

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

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

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

Received August 29, 1988

A b s t r a c t

V á h a l a, J., J. P o s p í š i l, P. Š p á l a and F. K a š e: 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 - 29 .

Blood sera of clinically healthy male and female antelopes of 11 species of the subfamilies Tragelaphinae, Hippotraginae and Aepycerotinae, 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.

Antelopes, health, blood serum, biochemistry

Haematological values found by us in the peripheral blood of clinically healthy antelopes kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem were reported previously (P o s p í š i l et al. 1984a, b, c, d). The present study reports the results of biochemical examination of the blood sera of antelopes of the following subfamilies:

- the Tragelaphinae including the bushbuck (Tragelaphus scriptus), the greater kudu (Tragelaphus strepsiceros), the small kudu (Tragelaphus imberbis), the bongo (Boocerus euryceros) and the cape eland (Taurotragus oryx);
- the Hippotraginae including the roan antelope (Hippotragus equinus), the sable antelope (Hippotragus niger), adax antelope (Addax nasomaculatus), the gemsbok oryx (Oryx gazella gazella) and the scimitar horned oryx (Oryx dammah);
- the Aepycerotinae including the South-African impala (Aepyceros melampus melampus).

Table 1

Biochemical parameters in the blood serum of roan antelopes (*Hippotragus equinus*) and sable antelopes (*Hippotragus niger*) kept in the VČ ZOO at Dvůr Králové nad Labem

	Roan antelope (<i>Hippotragus equinus</i>)				Sable antelope (<i>Hippotragus niger</i>)			
	N	\bar{X}	S. D.	min. - max.	N	\bar{X}	S. D.	min. - max.
Total bilirubin ($\mu\text{M/l}$)	11/5	4.881	2.945	2.75 - 12.50	0/2	5.751	2.872	3.72 - 7.78
Bound bilirubin ($\mu\text{M/l}$)		* a)						
Total protein (g/l)	10/5	65.22	8.88	47.0 - 82.0	0/3	79.0	6.92	75.0 - 87.0
Glucose ($\mu\text{M/l}$)	11/5	11.388	1.586	7.5 - 13.8	0/3	8.667	3.602	5.0 - 12.2
Creatinine ($\mu\text{M/l}$)	11/5	265.3	30.23	221.0 - 328.0	0/3	347.6	84.1	252.0 - 410.0
Urea ($\mu\text{M/l}$)		* b)				6.333	2.074	4.1 - 8.2
Total fat (g/l)	11/5	5.381	2.544	1.52 - 7.34	0/3	1.867	1.124	0.9 - 3.1
Triglycerides ($\mu\text{M/l}$)		* c)				1.550	0.113	1.47 - 1.63
Cholesterol ($\mu\text{M/l}$)	11/5	2.191	0.629	1.40 - 2.38	0/3	1.886	0.150	1.73 - 2.03
AP ($\mu\text{kat/l}$)	1/2	1.663	1.023	0.72 - 1.81	0/3	0.478	0.184	0.38 - 0.69
AST ($\mu\text{kat/l}$)	11/5	0.550	0.170	0.27 - 0.74	0/3	0.457	0.117	0.35 - 0.59
ALT ($\mu\text{kat/l}$)	11/5	0.381	0.116	0.22 - 0.50	0/3	0.333	0.085	0.25 - 0.42
LDH ($\mu\text{kat/l}$)	-	-	-	-	0/3	4.913	3.712	2.10 - 9.12
Magnesium (mM/l)	10/5	0.807	0.293	0.44 - 1.96	0/3	0.870	0.010	0.86 - 0.88
Calcium (mM/l)	11/5	2.299	0.249	1.72 - 2.79	0/3	2.367	0.368	2.05 - 2.77
Phosphorus (mM/l)	11/5	2.237	0.360	1.81 - 2.56	0/3	2.113	0.344	1.91 - 2.51
Chlorides (mM/l)	11/5	94.05	4.88	88.0 - 101.0	0/3	104.5	3.0	101.0 - 106.5
Sodium (mM/l)	5/0	147.0	5.6	143.0 - 151.0	0/3	143.6	9.2	136.0 - 154.0
Potassium (mM/l)	5/0	5.945	0.601	5.52 - 6.37	0/3	4.970	0.594	4.37 - 5.56
Copper ($\mu\text{M/l}$)	-	-	-	-	0/3	20.96	2.75	18.3 - 23.8
Zinc ($\mu\text{M/l}$)	-	-	-	-	0/3	73.9	30.9	52.0 - 95.8
Iron ($\mu\text{M/l}$)	11/5	42.38	21.07	22.5 - 127.0	0/3	34.46	15.98	30.7 - 52.0

* a) $P < 5\%$ * b) $P < 2\%$ * c) $P < 2\%$ M - N = 3 \bar{X} = 7.51, S.D. = 1.31M - N = 5, \bar{X} = 6.666, S.D. = 1.832M - \bar{N} = 5, \bar{X} = 310, S.D. = 0.660F - N = 11 \bar{X} = 4.81, S.D. = 1.96F - N = 11, \bar{X} = 9.179, S.D. = 1.722F - \bar{N} = 11, \bar{X} = 2.207, S.D. = 0.612

Information on some biochemical blood serum parameters of the foregoing antelope species was published by Dreveno et al. (1974), Seal and Makey (1975), Keep (1976), Kitchen (1978), Bush et al. (1983), Hawkey (1984), ISIS (1984), Reitkerk (1986).

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 basis 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 (roan antelopes, sable antelopes, gemsbok oryxes, scimitar horned oryxes, greater kudu, cape elands, bongoes) or captured without administration of any tranquilizing drug (adax antelopes, bushbucks, greater kudu, South African impalas). 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).

From the individual values, obtained in each animal, means (\bar{X}) and standard deviations (S. D.) were computed for each species. Where the number of animals of a given species made it possible, they were computed separately for males and females (roan antelopes, gemsbok oryxes, scimitar horned oryxes, cape elands). The significance of the differences of the means for males and females was assessed by Student's t-test. Where the level of significance exceeded 5 %, the means were tabulated separately for males and females. Where this was not the case, the mean values were subsequently computed for the whole sample (males plus females) of antelopes of a given species similarly to the approach used in samples comprising only few animals.

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 1 to 6.

Table 2

Biochemical parameters in the blood serum of bongoes (*Boocerus euryceros*) and South African impalas (*Aepyceros melampus*) kept in the VC ZOO at Dvůr Králové nad Labem

	Bongo (<i>Boocerus euryceros</i>)			South African impala (<i>Aepyceros melampus melampus</i>)					
	N	\bar{X}	S. D.	min. - max.	N	\bar{X}	S. D.	min. - max.	
Total bilirubin ($\mu\text{M/l}$)	4/1	2.320	0.375	1.95 -	2.75	6/0	6.396	2.816	2.50 - 10.11
Bound bilirubin ($\mu\text{M/l}$)	4/1	2.082	0.850	0.84 -	2.72	5/0	3.428	1.376	0.80 - 4.45
Total protein (g/l)	5/3	91.37	13.47	66.0 -	107.0	9/1	66.32	9.01	49.0 - 78.0
Glucose ($\mu\text{M/l}$)	5/3	6.197	1.929	2.80 -	8.44	9/1	5.497	2.432	3.11 - 7.92
Creatinine ($\mu\text{M/l}$)	5/3	228.7	49.5	160.0 -	292.0	9/1	272.5	84.9	124.0 - 372.0
Urea ($\mu\text{M/l}$)	5/3	4.907	0.983	4.00 -	6.99	9/1	6.872	1.669	3.62 - 9.31
Total fat (g/l)	5/3	3.025	1.240	1.20 -	5.21	0/3	3.342	0.831	2.42 - 4.6
Triglycerides ($\mu\text{M/l}$)	1/2	0.850	0.039	0.83 -	0.87	-	-	-	-
Cholesterol ($\mu\text{M/l}$)	5/3	2.737	0.525	1.84 -	3.50	9/1	2.589	1.634	1.84 - 6.91
AP ($\mu\text{kat/l}$)	3/2	1.102	0.097	0.99 -	1.23	3/1	1.234	0.453	0.89 - 1.83
AST ($\mu\text{kat/l}$)	5/3	0.648	0.205	0.21 -	0.89	9/1	0.768	0.149	0.43 - 0.88
ALT ($\mu\text{kat/l}$)	5/3	0.163	0.119	0.02 -	2.29	9/1	0.404	0.102	0.22 - 0.54
LDH ($\mu\text{kat/l}$)	2/3	10.53	5.07	4.72 -	14.08	3/1	8.643	4.088	4.96 - 13.21
Magnesium (mM/l)	5/3	0.706	0.320	0.33 -	1.12	8/1	0.698	0.234	0.42 - 1.06
Calcium (mM/l)	5/3	1.733	0.432	1.14 -	2.47	8/1	1.998	0.145	1.81 - 2.19
Phosphorus (mM/l)	5/3	2.212	0.383	1.94 -	2.74	9/1	2.543	0.589	1.65 - 3.42
Chlorides (mM/l)	5/3	98.93	11.90	88.5 -	119.0	8/1	92.31	15.67	73.0 - 121.2
Sodium (mM/l)	1/3	141.2	7.6	131.0 -	148.0	2/1	157.2	4.842	152.0 - 162.0
Potassium (mM/l)	1/3	6.192	1.396	4.88 -	7.40	2/1	8.232	4.011	5.48 - 11.4
Copper ($\mu\text{M/l}$)	1/3	25.5	12.1	7.6 -	34.4	2/0	27.80	0.14	27.7 - 27.9
Zinc ($\mu\text{M/l}$)	1/3	117.6	4.3	114.5 -	120.7	1/0	144.4	-	-
Iron ($\mu\text{M/l}$)	5/3	39.55	4.30	23.9 -	58.6	7/0	51.02	21.57	37.9 - 58.5

Table 3

Biochemical parameters in the blood serum of bushbucks (*Tragelaphus scriptus*) and greater kudus (*Tragelaphus strepsiceros*) kept in the VČ ZOO at Dvůr Králové nad Labem

	Bushbuck (<i>Tragelaphus scriptus</i>)				Greater kudu (<i>Tragelaphus strepsiceros</i>)				
	N	\bar{X}	S. D.	min. - max.	N	\bar{X}	S. D.	min. - max.	
Total bilirubin (μ M/l)	2/1	2.543	0.098	2.4 -	2.6	18/1	6.858	3.315	1.78 - 13.62
Bound bilirubin (μ M/l)	2/1	2.167	0.526	1.8 -	2.5	10/1	4.490	1.774	1.50 - 7.75
Total protein (g/l)	2/1	72.00	7.00	67.0 -	80.0	19/1	76.21	12.83	52.0 - 95.0
Glucose (μ M/l)	2/1	5.14	1.83	3.05 -	6.44	19/1	9.24	2.57	5.11 - 13.43
Creatinine (μ M/l)	2/1	188.8	28.4	168.2 -	221.3	19/1	239.5	28.7	186.0 - 292.0
Urea (μ M/l)	2/1	9.20	2.68	7.49 -	12.3	19/1	5.70	1.62	3.16 - 9.20
Total fat (g/l)	2/1	2.90	1.40	1.3 -	3.9	19/1	3.11	0.81	1.8 - 4.6
Triglycerides (μ M/l)	-	-	-	-	-	17/1	1.23	0.60	0.46 - 2.51
Cholesterol (μ M/l)	2/1	2.147	0.475	1.81 -	2.69	19/1	1.856	0.513	1.01 - 3.36
AP (μ kat/l)	-	-	-	-	-	10/0	2.386	2.521	0.87 - 9.39
AST (μ kat/l)	2/0	0.930	0.190	0.79 -	1.07	19/1	0.465	0.262	0.12 - 0.80
ALT (μ kat/l)	2/0	0.305	0.092	0.24 -	0.37	19/1	0.168	0.224	0.02 - 0.79
LDH (μ kat/l)	-	-	-	-	-	9/0	7.405	1.856	5.4 - 11.1
Magnesium (mM/l)	2/1	0.74	0.43	0.25 -	1.07	19/1	0.529	0.176	0.30 - 1.07
Calcium (mM/l)	2/1	1.91	0.13	1.79 -	2.05	19/1	1.84	0.38	0.99 - 2.23
Phosphorus (mM/l)	2/0	4.28	1.07	3.52 -	5.04	19/1	2.70	0.83	1.36 - 4.60
Chlorides (mM/l)	2/1	110.6	10.0	100.0 -	120.0	19/1	100.0	10.4	81.0 - 124.0
Sodium (mM/l)	-	-	-	-	-	9/0	145.8	8.8	135.0 - 161.0
Potassium (mM/l)	-	-	-	-	-	9/0	4.55	0.45	4.01 - 5.24
Copper (μ M/l)	-	-	-	-	-	6/0	27.8	10.0	17.2 - 46.9
Zinc (μ M/l)	-	-	-	-	-	3/0	91.36	44.65	48.6 - 137.0
Iron (μ M/l)	2/0	94.4	14.0	84.5 -	104.3	17/1	35.48	15.94	8.4 - 56.6

Table 4

Biochemical parameters in the blood serum of small kudus (*Tragelaphus imberbis*) and cape elands (*Taurotragus oryx*) kept in the VČ Zoo at Dvůr Králové nad Labem

	Small kudu (<i>Tragelaphus imberbis</i>)			Cape eland (<i>Taurotragus oryx</i>)				
	N	\bar{X}	S.D.	min. - max.	N	\bar{X}	S.D.	min. - max.
Total bilirubin (μ M/l)	3/2	2.852	1.408	1.46 - 5.02	-	-	-	-
Bound bilirubin (μ M/l)	1/1	1.320	0.098	1.25 - 1.39	-	-	-	-
Total protein (g/l)	6/2	81.62	14.64	69.0 - 116.0	-	-	-	-
Glucose (μ M/l)	6/2	9.958	1.735	7.27 - 12.3	5/5	10.312	2.678	3.51 - 12.83
Creatinine (μ M/l)	6/2	230.7	68.2	150.0 - 330.0	5/5	240.2	27.4	185.0 - 277.0
Urea (μ M/l)	6/2	4.655	1.146	3.00 - 6.66	5/5	8.582	2.354	5.6 - 13.5
Total fat (g/l)	6/2	3.625	1.252	2.00 - 5.60	5/5	2.166	0.490	1.6 - 3.4
Triglycerides (μ M/l)	6/2	1.696	0.745	0.53 - 2.03	1/5	1.942	0.231	1.64 - 2.18
Cholesterol (μ M/l)	6/2	3.547	1.387	1.78 - 6.25	5/5	2.342	0.871	1.19 - 4.52
AP (μ kat/l)	5/2	2.558	1.487	1.47 - 5.61	5/5	2.467	2.138	0.50 - 6.25
AST (μ kat/l)	6/2	0.846	0.183	0.48 - 1.13	5/5	0.606	0.123	0.45 - 0.86
ALT (μ kat/l)	6/2	0.273	0.125	0.07 - 0.47	5/5	0.305	0.329	0.13 - 1.23
LDH (μ kat/l)	4/2	9.758	4.094	4.8 - 14.8	4/4	6.437	2.391	3.88 - 10.0
Magnesium (mm/l)	6/2	0.748	0.149	0.62 - 0.95	5/5	0.835	0.141	0.50 - 1.06
Calcium (mm/l)	6/2	2.265	0.251	2.09 - 2.62	5/5	2.436	0.257	1.91 - 2.81
Phosphorus (mm/l)	6/2	2.320	0.791	1.24 - 3.37	5/5	2.436	0.257	1.91 - 2.81
Chlorides (mm/l)	6/2	104.4	9.4	87.0 - 120.0	5/5	84.5	18.8	62.0 - 101.0
Sodium (mm/l)	4/1	147.6	9.5	138.0 - 160.0	4/4	114.0	47.9	90.0 - 164.0
Potassium (mm/l)	4/1	5.718	1.582	4.34 - 8.35	4/4	5.862	0.348	5.39 - 6.25
Copper (μ M/l)	2/0	21.35	2.47	19.6 - 23.1	4/4	22.55	4.29	17.2 - 30.8
Zinc (μ M/l)	2/0	71.15	21.83	53.7 - 86.6	4/4	103.3	77.8	29.2 - 198.0
Iron (μ M/l)	4/1	53.94	12.29	39.6 - 69.8	5/4	39.6	10.5	15.9 - 50.5

* P < 1 %

M - N = 5 \bar{X} = 62.8, S.D. = 6.26F - N = 5 \bar{X} = 76.2, S.D. = 5.31

Table 5

Biochemical parameters in the blood serum of adax antelopes (*Adax nasomaculatus*) and gemsbok oryxes (*Oryx gazella gazella*) kept in the VČ Zoo at Dvůr Králové nad Labem

	Adax antelope (<i>Adax nasomaculatus</i>)				Gemsbok oryx (<i>Oryx gazella gazella</i>)				
	N	\bar{X}	S. D.	min. - max.	N	\bar{X}	S. D.	min. - max.	
Total bilirubin ($\mu\text{M/l}$)	3/2	5.112	1.114	3.88 -	6.63	9/4	5.932	2.297	2.91 - 11.50
Bound bilirubin ($\mu\text{M/l}$)	3/2	3.392	1.194	0.96 -	4.41	4/5	3.603	0.614	3.03 - 4.43
Total protein (g/l)	3/2	62.2	2.95	58.0 -	66.0	9/4	63.91	0.94	50.0 - 77.0
Glucose ($\mu\text{M/l}$)	3/2	5.253	0.945	4.33 -	6.66	9/4	10.662	2.943	5.0 - 14.8
Creatinine ($\mu\text{M/l}$)	3/2	209.0	33.5	159.3 -	248.0	9/4	251.4	60.2	162.0 - 369.0
Urea (mm/l)	3/2	8.022	1.636	5.83 -	10.30	9/4	6.055	1.325	4.00 - 8.49
Total fat (g/l)	3/2	17.5	2.6	14.5 -	21.4	9/4	3.169	0.727	2.1 - 4.4
Triglycerides ($\mu\text{M/l}$)				-	-		1.662	0.734	0.48 - 2.74
Cholesterol (mm/l)	3/2	2.100	0.477	1.76 -	2.90	9/4	2.549	2.385	1.03 - 6.83
AP ($\mu\text{kat/l}$)	3/2	1.462	0.221	1.19 -	1.77	9/4	0.540	0.262	0.15 - 1.14
AST ($\mu\text{kat/l}$)	3/2	0.500	0.116	0.39 -	0.65	9/4	0.591	0.267	0.11 - 1.18
ALT ($\mu\text{kat/l}$)	3/2	0.542	0.201	0.27 -	0.83	9/4	0.242	0.099	0.02 - 0.35
LDH ($\mu\text{kat/l}$)	-	-	-	-	-	5/4	5.124	0.476	4.80 - 6.35
Magnesium (mm/l)	3/2	0.904	0.068	0.82 -	0.99	9/4	0.772	0.213	0.29 - 1.15
Calcium (mm/l)	3/2	2.382	0.328	1.94 -	2.63	9/4	2.044	0.211	1.85 - 2.59
Phosphorus (mm/l)	3/2	2.414	0.225	2.13 -	2.74	9/4	3.016	0.710	2.03 - 4.67
Chlorides (mm/l)	3/2	98.2	5.8	82.0 -	95.0	9/4	105.3	7.7	87.0 - 112.0
Sodium (mm/l)	-	-	-	-	-	4/1	153.6	18.2	134.0 - 175.0
Potassium (mm/l)	-	-	-	-	-	4/1	5.387	0.242	5.27 - 5.83
Copper ($\mu\text{M/l}$)	-	-	-	-	-	2/1	16.20	1.22	17.8 - 19.0
Zinc ($\mu\text{M/l}$)	-	-	-	-	-	2/1	102.4	26.5	66.0 - 112.0
Iron ($\mu\text{M/l}$)	3/2	38.48	9.46	27.7 -	51.0	9/4	37.68	8.70	23.4 - 53.2

Table 6

Biochemical parameters in the blood serum of scimitar horned oryxes
(Oryx dammah) kept in the VČ Zoo at Dvůr Králové nad Labem

Scimitar horned oryx (Oryx dammah)		N	\bar{X}	S. D.	min.	max.	
Total bilirubin ($\mu\text{M/l}$)		10/5	11.122	6.632	3.0	33.3	* P < 5 %
Bound bilirubin ($\mu\text{M/l}$)		9/5	6.710	2.334	2.0	7.4	
Total protein (g/l)		10/6	52.69	8.56	42.0	69.0	M - N = 3, \bar{X} = 4.315
Glucose (mM/l)		10/5	14.032	3.675	4.2	17.8	S. D. = 1.153
Creatinine ($\mu\text{M/l}$)		10/6	233.6	36.5	168.0	319.0	
Urea (mM/l)		10/5	6.765	2.328	4.0	11.8	F - N = 4, \bar{X} = 1.946
Total fat (g/l)		10/6	2.633	0.790	1.2	4.9	S. D. = 0.926
Triglycerides (mM/l)							
Cholesterol (mM/l)		10/6	1.902	0.539	1.16	3.23	
AP ($\mu\text{kat/l}$)		7/4	4.580	3.246	0.45	11.50	
AST ($\mu\text{kat/l}$)		10/6	0.459	0.161	0.15	0.68	
ALT ($\mu\text{kat/l}$)		10/6	0.256	0.026	0.09	0.42	
LDH ($\mu\text{kat/l}$)		0/1	4.8	-	-	-	
Magnesium (mM/l)		10/6	0.496	0.173	0.33	1.05	
Calcium (mM/l)		9/6	2.117	0.183	1.95	2.64	
Phosphorus (mM/l)		10/6	2.420	0.502	1.36	3.33	
Chlorides (mM/l)		9/6	99.42	9.38	71.0	109.0	
Sodium (mM/l)		0/1	86.0	-	-	-	
Potassium (mM/l)		0/1	5.16	-	-	-	
Copper ($\mu\text{M/l}$)		0/1	23.6	-	-	-	
Zinc ($\mu\text{M/l}$)		-	-	-	-	-	
Iron ($\mu\text{M/l}$)		7/4	41.69	15.18	23.8	62.4	

Discussion

In discussing biochemical blood serum values of "healthy" animals a number of facts are to be kept in mind. Such values are to serve as tentative reference standards facilitating diagnosis and possibly prognosis of disease where deviations from these standards are found. The whole problem is associated with the question of "normality in biology" and is rather intricate as was pointed out by V á c h a (1980). Laboratory values obtained in clinically healthy animals depend on a number of factors that can be divided into two main groups:

- (1) Factors associated with the status of the animal at the time of blood withdrawal (age, sex, pregnancy, lactation, oestrus, season and time of day of blood withdrawal, geographical locality, herd management practices, etc.).
- (2) Factors associated with the methods used for determination of the values (preparation of the animal before blood withdrawal, mode of blood withdrawal, processing of the samples and mode of evaluation of the data).

Another factor involved in the development of "reference standards" for evaluation of laboratory findings is the number of animals examined and the number of examinations.

In developing any such tentative standards for non-domesticated animals kept in zoos and in evaluating them as to their validity due consideration must be given to the whole complex of the foregoing interacting factors. Such data are generally obtained on the basis of a small number of examinations made under specific conditions in animals kept under various management practices all of which are different from natural conditions. The sample collection itself (e. g. blood withdrawal) produces considerable stress the intensity of which, however, varies from animal to animal. The fact that the involvement of factors associated with the status of the animal at the time of blood withdrawal as well as the methods of examination vary with different studies makes comparison of the values reported for a given species rather difficult. In spite of these difficulties, of which we are fully aware, we regard some comparison as useful. Compared with the published evidence by D r e v e m o et al. (1974), S e a l and M a k e y (1975), K e e p (1976), K i t c h e n (1978), B u s h

et al. (1983), H a w k e y (1984), I s i s (1984), R e i t k e r k (1986) the biochemical blood serum values obtained in our study are markedly different in that the creatinine values found by us in a number of antelope species (the greater kudu, cape eland, South African impala, sable antelope, adax antelope, gemsbok oryx) are higher than those reported by the other investigators. On the other hand, the blood serum AST activity values found by us in greater kudus, small kudus, cape elands, bongoes, South African impalas, scimitar horned oryxes, gemsbok oryxes, roan antelopes and adax antelopes are lower than those reported by most of the other investigators.

In those cases where no comparable biochemical blood serum parameters of a given antelope species were available we thought it reasonable to resort to comparison with the zoologically nearest domestic animal. For this purpose we used the data reported for cattle and sheep by S o v a (1981) and by J a g o š and B o u d a (1981) and those reported for goats by R i d o u x et al. (1981).

This comparison showed relatively high blood serum glucose levels in all antelope species examined in our study, low blood serum protein levels in scimitar horned oryxes, high blood serum creatinine levels in all antelope species examined except bushbucks, high blood serum total lipid levels in adax antelopes, high blood serum triglyceride levels in all antelope species examined, low blood serum calcium levels in South African impalas, bushbucks, bongoes, gemsbok oryxes and scimitar horned oryxes, and high blood serum iron levels in small kudus, South African impalas, bongoes and roan antelopes, compared with the values for the afore-mentioned domestic animals.

Blood collections for biochemical examination of the blood sera in our study were made in antelopes either immobilized by administration of a tranquilizing drug or captured without pharmacological immobilization. We thought it of interest to find to what degree these two types of preparation of the animals before blood withdrawal would be reflected in the individual biochemical parameters. Comparison along this line showed little difference in most of the parameters under study. Only blood serum glucose levels of antelopes of three species captured without administration of any tranquilizing drug (South African impalas, adax antelopes and bushbucks) were markedly in the lower part of the range found in the remaining species.

In conclusion we wish to point out that we regard the biochemical blood serum parameters reported here for the individual antelope species only as tentative. Our future efforts will be directed towards obtaining, step by step, more accurate values by repeated examination under consideration of seasonal effects, age and physiological status of the animals.

Biochemické hodnoty krevního séra
zdravých antilop chovaných ve Východočeské
Zoologické zahradě Dvůr Králové nad Labem

I. Tragelaphinae, Hippotraginae, Aepycerotinae

V krevním séru 11 druhů klinicky zdravých antilop, samců i samic, starších 1 roku, zoologicky řazených do podčeledí Tragelaphinae, Hippotraginae a Aepycerotinae, 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 a aktivity alkalické fosfatázy, alanin aminotransferázy, asparát aminotransferázy a laktátdehydrogenázy.

Биохимические значения сыворотки здоровых антилоп,
содержащихся в Восточночешском зоопарке
Двур -Кралове над Лабой

I. Tragelaphinae, Hippotraginae, Aepycerotinae

В кровяной сыворотке 11 видов клинически здоровых антилоп, самцов и самок, старше 1 года зоологически входящих в подсемейства Tragelaphinae, Hippotraginae и Aepycerotinae, содержащихся в Восточночешском зоопарке Двур-Кралове над Лабой определили 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 и активность щелочной фосфатазы, аланин-аминотрансферазы, аспарат-аминотрансферазы и лактатдегидрогеназы.

References

- BUSH, M. - CUSTER, R. S. - WHITLA, J. C. - MONTALI, R. J.: Hematologic and serum chemistry values of captive scimitar horned oryx (*Oryx tao*): variations with age and sex. *J. Zoo An. Med.*, 14, 1983, 51 - 55.
- DREVEMO, S. - GROOTENHUIS, J. D. - KARSTAD, L.: Blood parameters in wild ruminants in Kenya. *J. Wildl. Dis.*, 10, 1974, 327 - 334.
- HAWKEY, C. M.: Clinical biochemistry: normal ranges for scimitar - horned oryx. London Zoological Society 1984. in: REITKERK, F. E.: Haematological and biochemical blood values of antelopes and gazelles. Vakgroep Pathologie Ziektekunde der Bijzondere Dieren. Faculteit der Diergeneeskunde Rijksuniversiteit, Utrecht, 1986, p. 68.
- 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, 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.
- KITCHEN, H.: Hematological values and blood chemistries for a variety of artiodactylids. in: FOWLER, M.: Zoo and wild animal medicine, W. B. Saunders, Philadelphia, 1978, pp. 815 - 830.
- POSPÍŠIL, J. - KAŠE, F. - VÁHALA, J. - MOUCHOVÁ, I.: Basic haematological values in antelopes - I: the Aepycerotinae and the Alcelaphinae. *Comp. Biochem. Physiol.*, 78A, 1984 a, 547 - 551.
- POSPÍŠIL, J. - KAŠE, F. - VÁHALA, J. - MOUCHOVÁ, I.: Basic haematological values in antelopes - II: the Hippotraginae and the Tragelaphinae. *Comp. Biochem. Physiol.*, 78A, 1984 b, 799 - 807.
- POSPÍŠIL, J. - KAŠE, F. - VÁHALA, J. - MOUCHOVÁ, I.: Basic haematological values in antelopes - III: the Reduncinae and the Antilopinae. *Comp. Biochem. Physiol.*, 78A, 1984 c, 809 - 813.
- POSPÍŠIL, J. - KAŠE, F. - VÁHALA, J. - MOUCHOVÁ, I.: Basic haematological values in antelopes - IV: a comparison and concluding remarks. *Comp. Biochem. Physiol.*, 78A, 1984 d, 815 - 821.
- POSPÍŠIL, J. - ŠPÁLA, P. - VÁHALA, J. - KAŠE, F.: 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.
- 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.
- REITKERK, F. E.: Haematological and biochemical blood values of antelopes and gazelles. Vakgroep Pathologie Ziektekunde der Bijzondere Dieren, Faculteit der Diergeneeskunde Rijksuniversiteit, Utrecht, 1986, p. 68.
- RIDOUX, R. - SILIART, B. - ANDRÉ, F.: Parametres biochimiques de la chèvre laitière. *Rec. Méd. vet.*, 157, 1981, 357 - 361.
- SEAL, U. S. - MAKEY, D. G.: Baseline laboratory data for captive native and exotic species. Data for Captive Native and Exotic Species. The

American Assotiation of Zoo Veterinarians, Semak System 1975. in: REITKERK, F. E.: Haematological and biochemical blood values of antelopes and gazelles. Vakgroep Pathologie Zeiktekunde der Bijzondere Dieren. Faculteit der Diergeneeskunde Rijksuniversiteit, Utrecht, 1986, p. 68.

SOVA, Z.: Použití SI jednotek v zootechnice a veterinární medicíně. Biologizace a chemizace živočišné výroby - Veterinaria, 15/21, 1979, 295 - 301.

VÁCHA, J.: Problém normálnosti v biologii a lékařství. Avicenum, Praha 1980, p. 178.



Symbols and Abbreviations

- ALT - alanine aminotransferase
- AP - alkaline phosphatase
- AST - aspartate aminotransferase
- LDH - lactate dehydrogenase
- max. - maximum value found in the sample
- min. - minimum value found in the sample
- N. - No. of animals examined (No. males examined/No. females examined)
- P - level of significance of the mean values compared
- S.D. - standard deviation
- VČ. ZOO East-Bohemian Zoological Garden at Dvůr Králové nad Labem
- \bar{x} - mean value
- * - level of significance ($\alpha \leq 5$) of the differences of the mean values between males and females was determined.