

Blood biochemical profiles of dairy cows and their calves from Bulgarian Black and White Cattle Breed

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Abstract

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This study examined the activities of aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), alkaline phosphatase (ALP), acid phosphatase (ACP), albumin (Alb), total protein (TP), creatin-phosphokinase (CPK), total lipid (TL), calcium (Ca) in the plasma of 304 dairy Holstein breed cows and their calves. 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 significant difference ($P < 0.05$) in mean of the ASAT, ALAT, ALP, ACP, Alb, TP, TL, Ca between cows and calves of the breed. Mean values of the ASAT, ALAT, Alb, TP, TL and Ca was higher in cow group than in calves group ($P < 0.05$), while ALP and ACP was lower in cow in comparison to the calves group ($P < 0.05$).

Keywords: blood; biochemical parameters; ASAT; ALAT; ALP; CP; calves

Introduction

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. It is known that highly productive animals compared to those who produce less are in a more or less negative energy status. The priority for high milk production is prevention of different metabolic diseases and other disorders. The first test of metabolic profiles by analyzing biochemical parameters in the blood of animals was introduced by Payne et al. (1970) to identify nutritional problems. Later Payne and Payne (1987) showed the indicators of blood enzymes that is a great contribution to veterinary medicine: aspartate aminotransferase (AST) and alanine aminotransferase (ALT).

Over the years, many authors have examined the blood indicators, and in various literature sources, the data presented vary from different factors (lactation, breed, age and others). Referent animals are difficult to select and because blood reference values and their variations are often unknown, results are often contradictory (Tainturier et al., 1984).

Determining AST activities in dairy cows is most often connected with fatty liver syndrome (Cebra et al., 1997), low appetite and the appearance of ketosis in dairy cows during early lactation (Steen, 2001). Increased AST activity in the serum is a sensitive marker of liver damage, even if the damage is of a subclinical nature (Meyer & Harvey, 1998). Unlike AST, horse, pig, and ruminant liver cells do not show high ALT activity, and the increased activity of that enzyme in the serum during liver damage, even in necrosis, is insignificant (Forenbacher, 1993).

Materials and Methods

Animals

Three hundred four Bulgarian Black and White cattle breed cows (2–12 years old, mean body weight 650 kg) and their calves (1–9 months old) farmed in Sud Bulgaria, were used for this study. All animals were clinically healthy. Their health status was evaluated based on a thorough clinical exam. All animals were kept under natural photoperiod and environmental temperature. All cows were fed a constant diet 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 ad libitum. The concentrate was formulated to meet the requirements of milk cows based on the recommendations of the National Research Council.

Blood sampling and analysis

Blood samples were collected at 8.00 am prior to feeding from jugular vein using 21G 1½ needles in vacutainer tubes (*BD Vacutainer® Plus* Plastic Serum Tubes) with spray-coated silica, used for biochemical determinations in serum. Serum was obtained following a centrifugation,

stored at 4–6°C and transported to the laboratory for 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, Caby semi-auto chemistry analyzer BA-88A (Mindray, China).

Statistical analysis was performed using SPSS 19.0.

Results

The results of variation of the biochemical parameters in cow of the Bulgarian Black and White 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 biochemical test data from the two experimental groups

The Student t-test showed significant difference ($P < 0.05$) in mean of the ASAT, ALAT, ALP, ACP, Alb, TP, TL, Ca between cows and calves of the breed (Figure 2). Mean values of the ASAT, ALAT, Alb, TP, TL and Ca was higher in cow group than in calves group ($P < 0.05$), while ALP and ACP was lower in cow in comparison to the calves group ($P < 0.05$)

Table 1. Blood biochemical parameters in cows Bulgarian Black and White cattle breed

	N	Minimum	Maximum	Mean ± SE	Vc %	Merck's	Vet.medicine 10 Ed
ASAT (U/L)	304	64.8	169.2	104.69* ± 1.09	18.14	60–125	78–132
ALAT (U/L)	304	26.17	103.2	54.39* ± 0.79	25.24		11–40
ALAT (U/L)	304	13.67	61.67	31.28* ± 0.51	28.29	18–153	0–500
ACP (U/L)	304	1.2	14.47	5.79* ± 0.13	40.07		
Alb (g/L)	304	20.00	50.40	38.20* ± 0.50	21.73	25–38	21–36
TP (g/L)	304	68.00	116.00	89.50* ± 0.40	7.82	67–75	57–81
CPK (U/L)	304	15.93	277.33	68.53 ± 1.68	42.68	0–350	35–280
TL (g/L)	304	1.95	8.25	4.96* ± 0.62	21.99		
Ca (mmol/L)	304	1.40	5.75	3.04* ± 0.05	27.96	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; TL: total lipids; Ca: calcium

Table 2. Blood biochemical parameters in calves (F1) Bulgarian Black and White cattle breed

	N	Minimum	Maximum	Mean ± SE	Vc %	Merck's	Vet.medicine 10 Ed
ASAT (U/L)	304	33.7	118.80	78.55 ± 0.85	18.96	60–125	78–132
ALAT (U/L)	304	15.63	334.90	35.50 ± 1.25	61.32		11–40
ALP (U/L)	304	23.73	146.00	73.95 ± 1.30	30.62	18–153	0–500
ACP (U/L)	304	1.50	37.50	6.35 ± 0.17	46.93		
Alb (g/L)	304	12.00	84.00	31.4 ± 0.05	27.39	25–38	21–36
TP (g/L)	304	53.30	100.30	74.70 ± 0.05	10.58	67–75	57–81
CPK (U/L)	304	27.23	128.40	68.69 ± 1.24	31.52	0–350	35–280
TL (g/L)	304	2.07	8.19	4.60 ± 0.55	21.02		
Ca (mmol/L)	304	1.40	5.65	2.77 ± 0.04	26.71	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; TL: total lipids; Ca: calcium

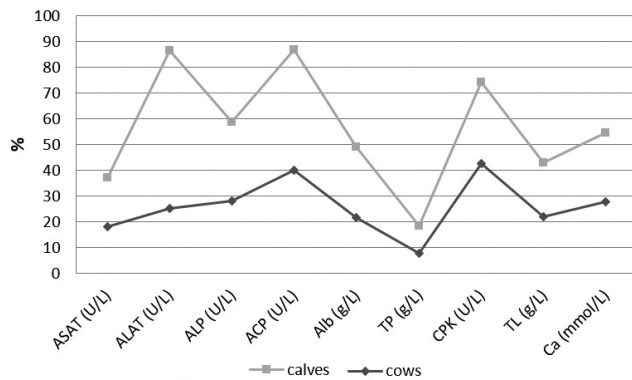


Fig. 1. Variance analysis on biochemical parameters in cows and calves from Bulgarian Black and White breed

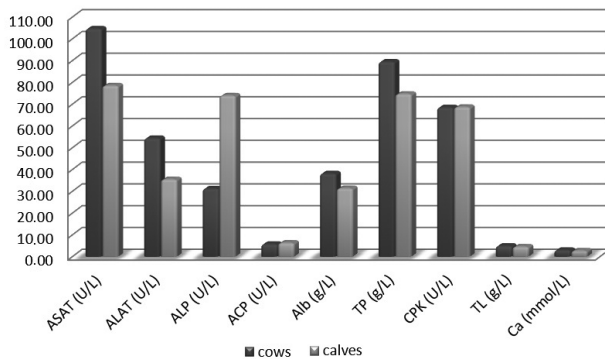


Fig. 2. Differences of biochemical parameters between cows and calves from Bulgarian black and white cattle breed (Student t-test)

Discussion

Calcium levels were established, respectively, of 3.04 ± 0.05 mmol/L and 2.77 ± 0.04 mmol/L in cows and calves. It is clear that cows have a slightly higher calcium level than calves, but in both groups it is within 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)

In our study total protein level was significantly higher ($P < 0.05$) in cows (89.50 ± 0.40 g/L) than that of calves (74.70 ± 0.05 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 38.20 ± 0.50 (g/l) and 31.4 ± 0.05 (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 catabolic 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, ALAT, 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 membrane 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.

Conclusions

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. 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.

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