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The metabolic profile of Simmental service bulls

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ABSTRACT

The levels of biochemical parameters in the blood serum of Simmental service bulls were studied. The research was conducted on twelve bulls at the age of four to seven. The blood was taken on four occasions by needle biopsy from the vena jugularis externa. In the samples of blood serum, the activities were specified of alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma glutamyl transferase (GGT), creatine-kinase (CK) and concentrations of the total proteins, albumins, calcium and magnesium, triglycerides and cholesterol. Since there are no data concerning bulls, the results obtained were compared with data from literature on cows. The levels of total proteins, albumins, GGT and CK in the serum of the examined bulls are higher than in cows, while the levels of AST and magnesium are lower. The levels of triglycerides, cholesterol and calcium are almost equivalent. The differences observed indicate the necessity of establishing referential rates for biochemical parameters in bulls as opposed to cows. The results obtained will be useful in routine diagnostics as the metabolic profile of Simmental bulls.

Key words: metabolic profile, service bulls, blood serum

Introduction

The role of clinical biochemistry in veterinary medicine is increasing for diagnostics and also for the treatment of disease. Numerous biochemical tests of blood and other body fluids of domestic animals have been performed to determine normal (reference) values and to determine deviations from normal values and specify the therapy. Over the years these tests have shown a significant variability in the chemical composition of blood serum among species, breeds and also between the sexes of one breed of domestic

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animals. Plasma has on average 5-7% proteins, which would be 50-70 g/L. Among proteins albumin is represented in serum with 35-50% of total protein (KANEKO et al., 1997). Albumins are indicators of the metabolic status of animals and are in close relation to body weight and nutrition (ROIL et al., 1974), and also with the amount of nitrogen taken, which will be used for further synthesis of body proteins. Their role in the body is the regulation of colloid-osmotic pressure and transport function. Hyperalbuminaemia is usually associated with dehydration and hypoalbuminaemia with liver-, kidney-, gastrointestinal diseases and blood or plasma loss (KANEKO et al., 1997). Serum albumin concentration in cows is influenced by their physiological stage. It has been proven that albumin concentration in the serum decreases just after calving (PAYNE and PAYNE, 1987). Some enzymes, especially alanine aminotransferase (ALT), aspartate aminotransferase (AST) are good indicators of serum protein deficiency which is a result of changes in functions in specific organs (PAYNE and LAWS, 1978). In the liver, AST, ALT and GGT (gamma glutamyl transferase) show high activity and are most often determined if there is a suspicion of acute and chronic liver disease. Determining AST and GGT 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 (KAUPPINEN, 1984; MEYER and HARVEY, 1998). GGT is good indicator of hepatobiliary diseases. Its activity in serum is higher when the epithelia of the bilious channels in the periportal regions are damaged, in necrotic changes of bile channels, bile obstruction, cholangiohepatitis, cirrhosis, fatty liver, etc. (KRAMER and HOFFMANN, 1997). Creatine-kinase (CK) is enzyme related to muscles and its activity will be elevated in changes to the skeletal muscles (PAYNE and PAYNE, 1987). Calcium is an important mineral in maintaining homeostasis in the organism. The roles of calcium include muscle contraction, blood coagulation, some enzyme activity, neural excitability and hormone secretion. Calcium, together with inorganic phosphorus, shares a very important function in organ growth, especially bones, and is very important in milk production (STOJEVIĆ et al., 2002). The reference value of blood calcium concentration in cattle is 2.80 mmol/L (ROSOL and CAPEN, 1997). Daily variations of the mineral are not of significant importance, while seasonal variations are possible and connected with nutrition (PAYNE and PAYNE, 1987). The most calcium is lost during lactation. Apart from in milk, calcium is also lost with urine and especially in animals with a simple stomach (PAYNE and PAYNE, 1987). Calcium concentration is under the control of parathyroid hormone and calcitonin, and changes in concentration of this mineral in the blood could be related to metabolic changes, as well as nutrition. The physiological role of magnesium may be seen inside and outside cells. Inside cells this mineral influences protein, carbohydrate and fat metabolism, transfer of metil-groups, oxidative phosphorylation, as part of all enzymes related to ATP, the function and stability of membranes, cell division, immune

response and maintaining normal potassium level. Outside the cells magnesium works as an antagonist to calcium. Hypomagnesaemia can have a serious outcome, because there is no direct homeostatic control, and magnesium deficiency is very quickly seen in the blood (STOJEVIĆ et al., 2003). Stress during animal testing may also cause an instant drop in serum magnesium level, especially in animals near the stage of hypomagnesaemia (PAYNE and PAYNE, 1987). Determining the level of this mineral is of great importance for ruminants changing to green forages rich in potassium which inhibit absorption of magnesium. ROMO et al. (1991), in their experiments on cattle, found a rise in magnesium blood concentration during calving, which is most probably the result of active bone resorption. FRERKING (1979) found average concentration 0.91 mmol/L (0.62-1.23 mmol/L), and concludes that magnesium concentration in cows varies physiologically (0.91-1.07 mmol/L). Triglycerides are a basic form of fat reserves in the body. Their solubility is lower than fatty acids, so triglycerides must connect to proteins to form transport complex of lipoproteins. Hyperlipemia comes in diabetes, obstructive icterus, nephrosis and thyroidal hypofunction. Hypolipemia starts in cases with hyperthyroidism, malabsorption, inadequate nutrition, liver diseases and hypolipoproteinemia (BRUSS, 1997). Cholesterol is precursor of the steroid hormones, vitamin D and bilious acids and is part of cell membrane. It could be found only in animal bodies, in esterified (60-80% cholesterol in blood) or non esterified form, but always binds on lipoproteins. As could be seen, the composition of blood serum in cows has been fully investigated, and some reference values are given (Table 1), but there is very little data about the biochemical composition of bulls' blood serum.

In this study, the values of the basic biochemical parameters in the blood serum of Simmental bulls were investigated. Setting up reference values would bring better knowledge of the health status of other bulls, better prophylactics, diagnostics and treatment of illness for those animals.

Materials and methods

Tests are conducted on 12 breeding Simmental bulls from the Centre for Animal Reproduction barns in Križevci. The bulls were from 4 to 7 years old. All the bulls were kept in boxes with the outside open part and fed by a standard diet. Blood samples were taken 4 times in late autumn and during the winter. The blood was taken with sterile needles, by biopsy of the vena jugularis externa in Vacutainer SST tubes with gel, without anticoagulant. Blood samples were centrifuged at 1250×g., by spectrophotometric measurements using the "Helios Delta Vis Spectrophotometer", enzymes in serum were determined: ALT, AST, GGT, CK, total proteins, albumins, calcium, magnesium, triglycerides and cholesterol. All the above biochemical parameters were determined by using a commercial kits of reagents ("Herbos Dijagnostika d.o.o.", Sisak, Croatia). To

determine the activity of AST, ALT, GGT and CK in the serum, the method of continued measurements was used. Triglycerides and cholesterol were tested using the colour-enzyme (PAP) method, total proteins by the biuret method, magnesium and albumins by the colorimetric method, and calcium by the complexometric method. Results were statistically expressed calculating the mean, standard deviation, standard error and coefficient of variability. For that purpose Microsoft Excel 2002 software was used (Microsoft Corporation 1985-2001).

Table 1. Biochemical composition of serum in clinical healthy cows (referable values) from different authors'

Author	Biochemical parameters		Concentrations/activities
Payne and Payne, (1987)	Albumin		35 g/L
	Calcium		2.37 mmol/L
	Magnesium		1.03 mmol/L
Kaneko et al. (1997)	Calcium		2.43-3.10 (2.78 ± 0.15) mmol/L
	Magnesium		0.74-0.95 (0.84 ± 0.1) mmol/L
	Albumin		30.3-35.5 (32.9 ± 1.3) g/L
	AST		78-132 (105 ± 27) U/L
	ALT		11-40 (27 ± 14) U/L
	GGT		6.1-17.4 (15.7 ± 4.0) U/L
	Creatin-kinase		4.8-12.1 (7.4 ± 2.4) U/L
	Total protein		67.4-74.6 (71.0 ± 1.8) g/L
	Triglyceride		0-0.2 mmol/L
	Cholesterol	Esterified	1.5-2.28 (1.89 ± 0.39) mmol/L
		Stable	0.57-1.35 (0.96 ± 0.39) mmol/L
		Total	2.07-3.11 mmol/L
Frerking, (1979)	Magnesium		0.91 mmol/L

Results

Research results are presented in Table 2.

Table 2. Values of the biochemical parameters in breeding bulls' serum

	Alb. g/L	Total proteins g/L	Trigl. mmol/L	Total chol. mmol/L	AST U/L	ALT U/L	GGT U/L	CK U/L	Ca mmol/L	Mg mmol/L
n	47	47	39	46	47	45	47	40	44	45
M	40.81	85.16	0.20	2.39	51.55	27.26	24.22	54.38	2.40	0.81
SD	3.85	6.31	0.06	0.54	10.44	6.37	3.83	16.86	0.40	0.14
2SD	7.7	12.62	0.12	1.08	20.88	12.74	7.66	33.71	0.80	0.28
mM	0.56	0.92	0.01	0.08	1.52	0.95	0.56	2.67	0.06	0.02
CV%	9.44	7.40	30.65	22.41	20.26	23.38	15.83	31.00	16.84	17.16

n - number of samples, M - mean, SD - standard deviation, mM - mean error of mean value, CV - coefficient of variability

Discussion

As mentioned in the introduction, there is no data about the metabolic profile of bulls. For the comparison referable values for cows were taken form literature. As is obvious from the table, most values for breeding bulls are similar to those found in literature although the data are for cows. Little difference was found from the results collected from breeding bulls to those found for cows. Concentrations of total proteins (85.16 ± 6.31 g/L), albumins (40.81 ± 3.85 g/L) and activities of both GGT (24.22 ± 3.83 U/L) and CK (54.38 ± 16.86 U/L) in the serum of the breeding bulls were higher than in cow serum, while AST activity (51.55 ± 10.44 U/L) was lower. The discrepancies in the results for some biochemical parameters could be explained by production use of the animals and nutrition. The amount of albumins and proteins is closely connected with body mass and nutrition (ROIL et al., 1974), and total digested nitrogen which will be used for further body protein synthesis. Body proteins with half life, and anabolic and katabolic processes of protein metabolism are always in a state of dynamic balance. We can conclude from this that body mass will have a considerable role in protein metabolism and will influence their concentration in blood. The anabolic role of testosterone in protein metabolism could result in raising the level in the blood. Large muscular mass will also influence the activity of CK in the blood, so elevated concentrations in the serum could also be explained by that fact. In this research differences were determined in values for specific biochemical parameters in bull serum compared to cows. Determining the signification of that difference would have no value. Data for cows were taken from literature. They are two different production groups. Concentrations of biochemical parameters for cows

are subject to lactation and pregnancy influence (STOJEVIĆ et al., 2002) while for bulls it is expected that there will be no significant changes in values. The results of this research will be used for the determination of health, and metabolic, and nutritional status. The measured values could be an indicator of the metabolic profile for breeding Simmental bulls, taking into consideration the number of animals, number of data, and also sampling over a longer time period.

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SAŽETAK

U radu su istražene razine biokemijskih pokazatelja u krvnom serumu rasplodnih bikova simentalske pasmine. Istraživanje je provedeno na 12 bikova u starosti od četiri do sedam godina. Krv je uzimana u četiri navrata punkcijom jugularne vene. U uzorcima krvnoga seruma određene su aktivnosti alanin-aminotransferaze (ALT), aspartat-aminotransferaze (AST), gama glutamil-transferaze (GGT), kreatinske-kinaze (CK) i koncentracije ukupnih proteina, albumina, kalcija, magnezija, triglicerida i kolesterola. Budući da ne postoje podatci koji se odnose na bikove, dobiveni rezultati uspoređeni su s podatcima iz literature koji se odnose na krave. Razine ukupnih proteina, albumina, GGT i CK u serumu istraživanih bikova više su nego u krava, dok su razine AST i magnezija niže. Razine triglicerida, kolesterola i kalcija su gotovo jednake. Uočene razlike upućuju na prijeku potrebu uspostavljanja referentnih vrijednosti biokemijskih pokazatelja za bikove, neovisno o onima za krave. Postignuti rezultati bit će korisni u rutinskoj dijagnostici kao metabolički profil bikova simentalske pasmine.

Ključne riječi: metabolički profil, rasplodni bikovi, krvni serum