Vet.Med.J.,Giza. Vol.54, No.1. (2006):61-74.

RELATIONSHIP BETWEEN LIPID PROFILES, PROGESTERONE AND POSTPARTUM FERTILITY IN BUFFALOES (WITH 3 TABLES & 9 FIGURES)

ATALLAH, S. A. and RAMADAN, T. M.

Departments of Theriogenology and Clinical Pathology.

Faculty of Veterinary Medicine, Suez Canal University.

Received: 5 . 9. 2005.

Accepted: 18. 9. 2005.

SUMMARY

Twenty normal parturient buffaloes, aged 4-8 years were used in this study to clarify any association between lipid profiles, progesterone and postpartum fertility in buffaloes. Based on the resumption of postpartum ovarian cyclicity, these animals were classified into three groups; buffaloes showing normal resumption of ovarian cyclicity at 65.18±19.90 days postpartum, buffaloes with delayed resumption of ovarian cyclicity at 138.33 ± 16.50 days postpartum and buffaloes in anoestrus up to 210 days postpartum. The involution of the uterus averaged 35.4 ± 7.6 days without any significant difference between the three groups. Highly significant (P<0.01) differences were recorded in the calving to conception interval length between buffaloes with normal resumption of ovarian cyclicity and the others. A highly significant (P<0.01) negative correlation was recorded between the resumption of postpartum ovarian activity and serum levels of progesterone and total cholesterol. Also a negative correlation (P<0.01) was recorded between the calving to conception interval and these biochemical parameters. No association was found between resumption of ovarian cyclicity or calving to conception interval with serum triglycerides concentrations.

INTRODUCTION

Metabolic disorders usually develop during the periparturient period. Lipid profiles (e.g cholesterol, cholesterol esters, triglycerides and lipoprotein fractions) have been used to predict periparturient problems and for the diagnosis of metabolic diseases and the assessment of the nutritional status of the animals. During the transition period and early lactation, modest energy intake fails to fully support the energy demands of fetal growth, colostrum synthesis and milk pro-

duction, results in a period of negative energy balance. A result of this negative energy balance, lipid mobilization occurs leading to elevated plasma non esterified fatty acids (NEFA) and hepatic triglycerides content with a subsequent increase in the probability of hepatic lipidosis, metabolic disorders and reduced fertility (Grummer, 1993 ; Nebel and McGilliard, 1993).

As mentioned lipid metabolism status, in particular cholesterol may influence the reproduction of cows, since it has been recognized as a precursor of ovarian steroidgenesis in vivo (Grummer and Caroll, 1988; Niswender and Nett, 1994; Staples et al., 1998; Buller, 2000; Taylor et al., 2003). For cattle, changes in the concentrations of various serum lipids and lipoproteins in the peripartum period have been investigated (Mazur et al., 1988; Schweigert, 1990; Guedon et al., 1999). They found an association between dietary lipid and ovarian function and noted the important role of High Density Lipoproteins (HDL) which serve as a source of cholesterol. Cholesterol is one of the precursors of steroid hormone synthesis as evidenced by increased progesterone synthesis when granulosa cells were incubated with lipoprotein cholesterol.

However, little information is available on lipid profiles and reproduction in buffaloes. Therefore the objectives of this study were:

To determine the concentration of cholesterol, triglycerides and progesterone during the first 12 weeks postpartum in buffaloes

To evaluate the relationship between these profiles and the resumption of the postpartum ovarian activity as well as the calving to conception interval length in buffaloes.

MATERIALS AND METHODS

A- Animals and sampling: a total of 20 normal parturient buffalo-cows aged 4 - 8 years, housed on the Animal Farm, Faculty of Veterinary Medicine in Ismailia were used in this investigation. The cows were fed with concentrates and green fodders twice a day in the morning and in the afternoon. Rice straw was always supplied. All animals were kept under veterinary supervision and were free of brucellosis and tuberculosis.

Starting on day 7 until day 90 postpartum , all animals were examined rectally twice a week to follow up uterine involution as well as resumption of ovarian cyclicity. When both uterine horns were almost equal in size and lying completely in the pelvic cavity, uterine involution was considered complete. The ovaries were palpated to estimate their size and to record palpable structures (follicle or CL) as mentioned by Jainudeen et al. (1983). Oestrus was detected with the help of an intact buffalo-bull running with the herd combined with close observation for at least 20 minutes early in the morning, on mid-day and in the evening for signs of oestrus. This regime continued up to 210 days postpartum. Pregnancy diag-

nosis was made by rectal examination 60 days post mating. The length of the calving to conception interval was calculated for pregnant animals.

Blood samples were collected once weekly during the first 12 weeks postpartum . All samples were centrifuged immediately after clot and the obtained sera were kept at -20°C till assay.

B-Biochemical analysis: Determination of serum levels of progesterone was performed as described by Kubosik (1984) using validated radioimmunoassay (Diagnostic Products Corporation, Los Angles CA).

Total cholesterol was determined enzymatically according to Richmond (1973). Serum triglycerides were determined enzymatically according to Fossaty (1982).

C- Statistical analysis : the obtained results were statistically analyzed using Statistical Analysis System " SAS" (1987).

RESULTS

Based on the resumption of ovarian activity, animals in this study were classified into 3 groups as normal resumption group that started cyclic activity at a mean time of 65.18 ± 19.90 days postpartum, delayed resumption group in which the average interval to the first oestrus ranged between 115-162 (with an average of 138.33 ± 16.50) days postpartum as well as acyclic group that failed to show cyclic activity up to 210 days after calving.

Uterine involution was completed between day 21 to day 45 (35.4 ± 7.6 days) postpartum (table 1). There were no significant differences between cyclic and acyclic buffaloes.

It is also shown in table 1, a highly significant ($P<0.01$) difference could be noticed in the length of the calving to conception interval between buffaloes that showed early resumption of ovarian cyclicity and those with delayed cyclic activity.

Between days 32 and 90 (65.18 ± 19.90) postpartum, 11 of 20 buffaloes showed resumption of ovarian cyclicity which was associated with increased progesterone levels (>0.8 ng/ml) on at least two successive samplings (7-days interval). A buffalo (7137) showed oestrous signs and was mated 37 days postpartum but progesterone concentration persisted at the basal levels (< 0.15ng/ml) until day 56 after calving. A transient minor peak of progesterone level (<0.5 ng/ml) was recorded on day 63. Thereafter, the animal came in oestrus on day 67, followed by a marked increase in progesterone level (> 0.8ng/ml). The animal conceived to the mating at this oestrus (fig. 1).

In case of buffalo 7154, the first oestrus occurred on day 55 postpartum and mated naturally but the subsequent increase of progesterone was of short duration as the animal returned to service on day 70 postpartum (Fig. 1).

As is shown in Fig.1, the remaining animals, (buffaloes 183, 7123, 209 and 285) showed normal resumption of regular cyclic activity associated with normal luteal phase progesterone levels (> 0.8ng/ml).

As shown in Fig. 2 which concerned with 6 buffaloes showing delayed resumption of ovarian activity at 138.33 ± 15.06 days postpartum. Two buffaloes in this group showed an irregular pattern of progesterone profile during the first 12 weeks postpartum (e.g buffalo 155) compared to four buffaloes displayed normal pattern of progesterone values over the same period (e.g., buffaloes 7119 & 7150). All these 6 buffaloes were acyclic up to 115 days postpartum.

As seen in Fig. 3, a low progesterone concentration throughout 84 days postpartum was observed in the anoestrous buffaloes.

The data concerning the postpartum total cholesterol profiles are presented in table 2 and figs 4-6. For buffaloes that showed normal or delayed resumption of their ovarian activity, total cholesterol pattern showed a marked increase during the first 12 weeks after calving. Significant ($P< 0.05$) differences in total cholesterol concentrations between normal and delayed resumption groups were found. Anoestrous buffaloes showed a highly significant ($P<0.01$) decrease in the serum levels of total cholesterol .

Table (1): Involution time, resumption of ovarian cyclicity and calving-conception interval length in buffaloes.

Animals	Involution time (X± S.E)	Resumption of ovarian cyclicity (X± S.E)	Calving-conception interval length (X ± S.E)
Group I (n = 11)	33.81 ± 8.35	65.18 ± 19.90^{a}	91.36 ± 19.77^{b}
Group II (n=6)	37.00± 7.77	138.33 ± 16.50^{c}	163.83 ± 11.19^{d}
Group III (n=3)	37.66 ± 7.50	Anoestrus	----------
Total	35.4 ± 7.6		

* Different superscripts (a - c), (b - d) mean highly significant differences ($P< 0.01$).

Table (2) : Serum concentrations (mean ± S.E) of total cholesterol and triglycerides in relation to postpartum fertility in buffaloes.

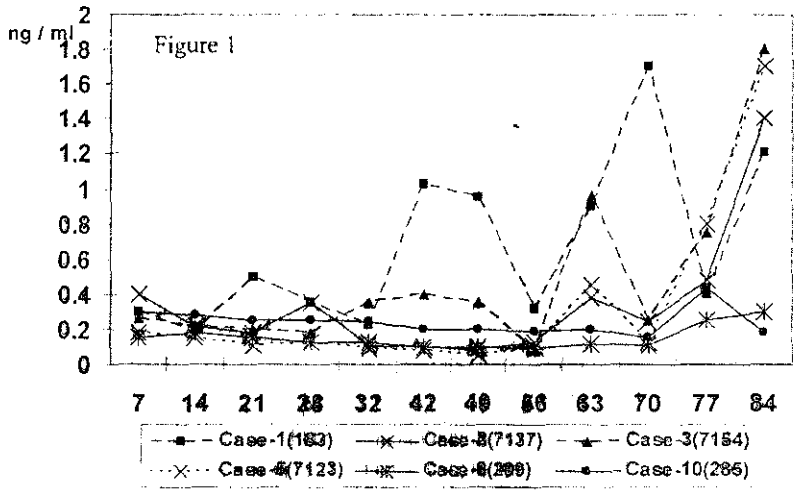
Serum parameters	Animals		
	Group 1 (n=11)	Group 2 (n = 6)	Group 3 (n = 3)
Total cholesterol (mg/dl)	10.80 ± 38.98[a]	80.41 ± 30.55[b]	47.33 ± 17.49[c]
Triglycerides (mg/dl)	22.75 ± 6.21	22.26 ± 5.39	22.27 ± 5.07

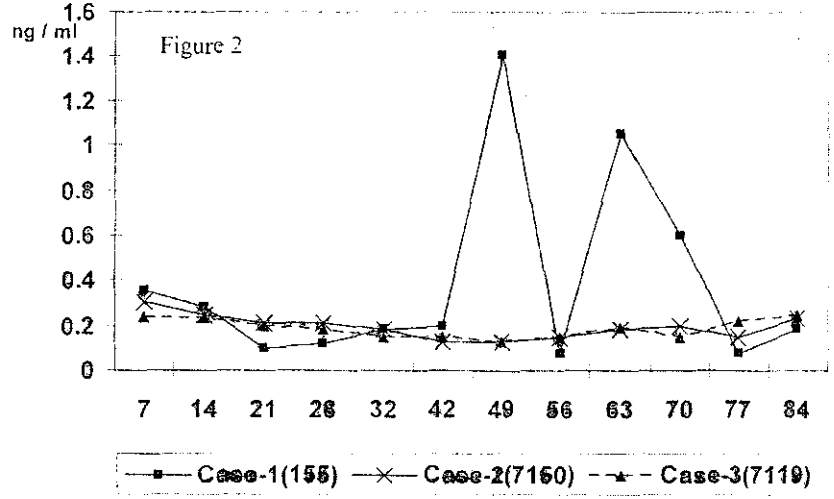
* Different superscripts (a - b) mean significant differences (P< 0.05).
* Different superscripts (a - c), (b - c) mean highly significant differences (P< 0.01).

Table (3) : Correlation coefficients between serum parameters and postpartum fertility in buffaloes.

Parameters	Parameters			
	Progesterone	Total cholesterol	Triglycerides	Resumption of ovarian cyclicity
Total cholesterol	+ 0.806**	-------	-------	------
Triglycerides	+0.213ns	+0.200ns	------	------
Resumption of ovarian cyclicity	-0.678**	-0.846**	-0.282ns	-------
Calving- conception interval	-0.650**	-0.835**	-0.254ns	-------

ns : non significant (P > 0.05).
** : highly significant (P < 0.01).





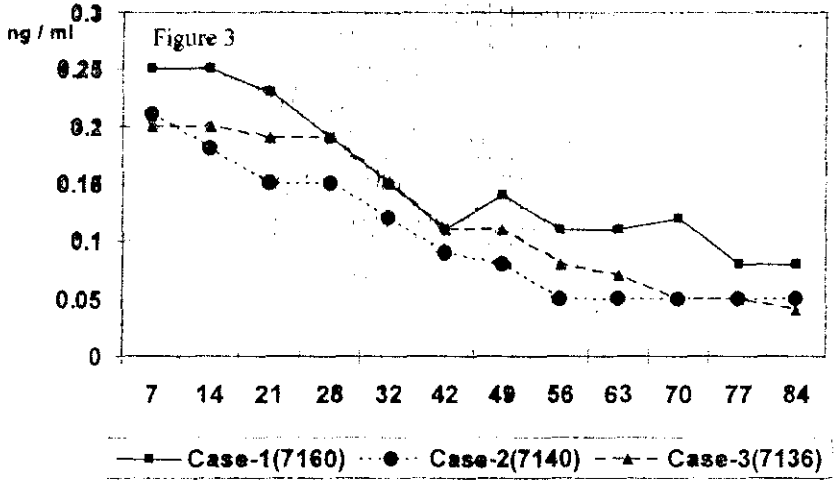
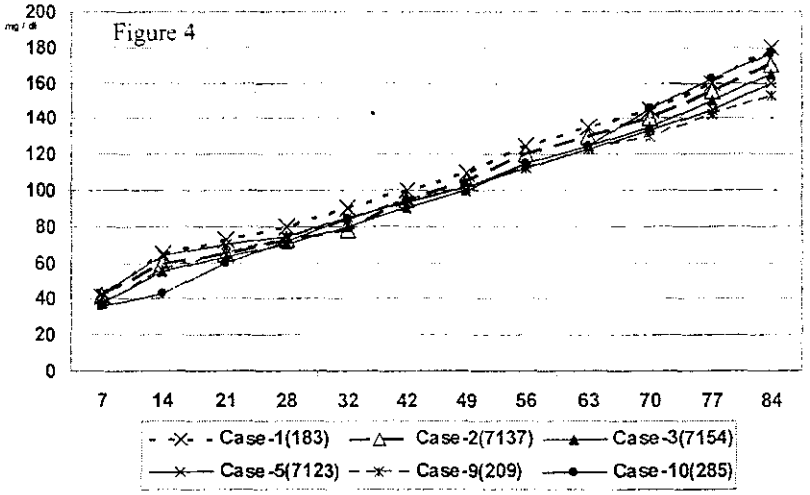
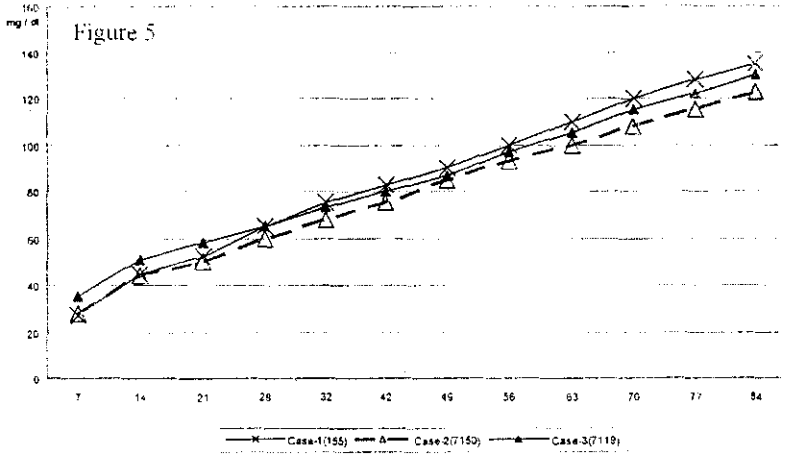


Figure 1: Individual progesterone profiles in 6 cases out of 11 buffalo-cows that showed early resumption of ovarian cyclicity (within a mean time of 65.18±19.9 days postpartum).

Figure 2: Individual progesterone in 3 cases out of 6 buffalo-cows that showed delayed resumption of ovarian activity (within a mean time of 138.33±16.50).

Figure 3: Individual progesterone profiles in anoestrus buffalo-cows.





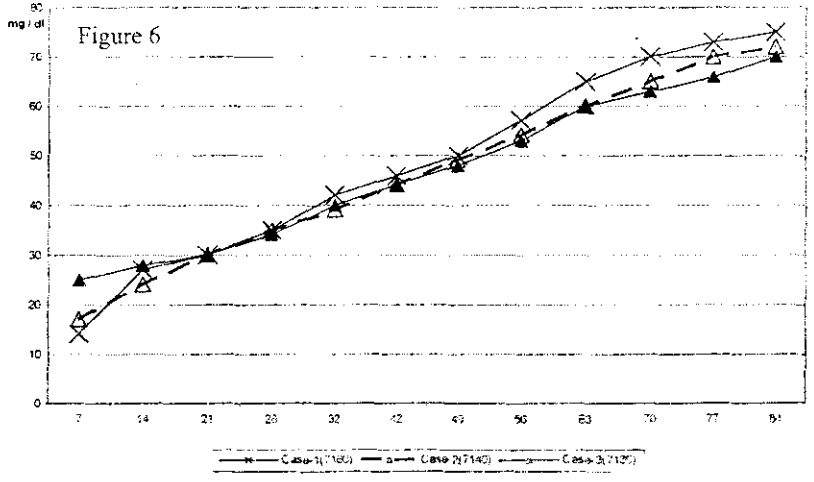
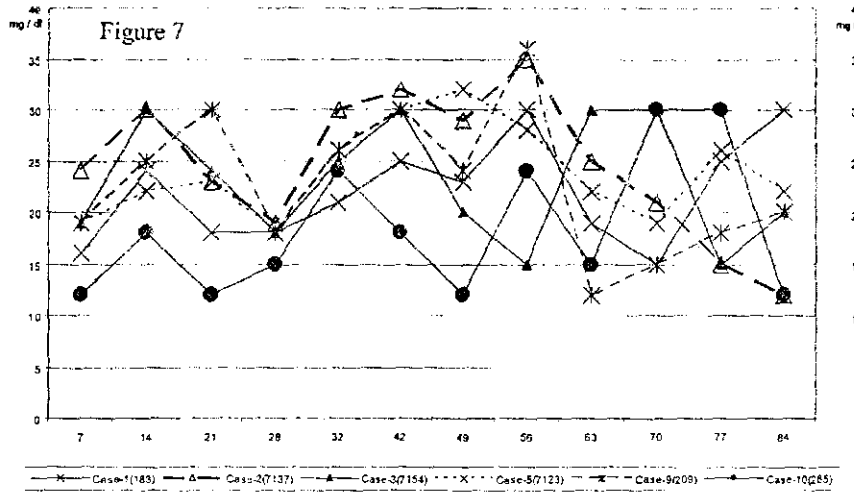
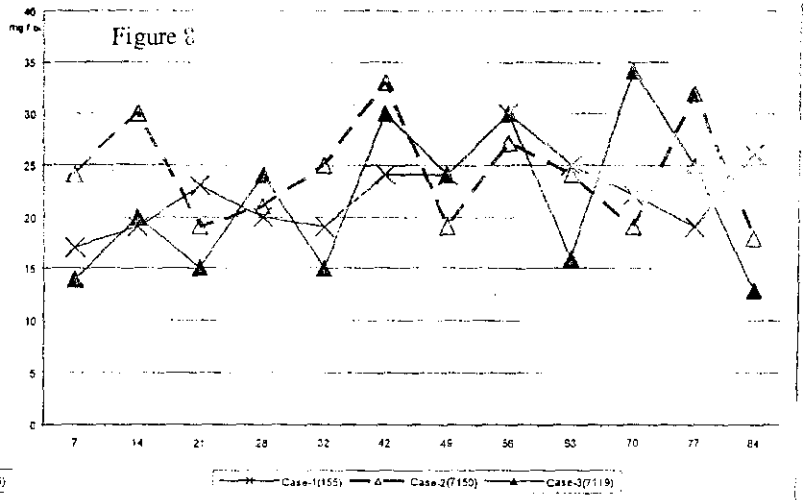


Figure 4: Individual cholesterol profiles in 6 cases out of 11 buffalo-cows that showed early resumption of ovarian activity (within a mean time of 65.18±19.9 days postpartum).

Figure 5: Individual cholesterol profiles in 3 cases out of 6 buffalo-cows that showed delayed resumption of ovarian cyclicity (within a mean time of 138.33±16.50 days postpartum).

Figure 6: Individual cholesterol profiles in anoestrus buffalo-cows.





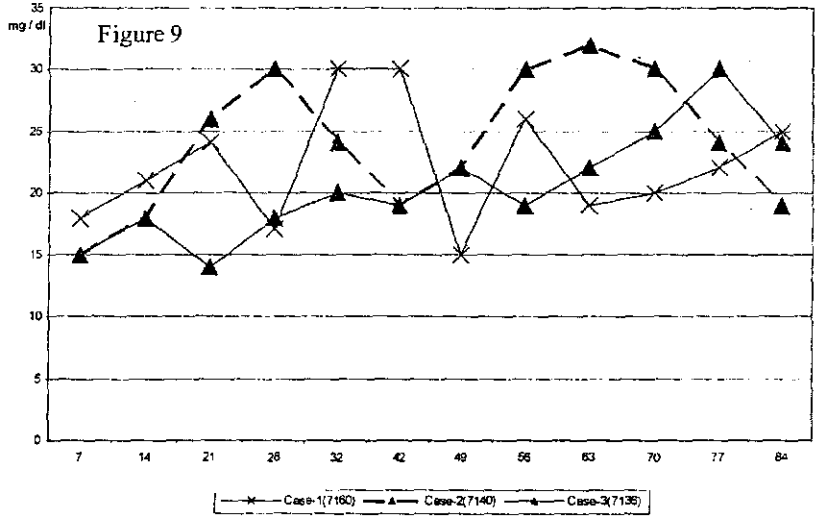


Figure 7: Individual triglycerides profiles in 6 cases out of 11 buffalo-cows that showed early resumption of ovarian activity (within a mean time of 65.18±19.9 days postpartum).

Figure 8: Individual triglycerides profiles in 3 cases out of 6 buffalo-cows that showed delayed resumption of ovarian cyclicity (within a mean time of 138.33±16.50 days postpartum).

Figure 9: Individual triglycerides profiles in anoestrus buffalo-cows.

As shown in table 2 and figs 7-9, postpartum concentrations of triglycerides seemed to be steady without any significant variations during the post partum period. No association between postpartum triglycerides profiles and the resumption of ovarian activity could be recorded.

Table 3, displayed a highly significant (P<0.01) negative correlation between the resumption of postpartum ovarian cyclicity, total cholesterol as well as progesterone was observed. A similar finding was observed for the length of the interval between calving and conception.

DISCUSSION

The results of our study indicated that uterine involution was completed 35.4 ± 7.6 days after calving which is in agreement with the previous data obtained by El-Fadaly (1978), Periris et al. (1982) and Jainudeen et al. (1983) . Anyhow, uterine involution is affected by a number of factors including dam parity, calving season and periparturient reproductive diseases (Usmani et al., 1985 and Perera et al. 1987).

Nasir et al. (1989) indicated that the average interval from calving to first oestrus in buffaloes ranged from 42 to 90 days. Our results are different: 55% of the animals, showed oestrus within 90 days postpartum at an average of 65.18 ± 19.90 days after calving. El-Fouly et al. (1976) and Jainudeen et al. (1983) reported that 32 to 38 % of their buffaloes showed resumption of ovarian activity within 3 months after calving. These differences in findings can be attributed to variations in climate, parity of the animals, nutrition, management and periparturient diseases.

In agreement with those of Arora and Pandey (1982) and Nasir et al. (1990), a highly siginificant (P<0.01) negative correlation between progesterone profile and resumption of postpartum ovarian activity was observed in our study. It could be explained as the resumption of postpartum ovarian cyclicity was earlier in buffaloes showing more or less moderate basal values of progesterone concentration during the first 12 weeks after calving compared to delayed resumption of cyclicity in buffaloes with lower concentrations of progesterone over the same period. On the other hand, the highly significant (P<0.01) positive correlation between the onset of ovarian cyclicity and calving to conception interval makes the highly significant (P<0.01) negative correlation between postpartum progesterone levels and calving to conception interval is possible and agreed with those of Jainudeen et al. (1983) and Nasir et al. (1989) .

Furthermore, the presence of a pre-oestrous rise (minor peak) in progesterone concentrations in our findings, agreed those of Bulman and Lamming (1978); Webb et al. (1980) and Perera et al.

(1987) . They interpreted the pre-oestorus rise in progesterone concentration as the preovulatory development of the follicle is inadequate, it either becomes luteinised in the absence of ovulation, or more likely luteinisation of the CL is inadequate. According to Lamming et al. (1981), such a transient rise in progesterone level may play a role in priming the normal feedback mechanisms which operate at the hypothalmic and pituitary levels to secrete gonadotrophins necessary for resumption of normal ovarian cyclicity.

Regarding the postpartum cholesterol pattern in relation to postpartum fertility, our findings agree with those of Huszenicza et al. (1988) and Gueorguieva and Gueorguieva (1997) who claimed an association between postpartum cholesterol pattern and the resumption of postpartum ovarian activity. In this regard, it is worth mentioning that, the marked decrease in progesterone and cholesterol concentrations in anoestrous buffaloes compared to those of cyclic animals may provide support to the claim that cholesterol is the precursor for biological synthesis of adrenal and ovarian steroid hormones (Mayes, 1993). The close association between total cholesterol concentrations and the resumption of postpartum ovarian cyclicity observed in our study was in line with the findings of Beam and Buller (1997) and Shrestha et al.(2004) who mentioned that the negative energy balance could be a risk factor for lower peripheral concentrations of some metabolic hormones as insulin-like growth factor-1(IGF-1) and LH which may compromise follicular growth and development and by turn leads to some ovarian dysfunctions.

On the other hand, we found no relation between postpartum triglycerides concentrations and resumption of ovarian cyclicity which support the findings of Wehrman et al. (1991) who stated that triglycerides don't appear to play a direct regulatory role in ovarian steroidgenesis.

In conclusion, a close relationship between the postpartum levels of total cholesterol and the onset of postpartum ovarian cyclicity in buffaloes was proven in this study. Therefore, a great attention should be given to treat and prevent nutritional and metabolic problems by feeding the animals with a well balanced diet according to their requirement for maintenance, pregnancy and lactation . Especially adequate energy is necessary for optimal function of all body systems and consequently for high reproductive efficiency.

REFERENCES

Arora, R.C. and Pandey, R.S. (1982): Current research status of buffalo reproductive endocrinology. World Rev. Anim. Prod., 18 (2): 15 - 23.

Beam, S.W. and Buller, W.R. (1997): Energy balance and ovarian follicle development prior to first ovulation postpartum in dairy cows receiving three levels of die-

tary fat. Biol. Reprod., 56 : 133 - 142.

Buller, W.R. (2000): Nutritional interactions with reproductive performance in dairy cattle. Anim. Reprod. Sci., 60/61 : 449 - 457.

Bulman, D.C. and Lamming, G.E. (1978): Milk progesterone levels in relation to conception , repeat breeding and factors influencing acyclicity in dairy cows. J. Reprod. Fertil., 54: 447- 458.

El-Fadaly, M.A. (1978): Studies on the puerperium in buffaloes. Ph.D. Vet. Sci., Thesis Cairo Univ.

El-Fouly, M.A.; Kottby, E.A. and El-Soby, H.E. (1976): Postpartum ovarian activity in suckled and milked buffaloes . Theriogenology, 5: 69-81. Fossaty, P. (1982): Serum triglycerides determined colrometrically with an enzyme that produce hydrogen peroxide. Principle J. Clinic. Chemistry, 28:20-77.

Grummer, R.R. (1993): Etiology of lipid - related metabolic disorders in periparturient dairy cows. J. Dairy Sci., 76: 3882-3896.

Grummer, R.R. and Caroll, D.J. (1988): A review of lipoprotein cholesterol metabolism: importance to ovarian function . J. Anim. Sci., 66:3160-3173.

Guedon, L.; Saumande, J.; Dupron, F.; Couquet, C. and Desbals, B. (1999): Serum cholesterol and triglycerides in postpartum beef cows and their relationship to the resumption of ovulation. Theriogenology, 51: 1405-1415.

Gueorguieva, T.M. and Gueorguieva, I.P. (1997): Serum cholesterol concentration around parturition and in early lactation in dairy cows. Revue Med. Vet., 3: 241-244.

Huszenicza, G.; Haraszti, J.; Molnar, L.; Solti, L.; Fekete, S.; Ekes, K. and Yaro, A.C. (1988): Some metabolic characteristics of dairy cows with different postpartum ovarian function. J. Vet. Med. A., 35: 506-515.

Jainudeen, M.R.; Bongso, T.A. and Tan, H.S.(1983): Postpartum ovarian activity and uterine involution in the suckeled Swamp buffalo (Bubalus Bubalis). Anim.Reprod. Sci., 5. 181-190.

Kubosik, N.D. (1984): Evaluation of direct solid phase radioimmunoassay for progesterone . Clin. Chem. , 30: 384.

Lamming,, G.E.; Watches, D.C.; and Peters, A.R. (1981): Endocrine pattern of the postpartum cow. J. Reprood. Fertil., Suppl., 30: 155-170.

Mayes, P.A. (1993): Harpers Biochemistry. 370 pages, Appleton and Lange Norwalk, Connecticut, San Mateo, California.

Mazur, A.; Guex, E.; Chilliard, Y. and Rayssiguier, Y. (1988): Changes in plasma lipoproteins and liver fat content in dairy cows during early lactation. Anim. Physiol. Anim. Nutr., 59: 233-237.

Nasir, H.S.; Willemse, A.H.; Van de Wiel, D.F.M. and Engel, B. (1989): Influence of season and parity on several reproductive parameters in Nili-Ravi buffaloes in Pakistan. Anim. Reprod. Sci., 22: 177-190.

Nasir, H.S.; Willemse, A.H. and Van de Wiel, D.F.M. (1990): Reproductive performance of Nili-Ravi buffaloes after a single injection of GnRH early postpartum. Tropical Animal Health and Production., 22: 239-246.

Nebel, R.L. and McGilliard, M.L. (1993): Interactions of high milk yield and reproductive performance in dairy cows. J. Dairy Sci., 76. 3257.

Niswender, G.D. and Nett, T.M. (1994) : Corpus luteum and its control in infraprimate species. In: Knobil E, Neill JD (eds), The Physiology of Reproduction.New

York: Raven Press, pp.781-804.

Perera, B.M.A.O.; De Silva, L.N.A.; Kuruwita, V.Y. and Karunaratne, A.M. (1987): Postpartum ovarian activity, uterine involution and fertility in Indigenous Buffaloes at a selected village location in Sri Lanka. Anim. Reprod. Sci., 14: 115-127.

Periris,G.S.; Mohamed, and Abeywardena, S.A. (1982): Studies on post involution of the uterus in the buffalo. Proceeding: Workshop on Water Buffalo Research in Sri Lanka, EC Report R3, Stockholm, composition in dairy co J. Anim. Physiol. Anim. Nutr., 63: 75-83.

Richmond, W. (1973): Enzy tic determination of cholesterol. Clin. Chem., 19: 13

Statistical Analysis System AS " User's Guide (1987): Statistics, SAS Institute Inc., Cary, NC.

Schweigert, F.J. (1990): Effect of gestation and lactation on lipoprotein pattern and composition in dairy cows. J. Anim. Physiol. Anim. Nutr., 63: 75-83.

Shrestha, H.K; Nakao, T; Higaki, T.; Suzuki, T. and Akita, M. (2004): Resumption of postpartum ovarian cyclicity in high producing Holstein cows. Theriogenology, 61: 637-649.

Staples, C.R.; Bruke, J.M. and Tatcher, W.W. (1998): Influence of supplemental fats on reproductive tissues and performance of lactaing cows. J. Dairy Sci., 81: 856-871.

Taylor, V.J.; Beever, D.E.; Bryant, M.J. and Wathes, D.C. (2003): Metabolic profiles and progesterone cycles in first lac tion. Theriogenology, 59 : 1661 - 1667.

Usmani, R.H.; Ahmad, M.; Inskeep, E.K.; Dailey, R.A.; Lewis, P.E. and Lewis, G.S. (1985): Involution and postpartum ovarian activity in Nili - Ravi buffaloes. Theriogenology, 24: 435 - 448.

Webb, R.; Lamming, G.E.; Haynes, N.B. and Foxcroft, G.R. (1980): Plasma progesterone and gonadotrophin concentrations and ovarian activity in postpartum dairy cows. J. Reprod. Fertil., 59: 133- 143.

Wehrman, M.E.; Welsh, T.H. and Williams, G.L. (1991): Diet-induced hyperlipidemia in cattle modifies the intrafollicular cholesterol enviroment , modulates ovarian follicular dynamics , and hastens the onset of postpartum luteal activity . Biol. Reprod., 45: 541-552.

العلاقة بين صور الدهون و هرمون البروجيستيرون ومستوي الخصوبة بعد الولادة في الجاموس

سيد عبدالنعيم عطاالله - رمضان طه محمد

قسم التوليد والتناسل والتلقيح الاصطناعي - قسم الباثولوجيا الإكلينيكية

كلية الطب البيطري - جامعة قناة السويس

اجريت هذه الدراسة علي عدد (٢٠) جاموسة في مزرعة كلية الطب البيطري بالاسماعيلية - تراوح عمر هذه الحيوانات بين ٤-٨ سنوات وكانت فيها الولاده ونزول المشيمة طبيعيا.

شملت الدراسة أخذ عينات دم من هذه الحيوانات وكذا متابعة التغيرات لتي تحدث في اللمبايض والرحم وحدوث أول شبق بعد الولاده عن طريق الجس بالمستقيم.

وبعد فصل مصل الدم وقياس مستوي بعض العناصر مثل البروجيستيرون - الكوايسترول الكلي وكذا الدهون التلاتية أوضحت النتائج مايلي:

١- متوسط المدة لانكماش رحمي كامل بعد الولادات الطبيعية هو ٣٥.٤ ± ٧.٦ يوما مع عدم وجود فروق معنوية بين الحيوانات التي شملتها الدراسة في هذه النقطة.

٢- بناء علي نشاط المبيض وظهور اول شبق بعد الولاده قسمت الحيوانات في هذه الدراسه الي:

- عدد ١١ جاموسة كان متوسط المدة لظهور أول شبق بعد الولادة هو ١٨.٦٥±١٩.٩ يوما وكان متوسط طول الفترة بين الولادة وحدوث الحمل بعدها هو ٩١.٣٦ ±١٩.٧٧يوما.
- عدد ٦ جاموسة كان متوسط المدة لظهور اول شبق بعد الولادة هو ١٣٨.٣٣ ± ١٦.٥ يوما بينما كان متوسط طول الفترة بين الولادة وحدوث الحمل بعدها ١٦٣.٨٣ ± ١١.٩يوما.
- عدد ٣ جاموسة تعاني من خمول المبايض وعدم الشياع حتي نهاية الشهر السابع بعد الولاده.

٣- أوضحت الدراسة وجود فروق معنوية في متوسط مستوي الكليستيرول الكلي بين الحيوانات التي كان فيها نشاط المبيض مبكرا وتلك التي تأخر فيها نشاط المبيض بعض الوقت والمجموعة التالية التي تعني خمول المبايض وعدم الشياع

٤- تبين من الدراسة وجود ارتفاع ملحوظ ومستمر في مستوي الكوليسترول الكلي علي مدار أربعة وثمانون يوما بعد الولادة في الحيوانات التي شهدت نشاط المبيض وظهور علامات الشبق مقارنة بالحيوانات التي تعاني من خمول المبايض وعدم الشياع.

٥- أظهرت الدراسة وجود علاقة سالبة عالية المعنوية بين نشاط المبيض وظهور أول شبق بعد الولادة ومستوي كلا من البروجيسترون والكوليسترول الكلي.

٦- كما أوضحت الدراسة وجود علاقة موجبة عالية المعنوية بين نشاط المبيض وظهور أول شبق بعد الولادة وطول الفترة بين الولادة وحدوث الحمل بعد ذلك.

٧- تبين عدم وجود أى علاقة بين متوسط مستوي الدهون الثلاثية خلال فترة تصل إلي أربعة وثمانون يوما بعد الولادة ونشاط المبيض وظهور أول شبق بعد الولادة وكذا طول الفترة بين الولادة وحدوث الحمل بعد ذلك كما لوحظ عدم وجود تغير ملحوظ في مستوي الدهون الثلاثية علي مدار أربعة وثمانون بعد الولادة.

× توصي الدراسة بضرورة تغذية الحيوان علي علائق مطابقة لأحتياجاته كما ونوعا في المراحل المختلفة من الحمل خاصة الأخيرة منها وكذا فترة مابعد الولادة حتي يتم التغلب علي مشاكل نقص الخصوبة وإضطرابات الحمل الناتجة عن نقص أو سوء التغذية أو كليهما.