

Haematological and biochemical values in blood of wild boar (*Sus scrofa ferus*)

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ABSTRACT

Blood samples for determining haematological and biochemical values were taken from 23 healthy wild boars selected for breeding. All animals were in good condition, aged 3 to 5 years, body mass 100 to 150 kg. Total numbers of erythrocytes, concentration of haemoglobin, haematocrit and MCV values were somewhat higher than physiological values of domestic pig, while total number of leukocytes was lower, with more segmented granulocytes, than in domestic pigs. Mean values of alanine aminotransferase and creatine kinase were higher than physiological values in domestic pig, and aspartate aminotransferase, alkaline phosphatase, total proteins, albumin, blood urea nitrogen and creatinine were within these values. Glucose level was significantly higher than values in domestic pigs.

Key words: haematology, biochemistry, serum enzymes, metabolites, wild boar, Croatia

Introduction

In the literature there were little data (TUŠEK et al., 1994; VITIĆ et al., 1994) on haematological or biochemical parameters in blood of wild boars.

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Much more serological or histopathological investigation was carried out on wild boars that were shot during hunting (VICENTE et al., 2002; HUBALEK et al., 2002; ŽUPANČIĆ et al., 2002; PEREZ-MARTIN et al., 2000; DEKKERS and ELBERS, 2000; WOLKERS et al., 1994). In our investigation, blood samples were taken from live animals which, after collecting the sample, were released back into the wild.

The aim of this study was to determine haematological and biochemical values from live wild boars that can be important for evaluation of the influences of diseases, habitat quality (climate, nutrition, population density) season, sex, age, and methods of blood sample collection and analysis.

Materials and methods

In the hunting grounds, an area of 12000 ha in Sisak-Moslavina County, there were around 200 wild boars and 250 to 300 sows, of which 30 males and 100 females were selected for breeding. During routine separation of animals they were directed to a fenced area, and then through tunnels to the cage, where blood samples were taken.

During herd inspection no signs of illness were detected. More detailed physical examination revealed only a few small wounds or scratches of various age, which caused no clinical signs.

Wild boars were 3 to 5 years old, with an average of 100 to 150 kg body mass. From randomly selected 23 males, blood samples for haematological and biochemical parameters were obtained in late summer.

Blood was extracted from *v. jugularis* into siliconised tubes with cork without anticoagulant, and in tubes with sodium-heparin for haematology. Transportation of samples to laboratory lasted 4 hours.

We determined the haematological profile, as well as activity of liver enzymes aspartate aminotransferase AST, alanine aminotransferase ALT, alkaline phosphatase AP, creatine kinase CK, total proteins, albumin, glucose, blood urea nitrogen (BUN), and creatinine. Results of haematological and biochemical findings were expressed as mean, standard deviation, minimal and maximal values, and compared with physiological values of domestic pigs.

All haematological measurements were obtained on Coulter Counter C.C.Z.F. device (Coulter, Luton, England). Blood smear was stained according to the May Grünwald-Giemsa method.

After centrifugation at 1,200 g for 10 minutes and separation of sera, all biochemical analyses were accomplished on auto-analyser Technicon RA 1000. AST (EC 2.6.1.1.) ALT (EC 2.6.1.2), and AP (EC 3.1.3.1.) were determined using Boehringer chemicals adopted for Technicon RA 1000. Total proteins were determined by biuret method, determination of albumins is based on their quantitative binding to bromocresol green indicator, glucose was determined by GOD-PAP method, urea was determined by UV test, and creatinine in sera samples was determined using the Jaffe method.

Results and discussion

Since in the literature there were little data on haematological or biochemical parameters in healthy wild pigs, the results obtained were compared to physiological values of domestic pigs. Although these values differ between themselves (among authors due to different methods used), they are sufficiently representative to make a comparison. Results obtained should be regarded with care, while haematological and biochemical values may be affected by a wide range of factors, including environment, season, diet, sex, age and, finally, stress.

Haematological parameters for total erythrocyte count (RBC), haemoglobin (Hb), haematocrit (PCV), and mean corpuscular volume (MCV) are presented in Table 1. Compared to physiological values of domestic pigs our results show that the mean value for erythrocyte was at the higher limit ($E = 8.002 \times 10^{12}/L$), while in five animals the erythrocyte count was above the physiological range of values in domestic pigs. The same applies to haemoglobin values, where mean value was 156.6 g/L, while four samples were higher than the physiological range of values. All haematocrit and MCV values were above the upper physiological limit for domestic pigs. BRENNER and GÜRTLER (1981) established that excitement caused by handling and restraint can induce spleen contraction and an increase in PCV of 10% or more. Higher values of haemoglobin, PCV and

Table 1. Comparison of haematological values (erythrocytic series) determined in wild boars with those cited for domestic swine

	Wild boars Mean \pm SD (Min - Max)	Domestic swine Mean (Min - Max)	References
RBC $\times 10^{12}/L$	8.00 \pm 0.68 6.87 - 9.03	6.5 (5.0 - 8.0) 6.7 (5.8 - 7.5)*	Thorn (2000)
		6.5 (5.0 - 8.0)	Jazbec (1990)
		6.0 - 8.0**	Swenson and Reece (1993)
		5.0 - 8.0	Gomerčić and Gomerčić (1996)
		5.0 - 7.0	Siegmund (1998)
		5.0 - 8.0	Blood (1995)
Hb g/L	156.6 \pm 17.32 123 - 183	130 (100 - 160) 141 (128 - 153)*	Thorn (2000)
		130 (100 - 155)	Jazbec (1990)
		133	Gomerčić and Gomerčić (1996)
		90 - 130	Siegmund (1998)
PCV %	60.98 \pm 4.20 55.4 - 69.4	100 - 160	Blood (1995)
		42 (32 - 50) 45 (41 - 50)*	Thorn (2000)
		32 (32 - 47)	Jazbec (1990)
		36 - 43	Siegmund (1998)
MCV fl	77.5 \pm 5.13 70 - 86	32 - 50	Blood (1995)
		60 (50 - 68) 59 (55 - 68)*	Thorn (2000)
		53 - 66	Jazbec (1990)
		52 - 62	Siegmund (1998)
		50 - 68	Blood (1995)

* for 1 year and older males Duroc - Jersey swine

** 6 weeks and older

MCV in wild boars were also established by TUŠEK et al. (1994), although they had determined parameters in wild piglets with from 35 to 40 kg body mass. Slightly increased values of total erythrocyte number, haemoglobin and PCV could indicate haemoconcentration as a consequence of thirst caused by the 12-hour transportation process, during which period animals had no access to water and also due to stress caused by their manipulation. However, total proteins and albumin are within normal range, indicating that haemoconcentration as a cause of higher values in PCV could be excluded. Higher values of MCV in wild pigs impute an enhanced need for oxygen (TUŠEK et al., 1994).

Total leukocyte count (WBC), portion of segmented leukocytes (Seg), nonsegmented leukocytes (Nseg), lymphocytes (Ly), and eosinophil granulocytes (Eo) are shown and compared with other authors in Table 2. Average leukocyte count in our samples is somewhat lower than standard values for domestic pigs, with slightly higher values of segmented granulocytes (except data from GOMERČIĆ and GOMERČIĆ, 1996). Other

Table 2. Comparison of haematological values (leukocytic series) determined in wild boars with those cited for domestic swine

	Wild boars Mean \pm SD (Min - Max)	Domestic swine Mean (Min - Max)	References
WBC $\times 10^9/L$	9.79 \pm 4.27 6.0 - 20.35	16 (11.0 - 22.0)	Thorn (2000)
		18.9 (13.4 - 25.3)*	
		15 (10.0 - 20.0)	Jazbec (1990)
		15.0 - 22.0**	Swenson and Reece (1993)
		7.0 - 22.0	Gomerčič and Gomerčič (1996)
		11.0 - 22.0	Siegmund (1998)
Segmented leukocytes	0.521 \pm 0.097 0.40 - 0.70	0.37 (0.28 - 0.47)	Thorn (2000)
		0.32 (0.11 - 0.49)*	
		0.38 (0.28 - 0.52)	Jazbec (1990)
		0.30 - 0.35**	Swenson and Reece (1993)
		0.30 - 0.70	Gomerčič and Gomerčič (1996)
		0.20 - 0.70	Siegmund (1998)
Nonsegmented leukocytes	0.004 \pm 0.009 0.00 - 0.03	0.01 (0.0 - 0.04)	
		0.006 (0.0 - 0.02)*	Thorn (2000)
		0.0 - 0.04	Jazbec (1990)
		0.0 - 0.04	Siegmund (1998)
Lymphocytes	0.441 \pm 0.099 0.25 - 0.58	0.53 (0.39 - 0.62)	Thorn (2000)
		0.55 (0.36 - 0.76)*	
		0.53 (0.40 - 0.64)	Jazbec (1990)
		0.55 - 0.60**	Swenson and Reece (1993)
		0.20 - 0.60	Gomerčič and Gomerčič (1996)
		0.35 - 0.75	Siegmund (1998)
Eosinophil granulocytes	0.034 \pm 0.036 0.00 - 0.11	0.035 (0.005 - 0.11)	Thorn (2000)
		0.035 (0.02 - 0.055)*	
		0.03 (0.01 - 0.08)	Jazbec (1990)
		0.02 - 0.05**	Swenson and Reece (1993)
		0.0 - 0.10	Gomerčič and Gomerčič (1996)
		0.0 - 0.15	Siegmund (1998)

* for 1 year and older males Duroc - Jersey swine

** 6 weeks and older

Table 3. Comparison of serum enzyme activities obtained in wild boars with those for domestic swine cited by other authors

	Wild boars Mean \pm SD (Min - Max)	Domestic swine Min - Max	References
AST U/L	52.31 \pm 8.48 (41 - 67)	8 - 25	Forenbacher (1993)
		17 - 45	Gomerčić and Gomerčić (1996)
		32 - 84	Kaneko et al. (1997)
		10 - 98	Kraft (1962)
		16 - 67	Friendship et al. (1984)
		32 - 84	Radostits et al. (2000)
		8 - 25	Jazbec (1990)
		35 - 87	Pratt (1985)
ALT U/L	153.69 \pm 45.65 (88 - 231)	9 - 17	Forenbacher (1993)
		31 - 58	Kaneko et al. (1997)
		17 - 72	Kraft (1962)
		15 - 46	Friendship et al. (1984)
		8 - 10	Schmidl and Forstner (1985)
AP U/L	45.62 \pm 11.01 (27 - 69)	9 - 31	Forenbacher (1993)
		180 - 813	Friendship et al. (1984)
		20 - 50	Jazbec (1990)
		120 - 400	Radostits et al. (2000)
		110 - 278	Pratt (1985)
		140 - 293	Schmidl and Forstner (1985)
CK U/L	918 \pm 382.24 (455 - 1756)	25 - 250	Jazbec (1990)
		91-1251	Friendship et al. (1984)
		2.4 - 22.5	Kaneko et al. (1997)
		2.9 - 14.9	Pratt (1985)
		Up to 1250	Schmidl and Forstner (1985)

values of leukocytic series (nonsegmented granulocytes, lymphocytes and eosinophil granulocytes) are within recommended physiological ranges.

As can be seen from Table 3. the upper limit of AST values is 98 IU/L (KRAFT, 1962), although the majority of newer data is even lower. The majority of data obtained in boars is within or a little higher than physiological values for domestic pig, except for three samples that had extremely high values (samples N^{os} 2., 12. and 16. had values of 201, 189 and 420 IU/L respectively).

For ALT values various authors propose significantly lower values than those we obtained (mean value 153.69 U/L), and it should be taken into consideration that even the lowest of our results were higher than the highest recommended physiological value for domestic pigs. The cause of increased ALT values in sera of all wild boars is questionable, considering that ALT is an enzyme which indicates changes in liver. These findings could indicate liver lesions, but additionally at least some clinical changes this is an unexpected arising.

When AP activity is taken into consideration, the authors quoted wide range of physiological values. The results obtained from our samples are fairly equalised: on average lower (mean value 45.62 U/L) than the majority of those recommended.

The greatest differences among recommended physiological ranges are found in the literature with regard to CK values, most probably due to different methods used. Mean value obtained from our samples is higher than that of other authors, except for SCHMIDL and FORSTNER (1985) and FRIENDSHIP et al. (1984). As CK and AST are enzymes specific for muscle tissue, it can be assumed that these animals were more physically active than others, or that there was muscle damage which caused leakage of the enzyme into the extracellular space. DUBREUIL et al. (1990) have shown that the amount of muscle tissue that lodges in the bore of a needle during jugular venipuncture significantly elevates CK levels.

Total protein values that are considered as physiological for domestic pigs (Table 4.) are usually within the range from 60 to 90 g/L, and for fattening pigs the upper limit is 115 g/L (FORENBACHER, 1993). Physiological albumin levels for domestic pigs are between 18 and 40 g/L. Values that we obtained from our wild boars for total proteins were within physiological values, while albumin values were a little higher.

Glucose values recorded by us in sera of wild boars are high. From all our values just three were lower than the highest values for domestic pigs recommended by KANEKO et al. (1997). High glucose values could be anticipated due to the stress (BRENNER and GÜRTLER, 1981) to which animals were exposed during movement and venipuncture, although the sera were not examined within the first six hours after venipuncture. Considering

Table 4. Comparison of serum metabolite obtained in wild boars with those for domestic swine cited by other authors

	Wild boars Mean \pm SD Min - Max	Domestic swine Min - Max	References
Total protein g/L	82.08 \pm 3.82 76 - 88	55 - 85	Schmidl and Forstner (1985)
		62 - 82	Jazbec (1990)
		79 - 89	Pratt (1985)
		65 - 90	Forenbacher (1993)
		52 - 83	Friendship et al. (1984)
		79 - 89	Kaneko et al. (1997)
		35 - 60	Radostits et al. (2000)
Albumin g/L	40.77 \pm 2.86 36 - 47	30 - 40	Jazbec (1990)
		19 - 42	Friendship et al. (1984)
		18 - 33	Kaneko et al. (1997)
		19 - 24	Radostits et al. (2000)
		18 - 40	Forenbacher (1993)
Glucose mmol/L	10.73 \pm 2.98 7.3 - 17.5	3.6 - 5.3	Radostits et al. (2000)
		3.2 - 5.2	Forenbacher (1993)
		3.9 - 6.1	Jazbec (1990)
		4.0 - 8.1	Friendship et al. (1984)
		4.7 - 8.3	Kaneko et al. (1997)
		5.7 - 7.5	Pratt (1985)
		4.0 - 6.4	Schmidl and Forstner (1985)
Urea Nitrogen mmol/L	2.43 \pm 0.58 (1.4 - 3.6)	2.3 - 6.7	Jazbec (1990)
		1.6 - 5.0	Kaneko et al. (1997)
		3.0 - 8.5	Radostits et al. (2000)
		2.6 - 8.6	Friendship et al. (1984)
		1.6 - 5.0	Pratt (1985)
		Up to 7.9	Schmidl and Forstner (1985)
Creatinine μ mol/L	216.46 \pm 14.73 (186 - 258)	90 - 240	Radostits et al. (2000)
		77 - 165	Friendship et al. (1984)
		80 - 221	Jazbec (1990)
		141 - 239	Kaneko et al. (1997)
		88 - 238	Pratt (1985)
		Up to 221	Schmidl and Forstner (1985)

the fact that glucose level lowers by about 7% each hour, this would indicate even higher levels at the moment of venipuncture.

Mean urea value in our samples was at the lower limit recommended by different authors for domestic pigs. Mean creatinine value is at the upper limit, while just one sample is above the limit.

From these results, and from comparison with physiological values of domestic swine that are recommended by various authors, it can be concluded that some haematological and biochemical parameters in sera of healthy wild boars differ from these values in the domestic pig. All displayed data indicate that there is a need for further and more detailed research on these parameters in wild boars. Also, some other parameters could be used to gain further insight into the metabolism of wild boars, especially because there are little data in available literature.

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SAŽETAK

Istraživanje je obavljeno na uzorcima krvi 23 zdrava vepira određena za rasplod. Veprovi su bili dobrog općeg stanja, u dobi od 3 do 5 godina, teški između 100-150 kg. Ukupni broj eritrocita, koncentracija hemoglobina, hematokrit i prosječni volumen eritrocita (MCV) bili su nešto viši od fizioloških vrijednosti ustanovljenih za domaću svinju, a ukupni broj leukocita bio je nešto niži od fizioloških vrijednosti s većim udjelom segmentiranih granulocita. Srednje vrijednosti aktivnosti alanin aminotransferase i kreatin kinaze bile su više, a aspartat aminotransferaze, alkalne fosfataze, ukupnih serumskih bjelančevina, albumina, dušika ureje (BUN) i kreatinina bile su unutar fizioloških vrijednosti utvrđenih za domaću svinju. Vrijednosti glukoze u serumu bile su znatno više od vrijednosti za domaću svinju.

Ključne riječi: hematologija, biokemija, serumski enzimi, metaboliti, vepar, Hrvatska
