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EFFECT OF PHYSIOLOGICAL STATUS ON SOME HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF OSSIMI SHEEP

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ABSTRACT

Eighteen Ossimi ewes (6 non-pregnant, 6 late-pregnant 4 weeks prior to lambing, 6 early-lactating ewes 4 weeks postpartum) were used to determine the influence of physiological status on some hematological and biochemical parameters in addition to levels of thyroid hormones. The ewes were averaged 2.5 years old and their mean body weights were 49.27 ± 4.40, 53.85±3.87 and 47.65±3.45 kg for non-pregnant, late-pregnant and early-lactating ewes respectively. The current results showed that late-pregnant ewes recorded higher (P<0.05) values of blood Hb and RBCs count compared to early-lactating and non-pregnant ewes. The PCV and monocyte values decreased (P<0.05) in late-pregnant and early-lactating compared to non-pregnant ewes. Total WBCs count decreased (P<0.05) in late-pregnant compared to non-pregnant and early-lactating ewes. Concerning neutrophil values and N: L ratio increased (P<0.05) in late-pregnant and early-lactating compared to non-pregnant ewes with no significant changes in eosinophil, basophil and lymphocyte values. Serum glucose and cholesterol levels decreased (P<0.01) in late-pregnant and early-lactating ewes compared to non-pregnant ones. Serum total protein decreased (P<0.05) in late-pregnant ewes compared to non-pregnant and early-lactating ewes. Serum albumin increased (P<0.05) in late-pregnant and non-pregnant ewes compared to lactating ones, while opposite trend was recorded for serum globulin. Serum total lipids increased (P<0.05) in late-pregnant and early lactating compared to non-pregnant ewes. Serum ALT activity showed higher (P<0.05) levels in late-pregnant and non-pregnant compared to early-lactating ewes with no significant difference in serum AST levels and creatinine concentrations. There were significant (P<0.05) differences in serum urea due to physiological status with highest values in late-pregnancy followed by early-lactation and non-pregnancy. Serum T_3 decreased (P<0.01) in non-pregnant and late-pregnant ewes compared to early-lactating, while the differences in serum T_4 concentrations were not significant. The results indicated that blood hematological and biochemical parameters as well as thyroid hormone (T_3) concentrations significantly changed as influenced by the physiological status of Ossimi ewes.

Keywords: *Ossimi sheep, physiological status, hematology, biochemical parameters, thyroid hormones.*

INTRODUCTION

The physiological status is one of the important factors affect blood parameters that are involved in the development of the blood metabolic profile (Roubies *et al.,* 2006). Metabolic profiles have been used to monitor and evaluate pre-partum and post-partum metabolic disorders, diagnosis of metabolic diseases and assessment of the nutritional status of the animals (Radostits *et al.,* 2000). Pregnancy and lactation develop metabolic stresses that perform changes dependent upon the reproductive status of the animals (Ceylan *et al.,* 2009). Those changes not only occur in producing animals but also lead to certain metabolic disorders that affect the concentration of hemato-biochemical parameters of small ruminants (Sobiech *et al.* 2008). These parameters are also important indicators of the health condition and metabolic activity in lactating animals (Karapehlivan *et al*., 2007). Thyroid hormones also play a relatively important role in pregnancy and lactation; and they are involved in the metabolic response via maintaining the homeostasis of energy and protein metabolism, thermoregulation, growth and productivity parameters (Huszenicza *et al*., 2002). Monitoring the concentration of blood parameters as well as thyroid hormones in

sheep gives a clear picture of their nutritional and health status before the changes are visible on the animal (Antunovic *et al.*, 2009). Understanding the normal values would be the useful index in the determination of the physiological aspects in various physiological status including non-pregnant or pregnant ewes. It's known that late pregnancy and early lactation are very demanding physiological state of the organism when nutritional requirements are increased (Goff and Horst, 1997). So, the present study aimed to determine the influence of physiological status on some hematological and serum biochemical parameters as well as thyroid hormone responses in non-pregnant, late-pregnant and early-lactating Ossimi sheep.

MATERIALS AND METHODS

The present study was conducted at the Farm of Animal Production Department, Faculty of Agriculture, El-Minia University during the months from October to December. The aim of this study is to determine the influence of physiological status on some hematological and serum biochemical parameters in addition to thyroid hormones concentration of Ossimi sheep. Eighteen Ossimi ewes (6 non-pregnant, 6 late-pregnant ewes at 4 weeks prior to lambing, 6 lactating ewes at 4 weeks postpartum were used in the current study. The ewes were averaged 2.5 years old and their mean body weights were 49.27 ± 4.40, 53.85±3.87 and 47.65±3.45 kg for non-pregnant, late-pregnant and early-lactating ewes respectively. The experimental animals were apparently healthy and proved to be free from internal and external parasites. The animals were fed on concentrate feed mixture and bean straw to cover their nutrient requirements according to their live body weight. The concentrate mixture contained 15 % yellow corn, 15 % soybean meal, 30 % sugar beet pulp, 37 % wheat bran, 2 % limestone and 1 % common salt. The constituents of concentrate feed mixture and its feeding values were calculated according to NRC (1985). These values were 67.75 % TDN and 15.46 % crude protein 2.53 ME (Mcal/kg). Feed was offered twice a day at 8 am and 2 pm. Also mineral blocks and fresh water were available to the animals throughout the experiment.

Blood sampling and measurements:

Heparinized blood samples were collected from the jugular vein of each animal at 8.00 am before feeding or drinking. Whole blood samples were analyzed after collection for hemoglobin (Hb, gm/dl), packed cell volume (PCV, %), red blood cell counts (RBCs, $x10^6$ / mm3) and white blood cell counts (WBCs, x103 / mm3). Moreover, blood samples were collected from the jugular vein and left to clot at room temperature for at least 4 h. The clots were removed and sera were cleared by centrifugation at 1500×g for 20 min and stored at –20 ºC until analyzed. The Hb concentration was determined according to Shali's method (Wintrobe, 1975). The PCV was determined using micro-hematocrit tubes with a micro-hematocrit centrifuge at 12000 r.p.m for three minutes. The RBCs and WBCs were counted using the light microscope. Stained blood smears with Lieshman's stain were prepared for the differential WBCs count (Dacie and Lewis, 1991). Blood serum was kept frozen at -20 ºC for later analysis. Serum triiodothyronine (T_3) and thyroxin (T_4) concentrations were determined by a direct solid-phase I^{125} radioimmunoassay techniques using (coat-A-count TKT3 and TKT4) RIA Kits purchased from Diagnostic Products Corporation (DPC, Los Angeles, CA, 90045-5597, USA). Triiodothyronine /thyroxin ratio was calculated. Serum glucose (mg/dl) and cholesterol (mg/dl) were determined using Bio-Merieux Kits (marcy-1, Etolie Charbnnieres-Les-Bains, France). Serum total protein (g/dl), albumin (g/dl) and total lipids (mg/dl) were determined using Bio-Analytics Kits (USA). Serum globulin concentrations were calculated by difference between total protein and albumin concentrations. Serum alanine transaminase (ALT), aspartate transaminase (AST) and creatinine were measured by Spectrophotometer using standard test kits supplied from Bio-Merieux Kits (marcy-1, Etolie Charbnnieres-Les-Bains, France) and Bio-Analytics kits (USA). The data were analyzed by least square means analysis of variance using General

Linear Models (GLM) procedure of the statistical analysis system (SAS, 1992). Duncan's Multiple Range test was used to detect differences between means of the experimental groups (Duncan, 1955).

RESULTS AND DISCUSSION

Hematological parameters:

The data presented in Table (1) show the effect of physiological status of Ossimi ewes on their hematological parameters. Late pregnant ewes recorded significant (P<0.05) higher values of blood Hb and RBCs count compared to those at early-lactation and non-pregnant ewes. There was a decrease (P<0.05) in PCV (%) values for late pregnant and early-lactating ewes compared to non-pregnant. These results obtained on Ossimi ewes agree with earlier studies on sheep and goats (El-Sherif and Assad, 2001; Iriadam, 2007; Pisek *et al.*, 2008; Antunovic *et al*., 2011a). Increased Hb content in late-pregnant ewes could be attributed to higher demand for oxygen and the requirements of higher metabolic rate for pregnancy. Decreased PCV (%) during late pregnancy and early lactation might be ascribed to the hemodilution effect resulting from an increase in plasma volume and/or the increasing water mobilization to mammary gland through the vascular system (El-Sherif and Assad, 2001). The fall of blood Hb during lactation was also found in Baladi goats (Azab and Abdel-Maksoud (1999). On the other hand, no variation was detected in hematological parameters of Lacaune sheep among the physiological status of non-pregnant, pregnant and lactating animals (Brito *et al.*, 2006). In other ruminants, Ate *et al.* (2009) revealed no significant differences in haematological parameters during third trimester of pregnancy and early lactation in cattle. Total WBCs count in Ossimi sheep decreased (P<0.05) in late pregnant compared to non-pregnant and early-lactating ewes. This result is in accordance with a study on Tsigai ewes by Antunovic *et al.* (2011a), suggesting that the low number of total WBCs count during pregnancy and the increase at parturition and early lactation is probably a response to uterine involution. The increase in total WBCs count in lactating Ossimi sheep compared to late pregnant ewes agree with the results reported in lactating buffaloes compared to pregnant ones (Serdaru *et al*., 2011). The differential WBCs count showed significant (P<0.05) changes due to the effect of physiological status of Ossimi ewes (Table, 1). Data revealed a significant (P<0.05) increase in neutrophil values and neutrophil: lymphocyte (N: L ratio) for late-pregnant and early lactating ewes compared to non-pregnant ewes with no significant changes in eosinophil, basophil and lymphocyte values, while the monocyte values decreased (P<0.05) in late pregnant and early lactating ewes compared to non-pregnant ones. These results may support the view that pregnancy is associated with dramatic changes in immune cell populations within the uterus. According to Bamerny (2013), there were significant increases in N: L ratio during the last two weeks of pregnancy and postpartum periods compared with pre-mating period in goats. This result could be attributed to the fact that pregnancy stress stimulates the anterior pituitary gland to secrete ACTH, which in turn induces the adrenal cortex to produce glucocorticoids, involved in the mobilization of neutrophils from body pool into the peripheral circulation (Adenkola *et al.*, 2009). In the present study, the insignificant changes in lymphocyte values between lactating and late pregnant Ossimi ewes are in accordance with the study of Serdaru *et al*. (2011) who found similar results in lactating buffaloes compared to pregnant ones. The decrease in monocyte values at early lactation in Ossimi ewes agree with the observation of Antunovic *et al*. (2011b) on Tsigai ewes. They found the monocyte numbers were minimal in blood of ewes at beginning of lactation. The total WBCs count and its differential cell percentages, in the current study, were within the normal hematologic reference ranges of sheep (Duncan and Prasse, 1986).

Table (1): The effect of physiological status on hematological parameters and differential white blood cell counts of Ossimi sheep (Mean ± SEM).

Parameters	Physiological status				
	Non-pregnant	Late pregnant	Early -lactation	SEM	Sig.
Hb (g/dl)	12.4 [b]	13.5 [a]	11.2 [c]	0.28	*
RBC ($x10^6/mm^3$)	11.5 [b]	12.7 [a]	10.8 [c]	0.22	*
PCV (%)	33.5 [a]	29.2 [b]	30.6 [b]	3.20	*
WBC ($x10^3/mm^3$)	9.25 [a]	8.53 [b]	9.78 [a]	0.45	*
Neutrophils (%)	29.2 [b]	33.0 [a]	32.6 [a]	3.70	*
Eosinophils (%)	4.07	4.0	4.3	0.30	NS
Basophils (%)	0.63	0.51	0.59	0.04	NS
Lymphocytes (%)	61.6	59.0	59.21	2.50	NS
Monocytes (%)	4.50 [a]	3.50 [b]	3.30 [b]	0.20	*
N/L ratio	0.47 [b]	0.56 [a]	0.55 [a]	0.05	*

[a,b,c] means within the same row having different superscripts are significantly different (* $P<0.05$), NS = not significant

Serum biochemical parameters and thyroid hormones:

The results presented in Table (2) show the changes in serum biochemical parameters as influenced by physiological status of Ossimi ewes. In sheep, the most relevant changes in serum metabolic profile have been detected at the end of gestation and the beginning of lactation (Brito *et al.*, 2006). As shown in table (2), data revealed significant ($P<0.01$) decreases in serum glucose concentrations in late-pregnant and early lactating Ossimi ewes reached 17.9 and 22.3 %, respectively compared with non-pregnant ones. These results are consistent with the findings of Brito *et al.* (2006) and Antunovic *et al.* (2011a) who found a decrease in glucose levels at late gestation and lactation periods. This decrease in blood glucose concentrations in lactating ewes have to be considered as a result of constant energy loss with the milk synthesis (Antunovic *et al.*, 2011a); and low glucose levels in high pregnancy are associated with fetus development and mobilization of maternal glucose to fetal blood circulation (Jacob and Vadodaria, 2001).

Data indicated significant ($P<0.05$) differences in serum concentrations of total protein (TP) due to physiological status of Ossimi sheep (Table, 2). There was a decrease in serum TP for late-pregnant ewes compared to non-pregnant and early-lactating ewes; meanwhile serum TP concentrations were increased in early-lactating ewes compared to late-pregnant and non-pregnant ewes. These results are agreeable with those obtained by Safsaf *et al.* (2012), revealing higher concentrations of serum TP in non-pregnant ewes compared to the late-pregnant ones. The decrease in serum TP in late-pregnancy may be ascribed to the fact that the foetus synthesises all its proteins from the amino acids derived from the mother, and foetus growth increases exponentially reaching a maximum level, especially in muscles, during late pregnancy (Jainudee and Hafez, 1994; Safsaf *et al.*, 2012). The higher values of TP in lactating ewes compared to pregnant and non-pregnant may be due the high energy needs for milk synthesis which exists in animals especially during the early lactation (Bremmer *et al.*, 2000). In lactating goats, an increasing serum TP levels were observed with the progress of lactation due to the catabolism of protein for milk synthesis (Krajnicakova *et al.*, 2003). However, in cattle, Ate *et al.* (2009) reported no significant differences in serum TP during third trimester of pregnancy and early lactation.

Table (2): The effect of physiological status on serum biochemical parameters and thyroid hormones concentrations of Ossimi sheep (Mean ± SEM).

Parameters	Physiological status				
	Non-pregnant	Late-pregnancy	Early-lactation	SEM	Sig
Glucose (mg/dl)	62.4 [a]	51.2 [b]	48.5 [b]	4.56	**
Total protein (g/dl)	7.25 [b]	6.94 [c]	7.62 [a]	0.30	*
Albumin (g/dl)	3.45 [a]	3.51 [a]	2.95 [b]	0.10	*
Globulin (g/dl)	3.80 [b]	3.43 [b]	4.67 [a]	0.20	*
Total lipids (mg/dl)	155.0 [b]	199.0 [a]	211.0 [a]	15.34	*
Cholesterol (mg/dl)	76.5 [a]	57.7 [b]	52.9 [b]	7.37	*
ALT (U/L)	16.5 [a]	18.8 [a]	12.8 [b]	1.43	*
AST (U/L)	101.9	103.7	104.5	9.33	NS
Creatinine (mg/dl)	1.55	1.66	1.72	0.14	NS
Urea (mg/dl)	35.7 [c]	48.8 [a]	39.5 [b]	4.60	*
T_3 (ng/ml)	1.49 [b]	1.58 [b]	1.97 [a]	0.05	**
T_4 (ng/ml)	36.9	38.36	41.0	5.80	NS

[a,b,c] means within the same row having different superscripts are significantly different (* P<0.05 and ** P<0.01). NS = not significant.

Moreover, a significant (P<0.05) increase in serum albumin was observed for late-pregnant Ossimi ewes compared to lactating ones (Table 2). The increase of albumin in late gestation proves the higher energy requirement for the fetal growth (Durak and Altiner, 2006). Meanwhile, the decrease in serum albumin at early-lactation could be explained by a rapid extraction of immunoglobulin from the plasma during the last few months of pregnancy when colostrum is being formed in the mammary gland (Kaneko *et al*., 2008). The opposite trend was detected for serum globulin concentrations which showed a significant (P<0.05) decrease in late-pregnant Ossimi ewes compared to lactating ewes. Similar decrease in serum globulin was also observed in the gestation period in goats (Bamemy, 2013).

Serum total lipids (TL) showed significant (P<0.05) increases in late-pregnant and early lactating Ossimi ewes amounted by 28.4 and 36.1 % compared to non-pregnant ewes respectively (Table, 2). This response was also detected in sheep by Piccione *et al*. (2009). They also noticed significant increases in TL in late-pregnancy compared to non-pregnant ewes. This increase could be attributed to the higher levels of free fatty acids (FFA) in pregnant than in non-pregnant ewes, caused by increased cortisol level as a result to stress induced by pregnancy (Fleming, 1997). Additionally, increased sensitivity of ewes to epinephrine hormone leads to an increase in serum FFA concentrations in late-pregnancy (Revell *et al*., 2000). According to Schlumbohm *et al*. (1997), the elevated level of TL in late gestation could be due to the reduced insulin-mediated inhibition of lipolysis observed in late pregnancy. Lipogenesis stimulated by insulin cause the increased values of TL observed in ewes during early lactation. In cattle, significant post-partum increase in serum TL induced an increase in FFA uptake by the liver from circulating plasma with increased triglyceride storage (Grummer, 1993).

Serum cholesterol showed significant (P<0.05) decreases in late-pregnant and early-lactating ewes amounted by 24.6 and 30.6 %, respectively compared with non-pregnant ewes. This reduction in serum cholesterol in late pregnancy has also been detected in sheep (Piccione *et al*., 2009), goats (Krajnicakova *et al*., 2003) and Friesian cows (Bekeova *et al*., 1987). This is probably related to the role of the compound in ovary steroidogenesis, so that the total cholesterol concentrations are under

control of the complex of factors (Bamerny, 2013). Decreased cholesterol concentrations in early lactation are consistent with an increased energy requirement and negative energy balance (Antunovic *et al.,* 2011a). The observed decrease during lactation compared to non-pregnant could be ascribed to the increased cholesterol uptake by tissues involved in milk synthesis (Piccione *et al*., 2009).

Higher levels (P<0.05) of serum ALT activity for ewes in late-pregnant and non-pregnant ewes compared to early-lactating ones, as shown in table (2). Meanwhile there was no significant difference in serum AST levels and creatinine concentrations among the experimental groups. These findings are consistent with earlier reports in sheep (Gurgoze *et al.,* 2009; Piccione *et al*., 2009; Antunovic *et al.,* 2011a) and goats (Waziri *et al.,* 2010). Changes in liver enzymes activity in the blood due to physiological status, especially in lactation, may be resulted in alteration in hepatic metabolism, and may be related to reduced dry matter intake around parturition (Greenfield *et al.,* 2000).

Data in Table (2) showed significant (P<0.05) differences in serum urea due to physiological status with the highest values in late-pregnancy followed by early-lactation and non-pregnancy. The highest values of blood urea over the gestation period were reported by El-Sherif and Assad (2001) in Barki ewes in which plasma urea level started rising during week 10 of pregnancy and reached a peak around parturition; and by Durak and Altiner (2006) in Chios ewes. Similar trend of blood urea was also observed in pregnant buffaloes compared with lactating buffaloes (Serdaru *et al*., 2011). Changes in blood urea content during lactation could depend on milk synthesis (El-Sherif and Assad, 2001). The highest values of blood urea were also observed in the last trimester of pregnancy in sheep (Antunovic *et al*., 2002). The high requirements for energy by pregnant sheep during their second half of pregnancy might led to an increase in serum urea levels (Piccione *et al*., 2009). Another reason for high urea concentration in pregnant ewes could be related to either high protein metabolism during pregnancy or nutritional management (Gurgoze *et al.,* 2009). It could also be a result of catabolizing muscle protein when large amounts of body reserves are mobilized (Antunovic *et al.,* 2011a).

As shown in Table 2, serum concentrations of triiodothyronine (T_3) were significantly (P<0.01) decreased in non-pregnant and late-pregnant ewes compared to those at early-lactation. Serum thyroxin (T_4) concentrations tended to be lower, but not significant in non-pregnant and late-pregnant ewes compared to those at early-lactation. This response of thyroid hormones to the physiological status of Ossimi sheep is almost comparable with the study on Barky ewes as reported by Khaled and Illek (2012). They reported that serum levels of T_3 and T_4 were significantly declined in last month of pregnancy and post-partum compared to early lactation. Novoselec *et al.* (2009) showed no significant differences in T_4 levels due to reproductive status of sheep; however, they found higher T_3 concentrations for non-pregnant and pregnant ewes than those at early-lactation. The increases in thyroid hormones during early-lactation could be explained by the galactopoietics which effect of thyroid hormones play an important role in regulation of lactation and stimulation of the basic metabolic rate via the metabolism of carbohydrates, lipids and proteins (Kaneko *et al.,* 1999). The decrease in thyroid hormones around parturition could be also due to alterations in cardiac output and increased blood volume **(**Khaled and Illek, 2012**)**.

In the current study, as far as the haematological parameters changes influenced by physiological status of Ossimi ewes are concerning, early lactation was associated with a reduction in blood Hb, RBCs count and monocytes (%). Late-pregnancy and early lactation were characterized with an increase in neutrophils (%) and N: L ratio and a decrease in PCV %. The highest values of blood Hb and RBCs count and lowest values of WBCs count were observed in late-pregnancy. In case of serum biochemical parameters, late pregnancy and early lactation were associated with a reduction in serum glucose and cholesterol concentrations but an increase in total lipids. Early lactation showed highest concentrations

of serum total protein and globulin and lowest levels of serum albumin and ALT activity. Highest concentrations of serum urea were observed in late pregnancy period. In respect of thyroid hormones, early lactation showed the highest values of serum T_3 followed by late-pregnancy and non-pregnancy periods with no significant change in serum T_4 levels.

In conclusion, the current results indicated that blood haematological and biochemical parameters as well as thyroid hormone (T_3) concentrations significantly influenced by the physiological status of Ossimi ewes. These results may help for further physiological, metabolic and nutritional studies on sheep with the aim of improving its production.

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EFFECT OF PHYSIOLOGICAL STATUS ON SOME HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF OSSIMI SHEEP

تأثير الحالة الفسيولوجية على بعض المقاييس الهيماتولوجية والبيوكيميائية للأغنام الأوسيمى

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أجريت هذه الدراسة على عدد 18 من النعاج الأوسيمى (6 غير حوامل ، 6 خلال الأربعة أسابيع المتأخرة من فترة الحمل ، 6 خلال الأربعة أسابيع المبكرة من الحليب) وذلك بهدف دراسة تأثير الحالة الفسيولوجية على المقاييس الهيماتولوجية للدم ومكونات السيرم البيوكيميائية وكذلك هرمونات الغدة الدرقية. وكان متوسط عمر النعاج 2.5 سنوات ، بينما كان متوسط أوزان الجسم 49.27 ± 4.40 ، 53.85± 3.87 ، 47.65 ±3.45 كجم للنعاج الغير حوامل ، والنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب ، على التوالى. وقد أظهرت النتائج أن النعاج فى الفترة المتأخرة من الحمل سجلت قيم أعلى معنوياً لهيموجلوبين الدم وعدد كريات الدم الحمراء بالمقارنة بالنعاج فى الفترة المبكرة من الحليب أو النعاج الغير حوامل. وقد حدث إنخفاض معنوى فى قيم النسبة المئوية للمكونات الخلوية للنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب بالمقارنة بالنعاج الغير حوامل. كما حدث إنخفاض معنوى فى العدد الكلى لكرات الدم البيضاء للنعاج فى الفترة المتأخرة من الحمل والنعاج الغير حوامل بالمقارنة بالنعاج فى الفترة المبكرة من الحليب. وقد وجد أيضاً زيادة معنوية فى قيم نسبة الكريات المتعادلة وكذلك فى النسبة بين الكريات المتعادلة والكريات الليمفاوية للنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب بالمقارنة بالنعاج الغير حوامل مع تغيرات غير معنوية فى نسبة الكريات حمضية الصبغ والكريات قاعدية الصبغ ، بينما إنخفضت نسبة الكريات الأحادية للنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب بالمقارنة بالنعاج الغير حوامل. حدث إنخفاض معنوى فى مستويات الجلوكوز والكوليستيرول فى السيرم للنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب بالمقارنة بالنعاج الغير حوامل. النعاج فى الفترة المتأخرة من الحمل أظهرت إنخفاض معنوى فى محتوى السيرم من البروتينات الكلية بالمقارنة بالنعاج فى الفترة المبكرة من الحليب والنعاج الغير حوامل كان هناك زيادة معنوية فى محتوى السيرم من الألبيومين للنعاج فى الفترة المتأخرة من الحمل والنعاج الغير حوامل بالمقارنة بالنعاج فى الفترة المبكرة من الحليب بينما لوحظ عكس ذلك بالنسبة لمحتوى السيرم من الجلوبيولين. وقد أظهرت تركيزات الليبيدات الكلية فى السيرم زيادة معنوية للنعاج فى الفترة المتأخرة من الحمل والنعاج فى الفترة المبكرة من الحليب بالمقارنة بالنعاج الغير حوامل. كما كان هناك أرتفاعاً معنوياً فى مستويات نشاط إنزيم ALT للنعاج فى الفترة المتأخرة من الحمل والنعاج الغير حوامل بالمقارنة بالنعاج فى الفترة المبكرة من الحليب مع تغيرات غير معنوية فى نشاط إنزيم AST وكذلك تركيزات الكرياتينين فى السيرم. لوحظ إختلاف معنوي فى محتوى السيرم من اليوريا بسبب الحالة الفسيولوجية وكانت القيم الأعلى للنعاج فى الفترة المتأخرة من الحمل يليها النعاج فى الفترة المبكرة من الحليب والنعاج الغير حوامل. أظهرت النتائج أنخفاض معنوى فى محتوى السيرم من هرمون تراي ايودوثيرونين للنعاج فى الفترة المتأخرة من الحمل والنعاج الغير حوامل بالمقارنة بالنعاج فى الفترة المبكرة من الحليب بينما كانت الإختلافات غير معنوية فى محتوى السيرم من هرمون الثيروكسين.

نستنتج من هذه الدراسة أن الحالة الفسيولوجية للنعاج الأوسيمى أدت إلى تغيرات معنوية فى مقاييس الدم الهيماتولوجية والبيوكيميائية وتركيزات هرمون الغدة الدرقية (تراي ايودوثيرونين).