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Selected blood biochemical indicators in Barky ewes during late pregnancy, *post-partum* and early lactation

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SUMMARY

The study was conducted to investigate the changes in the concentrations of selected blood metabolites related to protein and energy metabolism as well as plasma enzymes activity in Barky ewes during late pregnancy, *post-partum* and early lactation. The experiment was carried out on 10 clinically healthy Barky ewes fed on ration composed of concentrate mixture, berseem hay and horse bean straw according to their nutrient requirements during late pregnancy, *post-partum* and early lactation . Jugular blood samples were withdrawn from all ewes during the last 4 weeks of gestation, 2nd week *post-partum* and 4th week of lactation. The plasma concentrations of total protein, albumin, globulin, glucose, cholesterol, urea and triacylglycerol as well as plasma enzymes activity of Aspartate Amino Transferase (AST), γ- Glutamyl Transferase (GMT), Creatine kinase (CK), Lactate Dehydrogenase (LDH) and blood Glutathione Peroxidase (GSH-PX) were determined. Results revealed that significant effect of time ($p<0.05$) was identified on plasma concentrations of total protein, albumin, urea and triacylglycerol. In addition, there were significant ($p<0.05$) changes in plasma enzymes activity of AST and blood GSH-PX during different reproductive stages of ewes. In conclusion gestation and lactation periods affect the protein and energy metabolism of ewes, with requirement for energy varying in the different stages of reproduction.

Keywords: Barky ewes, blood metabolites, feeding

INTRODUCTION

Ewes should be in good condition and health during and after pregnancy so as to produce healthy lambs. Study of changes in the

metabolism of such ewes in different production stages, the evaluation of abnormal metabolic states and the prediction of some metabolic and nutritional disorders such as pregnancy toxaemia and fatty liver could provide some advantages to producers. Metabolic profiles have been used to predict prepartum and postpartum metabolic disorders and for diagnosis of metabolic diseases and assessment of the nutritional status of the animals (Radostits et al. 2000 and Khaled, 2001). Pregnancy and lactation are physiological statuses considered to modify metabolism in animals, (Krajničáková et al. 2003 and Iriadam 2007). Blood biochemical parameters including total protein, triglycerides, free fatty acids and urea are important indicators of the metabolic activity in lactating animals, (Karapehlivan *et al.* 2007). During pregnancy, maternal tissues are involved in providing energy for reproduction processes, which may affect blood serum chemistry values, affected also by several other factors as breed, age, malnutrition, foetal growth, or season, (Swanson *et al.* 2004 and Yokus *et al.* 2006). In sheep, during late pregnancy, blood serum lipids profile is characterized by increased concentration of total cholesterol, triglycerides and lipoproteins, (Schlumbohm *et al.* 1997) 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 fetal growth. Lipid profiles have been used to predict prepartum diseases; circulating blood triglycerides contribute significantly to milk fat synthesis (Nazifi *et al.* 2002). Relative to protein metabolism, a decrease in blood protein concentration during the late stages of gestation was observed in sheep; witness the utilization of amino acids for protein synthesis in the foetal muscles (Antunovic *et al.* 2002). It was also reported that plasma urea levels increased during week 10 of pregnancy, reaching a peak at parturition, (El-Sherif and Assad 2001), which in domestic ruminants was ascribed to the cortisol-stimulated catabolism of proteins in the body (Silánikove 2000). During lactation, the mammary gland secretory cells utilize 80% of the blood circulating metabolites for milk synthesis, depending on the speed of infiltration of precursors of milk compounds, free amino acids, glucose and fatty acids,(Khaled, 2001 and *Piccione et al. 2009).*

The aim of this study was to investigate the changes in selected blood biochemical indicators of Barky ewes in late pregnancy, *post-partum* and early lactation under indoor stable diet conditions.

MATERIALS AND METHODS

Ten clinically healthy Barky ewes were used (3.0 ± 0.4 years old), with mean body weight of 50 ±0.7 Kg, free from internal and external parasites and kept on one farm. All ewes were housed in a barn and fed twice a day (07:00, 19.00) with concentrate mixture, berseem hay and horse bean straw as shown in Tables (1 and 2) and formulated to meet the nutrient requirements of the ewes according to nutrient requirements of sheep, (NRC, 1985) and according to their physiological and productive status: Late pregnancy and post-partum in Table 3 (Fresh matter: 12.11% Crude protein (CP), 10.67 MJ/Kg Digestible energy (DE), 1.0 % Ca and 0.32 % P) and early lactation in Table 4 (Fresh matter: 13.0 % CP, 11.42 MJ/Kg DE, 1.0 % Ca and 0.39 % P). Fresh, clean water was given to the animals ad libitum. Samples of concentrate mixture, berseem hay and horse bean straw were analyzed (Table 2) for DM, CP, DE, Ca and P according to A.O.A.C. (1990). During the trial, all animals were kept under natural photoperiod and ambient temperature on a farm located in Cairo-Alexandria desert high way.

Blood samples, each of 10 ml, were withdrawn via jugular vein puncture from all ewes after morning meal during last 4 weeks of gestation, 2nd week *postpartum* and 4th week of lactation. The blood was collected and processed to provide samples for whole blood, plasma and serum analysis. The plasma concentrations of total protein, albumin, globulin glucose, cholesterol, urea, B-hydroxy butyric acid , triacylglycerol , serum non-esterified fatty acids (NEFA) as well as plasma enzymes activity of AST,GMT, CK, LDH and blood glutathione perioxidase (GSH-Px) were determined by photometric methods using automated analyzer (COBAS MIRA S, ROCHE) and according to methods described in bio-diagnostic kits. The blood B-hydroxy butyric acid concentration was performed using gas chromatography. Serum NEFA was analyzed colorimetrically.

All results were expressed as means and standard errors (SE). The analysis of variance (ANOVA) was used to test the overall significance of differences among the means. Differences at $p<0.05$ were considered significant. The **SPSS** Statistical Computer Software, (Copyright (c) SPSS Inc., 2007 version 16.0) was used for computations.

RESULTS AND DISCUSSION

Changes in selected blood metabolites related to protein and energy metabolism of ewes during the late pregnancy, *post-partum* and early lactation are shown in the table 5. Results revealed that significant effect of time ($p<0.05$) was identified on plasma concentrations of total protein, albumin, urea

and triacylglycerol. Plasma total protein showed a significant increase ($p<0.05$) in early lactation and late gestation compared to *post-partum* period. While, albumin was increased significantly ($p<0.05$) in early lactation *vs.* late gestation and *postpartum* periods. Meanwhile, urea showed a significant increase ($p<0.05$) in *post-partum* and early lactation compared to late pregnancy. Plasma triacylglycerol significantly increased ($p<0.05$) in late gestation compared to *post-partum* and early lactation. However, No significant variations were found in the concentrations of glucose, globulin, cholesterol, NEFA and B-hydroxy butyric acid during different reproduction stages of ewes. Our results showed that selected blood biochemical parameters related to protein and energy metabolism were affected by different reproduction stages of ewes similar to those established by Hindson and Winter (2002). On contrary, Baumgartner and Pernthaner (1994) had not found a significant effect of the reproduction stage on the serum concentration of total protein in Karakul sheep. Maternal serum protein and albumin concentrations were decrease due to an increased foetal growth, and especially the utilization of amino acids from the maternal circulation for protein synthesis in the foetal muscles (Antunovic *et al.* 2002). The higher levels of total protein in lactating ewes compared to *post-partum* phase prove the high energy need due to milk synthesis which exists in animals, as confirmed by other authors, especially during the early lactation (Bremmer *et al.* 2000). A significant decrease ($p<0.05$) in plasma albumin of ewes during late pregnancy and *post-partum* was noticed due to the high energy requirement for increased foetal growth (Durak and Altiner 2006). A significant drop ($p<0.05$) was found in plasma urea of ewes in late gestation *vs. post-partum* and early lactation which not being in accordance with a study by Karaphelivan *et al.* (2007) on Tuj ewes and Yokus *et al.* (2006) on Sakiz-Awassi crossbreds. Changes in blood urea content during lactation could depend on milk synthesis (El-Sherif and Assad 2001). The reason for those highest values could be due to the increased cortisol level affecting the catabolism of protein in the body (Silanikove 2000). Plasma glucose participates in the secretion of milk and approximately 85% of milk lactose is synthesized from glucose (Bed et al. 1997).

A significant decrease ($p<0.05$) in plasma triacylglycerol *post-partum* could be explained as the effect of increased lipolysis which is hormonally regulated, and not an expression of energy deficiency (Holtenius and Hjort 1990). The adipose tissue metabolism is strictly related to insulin, which stimulate lipogenesis

in pregnant ewes, while lactating individuals show a significant decrease in that triacylglycerol level. Significant decrease ($p<0.05$) in plasma triacylglycerol during early lactation of ewes has also been reported by Gradinski-Urbanac *et al.* (1986) while *post-partum* by Nazifi *et al.* (2002) who recorded lowest concentrations of triacylglycerol, 2-3 weeks *post-partum*. This was in accordance with other authors working on goats who showed increased values of serum triacylglycerols to occur just before parturition (Hussein and Azab 1998).

Mean concentrations of plasma enzymes activity of Aspartate amino transferase (AST), Gama-glutamyl transferase (GMT), Creatine kinase (CK), Lactate dehydrogenase (LDH) and blood glutathione peroxidase (GSH-Px) during late gestation, *post-partum* and early lactation were illustrated in table 6. The results showed that significant increase ($p<0.05$) in the mean concentration of plasma enzyme activity of AST during early lactation compared to late gestation. However, there were significant increase ($p<0.05$) in the plasma level of enzyme activity of GSH-Px *post-partum* compared to late gestation and early lactation. While, no significant changes in the plasma enzymes activity of GMT, CK and LDH were observed during different stages of reproduction. Changes in blood concentrations of enzymes may reflect alterations in the liver functions during pregnancy, *post-partum* and early lactation (Khatun et al., 2011). A decreased level of Aspartate amino transferase (AST) in plasma of ewes during late gestation is in agreement with study carried out by Manish-Mahawar et al. (2004) and Pouroucholtamane et al. (2005). Activity of plasma enzymes of AST, GMT, CK, LDH and GSH-Px were within normal ranges indicated improved liver function and health status of ewes during late pregnancy, *post-partum* and early lactation.

CONCLUSION

Marked changes in the selected blood biochemical parameters were related to the physiological adaptations of ewes to subsequent reproductive stages. Gestation and lactation periods affect the protein and energy metabolism of ewes, with requirement for energy varying in the different stages of reproduction. Blood biochemical parameters during the different reproductive stages should be considered as guidelines for the management strategies for ewes during farming condition.

Table 1: Physical composition of Concentrate mixture for sheep (14 % CP)

Ingredient	Inclusion rate (%)
Yellow corn, ground	56.70
Soya bean meal (44 % CP)	7.0
Linseed meal	10.0
Wheat bran	15.0
Rice bran	8.0
Salt	1.0
Limestone	2.0
Sheep premix*	0.30

***Composition of sheep premix:** vitamin A 12 000 000 IU; vitamin D_3 3 000 000 IU; vitamin E 30 g; Mn 50 g; Fe 50 g; Zn 50 g; Cu 5 g; I 0.85g; Co 0.15g; Se 0.15 g.

Table 2: Chemical composition of concentrate mixture, berseem hay and horse bean straw (as fed-basis)

	Concentrate mixture	Berseem hay	Horse bean Straw
DM %	88.0	90.0	89.0
CP %	14.11	13.4	6.6
DE (MJ/Kg)	13.15	10.67	7.52
Ca %	0.84	2.25	1.0
P %	0.58	0.26	0.15

Table 3: Physical and chemical composition of the diet fed to late pregnant ewes

Physical composition/ Ingredient	As fed / Kg	DM / Kg	DM %
Concentrate mixture	0.50	0.44	25.88
Berseem hay	1.00	0.90	52.94
Horse bean straw	0.40	0.36	21.18
Total	**1.9**	**1.7**	**100**
Chemical composition of the diet *			
CP %	12.11		
DE MJ/Kg	10.67		
Ca %	1.0		
P %	0.32		

***As fed-basis**

Table 4: Physical and chemical composition of the diet fed to early lactating ewes

Physical composition/ Ingredient	As fed / Kg	DM / Kg	DM %
Concentrate mixture	1.0	0.88	42.30
Berseem hay	1.1	0.99	47.60
Horse bean straw	0.23	0.21	10.10
Total	**2.33**	**2.08**	**100**
Chemical composition of the diet *			
CP %	13.0		
DE MJ/Kg	11.42		
Ca %	1.0		
P %	0.39		

***As fed-basis**

Table 5: The blood metabolites related to protein and energy metabolism in ewes during late pregnancy, *post-partum* and early lactation (Mean ± SE)

Parameter		Late pregnancy	*Post-partum*	Early lactation
Total protein	(g/l)	62.3 ± 2.25^{ab}	60.96 ± 1.91^{b}	66.60 ± 1.03^{a}
Albumin	(g/l)	28.64 ± 0.70^{b}	26.88 ± 0.93^{b}	32.08 ± 0.59^{a}
Globulin	(g/l)	33.66 ± 1.57	34.08 ± 1.98	34.53 ± 0.98
Urea	(mmol/l)	2.91 ± 0.42^{b}	4.58 ± 0.94^{a}	5.37 ± 0.25^{a}
Glucose	(mmol/l)	2.88 ± 0.24	2.66 ± 0.37	2.89 ± 0.09
Triglycerides	(mmol/l)	0.48 ± 0.04^{a}	0.25 ± 0.017^{b}	0.29 ± 0.015^{b}
Cholesterol	(mmol/l)	2.04 ± 0.16	2.16 ± 0.23	1.78 ± 0.07
NEFA	(mmol/l)	0.39 ± 0.17	0.41 ± 0.08	0.79 ± 0.15
B-hydroxy butyric acid	(mmol/l)	0.87 ± 0.48	0.31 ± 0.1	0.98 ± 0.18

a,b) Means within sub rows with no common superscripts differ significantly ($p<0.05$).

Table 6: Concentrations of blood enzymes activity in ewes during late pregnancy, *post-partum* and early lactation (Mean ± SE)

Parameter		Late pregnancy	*Post-partum*	Early lactation
AST	ukat/l	1.67 ± 0.13^{b}	1.89 ± 0.13^{ab}	2.27 ± 0.17^{a}
GMT	ukat/l	1.02 ± 0.08	1.23 ± 0.41	1.12 ± 0.08
CK	ukat/l	3.79 ± 1.31	3.54 ± 0.65	2.41 ± 0.31
LDH	ukat/l	17.26 ± 2.21	20.49 ± 4.42	17.77 ± 0.41
GSH-Px	ukat/l	417.22 ± 112.17^{b}	801.8 ± 191.34^{a}	525.83 ± 82.10^{b}

a,b) Means within sub rows with no common superscripts differ significantly ($p<0.05$).

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مؤشرات بيوكيميائية مختارة فى دم النعاج البرقى خلال فترات العشار المتأخر وبعد الولادة وبداية الحليب

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استهدفت الدراسة التعرف على التغيرات فى تركيزات مؤشرات فى الدم مختارة ذات علاقة بأيض البروتين والطاقة وكذلك النشاط الأنزيمى فى بلازما دم النعاج البرقى خلال الأربعة أسابيع الأخيرة من العشار والأسبوع الثانى بعد الولادة و الأربع أسابيع الأولى من فترة الحليب.

تم اجراء التجربة على عدد عشرة من النعاج البرقى السليمة اكلينيكية تغذت على علف يحتوى على مخلوط مركزات و دريس البرسيم وتبن الفول طبقا للاحتياجات الغذائية خلال الفترات السابقة المشار اليها. وتم تقدير معدل البروتين الكلى، الألبيومين، الجلوبيولين، الجلوكوز، الكوليستيرول، اليوريا و الدهون الثلاثية وبعض الأنزيمات فى بلازما الدم.

أوضحت نتائج الدراسة وجود إختلافات معنوية بين فترات التربية محل الدراسة بالنسبة لتركيز البروتين الكلى و الألبيومين واليوريا و الدهون الثلاثية و انزيمات الكبد و الجلوتاثيون بروكسيديز.

وقد خلصت الدراسة إلى ان فترة العشار وفترة الحليب تؤثر معنويا فى أيض البروتين و الطاقة فى النعاج مما يستوجب تحديد جيد للاحتياجات الغذائية وخاصة الطاقة لتلك المراحل.