

BIOCHEMICAL VALUES IN THE BLOOD SERUM OF ZEBRAS KEPT IN THE EAST-BOHEMIAN ZOOLOGICAL GARDEN AT DVŮR KRÁLOVÉ NAD LABEM

J. POSPÍŠIL, P. ŠPÁLA, J. VÁHALA and F. KAŠE

East-Bohemian Zoological Garden, 554 01 Dvůr Králové nad Labem

Received October 6, 1986

Abstract

P o s p í š i l. J., P. Š p á l a, J. V á h a l a, F. K a š e: *Biochemical Values in the Blood Serum of Zebras Kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem. Acta. vet. Brno, 56, 1987: 181-193.*

Twelve clinically healthy Hartman's zebras (*Equus zebra Hartmannae*), 32 Grévy's zebras (*Equus Grevyi*), 4 female Chapmann's zebras (*Equus Burchelli Chapmanni*), 4 dammar zebras (*Equus Burchelli antiquorum*) and 19 Böh'm's zebras (*Equus Burchelli Boehmi*) were subjected to biochemical examination of their blood sera covering total and bound bilirubin, total protein, glucose, creatinine, urea, total lipid, triglyceride, cholesterol, magnesium, calcium, phosphorus, chloride, sodium, potassium, copper, zinc and iron level and alkaline phosphatase, AST and ALT aminotransferase and lactate dehydrogenase activity. In Hartmann's zebras and Grévy's zebras an assessment was made of the differences in blood serum biochemical values between females and males. In Böh'm's zebras, the differences in blood serum biochemical values between maneless zebras and the animals of the normal form were assessed.

In 13 zebras and 3 Shetland ponies the effects of immobilization on their blood serum biochemical values were examined. During immobilization marked increases were observed in the blood serum levels of glucose and triglyceride and a decline in potassium level. The remaining blood serum biochemical values showed little change.

*Biochemistry, blood serum, Equus zebra Hartmannae, Equus Grevyi, Equus Burchelli Chapmanni, Equus Burchelli antiquorum, Equus Burchelli Boehmi.*

A previous report from our laboratory (P o s p í š i l et al. 1985) was concerned with haematological values in the peripheral blood of clinically healthy zebras kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem. The present study gives the results of biochemical examination of the blood serum of zebras kept in the same zoological garden. Search for relevant published information revealed data on blood serum biochemical parameters of zebras in the reports by S e a l et al. (1977),

Table 1  
Survey of published information on blood serum biochemical values in zebras (□ = expressed in terms of SI units)

	VAN HEERDEN et al. (1985) E. ZEBRA ZEBRA		SEAL et al. (1977) a E. BURCHELLI BOEHMI			NELSON (1978) E. ZEBRA HARTMANAE			E. BURCHELLI	
	N	X̄ (SD)	N	X̄ (SD)	N	X̄ (SD)	N	X̄ (SD)	X̄ (SD)	X̄ (SD)
Total bilirubin μmol/l	11	69.45 ± 10.06	36	66.0 ± 0.9 7.326 ± 0.416	31	77.0 ± 1.2 4.884 ± 0.244	-	6.84 ± 1.71	6.84 ± 1.71	6.84 ± 3.42
Total protein g/l	-	-	30	-	31	-	-	10.21 ± 1.88	6.11 ± 1.66	8.05 ± 3.71
Glucose mmol/l	11	137.55 ± 16.46	-	-	-	-	-	2.32 ± 0.79	3.16 ± 0.99	3.16 ± 0.99
Creatinine μmol/l	11	5.70 ± 1.36	36	2.822 ± 1.112	31	3.194 ± 0.091	-	3.082 ± 0.699	2.952 ± 0.259*	3.418 ± 1.165
Urea mmol/l	-	-	35	3.651 ± 0.121	31	2.874 ± 0.069	-	-	-	-
Cholesterol μmol/l	-	-	41	1.504 ± 0.070	31	1.319 ± 0.060	-	-	-	1.052 ± 0.668
Alkaline phosphatase μkat/l	11	4.129 ± 1.092	33	1.670 ± 0.106	31	1.770 ± 0.100	-	1.870 ± 0.460	1.696 ± 0.601	4.342 ± 2.672
AST μkat/l	-	-	29	4.559 ± 0.233	31	3.924 ± 0.060	-	3.089 ± 0.584	4.342 ± 2.004	6.513 ± 3.841
LDH μkat/l	-	-	-	-	-	-	-	-	-	-
Magnesium mmol/l	10	0.85 ± 0.16	-	-	-	-	-	-	-	-
Calcium mmol/l	8	2.91 ± 0.16	37	2.719 ± 0.024	31	3.193 ± 0.039	-	2.744 ± 0.249	2.719 ± 0.074	2.694 ± 0.124
Phosphorus mmol/l	9	1.39 ± 0.17	37	1.614 ± 0.035	31	1.582 ± 0.071	-	1.356 ± 0.226	1.548 ± 0.104	1.517 ± 0.290
Chlorides mmol/l	11	102.45 ± 2.80	31	94.4 ± 0.78	31	93.0 ± 0.73	-	-	-	94.0 ± 4.0
Sodium mmol/l	11	140.55 ± 4.03	29	140.0 ± 0.65	31	138.0 ± 0.73	-	-	-	139.0 ± 3.5
Potassium mmol/l	10	5.64 ± 0.72	30	4.40 ± 0.09	31	6.20 ± 0.11	-	-	-	4.2 ± 0.3
Iron μmol/l	7	29.26 ± 12.50	-	-	-	-	-	-	-	-

The values reported by Seal et al. (1977) and Nelson (1978) were expressed by us in terms of SI units according to Jago and Bouda (1981).

Nelson (1978) and Van Heerden et al. (1985) as are summarized in Table 1 and the data obtained by D'Agostino (1974) on the basis of examination of two Grévy's zebras (*Equus Grevyi*), specifying the following levels: calcium, 2.74 - 2.86 mmol/l; chloride 104 - 112 mmol/l; magnesium, 1.25 - 1.39 mmol/l; phosphorus, 1.93 - 2.13 mmol/l; potassium, 3.42 - 3.62 mmol/l; and sodium, 135 - 154.5 mmol/l.<sup>+</sup>)

The object of our study was to obtain data from zebras of all species kept in the East-Bohemian Zoological Garden by methods used in the clinical laboratory, to obtain information on some parameters not specified by the aforementioned investigators and to conduct an exploratory study on changes in biochemical values of the blood serum of zebras during their immobilization.

## Materials and Methods

The animals examined were 12 Hartmann's zebras (*Equus zebra Hartmannae*), 7 females and 5 males; 32 Grévy's zebras (*Equus Grevyi*), 26 females and 6 males; 4 female Chapmann's zebras (*Equus Burchelli Chapmanni*); 4 dammar zebras (*Equus Burchelli antiquorum*), 2 females and 2 males; and 19 Böhm's zebras (*Equus Burchelli Boehmi*) that are kept in the East-Bohemian Zoological Garden in two forms: normal (7 females and 2 males) and maneless (8 females and 2 males).

Blood collections were made from the v. saphena medialis in healthy zebras more than two years of age. Before being blood-sampled, the zebras were immobilized by i.m. administration of IMOBILONE (Reckit and Colman, Pharmaceutical Division, Ireland) at the dose rate of 1.5 to 1.6 ml per animal. The months in which the blood collections were made are shown in Table 2.

Examination of biochemical changes in the blood serum after immobilization was made in 3 female Shetland ponies between 2 and 5 years of age and 13 zebras of various species aged 2 to 8 years. IMOBILONE (Reckit and Colman, Pharmaceutical Division, Ireland) was given to Shetland ponies and zebras by i.m. administration using 1.7 to 2.0 ml and 1.5 to 1.6 ml per animal, respectively. Intervals at which the animals were blood-sampled from the v. saphena medialis after IMOBILONE administration are shown in Tables 4 and 5. Blood samples from Shetland ponies before IMOBILONE administration were withdrawn from the v. jugularis.

Biochemical values were determined in the blood serum. The methods used can be divided into two groups. One group comprised techniques using kits supplied by LACHEMA, Brno, and carried out according to the producer's instructions. Spectrophotometric measurements were made with a PM2K OPTON spectrophotometer. In this way determinations were made of total and bound bilirubin, total protein, glucose, creatinine, urea, triglyceride, total lipid, cholesterol, chloride and phosphorus level and of alkaline, ALT and AST aminotransferase and lactate dehydrogenase activity. The other group of methods comprised techniques based on atomic absorption spectrophotometry. This approach was chosen for the determination of calcium, magnesium, potassium, sodium, iron, copper and zinc level. The spectrophotometer used was a PERKIN-ELMER 2380 and the measurements were made according to the producer's instructions. With both methods the validity of the results was checked by including samples of control sera (CALIBRATE, LABORDIAGNOSTICA, German Federal Republic).

Means ( $\bar{X}$ ) and standard deviations (SD) were computed from the

<sup>+</sup>) Expressed by the present authors in terms of SI units.

Table 2  
 Numbers of zebras blood-sampled for examination of their blood serum biochemical values in individual months

	No. animals	No. animals blood-sampled in individual months													
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
Hartmann's zebras <i>Equus zebra Hartmannae</i>	12	-	-	-	2	2	-	-	-	-	-	6	1	1	-
Grévy's zebras <i>Equus Gravyi</i>	32	-	1	4	1	1	4	7	9	5	-	-	-	-	-
Chapmann's zebras <i>Equus Burchelli Chapmanni</i>	4	-	-	-	1	2	1	-	-	-	-	-	-	-	-
Dammars zebras <i>Equus Burchelli antiquorum</i>	4	-	1	-	1	2	-	-	-	-	-	-	-	-	-
Böhm's zebras <i>Equus Burchelli Boehmi</i>	19	-	-	-	-	2	-	-	-	-	-	-	3	5	9

individual values obtained.

The significance of the agreement or differences of the variances of two computed mean values was assessed by the F-test (R o t h et al. 1962).

The significance of the agreement or differences of two computed mean values was assessed:

- (a) by Student's t-test; before applying this test, the agreement of the variances was assessed by the F-test at the 5% level of significance and a modification of the t-test was chosen accordingly (R o t h et al. 1962) and
- (b) by Wilcoxon's rank-order test (R o t h et al. 1962).

## Results

The blood serum biochemical values found in clinically healthy zebras of the individual species kept at the East-Bohemian Zoological Garden at Dvůr Králové nad Labem are shown in Table 3.

In the groups of Hartmann's zebras and Grévy's zebras a comparison was made between the values computed separately for females and males using Student's t-test. In Hartmann's zebras, the differences between females were not significant ( $P < 0.05$ ) and therefore the mean values for females and males in Table 3 were combined. In Grévy's zebras, significant differences between females and males were found in mean creatinine and cholesterol values (by 2.2 and 0.4% respectively) as can be seen from Table 3. In the remaining mean values the differences between females and males were not significant and these values for females and males were therefore combined for tabulation.

In Böhm's zebras the significance of the differences in the mean blood serum values between 9 animals of the normal form and 10 animals of the maneless was assessed by Student's t-test. Since the differences in the mean values between the two forms were not significant ( $P < 0.05$ ), the values obtained for these two forms of Böhm's zebra were combined.

Intramuscular administration of IMOBILONE produced a significant rise in glucose and triglyceride level and a fall in potassium level in the blood sera of both zebras and Shetland ponies. In zebras, it also produced a significant fall in chloride level. The remaining blood serum biochemical levels under study showed no significant changes during immobilization in either zebras or Shetland ponies (Tables 4 and 5). Examination of the changes in the variances of the values during immobilization revealed significant differences in some values compared with those found 10 minutes after IMOBILONE administration in zebras and compared with those recorded before immobilization in Shetland ponies (Table 6).

## Discussion

The question of handling animals before blood collection for clinical and laboratory examination was discussed previously (P o s p í š i l et al. 1985) and changes of haematological values in the peripheral blood of zebras, Shetland ponies and Cape buffaloes after i.m. administration of IMOBILONE were the subject of another report from our laboratory (P o s p í š i l et al. 1986). Since immobilization of zebras is a necessity, it was of interest to find to which extent it would affect their blood serum biochemical values. Our objective was only to assess the effect of immobilization on the mean values but also to find whether it might not produce changes in the variances

Table 3  
Blood serum biochemical values of zebras kept in the East Bohemian Zoological Garden at Dvůr Králové nad  
Labem

	E. ZEBRA HARTMANAE		E. GREVYI		E. BURCHELLI BOEHMI		E. BURCHELLI CHAPMANNI		E. BURCHELLI ANTIQUORUM	
	N	$\bar{X}$ (SD)	N	$\bar{X}$ (SD)	N	$\bar{X}$ (SD)	N	$\bar{X}$ (SD)	N	$\bar{X}$ (SD)
Total bilirubin $\mu\text{mol/l}$	10	3.257 ± 1.683	30	5.707 ± 2.650	18	4.133 ± 1.559	4	6.561 ± 2.882	4	4.782 ± 5.988
Bound bilirubin $\mu\text{mol/l}$	2	2.310 ± 1.550	17	4.827 ± 2.534	18	2.842 ± 0.890	4	5.012 ± 1.982	-	-
Total protein g/l	12	77.44 ± 16.75	31	69.16 ± 13.39	19	67.39 ± 7.71	4	74.00 ± 5.94	4	78.12 ± 11.22
Glucose mmol/l	12	7.831 ± 4.205	32	8.565 ± 3.315	18	9.800 ± 1.900	4	11.250 ± 3.662	4	5.162 ± 1.896
Creatinine $\mu\text{mol/l}$	12	191.5 ± 46.7	26	197.4 ± 28.3	19	242.4 ± 34.6	4	224.2 ± 19.2	4	192.2 ± 27.4
Urea mmol/l	12	4.790 ± 1.047	32	5.682 ± 1.634	19	6.670 ± 1.192	4	4.220 ± 0.907	4	4.763 ± 1.509
Total lipid g/l		3.033 ± 1.748		3.941 ± 1.406		5.077 ± 1.711		3.402 ± 0.298		2.785 ± 2.370
Triglycerides mmol/l	11	1.068 ± 0.797	16	1.161 ± 0.853	-	-	4	2.037 ± 0.421	4	0.905 ± 0.939
Cholesterol $\mu\text{mol/l}$	12	2.684 ± 1.310	26	3.271 ± 1.115	18	2.880 ± 0.284	4	2.854 ± 0.442	4	2.977 ± 1.845
Alkaline phosphatase $\mu\text{kat/l}$	9	2.426 ± 1.474	28	5.010 ± 3.301	3	2.231 ± 0.982	4	1.532 ± 0.243	4	1.152 ± 0.494
AST $\mu\text{kat/l}$	12	0.862 ± 0.314	32	0.925 ± 0.340	18	0.498 ± 0.226	4	1.003 ± 0.039	4	0.772 ± 0.173
ALT $\mu\text{kat/l}$	12	0.249 ± 0.202	32	0.292 ± 0.179	3	0.173 ± 0.101	4	0.110 ± 0.021	4	0.125 ± 0.046
LDH $\mu\text{kat/l}$	5	5.940 ± 0.730	11	11.116 ± 6.284	7	5.762 ± 0.984	4	4.543 ± 0.772	4	7.142 ± 6.617
Magnesium mmol/l	12	0.636 ± 0.156	32	0.781 ± 0.161	19	0.878 ± 0.204	4	0.600 ± 0.043	4	0.797 ± 0.033
Calcium mmol/l	12	2.370 ± 0.368	32	2.760 ± 0.382	19	2.702 ± 0.636	4	2.123 ± 0.154	4	2.477 ± 0.412
Phosphorus mmol/l	12	1.332 ± 0.475	32	1.258 ± 0.453	19	0.998 ± 0.158	4	0.942 ± 0.126	4	1.520 ± 0.701
Chlorides mmol/l	11	98.20 ± 8.71	32	96.71 ± 8.89	19	97.63 ± 12.63	4	87.02 ± 6.82	4	102.04 ± 10.71
Sodium mmol/l	8	140.3 ± 9.5	16	139.4 ± 12.8	-	-	4	135.0 ± 7.8	3	140.9 ± 3.7
Potassium mmol/l	8	5.248 ± 0.610	16	4.376 ± 0.545	-	-	4	4.557 ± 0.242	4	4.893 ± 0.603

Continuation of Table 3

Blood serum biochemical value	E. ZEBRA HARTMANAE		E. GREVYI		E. BURCHELLI BOEHMI		E. BURCHELLI CHAPMANI		E. BURCHELLI ANTIQUORUM	
	N	$\bar{x}$ (SD)	N	$\bar{x}$ (SD)	N	$\bar{x}$ (SD)	N	$\bar{x}$ (SD)	N	$\bar{x}$ (SD)
Copper $\mu\text{mol/l}$	7	11.41 $\pm$ 0.65	14	20.74 $\pm$ 3.42	-	-	4	23.72 $\pm$ 4.12	3	21.76 $\pm$ 4.17
Zinc $\mu\text{mol/l}$	7	33.34 $\pm$ 9.62	13	37.48 $\pm$ 12.53	-	-	4	58.62 $\pm$ 15.27	4	-
Iron $\mu\text{mol/l}$	7	22.60 $\pm$ 5.12	28	23.02 $\pm$ 6.42	19	41.26 $\pm$ 15.67	-	-	4	42.12 $\pm$ 26.12

Table 4  
 Biochemical changes in the blood serum of zebras after i.m. administration of IMOBILONE

Blood serum biochemical value	Time (in minutes) after administration of IMOBILONE								
	10			20			30		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Total protein g/l	13	85.65	12.35	13	80.15	8.69	13	77.61	8.75
Glucose mmol/l	13	7.569	2.799	13	$\Delta$ 9.476	2.635	13	$\square$ 11.738	2.930
Creatinine $\mu$ mol	13	207.6	36.8	13	209.5	36.6	13	211.6	38.6
Urea mmol/l	12	4.666	1.213	12	5.183	1.046	12	5.561	1.463
Total lipid g/l	12	2.516	0.589	12	2.483	0.705	12	2.375	0.607
Triglycerides mmol/l	12	0.608	0.167	12	$\Delta$ 0.811	0.191	12	$\square$ 1.001	0.245
Cholesterol mmol/l	11	3.390	0.651	11	2.972	0.512	11	3.136	0.443
Alkaline phosphatase $\mu$ kat	12	2.556	1.495	12	2.660	1.253	12	2.646	1.334
AST $\mu$ kat	13	0.723	0.118	13	0.690	0.132	13	0.686	0.115
ALT $\mu$ kat	13	0.254	0.232	13	0.176	0.134	13	0.169	0.150
Magnesium mmol/l	12	0.720	0.107	12	0.715	0.105	12	0.691	0.091
Calcium mmol/l	12	2.564	0.447	12	2.617	0.403	12	2.540	0.426
Phosphorus mmol/l	12	1.250	0.558	12	1.055	0.238	12	1.135	0.533
Chlorides mmol/l	13	96.20	5.85	13	94.66	2.88	13	$\Delta$ 92.80	3.85
Sodium mmol/l	12	136.8	7.7	12	138.0	10.6	12	134.9	8.1
Potassium mmol/l	12	4.432	0.686	12	3.925A	0.354	12	$\Delta$ 3.782A	0.359

N - No. animals examined;  $\bar{X}$  = mean value; SD = standard deviation.

x 0.000 x assessed by Student's t-test

$\square$  assessed by Wilcoxon's rank order test

$\Delta$  - difference as against the value obtained at 10 min significant  $\alpha \leq 1\%$

$\Delta$  - difference as against the value obtained at 10 min significant  $\alpha \leq (1.5)\%$



Table 5  
 Biochemical changes in the blood serum of Shetland ponies after i.m. administration of IMOBILONE

Blood serum biochemical value	Time (in minutes) after administration of IMOBILONE														
	before administr.						10			20			30		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	SD	$\bar{X}$	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Total protein g/l	3	80.66	7.02	3	86.33	4.04	3	4.04	3	76.66	6.80	3	81.00	3.46	
Glucose mmol/l	3	4.100	0.529	3	5.033	0.907	3	0.907	3	7.539	0.231	3	9.133	0.493	
Creatinine $\mu$ mol/l	3	100.0	9.5	3	105.6	9.0	3	9.0	3	103.0	13.2	3	108.3	11.6	
Urea mmol/l	3	7.200	1.509	3	8.600	0.435	3	0.435	3	7.966	0.577	3	8.233	0.757	
Total lipid g/l	3	1.866	0.208	3	2.333	0.251	3	0.251	3	1.800	0.264	3	2.066	0.513	
Triglycerides mmol/l	3	0.400	2.276	3	0.530	0.190	3	0.190	3	0.620	0.170	3	0.516	0.083	
Cholesterol mmol/l	3	3.100	0.458	3	2.966	0.152	3	0.152	3	3.200	0.264	3	3.100	0.400	
Alkaline phosphatase $\mu$ kat/l	3	2.870	0.787	3	3.096	0.685	3	0.685	3	2.796	0.457	3	2.390	0.480	
AST $\mu$ kat/l	3	0.656	0.066	3	0.696	0.023	3	0.023	3	0.650	0.043	3	0.663	0.056	
ALT $\mu$ kat/l	3	0.106	0.005	3	0.136	0.020	3	0.020	3	0.133	0.020	3	0.123	0.023	
Magnesium mmol/l	3	0.703	0.112	3	0.693	0.020	3	0.020	3	0.606	0.202	3	0.536A	0.087	
Calcium mmol/l	3	2.426	0.441	3	2.230	0.049	3	0.049	3	1.970	0.610	3	1.853	0.280	
Phosphorus mmol/l	3	1.743	0.076	3	1.690	0.060	3	0.060	3	1.650	0.045	3	1.676	0.128	
Chlorides mmol/l	3	86.26	0.97	3	82.66	3.78	3	3.78	3	85.13	1.20	3	82.56	4.80	
Sodium mmol/l	3	121.3	33.9	3	123.6	16.5	3	16.5	3	123.0	36.3	3	113.3	25.7	
Potassium mmol/l	3	4.403	0.251	3	4.309	0.395	3	0.395	3	3.616	0.772	3	3.520	0.455	

N = No. animals examined;  $\bar{X}$  = mean value; SD = standard deviation.

□ = difference as against the value obtained at 10 min significant at  $\alpha \leq 1\%$  assessed by Student's

Δ = difference as against the value obtained at 10 min significant at  $\alpha \leq (1, 5 > \%)$  t-test

Table 6

Evaluation of the agreement of the variances of the blood serum biochemical values in zebras and Shetland ponies after immobilization +

	Zebras		Ponies		
	Time in min after immobilizat.				
	20	30	10	20	30
Total protein	-	-	-	-	-
Glucose	-	-	-	∇5%	-
Creatinine	-	-	-	-	-
Urea	-	-	-	-	-
Total lipid	-	-	-	-	-
Triglycerides	-	-	-	-	∇5%
Cholesterol	-	-	-	-	-
Alkaline phosphatase	-	-	-	-	-
AST	∇5%	-	∇5%	∇5%	∇5%
ALT	-	-	-	-	-
Magnesium	-	-	∇1%	-	-
Calcium	-	-	∇1%	-	-
Phosphorus	∇1%	-	-	-	-
Chlorides	∇5%	-	Δ5%	-	Δ1%
Sodium	-	-	-	-	-
Potassium	∇5%	∇5%	-	Δ5%	-

+ Agreement of the variances was assessed by the F-test. The variance of the computed mean values were compared with those of the mean values obtained 10 min after IMOBILONE administration in zebras and with those of the mean values obtained before immobilization in Shetland ponies.

Statistical significance: - ....  $p > 5\%$ , 5% ....  $p \leq 5\%$

1% ...  $p \leq 1\%$

∇ = variance of the values less than in the compared sample.

Δ = variance of the value larger than in the compared sample.

of the individual values so that potential clinical use could be envisaged.

Immobilization before blood collection affects the animal essentially in three ways. First the animal is disturbed by man's approach beyond the safety distance. This is followed by muscular exercise of the animal in its attempt to escape. The third factor is the effect of the administered drug. This implies that blood collections from animals for clinical and laboratory examination are made on animals subject to stress and affected by pharmacological treatment.

Reaction to stress is accompanied by two major effects concerning the metabolism of glucose and lipids (Schröber 1985). Enhanced glucose levels observed in the present study in the blood sera of zebras and Shetland ponies can be regarded as a consequence of non-specific reaction to the load. Increased blood serum glucose levels at blood collection were observed in sheep by Gohary and Bickhard (1979) and in springboks by Gericke et al. (1978). Hofmayer et al. (1973) found that blood serum glucose levels of zebras that were at rest before immobilization were  $4.410 \text{ mmol/l}^+$  immediately after immobilization and  $10.54 \text{ mmol/l}^+$  one hour after immobilization, whereas in those stressed before immobilization he found  $7.832 \text{ mmol/l}^+$  immediately before immobilization and  $9.721 \text{ mmol/l}^+$  one hour after immobilization. Our results confirm the observations of Hofmayer (1973). These considerations also explain why the blood serum glucose levels found by us in zebras of several species are, for the most part, markedly higher than those reported for horses ( $5.49 \pm 0.77 \text{ mmol/l}$ ) by Sová (1979).

Blood serum levels of lipids and their products rise under stress depending on the rate of their mobilization and utilization (Schröber 1985). This mechanism may be made responsible, to a certain extent, for the rise of triglyceride level in the blood serum of immobilized zebras and Shetland ponies, but this explanation is in contradiction with the fact that their lipid levels showed only little change. The decline in potassium level in the blood serum of immobilized zebras is at variance with the observations of Gericke et al. (1978) who found a rise of blood serum potassium level in stressed springboks. To which extent the effects observed by us may have been due not only to stress but also to the administration of IMOBILONE remains undisclosed, but a possible pharmacological effect certainly deserves consideration.

The objective of our study was to find which biochemical parameters of the blood serum of animals are affected by immobilization to such an extent that their use for further clinical purposes would be problematic. The evidence suggests that caution is needed in interpreting the values for blood serum glucose, triglycerides and potassium. The remaining blood serum levels under study did not change during immobilization to an extent that would impair their validity for diagnostic purposes. From this point of view it is reasonable to recommend that blood collections should be made at standard intervals after immobilization.

**Biochemické hodnoty krevního séra zebra chovaných ve Východočeské zoologické zahradě Dvůr Králové nad Labem**

Bylo provedeno biochemické vyšetření krevního séra klinicky zdravých 12 zebra Hartmannové (*Equus zebra Hartmannae*), 32 zebra Grévyho (*Equus*

<sup>+</sup> Expressed in terms of SI units to make comparison easier.

*Grevyi*), 4 samic zeber Chapmannových (*Equus Burchelli Chapmanni*), 4 zeber damarských (*Equus Burchelli antiquorum*) a 19 zeber Böhmových (*Equus Burchelli Boehmi*). V krevním séru těchto zeber byl stanoven obsah celkového a vázaného bilirubinu, bílkovin, glukózy, kreatininu, močoviny, celkových lipidů, triglyceridů, cholesterolu, vápníku, fosforu, hořčiku, chloridů, sodíku, draslíku, mědi, zinku, železa a aktivita alkalické fosfatázy, aminotransferázy AST a ALT a laktátdehydrogenázy. V krevním séru zeber Hartmannové a zeber Grévyho byly hodnoceny rozdíly zjišťovaných biochemických hodnot v závislosti na pohlaví. V krevním séru zeber Böhmových bylo provedeno hodnocení zjištěných biochemických hodnot u zeber obyčejné formy a zeber bezhřívých.

U 13 zeber a 3 pony Shetlandských byl sledován vliv imobilizace na změny biochemických hodnot v krevním séru. Vlivem imobilizace se výrazně zvyšovala v krevním séru hladina glukózy, triglyceridů a snižovala hladina draslíku, ostatní sledované biochemické hodnoty se výrazně neměnily.

Биохимические величины кровяной сыворотки зебр, содержащихся в Восточночешском зоопарке Двур-Кралове над Лабой

Проводили биохимические исследования кровяной сыворотки 12 клинически здоровых зебр Гартманн (*Equus zebra Hartmannae*), 32 зебр Гревви (*Equus Grevyi*), 4 самок зебр Чапманна (*Equus Burchelli Chapmanni*), 4 дамарских зебр (*Equus Burchelli antiquorum*) и 19 зебр Бэме (*Equus Burchelli Boehmi*). В кровяной сыворотке приведенных животных определяли содержание общего и связанного билирубина, белков, глюкозы, креатинина, мочевины, общих липидов, триглицеридов, холестерина, кальция, фосфора, магния, хлоридов, натрия, калия, меди цинка железа и активность щелочной фосфатазы, аминотрансферазы AST и ALT и лактатдегидрогеназы. В кровяной сыворотке зебр Гартманн и Гревви проводили оценку расхождений выявляемых биохимических величин в зависимости от пола. В кровяной сыворотке зебр Бэме оценивали полученные биохимические данные у зебр обычной формы и зебр безгривых.

У 13 зебр и 3 шетландских пони наблюдали за влиянием имобилизации на изменение биохимических величин в кровяной сыворотке. Обездвижением в кровяной сыворотке существенно повысился уровень глюкозы, триглицеридов и понизился уровень калия. Остальные исследуемые биохимические величины существенно не менялись.

## References

- D'AGOSTINO, V.: Unpublished, Bronx ZOO, N.Y., in: ALTMAN, P.L. - DITTMER, D.S.: *Biology Data Book*. second Ed., Volume III. Fed. of Am. Soc. for exper. Biol. Bethesda, Maryland, 1974, p. 1751-2041.
- GERICKE, M.E. - HOFMAYER, J.M. - LOUW, G.N.: The effect of capture stress and haloperidol therapy on the physiology and blood chemistry of springbok - *Antidorcas marsupialis*. Madoqua, 11, 1978: 5-18.
- GOHARY, G.S. - BICKHARDT, K.: Der Einfluss des Blutentnahmestresses auf die Blutmesswerte des Schafes. Dtsch. tierärztl. Wschr., 86, 1979: 225-228.
- HOFMAYER, J.M. - LOUW, G.N. - du PREES, J.S.: Incipient capture myopathy as revealed by blood chemistry of chased zebras. Madoqua, 1, 1973: 45-50.
- JAGOŠ, P. - BOUDA, J.: Základní biochemické a hematologické hodnoty u domácích zvířat a nové způsoby vyjadřování výsledků laboratorních vyšetření.

- Klub přátel Vysoké školy veterinární, Brno, 1981, p. 29.
- NELSON, L.: Equidae. p. 753-759 in: FOWLER, M.E.: Zoo and Wild Animal Medicine. W.B. Saunders Company, Philadelphia, London, Toronto, 1978, p. 951.
- POSPÍŠIL, J. - KAŠE, F. - VÁHALA, J.: Time-dependent influence of some sedating agents on basic haematological values in various Artio- and Perissodactylids. Comp. Biochem. Physiol., 85A, 1986: 305-308.
- POSPÍŠIL, J. - VÁHALA, J. - KAŠE, F. - FRAISOVÁ, L.: Haematological values in peripheral blood of zebras kept in the East-Bohemian Zoological Garden at Dvůr Králové. Acta vet. Brno, 54, 1985: 129-140.
- ROTH, Z. - JOSÍFKO, M. - MALÝ, V. - TRČKA, V.: Statistické metody v experimentální medicíně. SZdN, Praha, 1962, p. 589.
- SEAL, U.S. - SCHOBERT, E.E. - GRAY, C.W.: Baseline laboratory data for the Grant's zebra. J. Zoo Animal Med., 8, 1977: 7-16.
- SCHREIBER, V.: Stress. Avicenum, SZdN Praha 1985, p. 383.
- SOVA, Z.: Používání SI jednotek v zootechnice a veterinární medicíně. Biologizace a chemizace živočišné výroby - Veterinaria, 15(21), 1979: 295-301.
- VAN HEERDEN, J. - DAUTH, J. - DE VOS, V. - DENNY, J.E.F.M.: Blood chemical parameters in shot cape Mountain zebra *Equus zebra zebra*. J. South. African Vet. Assoc., 38, 1985: 145-146.