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EFFECTS OF PREGNANCY AND LACTATION ON SOME BIOCHEMICAL COMPONENTS IN THE BLOOD OF EGYPTIAN COARSE-WOOL EWES

(With 4 Tables)

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تأثير الحمل والحليب على بعض المركبات الكيميائيه في دم أغنام الصوف الخشن المصريه

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أستخدم فى هذه الدراسة عدد ٣٥ من أغنام الصعيدى (٣-٦ سنوات - ٤٢ كجم) المصرية وتم تغذيتها أثناء الحمل والحليب على ١ إلى ٥ ر ١ كجم للرأس يوميًا من مخلوط العلف المركز المحضر تجاريًا ويحتوى تقريبًا على ٧٣ ر ٢ ميجاكالورى من الطاقة المهضومة لكل كجم من العلف.

وقد تم أخذ عينات من الدم من عدد من النعاج التى تم اختيارها عشوائيًا أثناء الحمل والحليب عند أيام -٩٠ و -٧٥ و -٤٣ و -٢١ و +٤ و +١٥ و +٣٢ و +٥٥ باعتبار أن يوم الولادة هو اليوم الصفر.

وقد وجد أن مستوى الجلوكوز فى مصل الدم كان يميل إلى الارتفاع (٠٩ ر P<) فى النعاج الحلابه (٠٥ ر ٦٥ مجم/ ١٠٠ مل) عنه فى الحوامل (٤٦ ر ٥٨). وعلى العكس من ذلك فقد كان مستوى الكوليسترول اعلى معنويًا أثناء الحمل (٥ ر ١١٨ مجم/ ١٠٠ مل) عنه اثناء الحليب (٨ ر ٧٢). وفى أثناء كـــل مرحله (حمل وحليب) تميزت بعض الفترات بالزيادة المعنوية مثل اليوم -٢١ فى فترة الحمل واليوم +٥٥ فى فترة الحليب.

لم تظهر أى فروق معنويه بين النعاج الحوامل والنعاج الحلابه فى مستوى البروتين الكلى فى مصل الدم. وقد لوحظ انخفاضه بكمية بسيطة بلغت ٦٧ ر جم/ ١٠٠ مل بين اليوم -٩٠ واليوم -٢١ قبل الولاده (من ١٥ ر ٧ إلى ٤٨ ر ٦ مجم/ ١٠٠ مل) وارتفاعه بكمية كبيرة ولكن غير معنوية بلغت ٢٧ ر١ جم/ ١٠٠ مل بين اليوم +٤ و +٥٥ بعد الولادة (من ٤٢ ر ٦ إلى ٦٩ ر ٧ جم/ ١٠٠ مل).

أما الالبيومين فقد لوحظ انخفاضه معنويًا أثناء الحليب (٤٣ ر ٣ جم/ ١٠٠ مل) عنه فى فترة الحمل (٨٣ ر ٣) فى الوقت الذى كان يميل فيه الجلوبيولين للارتفاع أثناء الحليب (٤٣ ر ٣ جم/ ١٠٠ مل) بالمقارنه بفترة الحمل (٩٥ ر ٢). هذا بالاضافه إلى أن الجلوبيولين كان أعلى معنويًا فى أيام +٣٢ و +٥٥ عن الشهر الأول من الحليب .

مستوى نيتروجين اليوريا ارتفع قليلا أثناء الحمل (٥ ر ٢٨ مجم/ ١٠٠) عنه أثناء الحليب(٣ر٢٧) ولم تظهر أى فروق معنوية بين أيام الحمل ولكن فى فترة الحليب بلغ نيتروجين اليوريا أقل مستوى له عند بداية الحليب (اليوم +٤ و ٢٣ مجم/ ١٠٠) وأعلى مستوى له قرب نهاية الحليب (اليوم +٥٥ ; ٢ ر ٣٤).

SUMMARY

Thirty-five coarse wool Saidi ewes (3-6 yr, 42 Kg) of Upper Egypt were fed, during pregnancy and lactation, 1 to 1.5 Kg/hd daily of a pelleted concentrate mixture containing about 2.73 Mcal DE/Kg. Considering lambing day as d 0, blood samples were obtained at approximately -90, -75, -43, -21, +4, +15, +32 and +55. Serum glucose level tended to be higher (P<.09) in lactating ewes (65.05 mg/dl) than in pregnant ewes (58.46). Serum cholesterol level was higher (P<.01) during pregnancy (118.5 mg/dl) than during lactation (72.8). Within days, cholesterol means increased (P<.05) at d -21 and +55. No significant differences were detected between pregnant and lactating ewes in serum total protein (TP). However, serum TP diminished by as low as 0.676 g/dl between d -90 and d -21 (7.15 to 6.48 g/dl) and elevated by 1.27 g/dl between d +4 and d +55 (6.42 to 7.69 g/dl; P>.10). Lactation decreased (P<.03) the level of albumin (3.43 vs 3.83 g/dl) and tended (P<.10) to increase that of globulin (3.43 vs 2.95 g/dl), when compared to pregnancy. Globulin was also higher (P<.05) at d +32 and d +55 than earlier in lactation. The level of serum urea N during pregnancy slightly (P>.10) exceeded that of lactation (28.5 vs 27.3 mg/dl). No significant differences were detected within days of pregnancy, but the level of serum urea N was the lowest (P<.05) in early lactation (d +4; 23.0 mg/dl) and the highest (P<.05) in late lactation (d +55; 34.2 mg/dl) and fluctuated in between.
(Keywords; Sheep, ewes, pregnancy, lactation, blood).

INTRODUCTION

Pregnancy and lactation are the main events in the ewe reproductive cycle. The total requirements for nutrients at the end of pregnancy are about 75% greater than in a nonpregnant animal of the same weight *(BAUMAN and CURRIE, 1980)*. Lactation even imposes a greater demand upon the animal than pregnancy. Lactose production alone needs as much as 1200 g of glucose per day for a high producing cow or about 200 g per day for a sheep with twin lambs *(BERGMAN, 1983)*. The high demands during pregnancy and lactation, therefore, require repartitioning of nutrients to allow these physiological states to proceed even at the expense of other metabolic processes (homeorhesis, *BAUMAN and CURRIE, 1980)*. Studies measuring the level of certain constituents of the metabolic profile during pregnancy and lactation are contradictory especially in the ruminant animal, due to the complexity of the intervening factors. Therefore, an attempt has been made in the present study to investigate, in Saidi ewes of Upper Egypt, differences in certain serum metabolite concentrations between the pregnant and the lactating ewes on the one hand and differences within days of pregnancy and within days of lactation on the other hand.

MATERIAL and METHODS

In the Spring of 1991, a study was initiated in the Experimental Farm of the Department of Animal Production at Assiut University, to examine changes in the concentration of selected serum metabolites in ewes during pregnancy and lactation.

Saidi ewes, an indigenous coarse-wool breed of Upper Egypt, were weighed, housed in drylot and fed, in a group feeding trial, about 1 Kg/hd daily of a pelleted concentrate mixture prepared commercially. Three weeks after this initial adjustment period, the ewes were exposed to fertile rams twice daily and breeding dates were recorded. The level of concentrate feeding was increased to 1.5 Kg/hd daily during late pregnancy and lactation. The concentrate mixture consisted of wheat bran (40.5%), cottonseed meal (10%), soybean meal (2%), molasses (9%), corn (12%), rice hulls (7.5%), flax straw (14%), limestone (3.5%) and mineralized salt (1.5%) on D.M. basis. The chemical composition and digestible nutrients of the diet were evaluated *(SHETAEWI, 1993)*. The total digestible nutrients (TDN) in that diet amounted to 62% i.e approximately 2.73 Mcal of digestible energy (DE)/Kg *(NRC, 1985)*. Ewes were exercised daily and offered some Egyptian clover (Trifolium alexandrinum) or green fodder when available. All ewes had free access to water.

Blood samples were collected from 35 ewes, chosen from the flock according to breeding and lambing dates. Only ewes having single lambs were included in this study. Considering lambing day as d 0, samples were obtained at approximately d -90, -75, -43, -21, +15, +32 and +55. Durign each of these days samples were obtained from a representative group of the animals (not all of them). A total of 51 samples was obtained during pregnancy i.e. 12, 15, 13 and 11 at d -90, -75, -43 and -21, respectively; and a total of 44 samples was taken during lactation i.e. 13, 12, 12 and 7 at d +4, 15, +32 and +55, respectively. Samples were collected at 0900 by jugular venipuncture using a clean dry plastic syringe and then transferred to centrifuge tubes and allowed to clot at room temperature. Serum was then separated by centrifugation at 3000 rpm for 15 min. Serum was subsequently decanted into glass vials and stored at -20°C until it was analyzed. Serum glucose, cholesterol, total protein albumin and urea nitrogen were analyzed using assay kits supplied by bioMerieux, France; Bio-Analytics, Florida, U.S.A. and Diamond Diagnostic, Egypt. Serum globulin was calculated mathematically by difference.

Data were analyzed by one-way analysis of variance using general linear model (GLM) procedures of *SAS (1987)* for personal computers. Whenever a significant difference was detected, means were separated by LSD *(STEEL and TORRIE, 1980)*.

RESULTS

Body weight changes of ewes during breeding, pregnancy and lactation periods are shown in Table 1. Means of serum glucose, cholesterol, total protein, albumin, globulin and urea nitrogen concentrations are presented in Table 2. The changes in these serum constituents at days -90, -75, -43 and -21 prepartum are presented in Table 3, whereas the changes at days +4, +15, +32 and +55 postpartum are presented in Table 4.

DISCUSSION

The changes in body weights of ewes (Table 1) showed an average increase of 2.5 Kg in the 3 wk prebreeding period. The average increase in body weight during pregnancy was 8.7 Kg and the weight loss at parturition was 6 Kg, whereas the weight loss after 55 d of lactation averaged only 0.5 Kg. These results indicated that these ewes were poorly fed before starting the concentrate feeding in the prebreeding period. The increases in body weights during pregnancy and the minor loss during the suckling period indicated the plane of nutrition of ewes was fair enough to meet the increasing demands of pregnancy and lactation.

Serum glucose level (Table2) tended to be higher P<.09) in lactating ewes(65.05 mg/dl) than in pregnant ewes (58.46). Similary ,*SHETAEWI and ROSS (1991)* reported a slight increase (p>.10) in serum glucose level during lactation than during pregnancy in fine-wool ewes.But,Gill and hart (1980) noted a significant increase in lactating (90 to 95 mg/dl) than in nonlactating ewes (60 mg/dl). The decrease in serum glucose level during pregnancy could be attributed to its excessive use for fetal maintenance and growth. *LINDSAY and PETHICK* (1983) showed that the pregnant uterus and its constituents remove as much as 60 to 70% of the glucose produced by the ewe. Lactation imposes a greater demand for glucose upon the animal than pregnancy . *BAUMAN and CURRIE (1980)* reported that the maximally secreting mammary gland may require up to 80% of the total glucose turnover . This is because glucose is the precursor of lactose, provides glycerol-p for fatty acid estrification, is an important source of reducing equivalents for reductive synthesis of fatty acids and provides carbon skeleton for the synthesis of non - essential a mino acids in mammary tissue *(BALDWIN and SMITH, 1983)*. The increased requirement of lactating ewes is probably met partly through redirection of nutrient flow (homeorhesis, *BAUMAN and CURRIE, 1980)* from low-priority tissues toward the high-priority mammary gland, and partly through increased uptake, gluconeogenesis *(BALLARD and HANSON, 1969)* and recycling of glucose carbon via lactate and glycerol *(BALDWIN and SMITH, 1979; McNIVEN, 1984). COLLIER (1985)* indicated that glucose intake and gluconeogenesis are highest during early lactation. This might explain the relative increase of blood glucose level during lactation.

Serum cholesterol concentration was significantly higher during pregnancy than during lactation (Table 2). Within days of pregnancy (Table 3) means were almost similar at days -90, -75 and -43 prepartum and increased to a higher level at d -21. After lambing, means of serum cholesterol (Table 4) were almost similar at d +4, +15 and +32 postpartum and increased to a higher level as weaning approached (d +55). *SHETAEWI and ROSS (1991)*, found that serum cholesterol level was generally higher in ewes during pregnancy than during lactation and in ewes supplemented with concentrates and lasalocid than unsupplemented controls. *HALLFORD and GALYEAN (1982)* found also that serum cholesterol was significantly elevated in ewes at weaning time than at parturition. The present results, therefore, confirm earlier suggestion *(SHETAEWI and ROSS, 1991)* that improved nutrition and/or decreased physiological stress could increase blood cholesterol as a result of increased rate of synthesis and decreased rate of utilization.

Serum total protein level, in general, did not differ significantly whether the animal was pregnant or lactating (Table 2). However, within days of pregnancy (Table 3) i.e between d -90 and d -21 prepartum, serum total protein level decreased by .67 g/dl (about 9%). During lactation (Table 4), serum total protein level was elevated at the end of lactation (d +55, 7.69 g/dl) by as much as 1.27 g/dl (about 20%) compared to early lactation level (d +4, 6.42 g/dl). These differences were not significant. Therefore, the nutritional status of the animal can't be judged fairly from the level of serum total protein. In other words, serum total protein does not reflect clearly the nutritional or the physiological states of the animal. Similarly, *HALLFORD et al. (1982) and SHETAEWI and ROSS (1991)* found that the level of protein in the diet or concentrate supplementation of ewes during late pregnancy and lactation had no effect on serum total protein.

Serum albumin concentration was about 11.5% greater (P<.03) during pregnancy than during lactation. No differences due to day of pregnancy (Table 3) or day of lactation (Table 4) were detected. Because albumin serves as the major amino acid pool *(KANEKO, 1980 and CHEVILLE, 1983)*, catabolism of albumin provides protein precursors needed for the developing fetus and the lactating mammary gland. Therefore, these results suggest that rate of albumin catabolism was greater during lactation than during pregnancy.

Serum globulin concentration was 16% higher during lactation than during pregnancy (Table 2), this difference almost approached the significance level (P<.10). Within days of pregnancy, serum globulin concentration did not differ significantly (Table 3). On the other hand, serum globulin increased significantly in the second month of lactation (d +32) and remained higher in late lactation (d +55). A decrease in serum globulin concentrtation during late gestation was noted in Rambouillet ewes (*SHETAEWI and ROSS, 1991*) and was suggested to be due to more milk immunoglobulins being derived from blood and concentrated in the mammary gland during that period. In dairy cows, *BRANDON and WATSON* (1971) reported that animals begin to concentrate immunoglobulins from plasma into the mammary gland during late pregnancy, and the concentration process reaches a maximum approximately 2 wk before parturition. In general, the increase in serum globulin level which occurred at d +32 and +55 postpartum (Table 4) is in agreement with *HALLFORD and GALYEAN* (1982) who found that serum globulin in ewes was 4.1 g/dl before breeding, decreased (P<0.5) to 3.0 g/dl at parturition and increaswd (P<.05) to 3.4 g/l at weaning time.

Serum urea N was slightly higher in pregnant (28.5 mg/dl) than in lactating (27.3 mg/dl) ewes. This difference was not significant. During pregnancy, serum urea N did not differ (P>.10) with day prepartum. But during lactation, serum urea N was lowest (23 mg/dl) in early lactation (d +4) and highest (34.2 mg/dl) in late lactation (d +55) and fluctuated inbetween. Whether or not serum urea N can be used as a useful indicator of the nutritional or physiological status of the animal still unresolved. *LEWIS* (1957) stated that fluctuations in blood urea concentration in sheep are not primarily due to changes in the overall nitrogen intake. Hallford et al. (1982) found ewes fed adequate protein did not differ (P>.05) in serum urea N form those receiving inadequate dietary protein. It is possible that ruminants on low-protein diets reabsorb most of the urea filtered by the glomerulus, most of this urea enters the rumen where it eventually contributes to protein synthesis (*DUNCAN and PRASSE*, 1986). *SHETAEWI and ROSS* (1991) found no significant difference between pregnant and lactating ewes but means tended to be higher during lactation than during pregnancy. They found no effect of supplementary feed on serum urea N level.

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Table 1. Body Weight Changes of Saidi Ewes (Mean ± SE) at Different Stages of the Reproductive Cycle.

	Breeding		Pregnancy					Lactation	
Period[a]	A	B	C	D	E	F	G	H	I
Weight	36.6	39.1	39.9	41.7	43.1	45.1	47.8	41.8	41.3
S.E.	5.5	5.8	5.6	5.1	5.4	6.1	6.2	6.2	5.2

[a]A, prebreeding; B, breeding; C, 1 mo pregnant; D, 2 mo pregnant; E, 3 mo pregnant; F, 4 mo pregnant, G, prior to lambing, H, 1 d after lambing; I, 55 d after lambing.

Table 2. Overall Means of Selected Serum Constituent Concentrations in Pregnant and Lactating Saidi Ewes[a].

Constituent	Pregnant (51)[b]	Lactating (44)[b]	P[c]	
Glucose, mg/dl	58.46 ± 2.7	65.05 ± 2.9	0.09	NS
Cholest., mg/dl	118.50 ± 5.3	72.80 ± 5.7	0.01	**
Protein, g/dl	6.78 ± 0.26	6.53 ± 0.28	0.50	NS
Albumin, g/dl	3.83 ± 0.12	3.43 ± 0.13	0.03	*
Globulin, g/dl	2.95 ± 0.22	3.43 ± 0.23	0.10	NS
Urea N., mg/dl	28.50 ± 1.0	27.30 ± 1.0	0.40	NS

[a]Values are least-squares means ± standard errors.
[b]Number of samples analyzed for each constituent.
[c]Probability value; NS, not significant; *, significant; **, highly significant differences.

Table 3. Changes of Selected Serum Constituent Concentrations in Saidi Ewes Through Days of Pregnancy[a]

Constituent	Day prepartum[b]			
	-90	-75	-43	-21
Glucose, mg/dl	56.10 ± 4.7	62.40 ± 4.2	58.00 ± 4.5	56.20 ± 4.9
Cholest.,mg/dl	104.80 ± 7.9[c]	108.20 ± 7.0[c]	118.70 ± 7.6[c]	147.40 ± 8.2[d]
Protein, g/dl	7.15 ± .53	6.91 ± .48	6.66 ± .45	6.48 ± .50
Albumin, g/dl	4.13 ± .32	4.12 ± .29	3.50 ± .27	3.64 ± .30
Globulin, g/dl	2.98 ± .42	2.80 ± .39	3.16 ± .36	2.84 ± .40
Urea N, mg/dl	29.49 ± 1.6	26.19 ± 1.6	29.99 ± 1.5	27.90 ± 1.6

[a]Values are least-squares means ± standard error.
Means in the same row not having a common superscript differ significantly.
[b]No. of samples analyzed for each constituent were 12, 15, 13 and 11 at days -90, -75, -43 and -21, respectively.

Table 4. Changes of Selected Serum Constituent Concentrations in Saidi Ewes Through Days of Lactation[a].

Constituent	Day postpartum[b]			
	+4	+15	+32	+55
Glucose,mg/dl	56.30 ± 6.0	73.60 ± 6.3	63.50 ± 6.3	69.30 ± 8.2
Cholest.mg/dl	65.00 ± 11.5[c]	54.30 ± 11.9[c]	75.30 ± 11.9[c]	114.70 ± 15.6[d]
Protein, g/dl	6.42 ± .55	5.94 ± .58	6.56 ± .58	7.69 ± .75
Albumin, g/dl	3.32 ± .17	3.47 ± .17	3.40 ± .17	3.59 ± .23
Globulin, g/dl	3.10 ± .45[cde]	2.46 ± .47[d]	4.35 ± .47[ef]	4.11 ± .61[f]
Urea N, mg/dl	23.00 ± 1.7[ce]	32.00 ± 2.1[df]	24.90 ± 2.1[e]	34.20 ± 2.8[f]

[a]Values are least-squares means ± standard error.
Means in the same row not having a common superscript differ significantly.
[b]No. of samples analyzed for each constituent were 13, 12, 12 and 7 at days +4, +15, +32 and +55, respectively.