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ANALYSIS OF BLOOD BIOCHEMICAL PROFILES OF DAIRY COWS AND THEIR CALVES FROM BULGARIAN BROWN CATTLE BREED

Atanaska Teneva[1], Georgi Stoimenov[2], Kalin Hristov[2], Tsvetoslav Koynarski[3], Alexandar Stoimenov[2]

[1]University of Forestry, Faculty of Agronomy, Sofia, Bulgaria
[2]University of Forestry, Faculty of Veterinary Medicine, Sofia, Bulgaria
[3]Trakia Universiy, Faculty of Veterinary Medicine, Stara Zagora Bulgaria
E-mail: nas15@abv.bg

ABSTRACT

Present study was conducted to analyze the blood biochemical parameters of a total 271 Bulgarian Brown Cattle Breed and their calves. We evaluated the activities of aspartate aminotransferase (ASAT), alanine aminotrans-ferase (ALAT), alkaline phosphatase (ALP), acid phosphatase (ACP), albumin (Alb), total protein (TP), creatin-phosphokinase (CPK), total lipid (TL), calcium (Ca), ceruloplasmin (CP) in their serum. The cows was 2–12 years old, mean body weight 600 kg and the calves 1–9 months old. The cows were held in an intensive farm breeding premises. Their meal consisted of ordinary alfalfa, silage, hay and concentrates with energy and protein supplements. The Student t-test showed a significant difference ($P < 0.05$) in mean of the ASAT, ALAT, ALP, ACP, Alb, TP, TL, Ca, Cp between cows and calves of the breed. Mean values of the Alb, TP, CPK, Cp and Ca was higher in cow group than in calves group ($P < 0.05$), while ASAT, ALAT, ALP, ACP, TL was lower in cow in comparison to the calves group ($P < 0.05$).

Key words: blood, biochemical parameters, ASAT, ALAT, ALP, Cp, calves.

Introduction

Animals nutritional status is with big importans and is a basic measure of health and productivity of animals. Conventional and common methods to assess nutritional status of animals include: Body weights and body condition scoring system. Initially Payne et al. (1970) did test of metabolic profiles by analyzing biochemical parameters in the blood of animals to identify nutritional problems. Approximately two decades after, Payne and Payne (1987) showed the indicators of blood enzymes that is a great contribution to veterinary medicine: alanine aminotransferase (ALT) and aspartate aminotransferase (AST). After that use of blood metabolites in assessing nutritional status of cattle is becoming popular (Maurya & Singh 2015). In the modern standards of milk production, the priority in cattle breeding is keeping dairy cows in high milk productivity and healthy. The control of their feeding, metabolic and biochemical status is equally important for the health of the herd in the health control system. Blood metabolic profile tests are simple and cost-effective biochemical tests which are mostly used to identify nutritional and/or management challenges in dairy cattle herds, but they also can be used to find clinically health animals, but with hidden problems like low production performance, reproductive diseases and/or long calving intervals and other subclinical diseases. Fatty liver syndrome in dairy cows is often associated with high AST activities (Cebra et al., 1997), low appetite and the appearance of ketosis during early lactation (Steen, 2001). Raised AST activity in the serum is a sensitive marker of liver damage, even if the damage is of a subclinical nature (Meyer & Harvey, 1998). The other liver enzyme-ALT do not show high activity in pig, horse and ruminant liver cells, and the increased activity of that enzyme in the serum during liver damage,

even in necrosis, is negligible (Forenbacher, 1993). Calcium and phosphorus are important micro-elements and they have reserves in bones, while the magnesium reserve is low and has no primary hormonal response for the compensation (Larsen et al., 2001). Calcium works as a cofactor or activator of various enzyme systems. Disturbance in calcium and phosphorus ratio has been associated with subnormal fertility and anestrus conditions (Moddie, 1965). Ceruloplasmin is a plasma α-2 glycoprotein. This enzyme plays an important role in copper transport in the blood stream (95% of copper in animals) and iron metabolism (ferroxidase) (Floris et al., 2000; Lóvstad et al., 2006). Copper improves immune function by acting on the levels of various enzymes mediating the antioxidant system. Ceruloplasmin mediates the transport of copper by the enzymes lysyl oxidase and Cu-Zn superoxide dismutase, which play a role in tissue repair, and it plays a role in the antioxidant system. It also protects cells against oxidative damage. Phagocytosis and antimicrobial activity decrease if serum ceruloplasmin levels fall. As a result, the need for this enzyme increases in inflammatory conditions (Cerone et al., 2000).

Materials and Methods

A total of 271 Bulgarian Brown Cattle Breed (2–12 years old, mean body weight 560 kg) and their calves (1–9 months old) farmed in Sud Bulgaria, were used for this study. They fed the same diet and maintained under the same management regime. Diet was composed of good-quality concentrate mixture (oats 23%, corn 36%, barley 38%, and mineral supplements 3%). About 2.5 kg/animal of concentrate was distributed twice daily and water was available without restraint. The concentrate was formulated to meet the requirements of milk cows based on the recommendations of the National Research Council. Their health status was evaluated based on a thorough clinical exam. All animals were kept under natural photoperiod and environmental temperature.

Blood sampling were conducted at 8.00 am prior to feeding. Jugular vein was punctured using 21G 1½ needles and blood was collected in vacutainer tubes (BD Vacutainer® Plus Plastic Serum Tubes) with spray-coated silica, used for biochemical determinations in serum. The samples were centrifuged at 1200 g for 10 min. The serums were then transferred to Eppendorf tubes and stored at − 20°C until analysis. Serum samples were analysed within a maximum period of two weeks. All samples were tested for following blood biochemical parameters – ASAT, ALAT, ALP, ACP, Alb, TP, CPK, TL, CP and Ca, using fully auto chemistry analyzer BS-240 (Mindray, China).

Statistical analysis was performed using the SPSS®(SPSS 19, IL, USA) software program.

Results

The results of variation of the biochemical parameters in cow of the Bulgarian Brown Cattle Breed and calves (F1) of the same breed are presented in Table 1 and Table 2. Figure 1 presents a variation statistical analysis of bio-chemical test data from the two experimental groups. The Student t-test showed a significant difference ($P < 0.05$) in mean of the ASAT, ALAT, ALP, ACP, Alb, TP, TL, Ca, CP between cows and calves of the breed. Mean values of the Alb, TP, CPK, CP and Ca was higher in cow group than in calves group ($P < 0.05$), while ASAT, ALAT, ALP, ACP, TL, was lower in cow in comparison to the calves group ($P < 0.05$).

Table 1: Blood biochemical parameters in cows Bulgarian brown cattle breed

	N	Minimum	Maximum	Mean ± SE	Variance	Merck´s	Vet.medicine 10 Ed
ASAT (U/L)	271	43.30	102.60	72.73 ± 0.64*	110.255	60–125	78–132
ALAT (U/L)	271	18.63	84.00	46.08 ± 0.69*	130.153		11–40
ALP (U/L)	271	15.47	106.00	34.96 ± 0.99*	267.905	18–153	0–500
ACP (U/L)	271	1.51	9.77	5.11 ± 0.11	3.566		
Alb (g/L)	271	14.40	54.30	37.0 ± 0.40*	3.7	25–38	21–36
TP (g/L)	271	31.00	99.20	81.8 ± 0.60*	10.720	67–75	57–81
CPK (U/L)	271	16.21	118.12	58.58 ± 1.19*	386.391	0–350	35–280
Cp (mg/dl)	271	11.17	65.47	23.60 ± 0.27*	19.867		
TL (g/L)	271	3.50	8.22	5.79 ± 0.48	61.260		
Ca (mmol/L)	271	3.00	13.62	6.01 ± 0.13*	4.661	2.0–2.8	2.43–3.10

** p<0.05 ASAT: aspartate aminotransferase; ALAT: alanine aminotransferase, ALP: alkaline phosphatase; ACP: acid phosphatase; Alb: albumin; TP: total protein; CPK: creatine phosphokinase; Cp: ceruloplasmin; TL: total lipids; Ca: calcium*

Table 2: Blood biochemical parameters in calves (F1) Bulgarian brown cattle breed

	N	Minimum	Maximum	Mean ± SE	Variance	Merck´s	Vet. medicine 10 Ed
ASAT (U/L)	271	46.90	106.80	75.60 ± 0.67*	122.93	60–125	78–132
ALAT (U/L)	271	17.43	82.80	49.55 ± 0.67*	120.02		11–40
ALP (U/L)	271	14.60	95.33	50.48 ± 1.37*	509.54	18–153	0–500
ACP (U/L)	271	1.17	9.93	5.34 ± 0.13	4.67		
Alb (g/L)	271	15.70	61.71	32.81 ± 0.41*	0.53	25–38	21–36
TP (g/L)	271	26.00	98.11	75.9 ± 0.70*	1.20	67–75	57–81
CPK (U/L)	271	8.37	112.97	52.65 ± 1.28*	441.84	0–350	35–280
Cp (mg/dl)	271	8.87	31.00	18.94 ± 0.32*	28.32		
TL (g/L)	271	4.22	7.95	5.83 ± 0.51	70.66		
Ca (mmol/L)	271	2.50	11.80	4.59 ± 0.09*	2.22	2.0–2.8	2.43–3.10

** p<0.05 ASAT: aspartate aminotransferase; ALAT: alanine aminotransferase, ALP: alkaline phosphatase; ACP: acid phosphatase; Alb: albumin; TP: total protein; CPK: creatine phosphokinase; CP: ceruloplasmin; TL: total lipids; Ca: calcium*

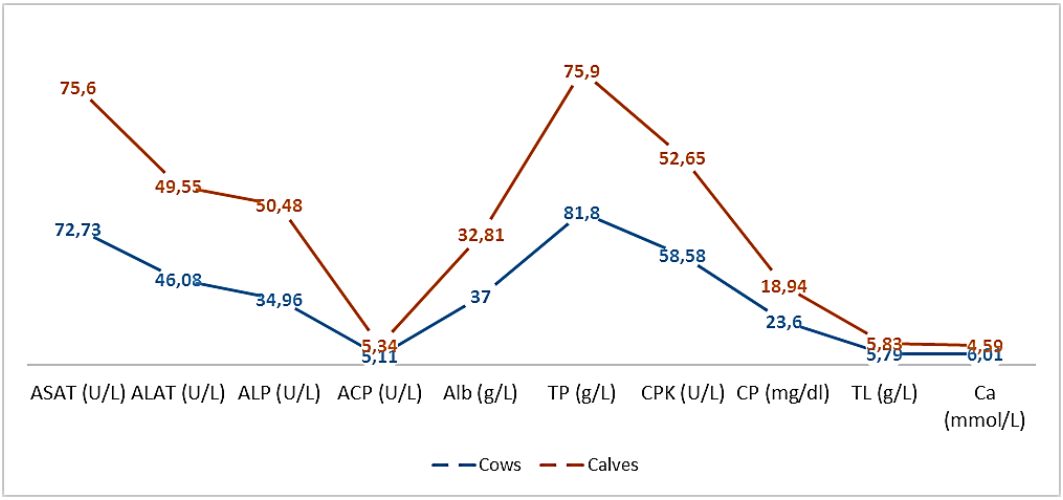

Figure 1: Variation statistical analysis of biochemical test data from the two experimental groups

Discussion

In our study total protein level was slightly higher ($P < 0.05$) in cows (81.8 ± 0.60 g/L) than that of calves (75.9 ± 0070 g/L), even in cows the values slightly exceed the reference limits. To a large extent, the level of total protein depends on the diet of the animals. Previous study (Roussel et al., 1982) showing in Jersey cows, total protein levels increased with age over a range of one to six years. So age is an important consideration in the interpretation of serum proteins. Albumin in cows and calves were 37.0 ± 0.40 (g/l) and 32.81 ± 0.41 (g/l) respectively. The lower values in calves are explained by that level was lower at birth and then increased, but fluctuate somewhat. The levels of albumins and proteins are connected with body mass and nutrition (Roil et al., 1974). Body proteins and anabolic and katabolic processes of protein metabolism are always in a state of dynamic balance. The anabolic role of testosterone in protein metabolism could result in raising the level in the blood. The mean values of ASAT, ALP, ACP in this study are in the reference values (Radostits et al., 2007). However, individual animals showed lower or higher values than those from other studies (Keneko et al., 1997). All of these enzymes have predominantly intracellular activity, therefore, in healthy animals, serum activity is very low or absent, and any increase is indicative of impairment and disruption of normal biochemical processes in tissues. ASAT is present in the cytoplasm and mitochondria, so its activity is increased mainly by cellular necrosis and a lower amount of cell mem-brane damage. ALP serum activity is higher in young animals than in adults and decreases with age, which is confirmed by other studies (Klinkon & Jezek, 2012). ALP activity is high in calves after birth, then decreases and remains stable until 60 days of age, later decreases slightly (Knowles et al., 2000). In adults, ALP activity can increase with increased activity of osteoblasts as well as acute and chronic liver diseases (especially cholestatic hepatopathies) and bone diseases.

Calcium levels were established, respectively, of 6.01 ± 0.13 mmol/L and 4.59 ± 0.09 mmol/L in cows and calves. It is clear that cows have a higher calcium level than calves, but in both groups it is slightly higher from the reference range. Higher calcium in blood serum in cows versus calves can be explained by bone deposition of more calcium in the growing young calf organism, and that the cow group includes both lactating and dry animals. In lactating cows, a lower level of calcium

is normally found, due precisely to milk production (Shil et al., 2012). Increased Calcium levels in both groups in the refence range is may be due to diet compositions.

Ceruloplasmin levels in cows and calves' groups was 23.60 ± 0.27 mg/dl and 18.94 ± 0.32 mg/dl respectively. Body condition score, the most important indicator of the body's energy balance, is one of the most important factors playing a role in the change in the amount of oxidative stress, which is, therefore, reported to cause changes in ceruloplasmin levels (Talukder et al., 2015). Serum ceruloplasmin levels in cows with endometritis which were not known before were significantly higher in the presence of endometritis, and the severity of endometritis plays an important role in this increase (Kaya et al., 2016).

Conclusion

It is in general consensus that a complete biochemical parameters are an important and powerful tools to monitor response to therapy, and the severity of illness. It is also concluded that traditional methods for assessment of cow's and calves' nutritional status should be combined with their blood biochemical profiles. Although, according to the results of this study, where all measured values are within the norm in both groups, comparison of the biochemical profile of patients with the reference values should always be made taking into account not only to the same age but to the same line or breed. Routine laboratory analyses of blood biochemical profile can help reduce financial losses significantly by facilitating early diagnosis of diseases.

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