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Short Communication

Assessment of Some Biochemical Parameters in Dairy Cows during Transition Period

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ABSTRACT

Dairy cows experience plentiful modifications during the transition from last stage of pregnancy to early lactation. This phase is essential in ascertaining soundness, output, and profitability of the dairy farms. The aim of this study is to describe variations of selected biochemical parameters throughout" transition" phase. A total number of 160 blood samples were collected from approximately 20 dairy cows from the 4th week prepartum until the 4th week postpartum. These samples were used for evaluation of serum glucose, cholesterol, triglycerides, total protein, albumin, Non-esterified fatty acid (NEFA), liver enzymes during this period. The findings of this research assert that transition period had major effect on different blood metabolites.

Key words: Parturition, blood metabolites, NEFA, liver enzymes

INTRODUCTION

Dairy cow is the most precious and noteworthy element in dairy production. The superb amelioration in feeding and breeding leads to substantial increase in milk productivity .Inappropriately, increase in milk production leads to elevation in incidence of Post-partum related conditions "infectious and metabolic". (Wensing *et al*., 1997).

The "transitional" phase for a dairy cattle usually start at 3 to 2 weeks pre-calving and continue until 2-3 week post-calving. The "transition" expression used to confirm the important physiologic, nutritional or metabolic modifications proceeding in this period (Drackley, 1999).

The method in which these modifications come about and dealt with are of immense implication as they strictly related to lactation rendering, numerous forms of post-calving illnesses as well as reproductive yielding which are in direct correlation to animal output (LeBlanc, 2006).

Most dairy cows during transitional period attain a state of negative energy equilibrium as a result of increased energy demands at parturition, decreased dry matter intake "DMI" just before parturition, and lagging of DMI compared with energy demands due to milk production (Gerloff, 2000; Hayirli *et al*., 2002). In energy deficit phase, the triglycerides stocked in animal's fat liberates and form free fatty acids, which spread to the circulation and distributed all over the body systems and tissues (Emery *et al*., 1992).

Extensive liberation of body fat reserves leads up to adipose deposition in the liver causing "fatty liver" (Goff and Horst, 1997). Negative energy balance and deficiency of glucose after calving cause excessive production of ketone bodies with subsequent ketosis (Loor *et al*., 2007).

The present study intended to describe variations of selected biochemical metabolites during transition period.

MATERIALS AND METHODS

This study was accomplished in *"Land mark dairy farm*" at the Alexandria-Cairo desert route, Egypt, over a period of 4 months, the analysis were performed in department of internal medicine laboratory, faculty of Veterinary Medicine, Cairo University.

Animals

Twenty Holstein dairy cows (n= 20) with different ages (4 years up to 7 years) and different body condition scores (3.25 up to 4) were involved in this study, with great consideration to animal welfare.

Blood samples

Eight blood samples were assembled from each animal from the 4th week prepartum until 4th week postpartum. The total number of collected blood samples was 160 samples. Each blood sample was divided into two portions, the first part collected without anticoagulant for serum separation and the second part collected on sodium fluoride anticoagulant.

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Serum samples were used for estimation of total protein, albumin, liver enzymes (ALT, AST and GGT), Triglyceride and Cholesterol, floriated plasma used for estimation of blood glucose concentration using respective test kits (Stanbio® Inc., USA and QCA Company).

Estimation of Non- Esterified fatty acids "NEFA"

Serum NEFA were determined according to (Soloni and Sardina, 1973) and (Brunk and Swanson, 1981).

Clinical examination and Body condition scoring

Clinical examination of each animal was performed (Jackson and Cockcroft, 2000). Special attention was directed toward examination of udder, genital tract, appetite, feces character, ruminal activity, temperature, pulse rate and respiratory rate. The body condition scores were determined (Edmonson *et al*., 1989).

Statistical analysis

Analysis of variance (ANOVA) was performed and results were evaluated in the light of P-value. P≥0.05 non-significant, P≤0.05 significant and P≤0.01 highly significant according to Milton and Tsokos (1983).

RESULTS

The present investigation revealed the presence of significant alterations in serum biochemical analytics in the comparison of means among the pre-calving and post-calving stages as clarified in Table (1) and Figure (1).

Blood glucose concentration reached the lowest level on 1st week post parturition with tendency to increase at 21 day postpartum. Although glucose mean value increased gradually, it does not reach prepartum levels. Serum cholesterol showed reduction in 1 week pre-calving and 1st week post-calving with sudden sharp increase at 2nd week postpartum. Blood triglyceride level was considerably higher in late gestation than post-calving.

Blood NEFA level behave dissimilarly and elevated at parturition, reaching peak levels on 1st week postpartum and started to decrease henceforward. Serum ALT and AST activities showed in tandem elevation from the first week post-calving, whereas GGT activity increase from 1 week pre parturition with subsequent gradual increase post parturition. Total protein concentration tended to decrease significantly from last week of pregnancy until first week postpartum then increased gradually. Albumin level began to decrease at first week postpartum then sharply increased from the 1st week postpartum.

DISCUSSION

Dairy cattle experience a remarkable congregation of metabolic acclimatization as they step out from late gestation to early lactation. These alterations are generally delicately synchronized by hormonal modifications to sustain the new physiologic status of lactation, the theory well-known as (homeorhesis). When these adaptive steps fall short or overwhelmed by ecological effects, periparturient illness proceeds (Darkely *et al*., 2005).

The current study demonstrates the profound fluctuations in definite biochemical parameters between pre-calving and post-calving phases. These modifications are not necessarily indicating the existence of disease but reflect physiological deviations.

The decrease in blood glucose concentration recorded in this study post calving may be attributed to several hormonal changes occur mainly to adjust the parturition and lactation requirements, and partially to regulate body metabolism leading to postpartum hypoglycemic state (Komatsu *et al*., 2005). The accelerating demand on glucose for milk production post parturition places an effort on the capability of the cow to supply the necessary glucose. The increase in feed consumption with subsequent increase in propionate production are not equivalent

Table 1: The blood metabolite analysis of dairy cows during transitional stage

Blood metabolite	Weeks relating to calving							
	-4wk	-3wk	-2wk	-1wk	1wk	2wk	3wk	4wk
Glucose (mg/dl)	60.748± 3.34	61.993± 4.16	58.423± 3.96	55.550± 3.90	47.572± 3.48**	48.841± 2.41	49.620± 2.48	49.764± 1.54
Cholesterol (mg/dl)	122.43± 5.34	119.3± 2.24	117.74± 2.23	108.39± 2.17**	94.166± 2.28**	102.18± 1.08**	105.72± 3.30*	110.48± 1.35*
Triglyceride (mg/dl)	20.443± 1.89	21.672± 1.56	22.203± 5.16	23.456± 2.65	18.667± 2.79**	13.772± 1.28**	12.546± 1.75	11.005± 1.74
NEFA (mmol/l)	0.220± 0.02	0.225± 0.04	0.230± 0.02	0.260± 0.03*	0.463± 0.06**	0.390± 0.01**	0.327± 0.03**	0.324± 0.04
AST (U/l)	48.43± 2.11	48.43± 2.82	49.65± 1.30	47.38± 1.24	69.50± 1.38**	64.84± 1.14**	63.45± 0.80	64.43± 0.90
GGT (U/l)	10.24± 0.95	9.750± 2.37	10.04± 2.50	15.39± 1.74**	19.77± 3.09**	19.88± 3.32	22.84± 1.47	21.14± 2.67
ALT (U/l)	13.03± 1.22	12.90± 1.13	12.68± 1.12	12.59± 0.92	16.33± 1.19**	18.25± 1.56*	18.94± 1.73	19.42± 1.99
Total protein (g/dl)	8.680± 0.630	8.840± 0.568	9.040± 0.691	7.644± 0.661*	6.500± 0.678*	6.900± 0.543	7.820± 0.554	8.160± 0.564
Albumin (g/dl)	3.656± 0.140	3.6640± 0.246	3.7400± 0.181	3.602± 0.201	2.874± 0.120**	3.414± 0.056**	3.421± 0.142	3.631± 0.135

"*, **, " in the same row indicate statistically significant differences; * P≤0.05 significant and ** P≤0.01 highly significant.

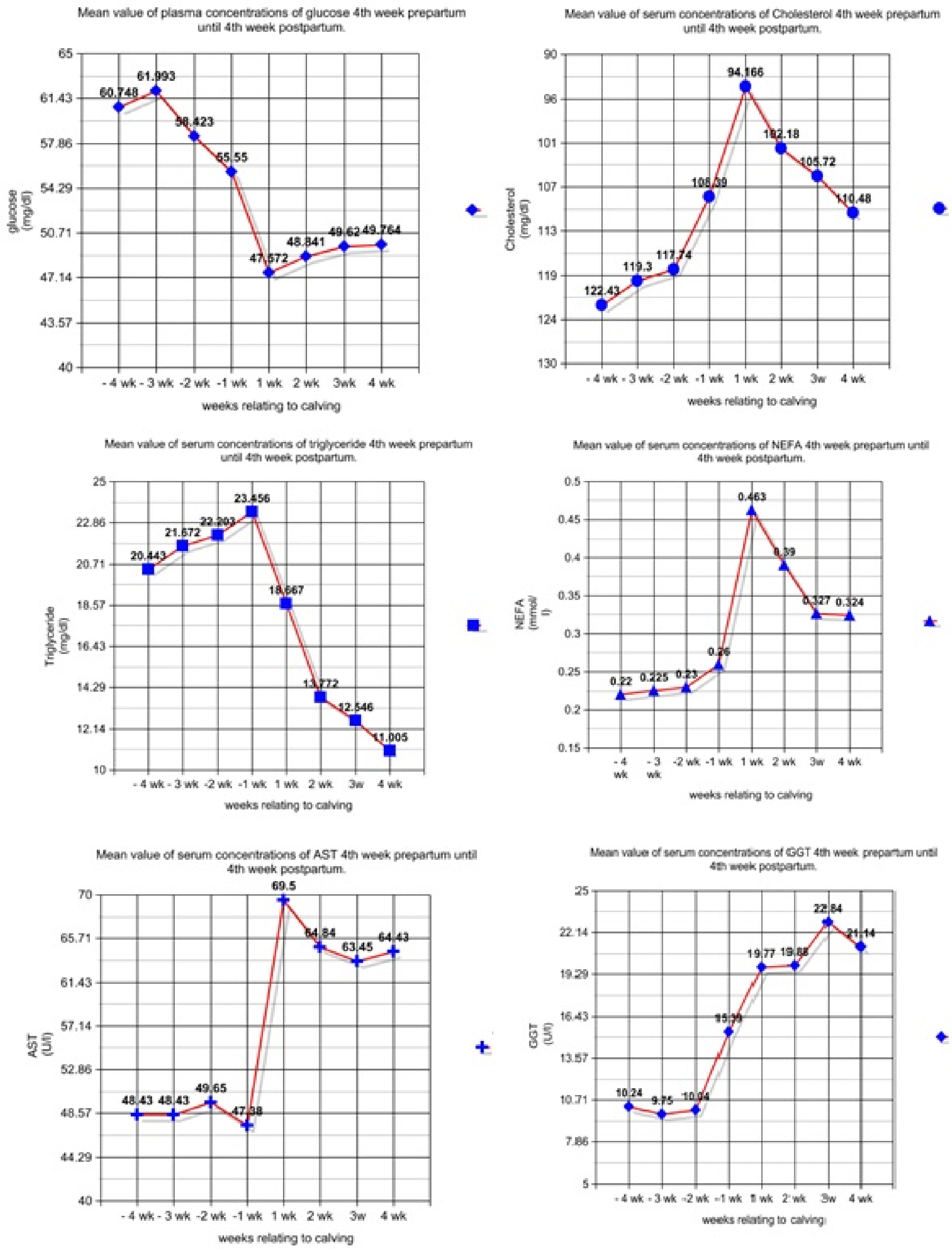

Fig. 1: Changes of different blood parameters mean value during transitional phase

to milk production requirement (Drackley *et al*., 2001) therefore, glucose level was assumed as an index of energy situation, in transition cows.

The increased demand of steroid hormone to face the fetal tissue requirement and the maternal glands is considered the primary cause to decrease the serum total cholesterol concentration in last phase of pregnancy in dairy cattle (Pysera and Opalka, 2000).

The fat content of cow's milk diverge from less than 3% to more than 6%, depending on breed and the phase of lactation. Milk fat is principally composed of triglycerides (97-98%), therefore the uptake by the mammary gland for the milk fat production during the course of lactation is properly the main cause in triglyceride concentration reduction post calving (Džidić, 1999).

When the parturition approaches, a gradual fall in DMI might leads to steady elevation in plasma NEFA levels (Bertics *et al*., 1992); with the increased demand on energy to sustain parturition and lactogenesis requirements, lipomobilization is must and elevation in NEFA level in blood will ensue (Grum *et al*. 1996).

Liver enzymes activities showed changes from 1-week pre-calving period with subsequent gradual decrease henceforth in the current investigation, these changes also described elsewhere (Seifi *et al*., 2007), AST activity showed significant decrease at day 22 pre-calving and increased gradually to reach highest peak at day 21 postpartum. However, ALT activity showed approximately 30% increase in postpartum period when compared to dry-off period, and the level gradually increased until week 6 of lactation (Klebaniuk *et al*., 2009). GGT level showed gradual increase from 1 week pre-calving and continue henceforward (Mikula *et al*. 2008). GGTP activity is a valuable test of hepatocellular damage and could be an indicator of hepatic disorders in the cows and its activity in plasma may rise at energy deficiency (Rico *et al*., 1977). These changes can support the notion of fat mobilization usually accompanied with liver function disruption.

In the present study, Total protein and albumin concentrations tended to decrease significantly after parturition. The reduction in Albumin level with the subsequent decrease in total protein level explained in different hypothesis. Reduction of albumin production by the liver, the rise in the degree of albumin catabolism, dilution in the serum by an increase in blood volume, or an increase in the albumin loss into the gut or extravascular fluids including milk, were the most common explications (Little, 1974).

Conclusions

The present investigation clarified alterations in different blood metabolites during transition phase. These compulsory modifications in highly producing dairy cattle develop due to negative energy equilibrium, which occur in three periods: in late gestation, in the beginning of lactation, and during ailments. Strict inspection and care of dairy cattle in this period is required to ovoid development of metabolic disorders.

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