variations of the rest of parameters were not significant ($P > 0.05$)

cholesterol toward the second week and an increase within four weeks of postpartum ewes. Zumbo *et al.* [21] in Maltese goats reported a significant decrease in cholesterol levels during 120 days of lactation.

Statistical analysis showed that total plasma protein decreased up to the second week, then increased during third and fourth week, but these variations are not significant ($P > 0.05$). El-Sherif and Assad, [12] found a

decrease in plasma proteins during four weeks of lactation. This trend of change in plasma proteins might represent an adaptive response, under semi-arid conditions, to the higher need of water mobilization by blood to mammary glands for milk production [12]. Drawing fluids from the extravascular space to the bloodstream under heat or thirst stress was found to cause a decrease in plasma protein concentration [22]. According to Vihan and Rai, [23] in ewe and Weaver *et al.* [24] in cow, the transport of immunoglobulins from serum to the mammary gland caused a decrease of total plasma protein. However, serum total protein showed a significant increase during all (early, mid and end) lactation [9, 19].

Albumin is synthesized in the liver and is the protein primarily responsible for the oncotic pressure in plasma [11]. In this study, lactation had no significant effect on serum albumin concentrations as lactation advance there was no significant decrease in albumin concentrations (Figure 1). El-Sherif and Assad, [12]; Karapehliyan *et al.* [17] found in ewe a significant decrease of serum albumin concentrations during four weeks of postpartum. However, Obidike *et al.* [10] showed that serum albumin concentrations decreased up to the 15th day then increased toward the 30th day in the postpartum ewe. Plasma albumin concentrations are reduced in cows with fatty liver, which may indicate a reduction in the ability of the liver to synthesize protein when triglyceride content is elevated [25].

Plasma creatinine level showed a significant ($P<0.01$) decrease during the experiment period. These results were confirmed by El-Sherif and Assad, [12] and Piccione *et al.* [19]. According to Haffaf *et al.* [26] in Ouled Djellal ewe, the reduction of plasma creatinine levels during postpartum could be compatible with an increased energy requirement coinciding with the lactation period when much of these metabolites are directed to the mammary gland. In dairy cows, plasma creatinine and muscle diameter decreased through the period from week one before calving to week four after calving [19]. However, Obidike *et al.* [10] reported a significant ($P<0.05$) increase in serum creatinine concentration in the postpartum ewe.

In the present study, serum urea concentrations increased until the third week and decreased during the fourth week but these variations are not significant. These results are in agreement with Brzostowski *et al.* [27] and Karapehliyan *et al.* [17]. Glomerular filtration and urea clearance were significantly reduced during lactation [28]. Greater urea concentration in lactating ewes can also be

a result of catabolizing muscle protein when large amounts of body reserves are mobilized [29]. However, El-Sherif and Assad, [12] found a significant decrease of serum urea levels during four weeks of the postpartum ewe.

The two transaminases Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were determined to provide an estimate of liver function [30]. AST and ALT seem to be good predictors of level of amino acids utilization during gluconeogenesis and therefore of body protein depletion on negative energy balances [31]. Serum AST determinations are still part of many biochemical profiles because of their relatively high sensitivity for detection of hepatocyte injury and myocyte injury and stability in serum [32]. Our results showed a significant decrease ($P<0.01$) of AST level during four weeks. However, Konig, [33] in ewes and Sarma and Ray, [34] in goats cited by El-Sherif and Assad, [12] found that AST was high during postpartum and was positively correlated with milk yield coinciding with mammary gland activity. AST increased activity in serum could be explained by greater liver weight [35].

The results obtained in this study reported an increase of ALT level up to the second week then a decrease during the third and the fourth week (Figure 1). Nevertheless, El-Sherif and Assad, [12] found a significant decrease of ALT during four weeks of postpartum. The observation of increased serum ALT activity indicates hepatocellular (or myocyte) injury, but it does not necessarily imply irreversible injury and does not suggest a specific cause [32]. Otherwise, the increase in ALT activity might due to rapid gluconeogenesis associated with lactation.

The mean values of Ca are presented in Figure 1. There was an increase until the second week, followed by a decrease toward the third week and finally an increase of Ca levels up to fourth week. However, Obidike *et al.* [10] found a significant increase of serum Ca levels during 30 days of the postpartum ewe. According to Braithwaite, [36] cited by Knowlton *et al.* [37] the postpartum ruminant is typically in negative Ca balance. A decrease of Ca levels in lactating cow was reported by Ivanov *et al.* [38]; Fikadu *et al.* [39] and in lactating goat was indicated by Krajniěáková *et al.* [9]. These authors showed that this decrease was in relation with the passage of Ca to the milk during lactation that leads to a several adaptation in the metabolism of this ion. However, the rising levels of plasma Ca in lactation due to high levels of plasma parathyroid hormone in this period which activates

osteoclasts and increases the level of calcaemia to mobilize skeletal Ca reserves [40]. Net bone resorption is likely a normal consequence in early lactation due to the rapid increase in demand for Ca to support milk yield [37, 41].

Sodium is the major extracellular cation and is responsible for most of the osmotic force that maintains the size of the extracellular fluid (ECF) compartment. Chloride is the major anion in ECF [11]. In our study, Changes in serum chloride tend to parallel those of sodium (Figure 1). This state because renal reabsorption of sodium is accompanied by reabsorption of chloride [11]. Statistical analysis showed that the changes of these ions were not significant ($P>0.05$) during the evaluated period. However, Krajničáková *et al.* [9] found a significant decrease ($P<0.05$) in plasma sodium concentration.

Concerning the rest of mineral elements obtained in this study (phosphorus, potassium and magnesium), there were no significant ($P>0.05$) variations. Krajničáková *et al.* [9] in goat showed no significant differences in plasma potassium, phosphorus and magnesium concentration.

Body Weight Change: In this study, there was a significant loss ($P<0.001$) of the body weight (-12.97 kg) during four weeks postpartum indicating the negative energy balance (Table 1). In agreement with our results, Chemmam *et al.* [42] in Ouled Djellal ewe showed that the body weight loss cumulated during four weeks post lambing was -12 kg. However, Benchohra *et al.* [43] found a significant decrease of mean body weight (3.280 kg) occurred in the first month of lactation. Maximum of losses were recorded during the first four weeks postpartum [44, 45]. After parturition, it is well known that the metabolic requirements increase in relation to the lactation process and that this may induce a decrease in the body weight if the nutritional level is not accurately balanced [46].

CONCLUSION

Changes in biochemical indices and body weight loss during postpartum indicate the energy deficit of ewes in early lactation. Therefore, it is recommended to monitor metabolic profile in order to assess nutritional status, take preventive measures against health problems that affect resumption of ovarian activity and create situations that would enhance increased more efficient ewe production.

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