

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

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Received October 6, 1986

Abstract

Pospíšil J., P. Špála, J. Váhala, F. Kaše:
Biochemical Values in the Blood Serum of Some Felids Kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem. Acta vet. Brno, 56, 1987: 343-360.

Biochemical values of the blood serum of 4 northern European lynxes *Lynx lynx lynx*/, 3 mountain lions *Puma concolor missolensis*/, a male leopard *Panthera pardus saxicolor*/, a female Corbett's tiger *Panthera tigris Corbetti*/, a male Althaic tiger *Panthera tigris Altaica*/, 5 jaguars *Panthera onca*/, 4 lions *Panthera leo leo*/ and 8 cheetahs *Acinonyx jubatus jubatus*/ are reported. The values include total bilirubin, protein, glucose, creatinine, urea, total lipid, triglycerides, cholesterol, magnesium, calcium, phosphorus, chlorides, sodium, potassium, copper, zinc and iron concentration and alkaline phosphatase, ALT and AST aminotransferase and lactate dehydrogenase activity.

Lion, lynx, jaguar, cheetah, leopard, tiger.

Haematological values in the peripheral blood of some clinically healthy felids *Carnivores, the Felidae*/ kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem were reported previously (Pospíšil et al. 1986). The present report gives the results of biochemical examination of the blood serum of clinically healthy felids including the northern European lynx *Lynx lynx lynx*/, mountain lion *Puma concolor missolensis*/, jaguar *Panthera onca*/, leopard *Panthera pardus saxicolor*/, Corbett's tiger *Panthera tigris Corbetti*/, Althaic tiger *Panthera tigris Altaica*/, lion *Panthera leo leo*/ and the cheetah *Acinonyx jubatus jubatus*/. Search for relevant literature revealed some data on blood serum biochemical values of mountain lions /Table 1/, leopards /Table 2/, tigers /Table 3/ and lions /Table 4/. In jaguars, only the data of D'Agostini (1974) on blood serum calcium (2.470 mmol/l) and phosphorus concentration (1.420 mmol/l) and in cheetahs only the data of Eulenberger

Table 1

Published information on blood serum biochemical values
of mountain lions (Puma concolor)

Biochemical value	Author	Value reported
Total bilirubin	umol/l	CURRIER, RUSSELL(1982) a) 3.42 - 5.13
		CURRIER, RUSSELL(1982) b) 8.55 - 11.97
Protein	g/l	CURRIER, RUSSELL(1982) c) 71.0 - 73.0
Glucose	mmol/l	CURRIER, RUSSELL(1982) c) 7.492- 8.547
Creatinine	umol/l	CURRIER, RUSSELL(1982) c) 217.4 -271.3
Urea	mmol/l	CURRIER, RUSSELL(1982) c) 4.980- 5.992
Cholesterol	mmol/l	CURRIER, RUSSELL(1982) a) 3.833- 4.791
		4.972- 5.542
Alkaline phosphatase		
A S T	ukat/l	CURRIER, RUSSELL(1982) c) 0.081- 0.121
	ukat/l	CURRIER, RUSSELL(1982) a) 0.968- 1.219
		CURRIER, RUSSELL(1982) b) 0.668- 0.784
A L T	ukat/l	CURRIER, RUSSELL(1982) c) 0.801- 0.951
L D H	ukat/l	CURRIER, RUSSELL(1982) a) 2.221- 3.283
		CURRIER, RUSSELL(1982) b) 2.137- 2.621
Magnesium	mmol/l	KUNTZE, HUNSDORFF (1976) 0.411- 0.987
Calcium	mmol/l	CURRIER, RUSSELL(1982) c) 2.612- 2.769
		D'AGOSTINO (1974) 2.078- 3.318
		KUNTZE, HUNSDORFF (1976) 2.969- 3.218
Phosphorus	mmol/l	CURRIER, RUSSELL(1982) a) 1.549- 2.034
		CURRIER, RUSSELL(1982) b) 1.420- 1.679
		D'AGOSTINO (1974) 1.524- 1.711
		KUNTZE, HUNSDORFF (1976) 2.567- 2.744
Chlorides	mmol/l	CURRIER, RUSSELL(1982) a) 111.9 -116.5
		CURRIER, RUSSELL(1982) b) 117.6 -119.1
Sodium	mmol/l	CURRIER, RUSSELL(1982) a) 143.4 -145.7
		CURRIER, RUSSELL(1982) b) 147.0 -148.0
Potassium	mmol/l	CURRIER, RUSSELL(1982) a) 4.4 - 4.7
		CURRIER, RUSSELL(1982) b) 4.1 - 4.6
		CURRIER, RUSSELL(1982) d) 4.3 - 4.6
		CURRIER, RUSSELL(1982) e) 3.9 - 4.2
		D'AGOSTINO (1974) 3.84

CURRIER; RUSSELL(1982) a) = wildlife animals, n = 17
 b) = zoo animals, n = 68
 c) = a) + b), n = 85
 d) = males, n = 50
 e) = females, n = 29

(1979) on blood serum iron concentration (18.616 ± 4.475 $\mu\text{mol/l}$) were available to us for comparison and no published data exist, to our knowledge, on the blood chemistry of lynxes.

Table 2

Published information on blood serum biochemical values of leopards (*Panthera pardus*)

Biochemical value	Author	Value reported
Total bilirubin	$\mu\text{mol/l}$ WAHLBERG, SANKARI (1979)	4.6 ± 2.7
Protein	g/l WAHLBERG, SANKARI (1979)	73.1 ± 7.7
Glucose	mmol/l WAHLBERG, SANKARI (1979)	8.9 ± 2.6
Creatinine	$\mu\text{mol/l}$ WAHLBERG, SANKARI (1979)	188.0 ± 69.0
	EULENBERGER (1981)	157.35 ± 21.21
Urea	mmol/l WAHLBERG, SANKARI (1979)	5.7 ± 2.5
Cholesterol	mmol/l WAHLBERG, SANKARI (1979)	3.4 ± 1.0
A S T	$\mu\text{kat/l}$ WAHLBERG, SANKARI (1979)	0.534 ± 0.200
A L T	$\mu\text{kat/l}$ WAHLBERG, SANKARI (1979)	0.634 ± 0.033
L D H	$\mu\text{kat/l}$ WAHLBERG, SANKARI (1979)	2.438 ± 1.369
Magnesium	mmol/l WAHLBERG, SANKARI (1979)	0.93 ± 0.06
	KUNTZE, HUNSSDORFF (1976)	$0.328 - 0.822$
Calcium	mmol/l WAHLBERG, SANKARI (1979)	2.52 ± 0.17
	D'AGOSTINO (1974)	$1.921 - 3.043$
	KUNTZE, HUNSSDORFF (1976)	$2.744 - 3.542$
Phosphorus	mmol/l WAHLBERG, SANKARI (1979)	1.93 ± 0.46
	D'AGOSTINO (1974)	$1.524 - 1.711$
	KUNTZE, HUNSSDORFF (1976)	$1.837 - 3.099$
Chlorides	mmol/l D'AGOSTINO (1974)	109.0
Sodium	mmol/l KUNTZE, HUNSSDORFF (1976)	$137.0 - 156.0$
Potassium	mmol/l D'AGOSTINO (1974)	3.56
	KUNTZE, HUNSSDORFF (1976)	$4.48 - 4.66$
Iron	$\mu\text{mol/l}$ EULENBERGER (1979) a)	22.73 ± 8.77
	EULENBERGER (1979) b)	23.44 ± 3.04

EULENBERGER (1979) a) = animals aged 9 months

b) = animals aged 2 years

WAHLBERG, SANKARI (1979) examined snow leopards (*Uncia uncia*)

Table 3
Published information on blood serum biochemical
values of tigers (Panthera tigris)

Biochemical value		Author	Value reported
Protein	g/l	EULENBERGER aj. (1974) a)	69.0 + 2.0
		EULENBERGER aj. (1974) b)	69.0 + 1.0
		EULENBERGER aj. (1974) c)	58.0 + 2.0
		EULENBERGER aj. (1974) d)	80.0 + 4.0
		SEAL aj. (1978)	70.0 + 8.0
Creatinine	μmol/l	EULENBERGER (1981) a)	88.40 + 26.52
		EULENBERGER (1981) b)	81.32 + 26.52
		EULENBERGER (1981) c)	106.08 + 26.52
		EULENBERGER (1981) d)	119.34 + 26.52
		EULENBERGER (1981) e)	123.76 + 44.20
UREA	mmol/l	SEAL aj. (1978)	5.146+ 0.149
Triglycerides	mmol/l	SEAL aj. (1978)	0.571+ 0.226
Cholesterol	mmol/l	SEAL aj. (1978)	6.060+ 0.150
Alkaline phosphatase	μkat/l	KUNTZE, HUNSSDORFF (1977)	0.030+ 0.437
		EULENBERGER aj. (1972)	0.801+ 0.278
A S T	μkat/l	SEAL aj. (1978)	0.233+ 0.010
		EULENBERGER aj. (1972) a)	0.158+ 0.035
A L T	μkat/l	EULENBERGER aj. (1972) b)	0.215+ 0.055
		EULENBERGER aj. (1972) a)	0.123+ 0.038
L D H	μkat/l	EULENBERGER aj. (1972) b)	0.270+ 0.061
		SEAL aj. (1978)	1.352+ 0.100
Magnesium	mmol/l	EULENBERGER aj. (1972) a)	3.507+ 0.835
		EULENBERGER aj. (1972) b)	2.54 + 0.061
		KUNTZE, HUNSSDORFF (1977)	0.616+ 0.892
Calcium	mmol/l	KUNTZE, HUNSSDORFF (1976) a)	0.357+ 0.686
		KUNTZE, HUNSSDORFF (1976) b)	0.370+ 0.917
		KUNTZE, HUNSSDORFF (1977)	2.669- 3.093
		SEAL aj. (1978)	2.819+ 0.024
		D'AGOSTINO (1974)	2.074+ 3.218
Phosphorus	mmol/l	KUNTZE, HUNSSDORFF (1976) a)	2.694- 3.542
		KUNTZE, HUNSSDORFF (1976) b)	2.669- 3.517
		KUNTZE, HUNSSDORFF (1977)	1.645- 2.744
		SEAL aj. (1978)	1.840+ 0.064
		D'AGOSTINO (1974)	1.711- 2.357
Chlorides	mmol/l	KUNTZE, HUNSSDORFF (1976) a)	1.398- 2.712
		KUNTZE, HUNSSDORFF (1976) b)	1.743- 2.712
		D'AGOSTINO (1974)	109.0 -124.0
Sodium	mmol/l	KUNTZE, HUNSSDORFF (1977)	128.3 -154.2
		D'AGOSTINO (1974)	155.7 -165.8
		KUNTZE, HUNSSDORFF (1976) a)	121.8 -150.0
		KUNTZE, HUNSSDORFF (1976) b)	130.5 -139.2
Potassium	mmol/l	KUNTZE, HUNSSDORFF (1976)	4.717- 5.863
		D'AGOSTINO (1974)	2.6 - 3.76
		KUNTZE, HUNSSDORFF (1976) a)	3.825- 4.794
		KUNTZE, HUNSSDORFF (1976) b)	4.054- 4.666

Continuation of Table 3

Biochemical value	Author	Value reported	
Iron	/umol/l	EULENBERGER (1979) a)	19.33 + 6.44
		EULENBERGER (1979) b)	33.11 + 7.87
		EULENBERGER (1979) c)	18.07 + 3.22
		EULENBERGER (1979) d)	17.90 + 6.26
		EULENBERGER (1979) e)	22.73 + 5.01
EULENBERGER aj. (1972)	a)	animals 10-14 weeks old, n = 17	
	b)	animals 14 days after weaning	
EULENBERGER (1981)	a)	animals 3 months old, n = 29	
	b)	animals 4 months old, n = 33	
	c)	animals 6-9 months old, n = 26	
	d)	animals 1-2 years old, n = 20	
	e)	animals more than 2 years old, n = 10	
EULENBERGER (1979)	a)	animals 3 months old, n = 23	
	b)	animals 3.5 months old (weaning), n = 6	
	c)	animals 6-9 months old, n = 13	
	d)	animals 1.5 year old, n = 15	
	e)	animals 2 years old, n = 21	
EULENBERGER (1974)	a)	animals 12 weeks old (sucklings), n = 15	
	b)	animals 14 days after weaning, n = 14	
	c)	animals 6 months old, n = 26	
	d)	older, adult animals, n = 7	
KUNTZE, HUNSSDORFF (1976)	a)	Indian tigers (<i>Panthera tigris</i> <i>tigris</i>) aged 9 to 11 years, n = 13.	
	b)	Altaic tigers (<i>Panthera tigris</i> <i>Altaica</i>) aged 1.5 to 10 years, n = 9.	

Table 4
Published information on blood serum biochemical values
of lions (*Panthera leo*)

Biochemical value	Author	Value reported
Protein	g/l SEAL aj. (1978)	74.0 ± 6.0
Creatinine	μmol/l EULENBERGER (1981)	293.4 ± 55.6
Urea	mmol/l SEAL aj. (1978)	3.48 ± 0.33
Triglycerides	mmol/l SEAL aj. (1978)	0.237± 0.022
Cholesterol	μmol/l KRITCHEVSKY (1958)	2.849± 4.144
A S T	ukat/l SEAL aj. (1978)	0.450± 0.050
A L T	mmol/l SEAL aj. (1978)	0.334± 0.033
L D H	ukat/l SEAL aj. (1978)	1.169± 0.167
Magnesium	mmol/l KUNTZE, HUNSSDORFF (1976)	0.73 ± 1.36
Calcium	mmol/l SEAL aj. (1978)	2.644± 0.748
	D'AGOSTINO (1974)	2.694- 3.068
	KUNTZE, HUNSSDORFF (1976)	3.542- 3.792
Phosphorus	mmol/l SEAL aj. (1978)	1.905± 0.645
	D'AGOSTINO (1974)	1.803- 2.066
	OLSEN, BURNS (1972)	1.194- 1.417
	KUNTZE, HUNSSDORFF (1976)	1.759- 2.518
Sodium	mmol/l KUNTZE, HUNSSDORFF (1976)	142.2 -148.7
Potassium	mmol/l KUNTZE, HUNSSDORFF (1976)	3.96 - 4.11
Iron	μmol/l EULENBERGER (1979)	21.48 ± 3.58

EULENBERGER (1979) a) animals aged 1 year
b) animals aged 3 years

Legends of Tables 1 to 4

For the sake of clarity and simplicity the values were converted by us to SI units using conversion coefficients as presented by Jagoš and Bouda (1981). An exception to this is the data of Wahlberg and Sakuri (1979) not concerning enzyme activities in Table 2 because these values were already expressed in SI units in the original study.

- = the value/s/ found in felids kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem is /are/ higher than those reported by the cited author.
- = the value/s/ found in felids kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem shows /show/ little difference from those reported by the cited author.
- = the value/s/ found in felids kept in the East-Bohemian Zoological Garden at Dvůr Králové nad Labem is /are/ markedly lower than those reported by the cited author.

Materials and Methods.

The numbers of animals of the individual species examined in this study, their age and sex, the months in which the animals were blood-sampled and the mode of anaesthesia before blood withdrawal are shown in Table 5. Basic data on management, housing and feeding practices and health status of the animals are presented in Table 6.

Biochemical values were determined in 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 bilirubin, protein, glucose, creatinine, urea, triglycerides, cholesterol, chlorides and phosphorus level and of alkaline phosphatase, 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 determination of calcium, magnesium, potassium, sodium, iron, copper and zinc levels. 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, Gödecke, German Federal Republic). Means (\bar{X}) and standard deviations (SD) were computed from the values obtained in the individual animals.

Results

Biochemical values of the blood serum of 2 female and 2 male northern European lynxes, 3 male mountain lions, 2 male and 3 female jaguars are presented in Tables 7, 8 and 9, respectively. Table 10 shows the results obtained for a male leopard, a female Corbett's tiger and a male Althaic tiger. The blood serum biochemical values of 2 male and 2 female lions and of 2 male and 6 female cheetahs are presented in Tables 11 and 12, respectively.

Discussion

Tables 1 to 4 provide a survey of blood serum biochemical data reported for felids in the relevant literature, together with identification of those values that are markedly different from the results reported in our study. As marked differences were regarded such cases where standard deviations of the corresponding values or their ranges did not overlap. The reasons of the differences in some values between our results and those reported in the relevant literature are difficult to analyse because only small numbers of animals were examined in the present study as well as in most studies by the aforementioned investi-

Table 5
Basic data on the felids examined and on the methods of examination

Animal species	Concurrent i.m. doses of KETAMIN (K) and Xylazine (X) per animal before blood withdrawal	Site of blood withdrawal	Sex	No. animals examined	Month of blood collection/No. animals	Age in years/No. animals
Northern European lynx (Lynx lynx lynx)	(K) 60-100 mg	v.	M	2	XI/2	> 2/2
	(X) 30-40 mg	saphena	F	2	XI/2	> 2/2
Mountain lion (Puma concolor missolensis)	(K) 190-200 mg	v.	M	3	IV/2, XI/1	2/2, 6/1
	(X) 80-200 mg	saphena				
Leopard (Panthera pardus saxicolor)	(K) 350 mg	v.	M	1	XII/1	1/1
	(X) 100 mg	saphena				
Jaguar (Panthera onca)	(K) 250-350 mg	v.	M	2	IV/1, X/2	2/1, > 5/1
	(X) 250-400 mg	saphena	F	3	I/1, X/2	2/1, > 5/2
Corbett's tiger (Panthera tigris Corbetti)	(K) 280 mg	v.	F	1	X/1	4/1
	(X) 400 mg	saphena				
Altaic tiger (Panthera tigris Altaica)	(K) 500 mg	v.	M	1	XI/1	9/1
		saphena				
Lion (Panthera leo leo)	(K) 600-800 mg	v.	M	1	X/1	5/1
	(X) 350-400 mg	saphena	F	3	VIII/2, X/1	3/1, 4/1, > 5/1
Cheetah (Acinonyx jubatus jubatus)	(K) 120-160 mg	v.	M	2	X/2	> 2/2
	(X) 60-80 mg	saphena	F	6	X/6	> 2/6

M = males, F = females, > = estimate of age with respect to the year the animal was imported.

Table 6

Basic data on housing, feeding and health conditions of the felids examined in the present study

Animal species	Housing	Feeding	Health status
Northern European lynx (Lynx lynx lynx)	All animals kept together	living feed (rabbit, goat, coypu)	no health problems
Mountain lion (Puma concolor missolensis)	All animals kept together	living feed (rabbit, hen), feed mixture	no major health problems, occasional occurrence of threadworms
Jaguar (Panthera onca)	Kept in pairs	eviscerated small animals	no health problems
Leopard (Panthera pardus saxicolor)	Kept in pairs	eviscerated small animals	no health problems
Corbett's tiger (Panthera tigris Corbetti)	Kept separate from one another	now and then small animals	no health problems
Altaic tiger (Panthera tigris altaica)	Kept separate from one another	now and then small animals	no health problems
Lion (Panthera leo leo)	Males and females kept separate for the night and together by day	feed mixture ⁺	no health problems
Cheetah (Acinonyx jubatus jubatus)	Males and females kept separate	now and then small animals,	persisting ulc- naria, otherwise no health problems

⁺ Feed mixture consisting of minced meat, oat flakes, carrot, milk powder, yeast, minerals- and vitamins-containing concentrate and vegetable oil.

Table 7
 Biochemical values in the blood serum of northern European lynxes (Lynx lynx lynx)

Biochemical value	Individual values				\bar{X}	SD
	b	b	a	a		
Protein	72.0	73.0	74.0	77.0	74.00	2.16
Creatinine	-	178.0	187.0	185.0	183.33	4.72
Urea	8.5	15.8	15.2	18.1	14.40	4.12
Triglycerides	-	2.04	1.95	1.95	1.98	0.05
Cholesterol	4.4	3.6	4.4	4.0	4.10	0.38
A S T	0.330	0.310	0.220	0.520	0.345	0.126
ALT	0.480	0.400	0.340	0.970	0.547	0.287
Magnesium	-	0.95	0.91	0.92	0.926	0.020
Calcium	-	2.41	2.40	2.38	2.396	0.015
Phosphorus	1.88	1.03	1.22	1.39	1.380	0.364
Chloride	-	137.0	128.0	134.0	133.0	4.5
Sodium	-	154.0	116.0	125.0	131.6	19.8
Potassium	-	4.28	4.15	4.50	4.350	0.180
Copper	-	13.1	13.7	18.2	15.00	2.78
Iron	-	20.4	10.4	18.8	16.53	5.37

a = male
 b = female
 \bar{X} = mean value
 SD = standard deviation

Table 8
 Biochemical values in the blood serum of mountain lions (*Puma concolor missolensis*)

Biochemical value	Males individual values	\bar{x}	SD
Total bilirubin	2.59	-	-
Protein	107.0	94.0	13.00
Glucose	12.4	8.03	3.83
Creatinine	238.0	228.5	13.4
Urea	4.3	6.10	2.54
Total lipids	7.6	-	-
Triglycerides	3.82	-	-
Cholesterol	7.4	4.85	3.46
Alkaline phosphatase			
A S T	0.54	-	-
A L T	0.30	0.38	0.043
L D H	0.35	0.82	0.253
Magnesium	2.44	-	-
Calcium	1.11	0.91	0.107
Phosphorus	2.36	1.82	0.272
Chlorides	1.67	1.445	0.318
Sodium	105.9	115.3	14.5
Potassium	167.0	128.0	20.7
Copper	2.93	3.67	1.09
Zinc	20.8	-	-
Iron	85.6	-	-
	19.8	-	-

mean value SD = standard deviation

Table 9
 Biochemical values in the blood serum of jaguars (*Panthera onca*) (a = male, b = female)

Biochemical value	Individual values						\bar{X}	SD
	b	a	b	a	b	a		
Total bilirubin	/ $\mu\text{mol/l}$	1.13	0.16	0.81	2.92	1.29	1.262	1.022
Protein	g/l	96.0	102.0	117.0	98.0	77.0	98.00	14.33
Glucose	mmol/l	9.0	7.2	7.2	5.4	11.1	8.0	2.15
Creatinine	$\mu\text{mol/l}$	123.0	171.0	150.0	255.0	202.0	180.2	50.8
Urea	mmol/l	-	-	-	7.1	6.1	6.60	0.70
Total lipids	g/l	17.3	6.8	10.3	6.5	7.3	9.64	4.54
Triglycerides	mmol/l	-	0.37	1.04	0.58	1.37	0.84	0.45
Cholesterol	mmol/l	3.17	4.50	11.40	6.40	8.60	6.81	3.27
Alkaline phosphatase	$\mu\text{kat/l}$	0.15	0.28	0.21	0.84	0.86	0.486	0.292
A S T	$\mu\text{kat/l}$	0.76	0.65	0.19	0.55	0.09	0.448	0.292
A L T	$\mu\text{kat/l}$	0.077	0.76	0.037	1.17	0.26	0.527	0.437
L D H	$\mu\text{kat/l}$	1.12	3.31	0.66	1.74	-	1.707	1.156
Magnesium	mmol/l	0.87	0.90	0.90	1.28	0.69	0.928	0.215
Calcium	mmol/l	2.40	2.44	2.55	2.43	1.58	2.280	0.395
Phosphorus	mmol/l	1.33	1.57	1.43	1.71	1.97	1.600	0.252
Chlorides	mmol/l	125.8	127.9	114.4	120.9	113.9	120.5	6.3
Sodium	mmol/l	117.0	131.0	147.0	166.0	147.0	141.6	18.5
Potassium	mmol/l	19.4	10.5	12.6	39.7	12.6	18.96	12.07
Zinc	$\mu\text{mol/l}$	-	24.8	87.7	24.9	56.4	48.50	30.09
Iron	$\mu\text{mol/l}$	-	-	25.8	25.4	26.2	25.80	0.40

\bar{X} = mean value
 SD = standard deviation

Table 10

Biochemical values in the blood serum of a leopard (*Panthera pardus saxicolor*), a Corbett's tiger (*Panthera tigris Corbetti*) and an Althaic tiger (*Panthera tigris Altaica*)

Biochemical value	Leopard (male)	Corbett's tiger (female)	Althaic tiger (male)
Total bilirubin	1.13	2.76	2.59
Protein	76.0	80.0	75.0
Glucose	9.0	5.5	7.6
Creatinine	210	185	231
Urea	9.7	6.3	10.4
Total lipids	9/1	7.6	8.3
Triglycerides	1.22	1.99	1.34
Cholesterol	3.9	5.9	5.7
Alkaline phosphatase	1.44	1.41	0.22
A S T	0.410	0.275	0.440
A L T	0.620	0.149	0.067
L D H	0.69	1.99	1.59
Magnesium	0.71	-	1.05
Calcium	2.36	-	-
Phosphorus	1.81	2.38	2.25
Chlorides	112.3	115.5	107.0
Sodium	214.0	-	180.0
Potassium	3.52	-	3.48
Copper	20.1	-	12.6
Iron	15.8	-	22.0

Table 11
Biochemical values in the blood serum of lions (Panthera leo leo)

Biochemical value	Individual values				\bar{X}	SD
	a	b	b	b		
Total bilirubin	/	2.43	1.46	1.30	1.73	0.61
Protein	g/l	88.0	100.0	92.0	88.75	10.43
Glucose	mmol/l	9.4	8.0	11.3	9.36	1.41
Creatinine	umol/l	392.0	317.0	340.0	345.2	35.7
Urea	mmol/l	11.1	5.7	14.3	10.67	3.60
Total lipids	g/l	7.7	6.0	6.0	6.50	0.81
Triglycerides	mmol/l	-	0.80	1.17	0.840	0.311
Cholesterol	mmol/l	5.91	4.30	4.00	4.77	0.84
Alkaline phosphatase	Ukat/l	0.57	0.54	0.43	0.485	0.082
A S T	Ukat/l	0.52	0.27	0.23	0.302	0.148
A L T	Ukat/l	-	0.29	0.35	0.303	0.041
Magnesium	mmol/l	1.48	0.80	0.81	0.972	0.338
Calcium	mmol/l	2.30	2.57	2.55	2.477	0.123
Phosphorus	mmol/l	1.69	1.72	1.34	1.667	0.241
Chlorides	mmol/l	113.5	113.2	76.0	105.8	20.1
Sodium	mmol/l	151.0	157.0	131.0	150.5	13.8
Potassium	mmol/l	4.98	4.36	3.85	4.335	0.473
Copper	umol/l	16.3	18.9	14.9	16.47	1.71

\bar{X} = mean value

SD = standard deviation

a = male

b = female

Table 12
 Biochemical values in the blood serum of cheetahs (*Acinonyx jubatus jubatus*)

Biochemical value	Males individual values					Females (N = 6)			min.	max.
						\bar{x}	SD			
Protein	g/l	67.0	71.0	72.50	11.05	60.0	92.0			
Glucose	mmol/l	5.2	7.5	7.06	1.15	5.2	8.4			
Creatinine	μ mol/l	208.0	147.0	212.6	65.5	162.0	322.0			
Urea	mmol/l	6.2	8.8	10.75	3.01	6.8	14.8			
Triglycerides	mmol/l	1.48	2.04	-	-	-	4.3			
Cholesterol	mmol/l	3.7	3.1	3.83	0.47	3.3	4.3			
A S T	μ kat/l	0.250	0.210	0.955	0.315	0.320	1.150			
A L T	μ kat/l	0.550	0.180	0.648	0.053	0.570	0.730			
Magnesium	mmol/l	0.92	0.97	0.950	0.063	0.870	1.030			
Calcium	mmol/l	2.77	2.92	2.585	0.248	2.52	3.23			
Phosphorus	mmol/l	2.22	2.25	2.393	0.538	1.90	3.45			
Chlorides	mmol/l	141.0	136.0	137.6	2.5	134.0	140.0			
Sodium	mmol/l	156.0	151.0	150.5	13.8	128.0	164.0			
Potassium	mmol/l	4.49	4.95	4.70	0.65	4.13	5.79			
Copper	μ mol/l	12.0	10.5	11.94	3.58	10.4	18.2			
Iron	μ mol/l	16.7	10.8	13.2	2.47	10.8	15.4			

\bar{x} = mean value

SD = standard deviation

min. = minimal value found in the blood serum of females

max. = maximal value found in the blood serum of females

gators, the only exception being the data reported for tigers by Seal et al. (1978) and for mountain lions by Currier and Russel (1982). Moreover, the results may have been affected by additional factors that are divided by Morgan (1978) into four groups and were reported by him to be involved in the results obtained on determination of seven blood serum biochemical values in healthy humans. In the first place Morgan (1978) records the effect of analytical factor, in other words the effect of methods used for determination of the values. The role of this factor is evidenced by the data obtained by Bentinck-Smith (1980) using two different methods for determination of blood serum biochemical values in cats. The second group of factors according to Morgan (1978) comprises preinstrumental effects including the mode of blood sample collection and handling of the samples before biochemical examination. This implies that not only the time and mode of blood collection and subsequent blood processing but also the treatment preceding blood collection (immobilization of the animals) are to be considered. Included by Morgan (1978) in the third group are intrasubject factors that influence homeostasis and effect individual blood serum biochemical values in various degrees, depending on time (seasonal effects, diurnal rhythm etc.) and on the state of the animal at the moment of blood collection. Relative size of the sum of these three factors with respect to total variation exerts a major effect on reliability of the reference interval as a criterion of health status (Vácha 1980). The fourth group according to Morgan (1978) includes intersubject factors.

From the aforementioned considerations it appears that the values reported in the present study as well as those reported so far in the relevant literature can be regarded only as tentative though, in our view, useful information which is of value to clinical practice in felids and as a contribution to the comparative physiology of mammals. Furthermore, the present study is the first, to our knowledge, to provide information on biochemical values in the blood serum of northern European lynxes *Lynx lynx lynx* and cheetahs *Acinonyx jubatus jubatus*.

Biochemické hodnoty krevního séra některých šelem kočkovitých chovaných ve východočeské zoologické zahradě Dvůr Králové nad Labem

V práci jsou uvedeny biochemické hodnoty krevního séra 4 rysů evropských *Lynx lynx lynx*, 3 pum kanadských *Puma concolor missoulensis*, samce levharta perského *Panthera pardus saxicolor*, samice tygra indočínského *Panthera tigris corbetti*, samce tygra ussurijského *Panthera tigris altaica*, pěti jaguárů *Panthera onca*, 4 lvů berberských *Panthera leo leo* a 8 gepardů afrických *Acinonyx jubatus jubatus*. V krevním séru těchto šelem kočkovitých byl stanoven obsah celkového bilirubinu, bílkovin, glukózy, kreatininu, močoviny, celkových lipidů, triglyceridů, cholesterolu, hořčíku, vápníku, fosforu, chloridů, sodíku, draslíku, mědi, zinku, železa a aktivita alkalické fosfatázy, aminotransferázy ALT a AST a laktátdehydrogenázy.

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

В работе приводятся биохимические величины кровяной сыворотки 4 рысей европейских (*Lynx Lynx Lynx*), 3 канадских кугуаров (*Puma concolor missolensis*), самца леопарда персидского (*Panthera pardus saxicolor*), самки индокитайского тигра (*Panthera tigris corbetti*), самца уссурийского тигра (*Panthera tigris altaica*), пяти ягуаров (*Panthera onca*) и 4 берберских львов (*Panthera leo leo*) и 8 африканских гепардов (*Acinonyx jubatus jubatus*). В кровяной сыворотке упомянутых кошачьих определяли содержание билирубина, белков, глюкозы, креатинина, мочевины, общих липидов, триглицеридов, холестерина, магния, кальция, фосфора, хлоридов, натрия, калия, меди, цинка, железа и активность щелочной фосфатазы, аминотрансферазы ALT и AST и лактатдегидрогеназы.

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