METABOLIC CHANGES DUE TO THE EFFECT OF PREGNANCY AND LACTATION ON HOLSTEIN COWS AND AGE ON NEWBORN CALVES

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ABSTRACT

This study was carried out on fifteen cows and twenty calves, to study the effect of pregnancy and parturition on some biochemical parameters and to study the effect of colostrum and milk feeding and weaning on calves. The obtained results revealed significant increase in total lipids and triacyl-glycerol (TG) and significant decrease in serum low density lipoproteins-cholesterol (LDL-C) and glucose in serum of pregnant cows. While, the serum of parturient cows exhibited significant increase in total lipids, total cholesterol, low density lipoproteins cholesterol (LDL-C) and ketone bodies, and significant decrease in serum glucose. While newborn calves, showed significant decrease in total lipids (at weaning age), triacylglycerol at (weaning and one week after weaning), total cholesterol (one week after weaning) and glucose (one week after weaning). On the opposite side, a significant increase was recorded in serum total lipids at one week of age than the level of 0-day old calf. The level of HDL-C and phospholipids showed non significant change in both cows and calves.

INTRODUCTION

The economic success of cattle breeding depends considerably on the technology of production. Production of healthy calves is the guarantee for obtaining healthy cattle herd either for dairy or beef purposes (Amstutz, 1980).

Several factors can alter lipid metabolism in ruminants, among these factors: diet, pregnancy, lactation, ketosis and age. Diet induced changes are particularly noticeable in newborn calves (Bennis *et al*, 1992). Pregnancy and lactation are critical periods in animal life due to increase mammary gland and fetal demands for glucose. If there is mismatch between glucose requirement and liver gluconeogenesis, hypoglycemia and ketosis will be resulted (Bergman, 1975).

Fatty liver due to triacylglycerol accumulation is common in dairy cows during periparturient period and usually accompanied by reduction in healthfulness, fertility and production (Herdt *et al*., 1982, Gerloff *et al*, 1986). Impaired hepatic secretion of TG-rich lipoprotein is involved in pathogenesis of bovine fatty liver. TG is secreted from the liver as very low density lipoprotein (VLDL) (Beynen *et al*., 1981, Reid *et al*, 1983 & and Gerloff *et al* 1986).

This study aimed to find the effect of pregnancy and parturition on lipid profile (total lipids, triacyl-glycerol, total cholesterol, HDL-c, LDL-c, cholesterol and phospholipids) and glucose to avoid fatty liver in these critical periods. Furthermore, to study the effect of colostrum, milk feeding and weaning on these parameters in calves.

MATERIALS AND METHODS

Animals:

Fifteen Holstein cows were used in this study. of which five non pregnant used as a control, five pregnant (Late stage) and five parturient dams (first day of parturition), in addition to twenty calves at different ages; of which, five calves just after birth and before feeding, used as control, five calves at one week age, five at weaning age (nine weeks) and five at one week after weaning.

Feeding program:

Cows were fed a daily ration formed from green corn, hay and concentrates (10% wheat brane, 65% Grind corn, 15% cotton seed extract and 10% as fat supplement and mineral mixture). The newborn calves were fed colostrum by natural suckling for two days, then were fed whole milk artificially for the first week. Then were fed milk and a ration formed from grind corn and amino acid mixture till weaning age (9 weeks). Then the ration was given ad-libitum.

Sampling:

Blood samples were once collected without anticoagulant by Jugular vein puncture and centrifuged for obtaining clear serum. These blood serum samples were collected in clean sterile vials and stored till used for biochemical analysis (at morning and before feeding).

Biochemical analysis:

The sera samples were analyzed for total lipids (Frings and Dunn, 1970), TG (Fossati , 1982), total cholesterol (Natio, 1988), HDL-C (Kostner, 1976), LDL-C (Gerard and William, 1998), Phospholipids (Zilversmit and Davis, 1950), Glucose (Trinder *et al*, 1969) and Ketone bodies (Henry *et al*, 1986). The statistical analysis was carried out using student T-test (Senedecor and Cochran, 1969).

RESULTS AND DISCUSION

In cows:

The significant increase in total lipids in periparturient and parturient cows is in accordance with those of Watson *et al*, (1993) who found that hyperlipemia in mare during these periods was due to mobilization of fatty acids from adipose tissue in response to negative energy balance. In addition to development of peripheral tissues insensitivity to insulin (Fowden *et al*, 1984). On opposite, Prakash and Tandon (1979) observed significant decrease in pregnant cows.

Triacylglycerol (TG) showed a significant increase in the serum of pregnant cows. This result is similar to the results obtained by Mazur and Rayssiguier (1988) and Watson *et al*, (1993) who attributed this elevation to increase synthesis of TG in liver and VLDL secretion due to activity of lipoprotein and hepatic lipases.

The elevation in serum total cholesterol of parturient cows, was found to be due to the reduction in thyroid hormone level (Prakash and Tandon, 1979), or to sustain ovarian hormone production (Schuler *et al.*, 1981).

There was a significant decrease in LDL-C level in pregnant cows. This result was confirmed by those of Hussein and Azab (1998). On the contrary, they observed significant decrease after parturition while the obtained result showed a significant increase. These changes may be attributed to the change in cholesterol level since the primary function of LDL- C particle is to provide cholesterol to peripheral tissues (Champe and Harvey, 1994).

The sharp decrease in serum glucose in pregnant and parturient cows resulted from the onset of lactogenesis that start in cows at 10 days before parturition (Ruckebusch *et al*, 1991). Also , due to increase fetal demand, since placenta can transport glucose from the mother to the fetus (Warnes *et al*, 1977).

The reduction in blood glucose is accompanied by elevation in serum ketone bodies and resulted from excessive utilization of fat as energy source (Baird, 1982). Stimulation of hormone sensitive lipase by cortisol hormone increased around parturition (Heitzman, *et al*, 1970).
In newborn calves: The plasma total lipids in serum of newborn calves showed a significant increase in the first week of age followed by decrease at weaning age. The elevation was found to be due to colostrum and milk ingestion (Bennis *et al*, 1992 & Hussein and Azab, 1998).

The level of TG was significantly decreased at and one week after weaning age. This decrease could result from better liver maturation and improved capacity to metabolize lipids for rapid increased body fat (Noble, 1981).
The reduction in serum total cholesterol one week after weaning , was due to reduction of LDL-C (Table, 2), since there is a strong relationship between the level of these two parameters (Robert *et al*, 1996). The reduction in LDL-C at and one week after weaning was supported by Jenkins *et al*, (1994) who observed that LDL-C was higher in 3 days old lamb than in older one.

The sharp decrease in serum glucose after weaning was confirmed by Oltner and Berglund (1982) who observed gradual decrease in serum glucose during the first 12 months of life. Moreover, Weekes (1979) found that the fore stomach development in calves and carbohydrate metabolism was changed to adult pattern as increase reliance upon gluconeogenesis due to increase the rate of fermentation in rumen.

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Table (1) Effect of pregnancy and parturition on some biochemical parameters in Holstien cows (mg/dl)

Biochemical parameters	Non pregnant cows	pregnant cows	parturient cows
Total Lipids	266.2±16.1	355.6±17.1**	370.0±9.3**
Triacylglycerol	90.8±6.6	150.4±21.6*	87.9±5.8
Total cholesterol	210.3±9.5	186.2±27.9	296.2±15.5**
HDL-cholesterol	57.3±5.5	59.3±3.4	64.2±6.6
LDL-cholesterol	138.5±10.2	102.8±8.2*	217.9±16.8**
Phospholipids	163.2±6.0	160.2±12.1	180.9±6.8
Glucose	63.2±3.7	36.0±5.6**	48.7±5.1*
Ketone bodies	2.3±1.0	6.0±1.6	7.4±1.8*

Table (2) Effect of age on some biochemical parameters in newborn calves. (mg/dL)

Biochemical parameters	0-day old calf	one week	weaning age	one week after weaning
Total Lipids	250.7±6.9	277.5±4.7**	216.5±12.7*	241.8±7.1
Triacylglycerol	80.2±6.9	82.8±8.8	33.1±4.9**	57.7±6.1*
Total cholesterol	165.5±21.9	194.4±18.1	154.8±15.7	112.5±11.4*
HDL-cholesterol	42.6±5.7	46.8±7.5	56.8±5.8	56.5±11.9
LDL-cholesterol	94.1±13.1	118.4±12.1	60.7±5.2*	30.8±6.3**
Phospholipids	148.4±8.9	138.2±9.6	146.5±5.3	149.6±6.8
Glucose	51.9±1.4	54.6±1.8	44.2±3.1	41.9±1.7**

* Significant changes at P≥0.05
** Significant changes at P≥0.01

الملخص العربى

التغيرات الأيضية التى يحدثها الحمل والولادة فى إناث الأبقار الهولشتين والعمر على العجول الصغيرة

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أجريت هذه الدراسة على عدد ١٥ من إناث الأبقار الهولشتين (خمسة منها غير حوامل استخدمت كمجموعة ضابطة و ٥ حوامل، ٥ بعد الولادة) وعدد ٢٠ من العجول الصغيرة (خمسة منها بعد الولادة مباشرة كمجموعة ضابطة، ٥ عمر أسبوع، ٥ عمر الفطام، ٥ أسبوع بعد الفطام). كان الغرض من الدراسة هودراسة تاثير الحمل والولادة على بعض مكونات الدم البيوكيميائية وكذلك دراسة تأثير رضاعة السرسوب واللبن وكذلك الفطام على عجول البقر الصغيرة. وقد اسفرت النتائج عن زيادة معنوية فى نسبة الدهون الكلية، الكوليستيرول الكلى والدهون منخفضة الكثافة والأجسام الكيتونية بينما حدث نقص معنوى فى نسبة الجلوكوز فى مصل الأبقار الحوامل وحديثة الولادة.

فى العجول الصغيرة أوضحت النتائج حدوث نقص معنوى فى نسبة الدهون الكلية (فى عمر الفطام)، الجليسريدان الثلاثية (عند الفطام وأسبوع بعد الفطام)، وكل من الكوليسترول الكلى ونسبة الجلوكوز (أسبوع بعد الفطام). على النقيض حدثت زيادة معنوية فى نسبة الدهون الكلية عند عمر أسبوع بمقارنتها بنسبتها فى العجول التى لم ترضع بعد. بينما لم يظهر أى تغيير معنوى فى نسبة الليبوبروتيبات عالية الكثافة والفوسفوليبدات فى كل من الامهات والعجول الصغيرة.