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PERIPARTURIENT CHANGES IN THE RELEVANT BLOOD CONSTITUENTS AND MAMMARY GLAND FUNCTION IN MULTIPAROUS RAHMANI X FINN EWES CROSSBREDS

Hafez, Y. M.*; A. M. El-Borady*; Aleyat A. Hassanein; F. E. El-Keraby** and Neama Ashmawy***

*Dept. of Animal Production, Faculty of Agriculture, Cairo Uni.
**Dept. of Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Dokki.

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SUMMARY

A total of seventeen (17) late pregnant multiparous Finn x Rahmani ewes crossbreds (8 ewes 1/2 Finn x 1/2 Rahmani (GI) and 9 ewes 1/4 Finn x 3/4 Rahmani (GII)) were used to study the changes in some constituents of blood and mammary gland secretions around parturition (7 days prepartum to 7 days postpartum). Morning mammary gland secretion samples (50 ml) were collected from the experimental ewes at -7, -4, at parturition, +1, +2, +3, +4 and +7 days relative to parturition. Morning blood samples (5 ml) were collected from the experimental ewes -7, -4, at parturition, +4 and +7 days relative to parturition. Total lipids, progesterone and Insulin like growth factor-1 (IGF-1) were quantified in the blood serum of the experimental ewes. Fat, protein, lactose, total solids, solids not fat and somatic cell counts were quantified in the mammary gland secretions.

The results indicated that the overall blood serum total lipids concentration (g/l) ranged between 0.65 and 3.46 for GI, the corresponding values for GII were 0.80 and

3.74(g/l). Serum IGF-1 levels increased sharply at parturition being 410.72 ng/ml for GI and 438.98 ng/ml for GII.

Progesterone concentration in serum of GI and GII showed sharp decline during the late prepartum period until parturition being 7.85ng/ml at - 7 days prepartum and 0.43ng/ml at parturition for GI and 8.74ng/ml at day - 7 prepartum, 0.28ng/ml at parturition for GII. The overall blood serum progesterone concentration (ng/ml) ranged between 0.01 and 17.41 for GI. the corresponding values for GII were 0.04 and 31.74 ng/ml.

Concerning the mammary secretions, the concentrations of total proteins, total solids, solids not fat and lactose at 7 days prepartum, at parturition and 1, 2, 3, 4 and 7 days postpartum were higher in GII than that in GI. Values of mammary secretions somatic cell counts (SCC) were lower for GII than GI.

It could be concluded that there were massive changes in serum IGF-1, total lipids and progesterone around parturition in the crossbred ewes under investigation. Massive changes in mammary function were also noticed around parturition. No significant differences between the two studied crossbred ewes in the relevant blood and mammary constituents' parameters investigated around parturition were noticed declaring that both groups adapted the same to parturition.

Keywords: Periparturient, ewes, blood, mammary secretions

INTRODUCTION

Massive changes in body physiology and mammary gland function occurred around parturition to prepare for the nourishment of the suckling young (Tucker, 2000). Prepartum sampling and milking is a good model to study changes in the mammary gland function associated with parturition (Greene et al. 1988). Physiological adaptation and mammary gland capacity toward parturition were greatly affected by genotype and parity, in goats, (Anderson *et al.* 1981 and Daniels, et al 2007) and in cows, (Knight and Peaker, 1984). Knight and Wilde, 1987 stated that prior to peak milk in goats, milk somatic cell activity plays a major role in determining milk yield and constituents. The objective of this study was to investigate the physiological adaptation associated with parturition with reference to periparturient changes in blood and mammary gland secretion constituents in two different ewes crossbreds (1/2 Finn x 1/2 Rahmani (GI) and 1/4 Finn x 3/4 Rahmani (GII)).

MATERIALS AND METHODS

The present study was carried out at Sakha Experimental Station, Kafr El-Sheikh Governorate, Animal Production Research Institute (APRI), Dokki, Giza, Egypt. The field work of the experiment lasted for 10 months starting from March, 2004 to January, 2005. Blood constituents were analyzed in Sheep and Goat Research Laboratory, blood analysis unit, Animal Production Research Institute, Dokki, Giza, Egypt. Mammary secretion constituents were analyzed in International Livestock Management Training Center (ILMTC), Sakha, Kafr El Sheikh.

1-Experimental animals:

A total of seventeen (17) multiparous Rahmani x Finn ewes (8 ewes 1/2 Finn x 1/2 Rahmani (GI) and 9 ewes 1/4 Finn x 3/4 Rahmani (GII)) were used to study the periparturient changes in relevant blood parameters and mammary gland secretion constituents. Ewes were late pregnant and utilized in this study at – 7 days prepartum calculated from the actual date of parturition (Table 1). Their age ranged between 3 and 5 years old and their parities ranged from 2 to 4. All ewes were delivered normally without any difficulties or human interference. Ewes were multiparous (Table 2).

Ewes were housed in semi-shaded open yards and fed according to NRC allowances of late pregnant and lactating ewes (NRC, 1985), periparturient days were considered to be ± 7 days around parturition. During these days blood and mammary gland secretions were collected.

Table (1): *Number of experimental ewes in each category of days prepartum at the beginning of the study

Actual days prepartum categories	1/2 Finn x 1/2 Rahmani (GI)	1/4 Finn x ¾ Rahmani (GII)
-27 days	1	---
-32 days	---	2
-36 days	1	---
-37 days	---	1
-40 days	4	1
-41 days	---	1
-42 days	---	1
-46 days	---	1
-48 days	1	---
-49 days	---	2
-51 days	1	---
Total number	**8**	**9**

* calculated from the actual date of lambing

Table (2): Assigned numbers of experimental ewes per each parity

Parities	Breed	
	1/2 Finn x 1/2 Rahmani (GI)	1/4Finn x ¾ Rahmani (GII)
2	4	5
3	3	2
4	1	2
Total number	**8**	**9**

Blood sampling and analysis

Blood samples (5 ml) were taken 7 and 4 days prepartum, at parturition and at 4 and 7 days postpartum. Blood samples were collected at 8 a.m. before morning feeding via jugular vein puncture, centrifuged (at 3000 rpm for 20 minutes) to separate serum and stored at -20°C till further analysis.

Spectrophotometric methods were executed to measure serum concentrations of total lipids (g/l) according to (Knight. et al 1972). Single antibody radioimmunoassay was applied to quantify progesterone using (RIA, DSL – 3900 California – USA) according to Nulsen and Peluso (1992). While, serum insulin like growth factor (IGF-1) was quantified using (IGF1–D–RIA–CT, KIP1588, BioSource, Belgium) according to Daughaday and Rotwein (1989). Inter– and Intra– assay coefficients of variability for progesterone were 6.5 and 11.7 %, respectively and those for IGF-1 were 8.15 and 5.6 %, respectively. The sensitivity of the assay (minimum detection limit) of progesterone was 0.12ng/ml and that of IGF-1 was 1 ng/ml.

Mammary gland secretions sampling and analysis

Prepartum milking was done at 7 days before parturition in the morning after adequate stimulation (3.0 min ± 0.05, ranged between 1 and 5 minutes) of the udder. Then, colostrum samples were collected daily from parturition till 4 days postpartum. Furthermore, transitional milk samples were collected from 4 to 7 days postpartum.

Analysis of mammary secretion samples was done using Milkoscan (Milkoscan® 133, B, N. Foss Electric, Denmark) to measure the concentrations of fat, protein, lactose, total solids and solids not fat. The somatic cell count in mammary secretion was measured using Somacount® 150, Bentley Instrument Inc, Minnesota, USA).

Statistical analysis

Data were subjected to the analysis of variance as repeated measurements (split plot in time) according to Neter et al. (1985) using SAS program (SAS, 2000), while differences among means were tested using Duncan multiple range test, (Duncan, 1955).

The following statistical model was utilized

$Y_{ijk} = \mu + (B)_i + (DRP)_J + (B*DRP)_{ij} + E_{ijk}$

Y_{ijk} = observation measured.

μ = overall mean.

$(B)_i$ = Effect of Breed ($_i$ = 1 in case of 1/2 Finn x ½ Rahmani (GI), $_i$ = 2 in case of 1/4 Finn x 3/4 Rahmani, (GII)).

$(DRP)_J$ = Days relative to parturition

J = 1 to 8 (-7, -4, 0, +1, +2, +3, +4, +7 days relative to parturition).

$(B*DRP)_{ij}$ = interaction effect between sheep breed and days relative to parturition

E_{ijK} = experimental error associated with Y_{ijk} observation, assumed to be randomly distributed $(0, \sigma^2)$.

RESULTS AND DISCUSSION

Periparturient changes in blood constituents relative to lambing

Periparturient change in blood constituents are presented in Figure (1); A gradual increase in serum concentration of total lipids was noticed toward lambing followed by a sharp increase at lambing (2.64 g/l and 2.72 g/l for GI and GII, respectively). After lambing a gradual increase in total lipids was noticed for (GII) to reach its highest value (2.85 g/l) at day 4 postpartum. On the contrary, a sharp decrease in serum total lipids at day 7 postpartum (1.73 g/l) was achieved. Gradual decrease was noticed for (GII) with the lowest value (1.79 g/l) at day + 7 postpartum. Overall blood serum total lipids concentration (g/l) ranged between 0.65 and 3.46 for GI, the same values for GII were 0.80 and 3.74 (g/l).

A kind of physiological adaptation toward parturition was noticed in goats (Mepham, 1987); in cows (Greene et al, 1988) and in sheep (Gonzalo et al, 1993 and Capote *et al*, 1999). Many investigators attributed the physiological adaptive response toward parturition for the preparation of the colostrogenesis period and for the massive growth of the fetus at the last trimester of pregnancy (Tucker, 1981 and Pennington and Malven, 1985).

A gradual increase in serum concentrations of IGF-1 was noticed during the prepartum period followed by a sharp increase at parturition being 410.72 ng/ml for (GI) and 438.98 ng/ml for (GII). After calving a gradual decrease was noticed for (GI), being the lowest 351.26 ng/ml at 4 days postpartum and for (GII) sharp increase being the highest (483.56ng/ml) at 4 days postpartum. Overall blood serum IGF1 concentration (ng/ml) ranged between 173.71 and 605.81 for GI, the same values for GII were 137.93 and 700.10 ng/ml. The value of IGF1 has been shown to be an important regulator of mammary cell survival (Hadsell et al., 2001).

Miller et al., (2006) stated that serum concentration of IGF-1 in cows increased as lactation advanced ($P < 0.001$). Karapehlivan et al. (2007) stated that the blood total protein levels the precursor of IGF-1 were higher 3 weeks after drying off compared to those on the first day of lactation ($P < 0.01$).

Progesterone concentration in serum of (GI and GII) showed sharp decline during the late prepartum period till parturition being 7.85ng/ml from 7 days prepartum and 0.43ng/ml at parturition for (GI) and 8.74ng/ml at day7 prepartum, 0.28ng/ml at parturition for (GII). A gradual decrease after parturition at 4, 7 days postpartum being 0.10, 0.30 ng/ml for (GI) and 0.14, 0.31 ng/ml for

(GII). The overall blood serum progesterone concentration (ng/ml) ranged between 0.01 and 17.41 for (GI), the corresponding values for GII were 0.04 and 31.74 ng/ml.

Tucker (1994); (2000) said that progesterone is the key negative regulator of lactogenesis and suppresses normal peripartum onset of synthesis of lactose and casein. Progesterone decreases about 2 days prepartum and high progesterone concentrations during pregnancy may occupy glucocorticoid receptors until near parturition

Table 3. Blood hormones (IGF1 and Progesterone) and total lipids (LSM ± SE) in the two ewe's crossbreds

Blood Constituents	1/2 Finn x 1/2 Rahmani	1/4 Finn x 3/4 Rahmani
IGF1, ng/ml	375.18[a] ± 16.77	368.84[a] ± 26.54
Progesterone, ng/ml	3.20[a] ± 0.86	5.46[a] ± 1.72
TL, g/L	2.18[a] ± 0.13	2.19[a] ± 0.15

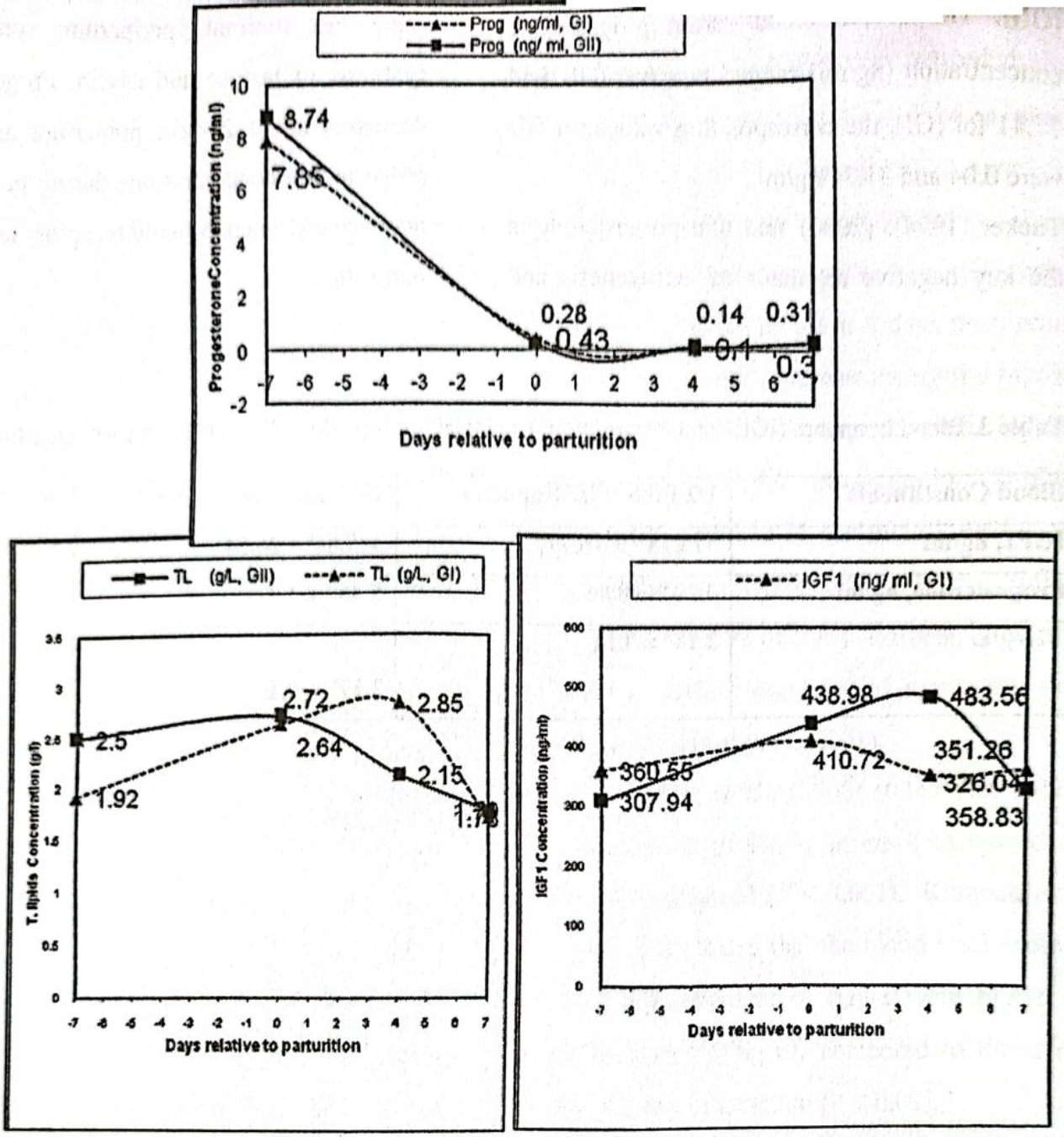

Fig 1. Periparturient changes in serum total lipids, insulin like growth factors-1 and progesterone of 1/2 Finn x 1/2 Rahmani (GI) and 1/4 Finn x 3/4 Rahmani (GII) ewes.

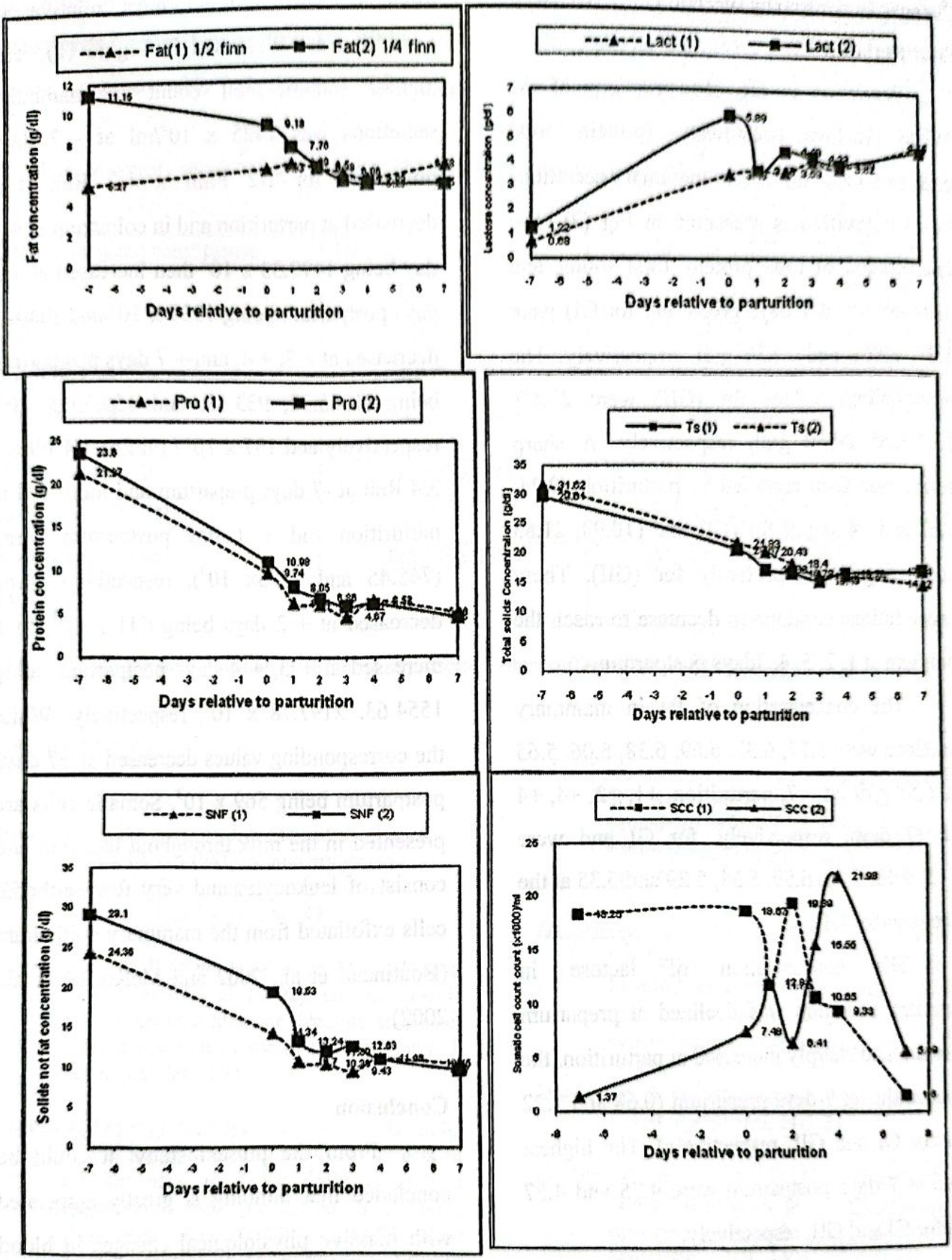

Fig 2. Periparturient changes in fat, lactose, total protein, total solids, solids not fat, and somatic cell count of mammary gland secretions of (1) 1/2 Finn x 1/2 Rahmani (GI) and (2) 1/4 Finn x 3/4 (GII) Rahmani ewes.

Changes in mammary secretion characteristics

Variation in the concentrations of the studied nutritive constituents (protein, total solids and solids not fat) in mammary secretions due to parturition is presented in Fig (2). The concentration of total protein, total solids, and solids not fat at 7 days prepartum for(GI) were 21.27, 29.61 and 24.36 g/dl, respectively. The corresponding values for (GII) were 23.60, 37.92 and 29.10 g/dl, respectively. A sharp decline was then recorded at parturition (9.74, 20.67 and 14.34g/dl for (GI) and (10.98, 21.83 and 19.53g/dl), respectively for (GII). These concentrations continue to decrease to reach the minimum at 1, 2, 3, 4, 7days postpartum.

The concentration of fat in mammary secretions were 5.27, 6.33, 6.69, 6.38, 6.06, 5.65 and 6.58 g/dl at – 7, parturition, +1, +2, +4, +4 and +7 days, respectively, for GI and were 11.15, 9.18, 7.76, 6.50, 5.54, 5.29 and 5.35 at the same days for GII.

The concentration of lactose in mammary secretion was declined at prepartum secretion and sharply increased at parturition, the lowest value at 7 days prepartum (0.68 and 1.22 g/dl for GI and GII, respectively). The highest value at 7 days postpartum were 4.75 and 4.57 g/dl for GI and GII, respectively.

The changes in somatic cell count (x 10^3/ml) present in mammary secretion throughout periparturient days relative to parturition are illustrated in Figure (2). The highest somatic cell count in mammary secretions was 1825 x 10^3/ml at - 7 days prepartum for 1/2 Finn x 1/2 Rah then decreased at parturition and in colostrum at + 1 day being 1172.33 x 10^3 then increased at + 2 days postpartum being 1939 x 10^3 and sharply decreased at + 3, + 4, and + 7 days postpartum being (1065.38, 933.13, and 159.60 x 10^3) respectively and 137 x 10^3 / ml For 1/4 Finn x 3/4 Rah at -7 days prepartum and increased at parturition and + 1 day postpartum being (748.45 and 1203x 10^3), respectively. And decreased at + 2 days being 641 x 10^3, then increased at + 3, + 4 days postpartum being 1554.63, 2197.78 x 10^3, respectively. While the corresponding values decreased at +7 days postpartum being 569 x 10^3. Somatic cells are presented in the milk throughout lactation and consist of leukocytes and very few epithelial cells exfoliated from the mammary epithelium (Boutinaud et al., 2002 and McKusick et al., 2002)

Conclusion

From the present study, it could be concluded that lambing is greatly associated with massive physiological changes in blood and mammary function. The periparturient changes in blood and mammary secretion

constituents were almost similar in the two crossbreds of ewes being adapted to lambing the same manner. No significant differences between the two crossbreds of ewes were detected in mammary secretions and blood constituents.

Table 4: Mammary secretion constituents (LSM ± SE) in two ewes' crossbreds

Mammary gland constituents	1/2 Finn x 1/2 Rah	1/4 Finn x 3/4 Rah
Fat, g/dl	$5.95^{a} \pm 0.18$	$6.36^{a} \pm 0.33$
Protein, g/dl	$8.57^{a} \pm 0.86$	$7.71^{a} \pm 0.73$
Lactose, g/dl	$3.63^{a} \pm 0.19$	$4.13^{a} \pm 0.29$
Total solids, g/dl	$18.89^{a} \pm 0.74$	$18.86^{a} \pm 0.97$
Solids not fat, g/dl	$12.9^{a} \pm 0.75$	$13.52^{a} \pm 0.82$
Somatic cell counts ($x * 10^{3}$)	$1383.58^{a} \pm 286.77$	$1012.46^{a} \pm 246.57$

Means within the same row having different superscript letters differ significantly ($P<0.05$).

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التغيرات في مكونات الدم ووظائف الغدة اللبنية للنعاج الخليط (فنلندي × رحماني) متعددة الولادة خلال الفترة حول الولادة

ياسين محمد حافظ* ، عبد الرحمن محمد البردى* ، عليات عبد العزيز حسنين** ، فكرى إبراهيم القربى ** ، نعمة عشماوي*

*قسم الإنتاج الحيواني- كلية الزراعة جامعة القاهرة
** قسم التكنولوجيا الحيوية- معهد بحوث الإنتاج الحيواني – مركز البحوث الزراعية.

استخدمت في التجربة 17 نعجة عشر متكررة الولادة (8 نعاج 2/1 فنلندي × 2/1 رحماني (GI) و 9 نعاج 4/1 فنلندي × 4/3 رحماني (GII) وذلك لدراسة التغيرات في بعض مكونات الدم و بعض إفرازات الغدة اللبنية في الفترة قبل الولادة (7 يوم قبل الولادة، +7 يوم بعد الولادة).

أتضح من النتائج أن (GI) متقارب في النتائج مع (GII) في مكونات سيرم الدم وإفرازات الغدة اللبنية فى الفترة حول الولادة ولا توجد فروق معنوية بينهما. حيث أشارت النتائج إلى أن مستوى الليبيدات في الدم بالجم/لتر يتراوح ما بين 0,65 و 3,46 للأغنام (GI) بينما كانت النتائج للمجموعة (GII) ما بين 0,8 و3,74 . وقد أرتفع تركيز عامل النمو شبيه الأنسولين في سيرم الدم في يوم الولادة إلي 410,72 نانوجرام/مل للمجموعة GI و 438,98 نانوجرام/مل للمجموعة GII. وكان تركيزهرمون البروجسترون فى سيرم الدم فى الفترة قبل الولادة 8,74 نانوجرام/مل و 7,85 نانوجرام/مل للمجموعة GII و المجموعة GI على التوالى وتركيز هرمون البروجسترون فى يوم الولادة كان 0,28 و 0,43 على التوالى. وكان المتوسط العام لهرمون البروجسترون يتراوح بين 0,01 و 17,41 للمجموعة GI و0,04 و 31,74 للمجموعة GII. وقد أوضحت النتائج الخاصة بإفرازات الغدة اللبنية أن تركيز البروتين و الجوامد الكلية والجوامد اللادهنية و اللاكتوز وعدد الخلايا الجسدية في الفترة قبل الولادة (-7 يوم) ويوم الولادة والأيام التالية بعد الولادة 1، 2 ،3، 4، 7 يوم متقارب بالنسبة للمجموعة GII مع المجموعة GI.

يتضح من النتائج أن هناك تغيرات فسيولوجية كبيرة في محتوي سيرم دم النعاج من عامل النمو شبيه الإنسولين والليبيدات الكلية والبروجستيرون حول الولادة. ايضا لوحظ تغيرات كبيرة فى وظائف الغدة اللبنية حول الولادة ولم يلاحظ أى فروق معنوية في مكونات الدم والغدة اللبنية محل الدراسة لخلطان النعاج تحت البحث و قد تأقلم كلا النوعين فسيولوجيا لاقتراب الولادة دون وجود فروق معنوية للقياسات محل الدراسة .