ACTA VET. BRNO, 58, 1989: 197–213

BIOCHEMICAL BLOOD SERUM VALUES OF HEALTHY ANTELOPES KEPT IN THE EAST-BOHEMIAN ZOOLOGICAL GARDEN AT DVŮR KRÁLOVÉ NAD LABEM - II. THE ALCELAPHINAE, THE REDUNCINAE AND THE ANTILOPINAE

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

East-Bohemian Zoological Garden, 544 01 Dvůr Králové nad Labem

Received August 29, 1988

Abstract

Váhala J., J. Pospíšil, P. Špála, F. Kaše: *Biochemical Blood Serum Values of Healthy Antelopes Kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem - II. The Alcelaphinae, the Reduncinae and the Antilopinae.* Acta vet. Brno, 58, 1989: 197–213.

Blood sera of clinically healthy male and female antelopes of 13 species of the subfamilies *Alcelaphinae, Reduncinae* and *Antilopinae,* over 1 year of age, kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem were examined for the following biochemical parameters: total and bound bilirubin, total protein, glucose, creatinine, urea, total lipids, triglycerides, cholesterol, magnesium, calcium, phosphorus, chlorides, sodium, potassium, copper, zinc, iron and alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase and lactate dehydrogenase activity.

Antelope, species, health, blood chemistry

This report is a continuation of our previous study (Váhala et al. 1988) on biochemical blood serum values of clinically healthy antelopes of 11 species of the subfamilies *Tragelaphinae, Hippotraginae* and *Aepycerotinae,* kept in the East-Bohemian Zoological Garden (VČ Zoo) at Dvůr Králové nad Labem. The present study covers the results of biochemical examination of the blood sera of antelopes of the following subfamilies:

the *Alcelaphinae* including the blesbok *(Damaliscus dorcas phillipsi),* the bontebok *(Damaliscus dorcas dorcas),* the brindled gnu *(Connochaetes taurinus taurinus),* the white-bearded gnu *(Connochaetes taurinus albojubatus)* and the white-tailed gnu *(Connochaetes gnou);*

the *Reduncinae* including the eastern waterbuck *(Kobus ellipsiprymnus ellipsiprymnus),* the defassa waterbuck *(Kobus ellipsiprymnus defassa),* the lechwe waterbuck *(Kobus leche),* the Lady Gray's waterbuck *(Kobus megaceros)* and the mountain reedbuck *(Redunca fulvorufula);*

the *Antilopinae* including the Grant's gazelle *(Gazella granti),* the dama gazelle *(Gazella dama)* and the springbok *(Antidorcas marsupialis).*

Published information on some biochemical blood serum parameters of the foregoing antelope species was summarized by us in Tables 1 to 6.

Table 1. Biochemical parameters in the blood serum of the *Damaliscus dorcas*, blesboks *(Damaliscus dorcas phillipsi)*, brindled gnus *(Connochaetes taurinus taurinus)* and springboks *(Antidorcas marsupialis)* cited in the literature

	Damaliscus dorcas phillipsi						*Damaliscus dorcas*			*Connochaetes taurinus taur.*			*Antidorcas marsupialis*		
	Keep s (1976)			Seal, Schobert i (1976)			ISIS (1984)			ISIS (1984)			ISIS (1984)		
	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.
Total bilirubin (μM/l)	–	–	–	–	–	–	23	6.84	5.13	9	8.5	5.1	4	5.1	3.4
Total protein (g/l)	10	61.0	–	25	62.0	5.7	23	67.0	9.0	9	63.0	9.0	6	58.0	12.0
Glucose (mM/l)	15	37.0	–	25	6.89	2.06	22	6.12	2.34	8	7.28	2.84	5	9.56	4.11
Creatinine (μM/l)	–	–	–	–	–	–	21	132.7	53.1	8	141.6	35.4	3	88.5	44.2
Urea (mM/l)	–	–	–	25	8.58	1.75	21	9.65	2.50	8	8.22	2.50	3	8.58	3.93
Cholesterol (mM/l)	–	–	–	25	2.12	0.28	23	1.04	0.62	9	2.25	2.67	5	1.63	0.34
AP (μkat)	–	–	–	25	2.47	1.78	16	2.07	1.68	9	3.55	2.23	4	5.82	4.49
AST (μkat/l)	–	–	–	25	0.90	0.18	20	2.30	1.01	8	2.27	0.85	4	2.27	0.71
ALT (μkat/l)	–	–	–	–	–	–	11	0.65	0.91	5	0.75	0.30	–	–	–
Magnesium (mM/l)	28	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–
Calcium (mM/l)	8	2.3	–	25	2.50	0.12	23	2.40	0.45	9	2.62	0.40	5	2.40	0.65
Phosphorus (mM/l)	26	1.8	–	25	2.00	0.27	23	2.26	0.48	9	2.48	0.42	5	2.58	0.61
Chlorides (mM/l)	–	–	–	25	97.4	3.2	16	97.0	4.0	6	99.0	5.0	4	106.0	2.0
Sodium (mM/l)	28	153.6	–	25	146.5	3.5	16	145.0	4.0	7	146.0	4.0	4	156.0	5.0
Potassium (mM/l)	28	5.9	–	25	5.10	0.55	16	4.7	1.0	7	4.7	0.5	4	5.5	0.5
Copper (μM/l)	28	20.3	–	–	–	–	–	–	–	–	–	–	–	–	–
Zinc (μM/l)	26	20.6	–	–	–	–	–	–	–	–	–	–	–	–	–
Iron (μM/l)	28	30.5	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 3. Biochemical parameters in the blood serum of eastern waterbucks *(Kobus ellipsiprymnus ellipsiprymnus)*, lechwe waterbucks *(Kobus leche)*, Lady Gray's waterbucks *(Kobus megaceros)*, dama gazelles *(Gazella dama)* and Grant's gazelles *(Gazella granti)* cited in the literature

	Kobus ellipsiprymnus ellip.			*Kobus leche*			*Kobus megaceros*			*Gazella dama*			*Gazella granti*		
	Reitkerk (1976) –ly MF i			ISIS (1984)			ISIS (1984)			ISIS (1984)			Seal, Schobert (1976)		
	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.
Total bilirubin (μM/l)	4/2	47.7	17.4	2	18.81	19.39	3	17.10	10.26	18	5.1	1.7		5.47	2.22
Bound bilirubin (μM/l)	4/2	45.7	10.4	–	–	–	–	–	–	–	–	–		–	–
Total protein (g/l)	4/2	74.7	8.8	2	62.0	8.0	3	52.0	16.0	22	62.0	8.0		61.0	0.5
Glucose (mM/l)	–	–	–	2	11.4	5.8	2	9.5	3.0	18	9.0	3.5		10.1	2.2
Creatinine (μM/l)	4/2	186.5	34.0	2	159.3	35.4	3	168.1	115.0	8	132.7	8.8	25	–	–
Urea (mM/l)	4/2	8.7	0.2	2	10.3	4.6	3	12.5	6.0	17	7.5	1.4	–	7.5	1.1
Cholesterol (mM/l)	–	–	–	2	3.03	0.88	3	1.71	0.65	18	1.09	0.21	30	2.00	0.69
AP (μkat/l)	4/2	3.59	0.46	2	1.23	0.26	3	5.52	3.99	18	3.77	2.27		3.94	2.25
AST (μkat/l)	4/2	1.20	0.28	2	2.63	0.50	3	1.77	0.58	16	2.37	0.81		1.31	0.26
ALT (μkat/l)	4/2	0.30	0.09	1	1.93	–	–	–	–	3	0.48	0.18		–	–
LDH (μkat/l)	–	–	–	2	12.65	3.00	3	19.38	8.28	18	9.56	1.97		3.07	1.20
Calcium (mM/l)	3/2	2.78	0.07	2	2.17	0.17	3	2.30	0.07	18	2.25	0.15		2.37	0.17
Phosphorus (mM/l)	3/2	1.81	0.31	2	2.03	0.35	3	2.68	0.77	17	1.94	0.65		1.96	0.45
Chlorides (mM/l)	4/2	98.3	2.50	2	99.0	6.0	2	103.0	7.0	10	114.0	5.0		108.0	5.30
Sodium (mM/l)	4/2	142.3	3.6	2	144.0	1.0	2	143.0	5.0	10	155.0	2.0		151.0	3.4
Potassium (mM/l)	4/2	4.3	0.7	2	4.4	0.6	2	5.8	1.0	10	3.8	0.2		4.4	0.5

Table 2
Biochemical parameters in the blood serum of white-tailed gnus *(Connochaetes gnou)* (Kitchen 1978)

	$\bar{x}$	Range
Total bilirubin (μM/l)	5.81	0.5—11.7
Glucose (mM/l)	6.66	4.97—8.50
Creatinine (μM/l)	154.8	131.7—172.5
Urea (mM/l)	8.49	7.15—10.81
Cholesterol (mM/l)	1.68	1.31—2.06
Calcium (mM/l)	2.35	2.17—2.50
Phosphorus (mM/l)	1.89	1.55—2.20

Materials and Methods

Blood samples for biochemical examination were collected only from clinically healthy male and female antelopes, over 1 year of age, kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem.

The health status of the animals was assessed in view of the herd and case history facts and on the basic of basic clinical examination before blood withdrawal. Before being blood-sampled, the antelopes were either immobilized using Immobilin (Reckitt and Colman, Pharmaceutical Division, Hull, U.K.) in doses recommended by the manufacturer with respect to body mass and animal species (brindled gnus, white-bearded gnus, white-tailed gnus, eastern waterbucks, defassa waterbucks, lechwe waterbucks, dama gazelles) or captured without administration of any tranquilizing drug (blesboks, bonteboks, Lady Gray's waterbucks, mountain reedbucks, Grant's gazelles, springboks). All blood collections were made from the v. saphena lateralis. After collection, the blood samples were allowed to stand for 30 minutes at room temperature and the blood sera were then obtained by centrifugation. Biochemical examination was carried out by methods routinely used in clinical practice as described in detail previously (Pospíšil et al. 1987).

Mathematical and statistical analysis was the same as in the previous report (Váhala et al. 1988). Statistical significance of the differences of the means computed for males and females was assessed in some biochemical blood serum values of bonteboks, white-tailed gnus, eastern waterbucks and springboks. Since biochemical blood serum values were assessed in two forms of springbok (black and white), the procedure chosen by us before final pooling of the individual values found in the two forms was analogous to that used in pooling the values for males and females (Váhala et al. 1988).

Results

The biochemical blood serum values of antelopes of the individual species kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem are shown in Tables 7 to 15. Statistical analysis revealed significant differences ($< 5\ \%$) of the means between males and females in white-tailed gnus (Table 9) and in creatinine, urea and total lipid levels in black-form springboks (Table 14). Significant differences were also found in the aforementioned biochemical parameters between springboks

Table 4. Biochemical parameters in the blood serum of antelopes of three species after immobilization and shooting dead (Drevemo et al. 1974)

	Redunca fulvorufula			*Connochaetes taurinus albojubatus*						*Gazella granti*		
	s			i			s			i		
	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.
Magnesium (mM/l)	8	0.70	0.33	17	0.78	0.12	11	0.95	0.12	20	1.11	0.21
Calcium (mM/l)	8	1.95	0.65	17	2.02	0.35	11	3.07	0.10	20	2.85	0.62
Phosphorus (mM/l)	13	1.58	0.52	17	1.10	0.26	11	1.48	0.26	22	1.61	0.29
Copper (μM/l)	14	12.44	3.31	8	15.59	2.52	7	15.91	2.68	18	16.38	3.94

Table 5. Biochemical parameters in the blood serum of springboks *(Antidorcas marsupialis)* of various ages cited in the literature

	Raphael et al. (1982)														
	MF lm-ly N = 16 > ly N = 18 0			F, > ly pregnant 0			F, > ly nonpregnant 0			MF lm-ly 0			> lm 0		
	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.
Total protein (g/l)	34	70.0	15.0	14	74.5	9.5	3	70.0	8.6	16	65.0	8.9	5	47.0	5.9
Glucose (mM/l)	34	7.57	1.92	14	7.62	2.01	3	7.78	1.95	16	5.93	0.85	5	10.62	5.12
Creatinine (μM/l)	34	132.7	17.7	14	138.9	15.0	3	134.5	15.9	16	100.0	10.6	5	86.7	9.7
Urea (mM/l)	34	9.40	1.64	14	9.51	1.86	3	9.51	1.18	16	7.76	1.68	5	8.65	5.42
AP (μkat/l)	34	1.56	0.92	14	1.19	0.84	3	1.70	0.18	16	3.03	0.26	5	12.3	10.3
AST (μkat/l)	34	3.40	0.76	14	3.48	0.88	3	3.29	0.66	16	3.44	0.48	5	3.19	1.53
ALT (μkat/l)	34	0.15	0.17	14	0.13	0.14	3	0.14	0.18	16	0.40	0.11	5	0.89	0.52
Calcium (mM/l)	34	2.05	0.39	14	2.08	0.18	3	2.10	0.15	16	2.10	0.56	5	2.68	0.17
Phosphorus (mM/l)	34	1.52	0.48	14	1.45	0.42	3	1.52	0.54	16	2.12	0.29	5	3.20	0.59
Chlorides (mM/l)	34	106.7	6.6	–	–	–	3	107.6	3.3	16	94.0	16.5	5	110.6	2.8
Sodium (mM/l)	34	145.9	2.9	14	146.4	2.9	3	145.4	2.3	16	147.7	5.9	5	146.2	4.9
Potassium (mM/l)	34	4.40	0.46	14	4.30	0.51	3	4.40	0.48	16	4.57	0.12	5	4.34	1.26

Table 6. Biochemical parameters in the blood serum of springboks *(Antidorcas marsupialis)* captured and shot dead (Gericke et al. 1978)

	Captured				Shot dead			
	N	$\bar{x}$	S.D.	Range	N	$\bar{x}$	S.D.	Range
Glucose (mM/l)	8	11.05	2.09	6.48 – 13.15	8	6.75	–	5.21 – 8.74
ALT (μkat/l)	–	–	–	–	8	0.257	–	0.195 – 0.318
LDH (μkat/l)	8	14.46	3.72	12.42 – 21.52	8	12.79	1.93	10.63 – 15.94
Sodium (mM/l)	8	165.0	3.0	160.0 – 170.0	8	153.0	–	149.0 – 157.0
Potassium (mM/l)	8	5.1	0.75	4.2 – 6.4	8	1.96	–	1.22 – 2.52

Table 7. Biochemical parameters in the blood serum of blesboks *(Damaliscus dorcas phillipsi)* and bonteboks *(Damaliscus dorcas dorcas)* kept in the VČ Zoo at Dvůr Králové nad Labem

	Blesbok *(Damaliscus dorcas phillipsi)*				Bontebok *(Damaliscus dorcas dorcas)*			
	N	$\bar{x}$	S.D.	min.-max.	N	$\bar{x}$	S.D.	min.-max.
Total bilirubin (μM/l)	6/2	3.467	1.862	1.95 – 7.46	2/4	2.395	0.834	1.62 – 4.00
Bound bilirubin (μM/l)	5/2	1.658	0.510	1.25 – 1.66	3/4	1.444	0.355	0.97 – 1.80
Total protein (g/l)	6/2	70.50	5.31	63.0 – 79.0	5/4	69.55	5.53	61.0 – 81.0
Glucose (mM/l)	6/2	6.521	1.086	5.44 – 8.60	5/4	6.843	2.687	3.66 – 11.20
Creatinine (μM/l)	6/2	207.2	38.3	127.0 – 256.0	5/4	230.6	19.5	212.4 – 258.0
Urea (mM/l)	6/2	8.683	1.702	6.16 – 11.20	5/4	9.71	1.74	8.16 – 13.7
Total lipids (g/l)	6/2	2.675	0.836	1.20 – 3.80	5/4	2.755	1.531	1.1 – 4.9
Triglycerides (mM/l)	6/2	1.290	0.585	0.13 – 1.88	2/0	1.940	0.631	1.49 – 2.39
Cholesterol (mM/l)	6/2	2.331	0.575	1.70 – 3.49	5/4	2.597	0.630	1.14 – 3.23
AP (μkat/l)	6/2	0.963	0.284	0.55 – 1.54	2/0	0.935	0.064	0.89 – 0.98
AST (μkat/l)	6/2	0.617	0.090	0.57 – 0.78	5/4	0.621	0.122	0.47 – 0.68
ALT (μkat/l)	6/2	0.307	0.085	0.27 – 0.45	5/4	0.266	0.088	0.10 – 0.37
LDH (μkat/l)	3/2	4.998	2.085	3.14 – 8.37	2/0	3.5	0.1	3.4 – 3.6
Magnesium (mM/l)	5/1	0.640	0.079	0.49 – 0.74	5/4	0.607	0.210	0.37 – 0.89
Calcium (mM/l)	6/2	2.315	0.270	1.98 – 2.89	5/4	2.021	0.357	1.77 – 2.65
Phosphorus (mM/l)	6/2	2.541	0.388	2.00 – 3.16	5/4	2.688	0.786	1.81 – 4.29
Chlorides (mM/l)	6/2	101.8	6.1	99.0 – 109.0	5/4	95.11	2.13	64.0 – 112.0
Sodium (mM/l)	1/0	155.0	–	–	2/0	129.5	0.7	129.0 – 130.0
Potassium (mM/l)	1/0	3.96	–	–	2/0	5.27	0.63	4.82 – 5.72
Copper (μM/l)	1/0	1.3	–	–	2/0	22.5	0.5	22.1 – 22.9
Zinc (μM/l)	1/0	14.8	–	–	2/0	65.2	44.2	33.9 – 96.5
Iron (μM/l)	6/2	22.40	7.11	19.7 – 31.2	5/4	29.40	6.41	22.0 – 36.0

Table 8. Biochemical parameters in the blood serum of brindled gnus *(Connochaetes taurinus taurinus)* and white-bearded gnus *(Connochaetes taurinus albojubatus)* kept in the VČ Zoo at Dvůr Králové nad Labem

	Brindled gnu *(Connochaetes taurinus taurinus*				White-bearded gnu *(Connochaetes taurinus albojubatus)*			
	N	$\bar{x}$	S.D.	min. – max.	N	$\bar{x}$	S.D.	min. – max.
Total bilirubin (μM/l)	7/2	3.533	0.849	2.11 – 5.67	5/1	5.621	1.432	3.88 – 7.46
Bound bilirubin (μM/l)	–	–	–	–	5/1	4.933	0.981	3.59 – 5.68
Total protein (g/l)	7/3	78.88	10.62	62.0 – 97.0	7/2	72.81	10.12	63.0 – 90.0
Glucose (mM/l)	7/3	8.974	1.970	5.16 – 13.00	7/2	5.012	0.972	3.00 – 8.38
Creatinine (μM/l)	7/2	215.0	20.1	167.0 – 256.7	7/2	192.2	15.1	177.0 – 265.5
Urea (mM/l)	7/3	7.470	1.423	5.16 – 9.70	7/2	5.521	0.912	4.16 – 6.70
Total lipids (g/l)	7/3	3.039	1.421	1.1 – 12.4	7/2	0.719	0.242	0.4 – 1.2
Triglycerides (mM/l)	7/2	1.328	0.240	0.86 – 1.82	2/1	0.983	0.321	0.84 – 1.27
Cholesterol (mM/l)	7/3	1.631	0.322	1.16 – 2.10	7/2	1.278	0.431	0.80 – 1.81
AP (μkat/l)	6/2	3.995	6.210	0.52 – 22.30	2/1	1.683	0.452	0.92 – 2.91
AST (μkat/l)	6/3	0.492	0.173	0.28 – 0.78	7/2	0.724	0.181	0.47 – 1.59
ALT (μkat/l)	7/3	0.327	0.121	0.21 – 0.39	7/2	0.512	0.152	0.22 – 1.72
LDH (μkat/l)	5/1	5.801	2.921	3.55 – 11.0	2/1	4.111	0.832	3.44 – 4.59
Magnesium (mM/l)	7/3	0.832	0.221	0.59 – 1.13	7/2	0.524	0.189	0.25 – 0.94
Calcium (mM/l)	7/3	2.162	0.298	1.64 – 2.46	7/2	1.921	0.452	1.00 – 2.43
Phosphorus (mM/l)	7/3	2.120	0.451	0.9 – 2.89	7/2	2.112	0.774	0.77 – 2.55
Chlorides (mM/l)	7/3	91.3	8.3	73.0 – 104.0	6/1	105.2	5.1	91.0 – 111.0
Sodium (mM/l)	6/1	141.2	10.4	129.0 – 153.0	1/1	141.5	4.9	138.0 – 145.0
Potassium (mM/l)	6/1	5.061	0.317	4.52 – 5.44	1/1	4.435	0.219	4.28 – 4.59
Copper (μM/l)	6/1	23.72	3.83	19.5 – 29.5	1/1	20.20	1.97	18.8 – 21.6
Zinc (μM/l)	2/0	47.6	3.9	44.8 – 50.4	1/1	93.35	2.61	91.5 – 95.2
Iron (μM/l)	7/3	34.21	9.12	26.0 – 50.40	7/2	25.49	12.34	9.13 – 47.6

Table 9. Biochemical parameters in the blood serum of white-tailed gnus *(Connochaetes gnou)* and mountain reedbucks *(Redunca fulvorufula)* kept in the VČ Zoo at Dvůr Králové nad Labem

	White-tailed gnu *(Connochaetes gnou)*				Mountain reedbuck *(Redunca fulvorufula)*			
	N	$\bar{x}$	S.D.	min. – max.	N	$\bar{x}$	S.D.	min. – max.
Total bilirubin (μM/l)	14/5	4.526	1.805	1.13 – 7.01	7/1	97.34	16.2	59.8 – 121.8
Bound bilirubin (μM/l)	●	a)			6/1	36.60	4.45	28.2 – 51.5
Total protein (g/l)	16/5	76.56	18.25	48.0 – 107.0	7/1	75.99	5.47	67.0 – 82.0
Glucose (mM/l)	16/5	9.303	4.114	3.8 – 21.8	7/1	10.298	1.421	8.8 – 12.4
Creatinine (μM/l)	16/5	236.3	35.23	192.0 – 345.0	6/1	228.3	23.7	185.9 – 250.0
Urea (mM/l)	16/5	6.174	1.643	3.7 – 9.0	6/1	6.103	0.752	5.1 – 7.0
Total lipids (g/l)	16/5	2.061	0.559	1.3 – 3.2	7/1	2.875	0.824	1.0 – 3.8
Triglycerides (mM/l)	16/5	1.646	0.641	0.85 – 2.99	5/0	2.358	0.668	1.3 – 3.0
Cholesterol (mM/l)	16/5	1.321	0.348	0.86 – 2.34	6/1	3.426	0.603	2.43 – 4.40
AP (μkat/l)	9/3	0.768	0.293	0.33 – 1.23	6/0	1.870	0.752	1.03 – 3.28
AST (μkat/l)	16/5	0.368	0.307	0.05 – 1.14	7/1	0.607	0.065	0.53 – 0.64
ALT (μkat/l)	16/5	0.364	0.042	0.30 – 0.47	7/1	0.243	0.047	0.17 – 0.31
LDH (μkat/l)	10/3	2.566	1.290	0.93 – 4.91	6/0	5.631	1.052	4.47 – 7.03
Magnesium (mM/l)	14/5	0.778	0.176	0.37 – 1.04	7/1	0.697	0.142	0.49 – 0.81
Calcium (mM/l)	14/5	2.122	0.467	1.51 – 3.10	7/1	1.978	0.240	1.63 – 2.22
Phosphorus (mM/l)	16/5	2.163	0.466	1.22 – 2.88	6/1	1.942	0.350	1.42 – 2.74
Chlorides (mM/l)	15/5	95.07	9.5	74.0 – 106	6/1	99.99	11.52	94.0 – 121.0
Sodium (mM/l)	8/2	145.6	12.7	118.0 – 163.0	6/1	153.3	3.2	148.0 – 156.0
Potassium (mM/l)	8/2	4.92	0.472	4.02 – 5.54	6/0	5.801	0.982	4.39 – 6.78
Copper (μM/l)	7/1	18.42	2.00	15.7 – 22.0	3/0	24.63	6.04	23.1 – 31.3
Zinc (μM/l)	7/1	71.3	30.2	19.5 – 107.2	4/0	34.6	19.1	21.5 – 62.6
Iron (μM/l)	10/4	43.52	12.81	27.2 – 54.7	7/1	36.65	12.45	20.4 – 73.6

a) $P < 5\ \%$, M – N = 3, $\bar{x} = 2.80$, S.D. = 0.50, F – N = 5, $\bar{x} = 5.03$, S.D. = 1.03

Table 10. Biochemical parameters in the blood serum of eastern waterbucks *(Kobus ellipsiprymnus ellipsiprymnus)* and defassa waterbucks *(Kobus ellipsiprymnus defassa)* kept in the VČ Zoo at Dvůr Králové nad Labem

	Eastern waterbuck *(Kobus ellipsiprymnus ellipsiprymnus)*				Defassa waterbuck *(Kobus ellipsiprymnus defassa)*			
	N	$\bar{x}$	S.D.	min. – max.	N	$\bar{x}$	S.D.	min. – max.
Total bilirubin (μM/l)	4/3	130.20	7.97	116.0 – 142.4	4/0	114.1	16.2	91.3 – 126.8
Bound bilirubin (μM/l)	4/3	51.22	6.53	44.0 – 60.9	4/0	47.2	4.14	41.3 – 50.1
Total protein (g/l)	4/3	70.57	6.94	62.0 – 79.0	5/0	71.4	6.1	62.0 – 77.0
Glucose (mM/l)	4/3	10.702	3.316	5.3 – 16.2	5/0	10.180	2.551	7.66 – 13.82
Creatinine (μM/l)	4/3	324.3	63.25	261.0 – 451.0	5/0	311.5	30.8	292.1 – 354.0
Urea (mM/l)	4/3	6.774	1.201	4.3 – 8.1	5/0	6.362	1.015	4.84 – 7.66
Total lipids (g/l)	4/3	7.200	4.641	3.4 – 17.1	5/0	2.362	1.371	1.2 – 4.0
Triglycerides (mM/l)	0/2	3.975	2.878	1.94 – 6.01	–	–	–	–
Cholesterol (mM/l)	4/3	6.082	1.021	4.24 – 7.05	5/0	5.124	0.518	4.68 – 5.95
AP (μkat/l)	0/2	1.492	0.812	0.88 – 2.11	1/0	0.29	–	–
AST (μkat/l)	4/3	0.624	0.143	0.45 – 0.82	5/0	0.512	0.132	0.47 – 0.67
ALT (μkat/l)	4/3	0.394	0.187	0.22 – 0.76	5/0	0.356	0.141	0.22 – 0.59
LDH (μkat/l)	0/1	9.71	–	–	1/0	0.32	–	–
Magnesium (mM/l)	4/3	0.995	0.105	0.86 – 1.15	5/0	0.500	0.231	0.37 – 0.82
Calcium (mM/l)	3/3	2.636	0.555	1.96 – 3.47	5/0	2.481	0.182	2.35 – 2.62
Phosphorus (mM/l)	3/3	1.900	0.955	1.26 – 3.87	5/0	1.956	0.583	1.16 – 2.52
Chlorides (mM/l)	4/3	109.6	10.2	98.0 – 126.0	5/0	109.2	11.0	90.0 – 118.0
Sodium (mM/l)	0/1	152.0	–	–	–	–	–	–
Potassium (mM/l)	0/1	5.63	–	–	–	–	–	–
Copper (μM/l)	–	–	–	–	–	–	–	–
Zinc (μM/l)	–	–	–	–	–	–	–	–
Iron (μM/l)	4/1	14.21	6.63	9.49 – 25.2	5/0	27.34	20.23	14.0 – 61.9

of the black form and those of the white form. Also the mean values of total and bound bilirubin showed differences between black-form and white-form springboks (Table 15).

Discussion

The problems of discussing biochemical blood serum parameters of »healthy« animals kept in zoological gardens were considered in our previous report (Váhala et al. 1988) together with major general factors that may markedly affect these parameters and thus reduce the possibility of meaningful comparison of the findings reported by various authors for a given animal species. The same problems face us in the present study. In defassa waterbucks no published information on biochemical blood serum parameters was available to us for comparison. The results obtained by us in bonteboks can be compared only with the data reported by ISIS (1984) for the *Damaliscus dorcas* in general. Published information on biochemical blood serum parametres as summarized by us in Tables 2 an 4 (Kitchen 1978; Drevemo et al. 1974) covers only some of the parameters investigated in our study.

Compared with the published data summarized by us in Tables 1 to 6, the biochemical blood serum levels obtained in our study are markedly different in that the creatinine values found by us for some antelope species (brindled gnus, white-tailed gnus, bonteboks, Lady Gray's waterbucks, lechwe waterbucks and eastern waterbucks) are higher while the alkaline phosphatase and aspartate aminotransferase activity levels in the blood serum of eastern waterbucks, Lady Gray's waterbucks and bonteboks are lower than those reported by the other investigators.

Interspecies comparison of the biochemical blood serum values of antelopes showed markedly high levels of both total and bound bilirubin in eastern waterbucks, defassa waterbucks and mountain reedbucks. These values also exceeded those found in domestic animals (cattle, pigs, sheep, horses, dogs and cats) as reported by Jagoš and Bouda (1981). For comparison of our values with those found in the aforementiond antelope species by other investigators only the information published by Reitkerk (1986) was available. His values reported for total bilirubin blood serum levels of eastern waterbucks are also markedly high, even though by far not so high as those found in our study. In none of the animals of these species either icteric pigmentation of the blood serum or clinical signs of icterus were observed. The clinical method (Bio-test, Lachema) used by us for bilirubin determination in blood serum is based on the principle that bilirubin combines with diazotized sulphanilic acid to yield an intensely stained solution suitable for photometric determination. The findings of high blood serum bilirubin levels in antelopes of these species are difficult to interpret. Two alternative explanations seem possible: either high blood serum bilirubin levels are characteristic of the species or the method used in our study and designed particularly for human medicine is, for one reason or another, unsuitable for blood serum analysis in these antelope species. The significant differences of the means of blood serum total and bound bilirubin, creatinine, urea and total lipid levels between the black and white forms of the springbok are, in our view, due to the fact that the animals were kept in two separate herds rather than to specific differences between the two forms.

In conclusion we wish to point out as we did also in our previous communication (Váhala et al. 1988) that we regard the biochemical blood serum parameters reported here for the individual antelope species only as tentative.

Table 11. Biochemical parameters in the blood serum of lechwe waterbucks *(Kobus leche)* and Lady Gray's waterbucks *(Kobus megaceros)* kept in the VČ Zoo at Dvůr Králové nad Labem

	Lechwe waterbuck *(Kobus leche)*				Lady Grays' waterbuck *(Kobus megaceros)*			
	N	$\bar{x}$	S.D.	min. – max.	N	$\bar{x}$	S.D.	min. – max.
Total bilirubin (μM/l)	5/2	7.934	4.044	4.05 – 12.79	2/1	12.32	5.332	6.33 – 16.54
Bound bilirubin (μM/l)	4/2	6.543	3.813	1.39 – 10.64	2/1	5.67	1.64	6.09 – 7.06
Total protein (g/l)	5/2	67.14	11.50	48.0 – 80.0	2/1	75.66	11.06	64.0 – 86.0
Glucose (mM/l)	5/2	10.317	1.470	8.55 – 12.49	2/1	7.182	2.471	4.72 – 9.66
Creatinine (μM/l)	4/3	303.4	94.8	194.7 – 442.5	2/1	448.5	88.6	363.0 – 540.0
Urea (mM/l)	5/3	7.131	2.089	3.6 – 10.6	2/1	5.603	2.107	3.33 – 7.49
Total lipids (g/l)	5/3	2.575	0.736	1.2 – 3.6	2/1	2.367	0.929	1.3 – 3.0
Triglycerides (mM/l)	3/0	1.453	0.412	0.98 – 1.73	1/1	2.200	0.311	1.98 – 2.42
Cholesterol (mM/l)	4/3	1.778	0.496	1.37 – 2.81	1/1	2.995	0.219	2.84 – 3.15
AP (μkat/l)	3/2	1.292	1.083	0.64 – 3.21	2/1	1.447	1.085	0.69 – 2.69
AST (μkat/l)	5/2	0.667	0.168	0.47 – 0.87	1/1	0.590	0.000	0.59 – 0.59
ALT (μkat/l)	5/2	0.600	0.196	0.33 – 0.87	1/1	0.415	0.035	0.39 – 0.44
LDH (μkat/l)	2/2	7.205	2.512	4.34 – 10.34	1/1	8.485	0.516	8.12 – 8.85
Magnesium (mM/l)	5/2	0.842	0.158	0.58 – 1.07	1/1	0.47	0.08	0.41 – 0.53
Calcium (mM/l)	5/3	2.725	0.957	1.86 – 3.81	1/1	2.31	0.79	1.75 – 2.87
Phosphorus (mM/l)	5/2	1.825	0.558	1.19 – 2.78	1/1	1.72	0.16	1.61 – 1.84
Chlorides (mM/l)	5/2	96.8	6.1	86.0 – 105.0	2/1	82.33	19.50	60.0 – 96.0
Sodium (mM/l)	1/0	145.0	–	–	–	–	–	–
Potassium (mM/l)	1/0	5.03	–	–	–	–	–	–
Copper (μM/l)	1/0	18.6	–	–	–	–	–	–
Zinc (μM/l)	1/0	46.8	–	–	–	–	–	–
Iron (μM/l)	5/2	51.63	25.16	32.7 – 104.9	1/1	27.85	3.18	25.6 – 30.1

Table 12. Biochemical parameters in the blood serum of Grant's gazelles *(Gazella granti)* and dama gazellas *(Gazelle dama)* kept in the VČ Zoo at Dvůr Králové nad Labem

	Grant's gazelle *(Gazella granti)*				Dama gazelle *(Gazella dama)*	
	N	$\bar{x}$	S.D.	Range	Male	Female
Total bilirubin (μM/l)	2/0	3.075	2.298	1.45— 4.70	—	—
Bound bilirubin (μM/l)	2/0	2.285	0.304	2.07— 2.50	—	—
Total protein (g/l)	2/1	63.0	3.6	59.0 — 66.0	71.0	58.0
Glucose (mM/l)	2/1	8.657	0.857	7.71— 9.38	7.7	7.40
Creatinine (μM/l)	2/1	225.0	68.6	177.0 —274.0	194.7	123.9
Urea (mM/l)	2/1	5.103	1.709	3.66— 6.99	5.99	6.33
Total lipids (g/l)	2/1	1.1	0.2	0.9 — 1.3	1.1	1.7
Triglycerides (mM/l)	2/1	1.74	0.32	1.39— 2.04	1.28	—
Cholesterol (mM/l)	2/1	1.293	0.191	1.09— 1.47	1.06	1.6
AP (μkat/l)	2/1	3.023	2.066	0.87— 4.99	1.225	—
AST (μkat/l)	2/1	0.550	0.130	0.39— 0.64	0.610	0.370
ALT (μkat/l)	2/1	0.427	0.091	0.33— 0.51	0.254	0.270
LDH (μkat/l)	2/0	6.405	4.404	3.29— 9.52	—	—
Magnesium (mM/l)	2/2	0.52	0.10	0.41— 0.62	0.78	0.66
Calcium (mM/l)	2/1	2.25	0.07	2.18— 2.33	2.01	2.03
Phosphorus (mM/l)	2/1	2.19	0.97	1.36— 3.26	2.71	1.26
Chlorides (mM/l)	2/1	100.6	8.1	95.0 —110.0	103.0	103.0
Iron (μM/l)	2/1	40.40	30.03	8.41— 68.00	101.1	63.7

Table 13. Biochemical parameters in the blood serum of springboks *(Antidorcas marsupialis)* kept in the VČ Zoo at Dvůr Králové nad Labem
(pooled values for males and females of both the white and the black form)

	N	$\bar{x}$	S.D.	Range
Total protein (g/l)	25/12	73.67	9.50	56.0 —120.0
Glucose (mM/l)	27/13	8.38	1.80	5.55— 18.59
Triglycerides (mM/l)	10/5	1.00	0.28	0.03— 2.01
Cholesterol (mM/l)	24/13	2.40	1.38	1.03— 7.3
AP (μkat/l)	10/5	1.124	0.743	0.08— 3.34
AST (μkat/l)	27/13	0.428	0.163	0.36— 0.96
ALT (μkat/l)	27/13	0.247	0.085	0.02— 0.46
LDH (μkat/l)	4/1	3.662	1.280	3.05— 4.55
Magnesium (mM/l)	27/11	0.710	0.268	0.33— 1.22
Calcium (mM/l)	27/13	2.255	0.297	1.69— 3.09
Phosphorus (mM/l)	27/12	2.320	0.493	1.39— 3.93
Chlorides (mM/l)	24/13	105.9	6.38	83.0 —118.0
Sodium (mM/l)	12/6	148.0	11.6	117.0 —162.0
Potassium (mM/l)	12/6	5.16	0.78	3.94— 5.96
Copper (μM/l)	8/4	19.28	2.29	7.2 — 23.1
Zinc (μM/l)	4/1	40.53	17.24	30.0 — 54.0
Iron (μM/l)	21/10	44.83	22.83	14.0 — 83.6

Table 14. Biochemical parameters in the blood serum of springboks *(Antidorcas marsupialis)* kept in the VČ Zoo at Dvůr Králové nad Labem

(black form - females)

	N	$\bar{x}$	S.D.	Range
Creatinine (μM/l)	19	145.6	25.2	103.0—195.0
Urea (mM/l)	19	5.93	1.09	4.4— 8.8
Total lipids (g/l)	19	1.69	0.56	1.0— 3.3

(black form - males)

	N	$\bar{x}$	S.D.	Range
Creatinine (μM/l)	11	175.1	29.9	119.0 —230.0
Urea (mM/l)	11	8.03	2.12	4.81— 11.3
Total lipids (g/l)	11	2.809	1.74	1.10— 6.50

(white form - males plus females)

	N	$\bar{x}$	S.D.	Range
Creatinine (μM/l)	8/2	210.0	22.3	168.0 —248.0
Urea (mM/l)	8/2	7.42	1.40	5.33— 11.80
Total lipids (g/l)	8/2	3.97	0.23	2.9 — 4.6

Table 15. Total and bound bilirubin in the blood serum of springboks *(Antidorcas marsupialis)* kept in the VČ Zoo at Dvůr Králové nad Labem

(males plus females)

	Black form				White form			
	N	$\bar{x}$	S.D.	Range	N	$\bar{x}$	S.D.	Range
Total bilirubin (μM/l)	18/9	2.604	1.433	0.80—6.63	8/2	5.581	1.982	2.26—8.16
Bound bilirubin (μM/l)	15/8	1.502	0.884	0.68—2.72	7/2	4.806	2.420	0.68—7.61

Biochemické hodnoty krevního séra zdravých antilop chovaných ve Východočeské zoologické zahradě Dvůr Králové nad Labem
II. *Alcelaphinae, Reduncinae, Antilopinae*

V krevním séru 13 druhů klinicky zdravých antilop, samců i samic, starších 1 roku, zoologicky řazených do podčeledí *Alcelaphinae, Reduncinae a Antilopinae,* chovaných ve Východočeské zoologické zahradě Dvůr Králové nad Labem, byly stanoveny následující biochemické hodnoty: hladina celkového a vázaného bilirubinu, celkových bílkovin, glukózy, kreatininu, močoviny, celkových lipidů, triglyceridů, cholesterolu, hořčíku, vápníku, fosforu, chloridů, sodíku, draslíku, mědi, zinku, železa, aktivity alkalické fosfatázy, alanin aminotransferázy, aspartát aminotransferázy a laktátdehydrogenázy.

Биохимические значения кровяной сыворотки здоровых антилоп, содержимых в Восточночешском зоопарке Двур-Кралове над Лабой — *II. Alcelaphinae, Reduncinae, Antilopinae*

В кровяной сыворотке 13 видов клинически здоровых антилоп, самцев и самок, старше 1 года, зоологически входящих в подсемейства Alcelaphinae, Reduncinae и Antilopinae, содержащихся в Восточночешском зоопарке Двур-Кралове над Лабой, определяли следующие биохимические значения: уровень общего и связанного билирубина, общих белков, глюкозы, креатинина, мочевины, общих липидов, триглицеридов, холестерина, магния, кальция, фосфора, хлоридов, натрия, калия, меди, цинка, железа, активность щелочной фосфатазы, аланин-аминотрансферазы, аспарат-аминотрансферазы и лактатдегидрогеназы.

References

DREVEMO, S. — GROOTENHUIS, J. D. — KARSTAD, L.: Blood parameters in wild ruminants in Kenya. J. Wildl. Dis., **10**, 1974: 327—334.
GERICKE, M. D. — HOFMEYR, J. M. — LOUW, G. N.: The effect of capture stress and haloperidol therapy on the physiology and blood chemistry of springbog Antidorcas marsupialis. Madaqua, **11**, 1978: 5—18.
ISIS,: Annual species inventory for 1984. Minn. Zool. Garden, West St. Paul, Minnesota. in: REITKERK, F. E.: Haematological and biochemical blood values of antelopes and gazelles. Vakgroep Pathologie Ziektekunde der Bijzondere Dieren, Faculteit der Diergeneeskunde Rijksuniversiteit, Utrecht, maart 1986: p. 68.
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. SVS - oddělení veterinární osvěty.
KEEP, M. E.: Some physiological serum normals in free-living wild animal species from Natal, South-Africa. J. Zoo An. Med., **7**, 1976: 7—10.
POSPÍŠIL, J. — ŠPÁLA, P. — VÁHALA, J. — KAŠE, F.: Biochemical values in the blood serum Zebras kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem. Acta vet. Brno, **56**, 1987: 181—193.
POSPÍŠIL, J. — VÁHALA, J. — ŠPÁLA, P. — KAŠE, F.: Haematological and biochemical values in the peripheral blood of cape hunting dogs kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem. Acta vet. Brno, **56**, 1987: 195—205.
RAPHAEL, B. L. — OLSEN, J. — SENIOR, D. — SCHOBERT, E. E. — JACOBSON, E. R.: Hematologic and serum chemistry values for captive springbok (Antidorcas marsupialis). J. Zoo An. Med., **13**, 1982: 65—69.
REITKERK, F. E.: Haematological and biochemical blood values of antelopes and gazelles.

Vakgroep Pathologie Ziektekunde der Bijzondere Dieren. Faculteit der Diergeneeskunde Rijksuniversiteit, Utrecht, maart 1986: p. 68.
SEAL, U. S. – SCHOBERT, E. E.: Baseline laboratory data for the blesbok (Damaliscus dorcas phillipsi). J. Zoo An. Med., 7, 1976: 18–22.
SEAL, U. S. – SCHOBERT, E. E.: Baseline laboratory data for the Grant's gazelle (Gazella granti). J. Zoo An. Med., 7, 1976: 7–10.
VÁHALA, J. – POSPÍŠIL, J. – ŠPÁLA, P. – KAŠE, F.: Biochemical blood serum values of healthy antelopes kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem - I. The Tragelaphinae, the Hippotraginae and the Aepycerotinae. Acta vet. Brno, **58**, 1989: 17–30.

Symbols and Abbreviations

ALT – alanine aminotransferase
AP – alkaline phosphatase
AST – aspartate aminotransferase
F – female
i – immobilization by administration of a tranquilizer
LDH – lactate dehydrogenase
m – month
M – male
max. – maximum value found in the sample
min. – minimum value found in the sample
N – No. animals examined (No. males examined/No. females examined)
O – capture of animals without using a tranquilizer
P – level of significance of the mean values compared
s – blood withdrawal after the animal was shot dead
S.D. – standard deviation
VČ Zoo – East-Bohemian Zoological Garden at Dvůr Králové nad Labem
w – week
$\bar{x}$ – mean value
y – year
● – level of significance ($\alpha \leq 5$) of the differences of the mean values between males and females was determined