

METABOLIC PROFILE OF DAIRY ANIMALS UNDER FIELD CONDITIONS IN HISAR DISTRICT OF HARYANA

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ABSTRACT

The present study was undertaken to assess the metabolic profile of dairy animals under field conditions from some villages in and around Hisar district of Haryana state. A total of 146 apparently healthy lactating and/or pregnant dairy animals viz. cattle (n=19) and buffaloes (n=127) were selected from unorganized dairy sector. Of these, 120 animals were in different phases of lactation viz. early (n=33), mid (n=58) and late (n=29) lactation while 26 were non-lactating, dry and/or pregnant animals. These animals were either irregularly or not at all supplemented with mineral mixture in the feed. The serum samples collected from these animals were analyzed for estimation of total calcium, inorganic phosphorus (Pi), magnesium, glucose, total proteins, albumin, globulins, A:G, triglycerides, total cholesterol, aspartate aminotransferase (AST), blood urea and creatinine. Major biochemical findings were hypocalcaemia and hypermagnesaemia. Other biochemical parameters were within normal reference range. No significant difference was observed in the mean values of serum biochemical parameters of cattle and buffaloes except for significantly higher level of serum albumin and AST and lower total cholesterol level in buffaloes than those in cattle. Total cholesterol, AST and blood urea levels were significantly higher in lactating animals than those in non-lactating animals. Amongst the animals in different stages of lactation, serum Pi level was significantly higher in animals in early lactation followed by mid and late lactation. It is concluded that the dairy animals from unorganized sector in and around Hisar are nutritionally adequate and healthy except for hypocalcaemia and hypermagnesaemia which may be corrected by regular supplementation of balanced mineral mixture in feed of animals.

Key words: Dairy animals, field conditions, Hisar, metabolic profile, unorganized sector

Metabolic profile testing is an invaluable tool to assess the nutritional and physiological status of dairy animals in modern dairy husbandry. With raising awareness about dairy husbandry, the progressive dairy farmers are more cautious about the health and productivity of their animals and feeding as per the recommended guidelines. However, under field conditions, the majority of dairy animals from unorganized sector are fed as per available feedstuffs with farmers, without considering the productivity and reproductive performance of animals. Therefore, it is imperative to know the nutritional status of dairy animals under field conditions, so as to feed them as per their physiological status and to improve their productive and reproductive performances. Body weights and body condition scoring systems are the traditional methods used to assess nutritional status of animals but these methods have several limitations. However, more accurate assessment of nutritional status of animals can be made by analysis of blood metabolites (Ndlovu *et al.*, 2007). The present study was thus undertaken to evaluate the blood metabolites in order to assess the nutritional status of dairy animals under field conditions in and around Hisar district of Haryana state.

MATERIALS AND METHODS

Selection of Animals: A total of 12 villages (Ludas, Siswala, Rawalwas Kalan, Dheeranwas, Hindwan, Rawalwas Khurd, Kaimari, Mangali, Satrod Kalan, Ghirai, Rajli and Kirmara) in and around Hisar district of Haryana state were selected for collection of blood samples from lactating and/or pregnant dairy animals. The animal owners at these places were also enquired about the frequent metabolic disorders encountered in dairy animals. A total of 146 apparently healthy lactating and/or pregnant dairy animals viz. cattle (n=19) and buffaloes (n=127) were selected from unorganized dairy herds. Out of these, 120 animals were in different phases of lactation viz. early (n=33), mid (n=58) and late (n=29) lactation while 26 were non-lactating, dry and/or pregnant animals. The average milk yield in lactating animals was 9 liters/day/animal. These animals were fed as per the feedstuffs available with the farmer and the feed was either irregularly or not at all supplemented with mineral mixture.

Blood Sampling and Processing: The blood samples were collected in vials without anticoagulant and the serum samples harvested were kept at -20°C till analysis. These samples were analyzed for certain serum

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biochemical parameters of metabolism/function (Table 1) using fully automated random access clinical chemistry analyzer (EM Destiny 180, Erba Diagnostics Mannheim GmbH).

Statistical Analysis: The data generated was analyzed statistically by independent samples t-test or one-way analysis of variance (ANOVA) using statistical software package (SPSS 16.0).

RESULTS AND DISCUSSION

As per the information gathered from animal owners regarding various metabolic disorders encountered in dairy animals (n=146), parturient paresis (23.2%) was found to be the most frequent metabolic disorder followed by ketosis (17.8%). The serum metabolic profile of dairy animals is depicted in Table 2. Major biochemical findings were hypocalcaemia and hypermagnesaemia. Other biochemical parameters were within normal reference range. These findings suggest an adequate energy and protein metabolism of dairy animals with normal liver and kidney function tests. The mineral metabolism of dairy animals was found altered. Maurya and Singh (2015) also observed hypocalcaemia in dairy buffaloes under field conditions which may be the cause of parturient paresis; the major metabolic disorder encountered in dairy animals in the study area. Hypermagnesaemia is usually associated with parturient paresis in dairy animals where low serum calcium levels are present (Radostits *et al.*, 2007) which corroborates with our findings. Hypocalcaemia with hypermagnesaemia observed in the present study might be due to either irregular or lack of provision of mineral mixture in feed of animals.

Serum Metabolic Profile of Cattle vs Buffaloes: No significant (P<0.05) difference was found in the mean values of serum biochemical parameters of cattle and buffaloes except for albumin, total cholesterol and aspartate aminotransferase (AST) levels as depicted in

Table 2. Serum albumin and AST levels in buffaloes were significantly (P<0.05) higher than those of cattle while serum total cholesterol level was significantly (P<0.05) lower in buffaloes as compared to cattle. Plasma proteins, including albumin, are in a state of equilibrium with amino acids and tissue proteins. Albumin is synthesized by the liver and functions to maintain the osmotic pressure within the circulatory system. Decreased albumin levels have been reported as characteristics of liver disease, kidney disease, inflammatory conditions, and malnutrition (Lager and Jordan, 2012). AST is an enzyme that is expressed in many tissues, particularly in liver and cardiac muscle and its increased activity is a sensitive marker of liver damage, even if the damage is of a subclinical nature (Stojevic *et al.*, 2005). Hyperalbuminaemia and elevated transaminases have been associated in patients on high protein diets combined with high intensity exercise (Mutlu *et al.*, 2006). Similarly, higher levels of albumin and AST activity in the serum of buffaloes might be due to feeding of high protein diets and heavy build as compared to cattle. Blood lipids are fundamental for the synthesis of milk fat (Kaneko, 2008). The main sources of this fat are triglycerides, phospholipids, cholesterol esters (part of the total cholesterol) and bloodstream non-stratified fatty acids (NEFA) derived from lipolysis (Tripathi *et al.*, 2010). Lower serum total cholesterol levels in buffaloes might be due to excessive utilization in synthesis of milk fat as buffaloes' milk has higher fat content as compared to cow's milk (Menard *et al.*, 2010).

Serum Metabolic Profile of Lactating vs Non-Lactating Animals: No significant (P<0.05) differences were observed in the mean values of serum biochemical parameters of lactating and non-lactating animals except for total cholesterol, AST and blood urea as depicted in Table 3. Serum total cholesterol, AST and urea levels in lactating animals were significantly (P<0.05) higher than those of non-lactating, dry and/or pregnant animals. The serum total cholesterol levels are minimal following calving and get build up as the lactation progresses (Rowland *et al.*, 1980). Higher serum cholesterol levels in lactating animals as compared to non-lactating, dry and/or pregnant animals might be a physiological adjustment to meet the lactation requirements. Similar findings have also been reported in dairy buffaloes by other workers (Nath *et al.*, 2005; Hagawane *et al.*, 2009). Lactation has a significant impact on blood biochemical parameters of dairy animals, reflecting the metabolic demands. Amongst all, the activity of

Table 1
Metabolic profile components

Metabolism/Function	Serum biochemical parameters
Mineral metabolism	Total calcium (mg/dl), inorganic phosphorus (Pi; mg/dl), magnesium (mg/dl)
Energy metabolism	Glucose (mg/dl), triglycerides (mg/dl), total cholesterol (mg/dl)
Protein metabolism	Total proteins (TP; mg/dl), albumin (Alb.; mg/dl), globulins (mg/dl), A:G, urea (mg/dl)
Liver function	Aspartate aminotransferase (AST; U/L)
Kidney function	Urea (mg/dl), creatinine (mg/dl)

Table 2
Serum metabolic profile of dairy animals (Mean±S.E.)

Serum biochemical parameter	Cattle vs Buffalo		Total dairy animals (n=146)	Normal reference range	Reference
	Cattle (n=19)	Buffalo (n=127)			
Total calcium (mg/dl)	7.05±0.38	7.55±0.13	7.48±0.12	9.7-12.4	Radostits <i>et al.</i> (2007)
Inorganic phosphorus (mg/dl)	5.08±0.36	4.85±0.11	4.88±0.11	5.6-6.5	
Magnesium (mg/dl)	3.33±0.29	3.54±0.10	3.51±0.10	1.8-2.3	
Glucose (mg/dl)	47.24±2.88	45.75±1.14	45.94±1.05	45-75	
Total protein (mg/dl)	6.67±0.45	6.98±0.11	6.94±0.11	6.2-8.2	The Merck Veterinary Manual (2005)
Albumin (mg/dl)	3.14±0.19 ^a	3.45±0.04 ^b	3.41±0.04	2.8-3.9	
Globulin (mg/dl)	3.53±0.29	3.52±0.07	3.52±0.07	2.9-4.9	
A:G	0.97±0.06	1.02±0.02	1.01±0.01	H ⁺ 1.0	
Triglycerides (mg/dl)	13.73±2.75	13.55±0.74	13.57±0.73	0-14	Radostits <i>et al.</i> (2007)
Cholesterol (mg/dl)	161.95±20.38 ^a	110.54±4.05 ^b	117.23±4.60	65-220	
AST (U/L)	80.35±8.02 ^a	144.39±4.03 ^b	136.06±4.06	78-132	
Blood urea (mg/dl)	26.06±3.91	28.63±1.20	28.30±1.15	12.84-57.78	
Creatinine (mg/dl)	1.25±0.05	1.36±0.02	1.34±0.01	1-2	

Value with different superscripts differ significantly (P<0.05) for a parameter in a row

aminotransferases in blood is very important and changes in their levels in the blood are a consequence of their increased activity in cells. During early lactation, the AST activity has been recorded to be maximum with gradual decrease in its value in the blood as the lactation advances and the lowest during the dry period (Stojevic *et al.*, 2005). The present findings also reflect the similar pattern with higher serum AST levels in lactating as compared to non-lactating, dry animals that can be explained on the basis of increased physiological stress during early lactation. Serum urea has been considered to be the most common metabolite for monitoring protein status and intake of dairy animals (Radostits *et al.*, 2007). Higher serum urea levels in lactating animals as compared

to non-lactating animals might be due to higher protein intake associated with practice of more concentrate feeding in lactating animals.

Serum Metabolic Profile of Lactating Animals in Different Phases of Lactation: Even amongst lactating animals in different phases of lactation, no significant (P<0.05) differences were found in the mean values of serum biochemical parameters except for inorganic phosphorus (Pi) as depicted in Table 3. Serum Pi level was found significantly (P<0.05) higher in animals in early lactation followed by mid and late lactation. However, these levels are within normal reference range. Higher serum Pi level in early lactation might be due to mobilization of phosphorus from bones under

Table 3
Comparative serum metabolic profile of dairy animals with respect to lactation (Mean±S.E.)

Serum biochemical parameter	Non-lactating vs. Lactating		Lactating animals in different phases of lactation		
	Non-lactating (n=26)	Lactating animals (n=120)	Early lactation (n=33)	Mid-lactation (n=58)	Late lactation (n=29)
Total calcium (mg/dl)	7.52±0.30	7.47±0.14	7.21±0.26	7.58±0.20	7.56±0.30
Inorganic phosphorus (mg/dl)	4.68±0.28	4.92±0.12	5.32±0.23 ^a	4.85±0.16 ^{ab}	4.61±0.26 ^b
Magnesium (mg/dl)	3.93±0.24	3.42±0.11	3.23±0.23	3.44±0.15	3.60±0.20
Glucose (mg/dl)	42.04±2.08	46.79±1.19	45.30±2.09	47.16±1.78	47.73±2.52
Total protein (mg/dl)	6.66±0.25	7.00±0.12	7.10±0.23	6.92±0.19	7.04±0.22
Albumin (mg/dl)	3.37±0.12	3.43±0.05	3.45±0.10	3.42±0.83	3.45±0.09
Globulin (mg/dl)	3.38±0.15	3.56±0.08	3.64±0.16	3.49±0.13	3.58±0.84
A:G	1.00±0.04	1.01±0.02	1.00±0.04	1.03±0.03	1.00±0.04
Triglycerides (mg/dl)	14.96±1.35	13.27±0.84	15.36±1.52	12.36±1.04	12.72±2.18
Cholesterol (mg/dl)	76.34±6.68 ^a	126.09±5.07 ^b	136.39±9.52	125.16±7.15	116.24±10.85
AST (IU/L)	109.70±8.66 ^a	141.77±4.42 ^b	142.11±10.15	146.51±5.89	131.92±7.99
Blood urea (mg/dl)	22.08±2.39 ^a	29.65±1.28 ^b	32.54±2.53	28.40±1.77	28.84±2.69
Creatinine (mg/dl)	1.31±0.04	1.35±0.21	1.31±0.04	1.35±0.02	1.41±0.04

Value with different superscripts differ significantly (P<0.05) for a parameter in a row

physiological stress of lactation which is replenished during later part of lactation when feed intakes are higher. In contrary, Hagawane *et al.* (2009) found lower Pi level in early lactation in dairy buffaloes as compared to healthy control without significant changes in different phases of lactation.

From the present study, it can be concluded that the dairy animals from unorganized sector in and around Hisar are nutritionally adequate and healthy except subclinical hypocalcaemia and elevated magnesium levels in blood which may be corrected by regular supplementation of balanced mineral mixture in the feed of animals. Albeit, variations in some biochemical parameters were present with respect to species, lactation and phases of lactation but these were within normal reference range.

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