Scientific Works. Series C. Veterinary Medicine. Vol. LXVII (1), 2021
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

COMPARATIVE STUDY OF THE GESTATION AND LACTATION PERIODS IN EWES, IN TERMS OF VARIATIONS OF THE MAIN METABOLIC PARAMETERS

Simona NICOLAE, Iuliana CODREANU, Liliana DECEI, Mario Darius CODREANU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Veterinary Medicine, 105 Splaiul Independentei, Bucharest, Romania

Corresponding author email: simona.calin93@yahoo.com

Abstract

This research aims to highlight the differences between the metabolic status in gestation and lactation in ewes, translated by a series of variations of the haematological parameters. A number of 25 representative blood parameters was determined in the 90th day of gestation and 40th day of lactation. We observed similarities in these parameters' variations in both periods, but also some discrepancies - more pronounced variations in the lactation period. Regarding the biochemical profile, almost all parameters decreased in lactation; Triglycerides, Cholesterol, Albumin decreased significantly ($p<0.05$). On the contrary, the Urea increased significantly ($p<0.05$). As concerning the enzymatic activity, it was increased in both periods, but more pronounced in lactation; GGT and AST increased significantly ($p<0.05$). The calcium decreased significantly ($p<0.05$) in lactation, while the other electrolytic parameters did not show significant variations. The RBC and Hb decreased non-significantly ($p>0.05$), whereas Ht decreased significantly ($p<0.05$) in lactation. Overall, the parameters maintained the same trend in both periods, but more important variations were observed in the lactation period, indicating that, compared to gestation, lactation represents a more demanding period in this species.

Key words*: gestation, lactation, metabolic profile, ewes*

INTRODUCTION

The physiological status exerts a crucial influence on the respective individual's metabolic necessities. In order to ensure the proper health conditions of the animal, along with the appropriate resources for production and reproduction, it is mandatory to monitor the main physiological changes that occur in the body especially during demanding periods, such as gestation and lactation (Khaled & Illek, 2012).

The most relevant and conclusive method of monitoring the health status in direct correlation with the physiologic stage of the individual is by performing a series of paraclinical investigations. The haematological and blood biochemical paraclinical exams are considered by the specialty literature to be among the most useful tools in monitoring the individuals during important and extremely demanding physiological periods, namely gestation and lactation (Antunovic et al., 2011).

Therefore, during this study, the main objective was to monitor the health status of a group of ewes during gestation and, later, during lactation, using for this purpose the haematology and blood biochemistry paraclinical exams. The fluctuations of the 25 representative blood parameters that were studied in both gestation and lactation periods allows us to correctly assess the physiological processes that occur in these periods, and also to prevent the occurrence of pathological entities, our main objective being ensuring the health and wellbeing of the animals, while preserving their productive capacity at maximum desired levels.

MATERIALS AND METHODS

The present study took place in a flock of Ţurcană mixed-breed ewes. The entire herd was subjected to mandatory prophylactic programs - vaccinations and periodic deworming. For this study, 10 clinically healthy ewes were selected, forming the experimental group. The selection criteria were represented by health, age and number of previous gestations. Thus, the group consisted

of clinically healthy and without history of pathologies, approximately 3 years old, multiparous ewes.

For the gestation period, the blood sampling was performed on December 11th 2017, in the 90th day of gestation. For the lactation period, the blood sampling was performed on March 17th 2018, in the 40th day of lactation. Melet Schloesing MS-45™ haematology analyser was the device used to process the whole blood samples to determine the haematological parameters and Spotchem EZ 4430 ARK RAY analyser was used to process the plasma samples to determine the biochemical parameters.

RESULTS AND DISCUSSIONS

The variations of the main haematological parameters in lactation, compared to gestation, were predominantly not significant from a statistic point of view ($p>0.05$), with only one exception – the haematocrit, that decreased significantly ($p<0.05$) in the lactation period. The mean values of the studied haematological parameters can be observed in Table 1. Also, it is important to mention the fact that all the mean values of the haematological parameters were found within the limits of the reference ranges for this species.

Table 1. The haematological profile parameters' mean values in gestation and lactation for the studied group of ewes

	90th day of gestation	40th day of lactation	Refference range
WBC (m/mm^3)	7.66 ± 0.31	7.21 ± 0.29*	**4-12**
RBC (M/mm^3)	12.18 ± 1.51	10.51 ± 1.46*	**9-15**
Hb (g/dL)	13.40 ± 1.98	11.24 ± 1.03*	**9-15**
Ht (%)	41.0 ± 3.91	32.7 ± 2.84**	**27-45**
MCV (fl)	33.6 ± 2.31	31.7 ± 2.63*	**28-40**
MCH (pg)	10.8 ± 0.65	10.7 ± 0.49*	**8-12**
MCHC (g/dL)	32.7 ± 2.06	34.3 ± 1.99*	**29-40**

*p>0.05 – statistically non-significant differences
**p<0.05 – statistically significant differences

The overview of the haematological parameters in correlation with the physiological status - gestation vs. lactation, reveals the fact that as the lactation sets in, a slightly, statistically non-significant ($p>0.05$) decrease of the number of leukocytes (WBC), the number of red blood cells (RBC) and blood haemoglobin concentration (Hb) can be observed. Similar results were obtained also by many authors in their research regarding the hematologic parameters in this species (Antunovic et al., 2011; Bahkci et al., 2007; Liesegang et al., 2007).

The mean values of mean erythrocyte volume (MCV), mean erythrocyte haemoglobin content (MCH) and mean erythrocyte haemoglobin concentration (MCHC) tend to remain relatively constant throughout the research, with no statistically significant variations ($p>0.05$).

The only haematological parameter that decreased significantly ($p<0.05$) during lactation was the haematocrit (Ht). One hypothesis emitted by several authors for this decrease of main haematological parameters, especially of the haematocrit, is based on the fact that in gestation is physiological to find an increased oxygen requirement and also the intensification of the metabolic rate, therefore all haematological parameters connected to the oxygen transport (RBC, Hb, Ht) tend to be higher in this period compared to lactation, which does not require additional oxygen transportation and is, therefore, considered to be a less physiologically demanding period for the ewe from this perspective.

The hypothetical reason for this variations of the red blood cells number, haemoglobin concentration and, especially, of the haematocrit mean values, being that in gestation the oxygen requirement is higher than in lactation, therefore lactation is considered to be a less demanding physiological period for the mother than gestation in terms of oxygen consumption. The probable cause for the decrease of the white blood cells count mean values in lactation is represented by the migration of the leukocytes from the ewe's blood into milk, this way providing the necessary antibodies for the lamb and, also, natural protection of the mammary gland.

The variations observed in the case of the main blood biochemical parameters in the lactation period, compared to the gestation period, were, as in the case of the main haematological parameters, predominantly not significant from a statistic point of view ($p>0.05$), with only a few exceptions, namely, the calcium, the

cholesterol and the triglycerides, that decreased significantly ($p<0.05$) and the AST and GGT that, on the contrary, increased significantly ($p<0.05$) in the lactation period. The mean values of the studied biochemical blood parameters are synthetically presented in Table 2 and Graph 1. Except for the GGT, that exceeded the upper limit of the reference range in the lactation period, all the mean values of the biochemical parameters were found within the limits of the reference ranges for this species.

Table 2. The biochemical profile parameters' mean values in gestation and lactation for the studied group of ewes

	90th day of gestation	40th day of lactation	Refference range
Ca (mg/dL)	9.41 ± 2.68*	8.75 ± 2.11**	**9.3-11.7**
P (mg/dL)	4.28 ± 0.61*	5.78 ± 0.44*	**4-7.3**
K (mmol/L)	5.83 ± 0.40*	5.97 ± 0.48*	**4.3-6.3**
Na (mmol/L)	144.01±1.88*	145.82±2.04*	**142-160**
Cl (mmol/L)	112.05±1.27*	112.70±1.93*	**101-113**
ALT (U/L)	19.70 ± 3.84*	16.80 ± 3.44*	**8-57**
AST (U/L)	14.66 ± 3.32*	18.20±3.62**	**9-49**
CK (U/L)	85.80 ± 6.71*	87.10 ± 7.11*	**7.7-101**
GGT (U/L)	8.60 ± 2.19*	11.88±1.38**	**1-10**
LDH (U/L)	387.1±46.84*	397.6±41.62*	**83-476**
Glu (mg/dL)	87.4 ± 12.11*	82.2 ± 11.02*	**65-118**
Urea (mg/dL)	19.90 ± 2.59*	24.20 ± 4.01*	**10-28**
Cholesterol (mg/dL)	72.20 ± 9.91*	50.33±7.78**	**44-90**
Triglycerides (mg/dL)	15 ± 2.68**	11 ± 2.04**	-
Creatinine (mg/dL)	0.87 ± 0.07*	0.76 ± 0.02*	**0.5-1.6**
Total proteins (g/dL)	7.10 ± 0.75*	6.79 ± 0.56*	**5.4-7.4**
Albumin (g/dL)	3.69 ± 0.51*	3.28 ± 0.31*	**2.7-3.7**
Total bilirubin (mg/dL)	0.27 ± 0.06*	0.32 ± 0.07*	**0.1-0.6**

*p>0.05 – statistically non-significant differences
**p<0.05 – statistically significant differences

A statistically significant decrease ($p<0.05$) of the calcium concentration compared to the mean values obtained in pregnant ewes was observed in ewes in the 40th day of lactation. The inorganic phosphorus mean concentration shows in the lactation period a statistically non-significant increase ($p>0.05$) compared to the mean values obtained in gestation. Some authors stated that this decrease of the calcium mean concentration in ewes' blood at the beginning of the lactation period may be associated with increased calcium secretion through milk and its rearrangement in bones (Liesegang et al., 2007). Similar results in terms of calcium and inorganic phosphorus concentrations variation during lactation were often mentioned in the speciality literature (Bahkci et al., 2007). Furthermore, phosphorus and calcium are mobilized from bones using similar physiological pathways, but a much more significant amount of calcium is secreted through milk, phosphorus being also secreted, but in a much smaller amounts than calcium and, consequently, its concentration in the ewe's blood is expected to be much higher than that of calcium. In lactating ewes, were recorded higher potassium concentrations compared to pregnant ewes, the increase of the average values being, although, statistically not significant ($p>0.05$). Physiologically, maintaining the level of blood potassium as constant as possible is necessary in order to maintain homeostasis since substantial fluctuations of the electrolytes' values, especially of potassium, can lead to serious structural and functional imbalances of the muscles and the heart, aspects frequently mentioned in the speciality literature (Codreanu M.D., 2016; Călin et al., 2020; Ognean et al., 2016).

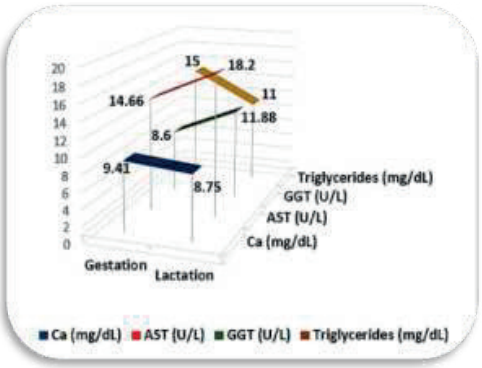

Figure 1. The dynamics of the Ca, AST, GGT and Triglycerides mean values in gestation and lactation for the studied group of ewes

The sodium and chloride concentrations mean values did not vary significantly ($p>0.05$), maintaining approximately similar mean values during the study.

Significantly increased concentrations of AST and GGT ($p<0.05$) were observed in lactating ewes. An opposite, decreasing trend was observed in the case of ALT concentration but without being statistically significant ($p>0.05$). The increased hepatic transaminases' activity,

namely, AST and GGT in lactating ewes indicates an increase of the hepatic metabolism, that can also be associated with high productivity. The results obtained in the present study are consistent with those reported in the past in the speciality literature (Antunovic et al., 2011).

The CK activity did not show statistically significant variations ($p>0.05$), although a moderate increase could be observed during lactation. Also, a more intense enzymatic activity of the LDH could be observed in lactating ewes compared to pregnant ewes, but with statistically non-significant differences ($p>0.05$). The results are consistent with the general trend of increased enzymatic activity observed in this physiological stage.

Mean plasma glucose values decreased, but non-significant ($p>0.05$) during lactation. This decrease of the mean glucose values at the beginning of the lactation period can be considered the result of a loss of energy through milk. More specifically, it suggests the increased use of glucose for the synthesis of milk lactose. The results can be also associated with an increased milk production and an intense activity of the mammary gland (Tygesen et al., 2008; Codreanu & Călin, 2018).

Elevated urea levels in lactating ewes may be the result of muscle protein catabolism when large amounts of body reserves are mobilized (Anwar, 2012). The speciality literature mentions the fact that this aspect is, most likely, directly correlated with the body status score and the body weight of the ewe, individuals with lower body status score presenting higher concentrations of urea in the blood (Khaled, 2012). Other authors have obtained similar results in their research regarding the variations of the blood biochemical profile in sheep and goats (Crivineanu et al., 2010; Bociu et al., 2015). The negative energy balance leads also to the mobilization of the body reserves and proteins catabolism, translated into increased blood urea levels.

The decrease of the total protein and albumin mean values is statistically non-significant ($p>0.05$) and can be explained by the massive mobilization of plasma immunoglobulins and their transfer to milk (Cotor et al., 2011).

The mean values of the triglycerides and cholesterol are statistically significant ($p<0.05$) lower in lactating ewes, being in total accordance with the increased energy requirement and the negative energy balance of this physiological status. Other several authors reached similar conclusions (Antunovic et al., 2011; Anwar et al., 2012).

Analysing the data, we could also observe a statistically non-significant increase ($p>0.05$) of the mean concentration of total plasma bilirubin in lactating ewes. This increase may be corelated with an increased hepatic metabolism and is correlated with the results obtained in the determination of the main hepatic transaminases - GGT and AST.

The hypothesis of an increased hepatic activity was emitted by several authors, being considered a necessary condition for sustaining the milk production at normal levels and is also strengthened by the increase of the mean values of the total bilirubin and LDH, but without statistical significance ($p>0.05$).

Regarding the average plasma creatinine concentrations, no statistically significant variations ($p>0.05$) in correlation with the physiological status were observed.

CONCLUSIONS

Regarding the influence of the physiological status - gestation, respectively, lactation - on the main parameters of the haematological profile in the studied group of pregnant/ lactating ewes, the following conclusions can be mentioned:

- the variations recorded in the case of the studied haematological parameters were almost exclusively not significant from a statistical point of view ($p>0.05$) in the two physiologic periods;
- all the mean average values of the hematologic parameters were found within the reference intervals for this species;
- in lactation, the most important parameters, namely, WBC, RBC, Hb and Ht decreased, the one that decreased significantly ($p<0.05$) being the haematocrit.

As concerning the influence of the physiological status - gestation and lactation, respectively, - on the main parameters of the biochemical profile in the studied group of

pregnant/lactating ewes, the following conclusions can be mentioned:

- during the study, the values of the main biochemical parameters were generally found withing the reference range for this species, with only one exception - the GGT that slightly exceeded the upper limit of the reference interval during lactation;
- the variations of the main blood biochemical parameters were predominantly not significant from a statistic point of view ($p>0.05$), with a few exceptions, namely, the calcium, the cholesterol and the triglycerides, that decreased significantly ($p<0.05$) and the AST and GGT that increased significantly ($p<0.05$) in the lactation period;
- the only electrolyte in which case a significant variation was recorded was the calcium, that decreased significantly ($p<0.05$) in lactation, this result being expected and most likely associated with the increased milk synthesis and the excretion of calcium through milk;
- the increased energy requirements during the lactation period was translated in a significant decrease ($p<0.05$) of the triglycerides and cholesterol mean values and a not significant ($p>0.05$) decrease of the glucose mean value;
- an increased blood enzymatic activity was observed in lactation, the hepatic transaminases GGT and AST increased significantly ($p<0.05$) indicating the intensification of the hepatic metabolism in this period.

REFERENCES

Antunovic, Z., Novoselec, J., Sauerwein, H., Speranda, M., Vegara, M., Pavic, V. (2011). Blood metabolic profile and some hormones concentrations in ewes during different physiological status. Bulg. J. Agric. Sci., 17, 687-695.

Anwar, M.M., Nour El-Din, A.N.M., Taha, T.A. (2012). Changes in some hematological and serum biochemical parameters during the first week after lambing in six consecutive parities in some Egyptian sheep breeds. Egyptian J. Anim. Prod., 49(3), 293-302.

Bahkci, E., Yildiz, A., Gurdogan, F. (2007). Blood metabolite concentrations during pregnancy and postpartum in Akkaraman ewes. Small Rumin. Res. 67, 247-251.

Bociu, N.A., Bălăşcău, B., Ivaşcu, C., Micşa, C., Cotor, G., Ghiţă, M, Dănacu, V., Viţălaru, B.A. (2015). Estrus inducing and synchronization in sheep outside of the breeding period. Journal of Biotechnology, Volume 208, Supplement, 1S43

Călin, S., Codreanu, I, Iacobescu, M., Codreanu, M.D. (2020). Correlations between different physiological stages and the prevalence of calcium metabolism disorders in ewes. Lucr St Med Vet Timisoara, 53(2), 23-29.

Crivineanu, V., Leonidis, A., Goran, G.V., Codreanu, I. (2010). Blood and wool lead levels in sheep farmed near roads from province of Thessaloniki. Lucr St Med Vet Timisoara, 43(2), 140-146.

Codreanu, I., Călin, S. (2018). Investigations regarding the influence of the physiological status on some electrolytic, enzymatic and biochemical blood parameters in ewes. Rev Rom Med Vet, 28(4), 5-13.

Codreanu M.D. (2016). Medicina internă a animalelor domestice. Editura Printech, Bucureşti

Cotor, G., Pop, A., Ghiță, M. (2011). The effect of ovine placenta extract on mammogenesis, lactogenesis, and galactopoiesis in sheep. Turk. J. Vet. Anim. Sci., 35(1), 137-142.

Khaled N.F., Illek J. (2012). Changes in selected blood minerals, vitamins and thyroid hormones in Barky ewes during late pregnancy, post-partum and early lactation, J. of Appli. Biological Sci., 6: 5-8.

Liesegang, A., Risteli, J., Wanner, M. (2007), Bone metabolism of milk goats and sheep during second pregnancy and lactation in comparison to first lactation. J. Animal Physiol Anim Nutr (Berl), 91, 217-225.

Ognean, L., Blidar, R., Oana, L., Muntean, S., Ghișe, A., Ștefănuț, C. (2016). Cellular types in sheep colostrum and its evolution in the transitions from colostrum to milk. Lucr St Med Vet Timisoara, 49(1), 122-127.

Tygesen, M., Nielsen, M., Nørgaard, P., Ranvig. H, Harrison A., Tauson A. (2008). Late gestational nutrient restriction: effects on ewes' metabolic and homeorhetic adaptation, consequences for lamb birth weight and lactation performance. Arch Anim Nutr., 62(1), 44-59