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Some Blood Biochemical Parameter Values in a Herd of American Bison (*Bison bison* L.) from an Experimental Animal Farm in Poland

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The blood samples of 17 bison (7 cows, a heifer, a young bull and 8 calves) formed the basis for conducting analyses of blood plasma. The measurements were carried out by using ionoselective electrodes aided by a Hitachi 917 biochemical analyser. An interpretation of the results was possible due to comparison with the results of similar analyses completed in the United States. Many differences in blood chemistry values in bison bred at Kurozwęki were found in comparison to bison from the US.

Key words: Blood chemistry, American bison, *Bison bison*.

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Farm husbandry of animals which until recently have lived in the natural environment is becoming more and more popular around the world. In Poland, the most common animals raised in animal husbandry are: deer, boar and pig-boar. This type of farming is not limited to native species only. In 2000, the husbandry of American bison (*Bison bison* L.) started in Poland. The introduction of this species to Poland was very controversial, since Poland is a leading country in the recovery of the European bison (*Bison bonasus* L.). The opponents of the import of the bison to Poland claim that cross-breeding of these two species is risky. The supporters emphasize the economic benefits of bison breeding. It gives the opportunity to use areas of poor agricultural value and does not require the building of any special shelters. Research confirms that bison demonstrate a very good ability to adjust to difficult climatic and environmental conditions (BLOOD 2000). In winter, these animals are able to lower their metabolism, and their wool-like fur is excellent insulation against freezing temperatures (even down to –30°C). The bison is able to digest low-protein and high-fibre fodder (BLOOD 2000). Their basic diet includes grass, sedge, tree leaves and shrub branches. It was demonstrated that if the protein level equals 8% or less, then buffalo use fodder nutrients 5-13% more efficiently than cattle (FEIST 2000).

The first European farms of this species were established in the 1980s. Currently, such animal husbandries are *inter alia* in: Belgium, Finland, France, Germany, Switzerland and the United Kingdom. The bison farm founded in Kurozwęki in Poland, is experimental, hence, there is a need to gather information concerning the behaviour, nutrition, breeding and physiological disorders.

The contents of blood plasma components are one of the best indicators of the physiological state and condition of the animals. Therefore, biochemical tests were carried out and the level of individual elements in the blood plasma of the bison from Kurozwęki was determined. Our results were compared with the results of American researchers.

Material and Methods

The test materials were the blood samples of 17 bison (7 cows, 1 heifer, 1 young bull and 8 calves)

sampled in November 2007. Blood was taken from the left zygomatic vein. The blood samples, their preparation and storage was conducted in compliance with the procedure provided by the laboratory of the Jagiellonian University in Kraków. The analysis was carried out by means of ionoselective electrodes (ISE method) using the Hitachi 917 biochemical analyzer. The advantage of this method is that it allows the quantification of the concentration of only the free ionized (not connected with other components of the biological fluid) fraction of the marked ions. In the samples the level of the following substances was quantified: glucose, total protein, albumin, bilirubin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase, urea (BUN), creatinine, lactate dehydrogenase (LDH), iron (Fe), magnesium (Mg), phosphorus (P), calcium (Ca) and ionized calcium, sodium (Na), potassium (K), and chlorides (Cl). It should be emphasized that these blood analyses of the American bison were performed in Poland for the first time.

In order to compare our results with the results of American researchers, their results were converted to the units which are currently used in Poland and are in agreement with the SI standards (SI 2006). The original results of the American authors can be found in their publications.

Results and Discussion

Results of the blood chemistry are presented in Table 1 and Table 2.

Blood tests are very helpful in the diagnosis of metabolism disorders and animal nutrient deficiencies, in wild animals in particular (BORJESSON *et al*. 2000). The contents of the components of plasma depend, among other factors, on: age, sex, health, physiological state, stress, season of the year and type of food (KEITH *et al*. 1978; HAWLEY & PEDEN 1982; VESTWEBER *et al.* 1991). Sodium, potassium, chlorine are very important components. Na and K ions create the so called 'sodium and potassium pump'. All three elements, among others, maintain the acid-alkaline balance and the required osmotic pressure in the organism. They also regulate water metabolism, activate many enzymes and are indispensable for the paunch's bacterial development. As no tests were carried out on bison regarding the effects of deficiency of these elements, there are some suggestions in the literature that bison would demonstrate similar reactions as those of other big ruminants, i.e. cattle. Cattle, with sodium deficiency, give less milk and eat less fodder. Potassium deficiency causes diarrhoea and significant muscle weakening. Chlorine is used as a component of hydrochloric acid in the

Table 1

Serum biochemical data for adult ranched bison in Kurozwęki

Value	1 heifer	2 bull	3 cow	4 cow	5 cow	6 cow	7 cow	8 cow	9 cow	Mean for cows
Glucose mmol/l	5.2	5.0	7.1	7.6	6.6	5.0	7.0	4.0	4.7	6.0
Total protein g/l	53.0	62.0	82.0	78.0	74.0	69.0	79.0	58.0	70.0	72.9
Albumin g/l	23.0	24.0	38.0	36.0	37.0	33.0	34.0	23.0	32.0	33.3
Bilirubin umol/l	2.6	2.9	4.3	4.0	6.6	5.4	4.4	4.3	4.1	4.7
AST U/l	80.2	102.0	133.5	124.9	156.2	117.2	141.4	96.6	97.5	123.9
Alkaline phosphatase U/l	71.0	67.0	71.0	82.0	73.0	92.0	71.0	47.0	61.0	71.0
BUN mmol/l	6.5	9.8	6.0	5.8	7.0	4.5	5.2	5.8	7.7	6.0
Creatinine µmol/l	174.5	141.5	221.8	67.0	196.3	43.5	252.9	189.6	267.5	176.9
LDH U/l	1603.0	1867.0	1795.0	2195.0	2184.0	1856.0	1731.0	266.0	288.0	1473.6
Ca mmol/l	1.6	2.1	2.46	1.96	2.26	2.07	2.28	1.85	2.22	2.2
P mmol/l	2.01	2.79	2.14	2.45	1.84	1.57	2.28	1.64	1.75	2.0
Na mmol/l	109.1	134.3	152.5	128.4	130.1	119.9	125.6	115.3	135.1	129.6
K mmol/l	4.8	6.3	7.0	117.9	5.6	0.9	5.9	4.9	5.6	6.6
Cl mmol/l	80.0	91.0	116.0	95.0	88.0	89.0	91.0	83.0	102.0	94.9

Table 2

Serum biochemical data for young ranched bison in Kurozwęki

Value	10 calf	11 calf	12 calf	13 calf	14 calf	15 calf	16 calf	17 calf	Mean for calves
Glucose mmol/l	4.7	6.6	7.2	5.3	3.3	5.1	5.3	5.1	5.33
Total protein g/l	55.0	58.0	75.0	69.0	55.0	61.0	63.0	49.0	60.63
Albumin g/l	32.0	32.0	41.0	38.0	30.0	36.0	33.0	32.0	34.25
Bilirubin umol/l	4.6	2.6	5.7	3.8	3.6	5.4	3.7	3.4	4.10
AST U/l	95.4	80.4	101.0	93.7	85.6	112.8	100.6	132.5	100.25
Alkaline phosphatase U/l	195.0	186.0	209.0	212.0	118.0	179.0	165.0	371.0	204.38
BUN mmol/l	6.6	5.1	8.1	8.7	5.8	6.3	9.0	6.6	7.03
Creatinine µmol/l	141.8	190.3	195.4	198.2	180.6	198.0	197.2	87.0	173.56
LDH U/l	2112.0	1656.0	2167.0	330.0	302.0	**330.0**	319.0	321.0	942.13
Ca mmol/l	2.03	1.99	2.61	2.32	1.95	2.16	2.00	1.98	2.13
P mmol/l	1.86	1.89	2.53	2.50	2.37	2.82	2.38	2.89	2.41
Na mmol/l	117.9	112.9	139.5	137.7	110.6	119.5	120.3	126.9	123.16
K mmol/l	5.7	5.9	5.5	5.8	5.1	6.9	6.8	7.2	6.11
Cl mmol/l	86.0	77.0	95.0	101.0	79.0	84.0	95.0	109.0	90.75

paunch and thus it affects nutrient absorption. Its deficiency mainly lowers the cattle growth index (MCDONALD *et al.* 2002). Calcium is one of the most abundant elements in the organism. It fulfils important functions in the process of blood coagulation, cell membrane transmission, muscle contraction (including myocardial contraction), the functioning of neurons and enzyme activation. As fodder is not rich in phosphorus, the animals are given a supplement. Together with calcium, phosphorus influences bone building and cell growth. It is also indispensable for the development of the paunch's bacterial flora. Magnesium is used in the metabolism of carbohydrates and fats, and it is a catalyst of over 300 enzymes.

One of the first tests of bison blood components was carried out in Kansas (MARLER 1975). The influence of fodder dosage on the blood parameters was also examined (KEITH *et al.* 1978). The blood components of bison kept on farms and those of free living bison were compared in 1990. The values of many parameters were similar in these two groups (SIKARSKIE *et al*. 1990). Another team of researchers (ZAUGG *et al.* 1993) carried out similar tests on bison living in the wild in Yellowstone National Park, but divided them into young and adult groups. The results obtained by SIKARSKIE *et al.* (1990) and ZAUGG *et al.* (1993) were compared with the results received from our bision from Kurozwęki. By analyzing the numbers in the Table 1, it was found that both the young and adult bison bred in Kurozwęki had a higher level of urea (according to SIKARSKIE 21.60 mg/dl for ranched bison and 17.15 mg/dl for free-ranging bison), bilirubin (according to ZAUGG 0.13 mg/dl for bulls and cows and 0.14 mg/dl for calves), alkaline phosphatase (according to ZAUGG 48.80 U/L for bulls, 55.60 U/L for cows and 60.00 U/L for calves), phosphorus (according to SIKARSKIE 6.50 mg/dl for ranched bison and 4.37 mg/dl for free-ranging bison) and AST (according to SIKARSKIE 109.95 IU/L for ranched bison and 80.40 IU/L for free-ranging bison). The level of glucose (according to ZAUGG 167.26 mg/dl for bulls, 278.09 mg/dl for cows and 347.11 mg/dl for calves), creatinine (according to ZAUGG 3.44 mg/dl for bulls, 3.03 mg/dl for cows and 3.29 mg/dl for calves), total protein (according to ZAUGG 8.08 g/dl for bulls, 8.07 g/dl for cows and 7.60 g/dl for calves, according to SIKARSKIE 7.14 g/dl for ranched bison and 7.46 g/dl for free-

ranging bison), albumin (according to ZAUGG 4.23 g/dl for bulls, 4.12 g/dl for cows and 4.48 g/dl for calves, according to SIKARSKIE 4.10 g/dl for ranched bison and 4.20 g/dl for free-ranging bison), sodium (according to ZAUGG 137.50 mEq/l for bulls, 142.52 mEq/l for cows and 141.69 mEq/l for calves, according to SIKARSKIE 7.14 mEq/l for ranched bison and 7.46 mEq/l for free-ranging bison) and chloride (according to ZAUGG 102.11 mEq/l for bulls, 104.46 mEq/l for cows and 102.87 mEq/l for calves, according to SIKARSKIE 105.90 mEq/l for ranched bison and 107.10 mEq/l for free-ranging bison) was lower than that of the US bison. The amount of potassium in the bision from Kurozwęki was similar to the amount of this element in the domestic bison from Michigan (according to SIKARSKIE 4.95 mEq/l for ranched bison and 5.57 mEq/l for free-ranging bison). However, compared to the wild bison from Yellowstone, it was significantly lower (according to ZAUGG 14.42 mEq/l for bulls, 11.70 mEq/l for cows and 13.00 mEq/l for calves). The results from the literature indicate that the increased activity of the intracellular AST enzyme is connected with organ cell damage (mainly, liver damage) and tissue damage (SIKARSKIE *et al.* 1990). Usually, the AST level is higher in animals living in the wild than in those which are bred in farms. The increased AST level can be caused by 'capture myopathy' syndrome, as found amongst a herd of Michigan bison (SIKARSKIE *et al.* 1990). The tests which were carried out in Kurozwęki demonstrated a relatively high AST level. As two cows out of that herd died, and the veterinary tests did not reveal a clear cause of death, it can be assumed that the 'capture myopathy' syndrome was the cause. VESTWEBER *et al.* (1991) determined the level of blood components in bison of different ages from the Konza Prairie in Kansas. Our comparison of the results obtained from the Kurozwęki bison and VESTWEBER *et al.* sample revealed that the total protein level had increased with age, however, the albumin level had not changed. This is natural and it is connected with the development of the immunological system. With aging, an increase in creatinine level and decrease in alkaline phosphatase level (an enzyme associated with osteoblast activity and physical development) was also noted. In contrast to the results for the Kansas bison, the glucose level had increased in the Kurozwęki bison. A dependency between age and decrease in potassium level was not found in the Kurozwęki bison.

Numerous factors, both of genetic and environmental nature (including stress and illness levels), as well differences in analysis methods can affect the obtained results of biochemical analyses (KEITH *et al.*1978).

The level of individual elements in blood plasma can signal diet deficiency and thus, it can be an indicator of correct nutrition. The Kurozwęki bison have lower levels of sodium, chlorine, calcium, magnesium and glucose in the blood plasma than the US bison. This may be caused by the limited variability of pastureland, excessive pasture exploitation and insufficient diet supplementation with farm fodder. The listed elements of the blood plasma were compared with the norms of the reference values for cattle (WINNICKA 2004). All the values specified for the bison were lower than in cattle, except for the glucose which exceeded the norms developed for livestock. The difficulties with shedding winter fur, diarrhoea and emaciation observed in certain animals could be the effect of the element deficiencies. The high level of phosphorus and urea could also be connected with the high protein level in the fodder (KEITH *et al.*1978). It should be emphasized that bison are more susceptible than cattle to a high protein content in fodder. Therefore, the fact that the phosphorus and urea contents for the bison from the Kurozwęki herd keep within the norms developed for cattle is not significant.

In light of the above results, routine blood plasma tests should be helpful in determining element deficiency in the diet and disease. They could also be useful for comparisons with other European bison stock farmers.

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