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SOME HEMATOLOGICAL PARAMETERS OF EUROPEAN WILD HOGS (*SUS SCROFA*)

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ABSTRACT

Anticoagulated blood from 70 European wild hogs (*Sus scrofa*) was analyzed for red blood cell count, white blood cell count (total and differential), packed cell volume, hemoglobin concentration and platelet count. The values for mean corpuscular volume and mean corpuscular hemoglobin were calculated. Subadult free-roaming hogs were somewhat higher in RBC counts, WBC counts, packed cell volumes, hemoglobins and platelet counts than adults. Among pen-reared animals, however, subadults had slightly lower values for all these parameters than adults. The ratios of white blood cells in the differential counts were similar for each age group from the same location, though all of the pen-reared animals exhibited a lymphocytic profile while that of the free-roaming hogs was neutrophilic. Statistical analysis of the data proved that this difference was significant while the only parameter that was significantly influenced by age was platelet counts. Sex did not significantly affect any parameter tested.

INTRODUCTION

No previous data could be found on the hematological parameters of the European wild hog (*Sus scrofa*). The present study was conducted as part of a long-term project on the life history and ecology of the European wild hog in the Great Smoky Mountains National Park. Although the primary goal was to collect a foundation of hematological data, it was assumed that the results would be more meaningful if comparisons were made with wild hogs which had been reared in captivity. Additionally, the data could be compared, at least superficially with known values for domestic swine. Rarely does the opportunity arise to contrast a wild, exotic game animal with its domestic counterpart of the same genus and species.

MATERIALS AND METHODS

Thirty-three free-roaming European wild hogs were live-trapped in the Tennessee area of the Great Smoky Mountains National Park between February and December, 1971. Thirty-seven additional animals which had been reared in captivity were also studied. These latter hogs were alleged to be direct descendants of the same imported animals which had originated the present wild population in the Park (Linzey and Linzey, 1971). The pen-reared animals differed from the free-roaming hogs only in that they were more accustomed to the proximity of humans. Kept in large enclosures, they were never handled nor subjected to any management practices usually associated with the production of domestic stock with the exception of irregular feedings. Basically this feed was straight corn. Measures were also taken to prevent escape as well as the entrance of any domestic swine.

The animals were manually restrained in a dorsally recumbent position while blood samples were drawn from the anterior vena cava, using 18 gauge x 10 cm. hypodermic needles with a Vacutainer-Luer adaptor attached between the needles and the 10 mm. Vacutainers into which the blood was collected. These tubes were commercially prepared with potassium oxalate as the anticoagulant of choice. Blood film smears for differential enumeration of white blood cells were made with a drop of blood from a peripheral ear vein and immediately fixed in methanol. These smears were stained in the usual manner with Wright's blood stain. Cellular studies were completed as soon as possible after collection, usually within 3 to 4 hours. At the time of blood sampling, all hogs were sexed and ages were determined by dental formulae examinations (Matschke, 1967).

An electronic cell counter (Model F Coulter Electronic Cell Counter) was used for the red and white cell counts (Weide *et al.*, 1962; Wisecup and Crouch, 1962).

The standard cyanmethemoglobin technique was utilized to determine values for red blood cell hemoglobin content (Drabkin, 1954). Samples were analyzed spectrophotometrically (Model 139, Hitachi UV-VIS Spectrophotometer).

The packed cell volumes (hematocrits) were determined by a micro-method (Guest and Siler, 1934) using capillary tubes, a Microhematocrit Centrifuge and a circular reader. The average of two determinations was reported as the packed cell volume for each sample.

Platelets were counted by phase microscopy (Brecher and Cronkite, 1953). A Bright-Line phase hemacytometer (Model F Coulter Electronic Cell Counter) was used. Dilutions were typically made with a red blood cell-diluting pipette.

The values for mean corpuscular volume and mean corpuscular hemoglobin were calculated.

The formal method of statistical analysis of the data was a three way analysis of variance to examine the influences of location upon groups of comparable sexes and ages and also of age upon groups of comparable sexes and locations. Significance was noted at the 95 percent level of F based upon the appropriate degrees of freedom. It was felt that a more detailed statistical examination would be unreliable due to the small size of certain sample cells.

RESULTS AND DISCUSSION

The results of the cellular hematological analyses for the free-roaming and pen-reared hogs are presented in Table 1. In Table 2, the normal hematological values for domestic swine, as reported by various researchers, are presented for purposes of comparison.

Ages among free-roaming hogs ranged from approximately 6 weeks to greater than 26 months, with the majority (>90%) between 6 and 20 months. All of the pen-reared hogs were within this latter range of ages. For statistical considerations, the division between adults and subadults was arbitrarily made at 10 months. It was felt that the parameters under study would be stabilized beyond this age. Miller *et al.* (1961) reported that various erythroytic values assumed stable adult levels in hogs between eight and eleven months.

Three of the free-roaming sows were nursing litters and only 2 others were in mid-pregnancy at the time of the sampling. All of the pen-reared females tested were nulliparous.

TABLE 1: *Values for Cellular Blood Parameters of European Wild Hogs by Age.*

Determination	Free-Roaming				Pen-Reared			
	Adult (n=28)		Subadult (n=14)		Adult (n=31)		Subadult (n=6)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Erythrocyte Count (mill/cu mm)	6.72	1.34	8.36	1.16	7.84	0.90	7.12	0.63
Leukocyte Count (thous/cu mm)	11.64	3.89	13.42	5.59	19.43	11.25	15.67	5.76
Packed Cell Volume	36.61	6.24	43.86	6.24	42.77	3.72	39.00	2.97
Hemoglobin (gm/100 ml)	14.17	2.61	16.11	1.91	15.36	1.29	14.52	0.54
Platelet Count (thous/cu mm)	267.68	268.71	434.14	320.22	432.64	299.77	342.50	106.85
Differential (%)								
Neutrophils	56.04	19.23	52.28	17.44	36.35	7.67	42.67	7.31
Lymphocytes	39.75	19.21	42.93	14.98	56.06	8.24	53.83	4.07
Monocytes	2.93	2.99	3.00	2.54	3.45	2.32	2.00	2.45
Eosinophils	1.32	1.98	1.93	3.34	4.03	4.23	1.50	3.21
Basophils	0.11	0.42	0.00	0.00	0.06	0.25	0.00	0.00
Mean Corpuscular Volume	55.32	7.88	52.78	6.34	55.00	4.79	55.17	2.71
Mean Corpuscular Hemoglobin	21.46	3.21	19.50	1.83	19.77	1.56	20.67	1.51

TABLE 2: *Normal Hematological Values for Domestic Swine.*

Determination	Age and/or Weight	Mean and/or Range	Source
Erythrocytes		6.7	Scarborough, 1931-32
Count		7.9	Wintrobe, 1951
(mill/cu mm)		7.4	Dukes, 1955
Leukocyte		8-20	Scarborough, 1931-32
Count		7-20	Wintrobe, 1951
(thous/cu mm)	ad. sows	15.9	
	bacon pigs	13.7	Luke, 1953
Packed Cell		39.0	Wintrobe, 1934
Volume		46.0	Tegeris, 1965
	10-94 da.	(20.4-32.9)	Weide & Twiehaus, 1969
Hemoglobin	180 da.	12.6	Craft & Moe, 1932
(gm/100 ml)		15.0	Wintrobe, 1951
	adult	(14-15)	McClellan, 1965
Platelet		404	Tegeris, 1965
Count	6 mos.	330	
(thous/cu mm)	18 mos.	(200-250)	McClellan, 1965
		403	Hikmet, 1927
Differential			
Neutrophils (%)		39.0	
Lymphocytes (%)		52.1	
Monocytes (%)		3.3	
Eosinophils (%)		4.5	
Basophils (%)		1.2	Scarborough, 1931-32
Neutrophils (%)	180 da.	30.6	
Lymphocytes (%)		64.9	
Monocytes (%)		—	
Eosinophils (%)		4.4	
Basophils (%)		—	Craft & Moe, 1932
Neutrophils (%)		41.0	
Lymphocytes (%)		47.0	
Monocytes (%)		8.0	
Eosinophils (%)		2.5	
Basophils (%)		<1.0	Dukes, 1955

TABLE 2: (cont.) *Normal Hematological Values for Domestic Swine*

Determination	Age and/or Weight	Mean and/or Range	Source
Mean Corpuscular Volume	10 mos.	(51.4 ± 4.6) (59-63) (60.5 ± 1.4)	Tumbleson, 1969 Wintrobe, 1934 Miller, 1961
Mean Corpuscular Hemoglobin	10 mos.	(16.8 ± 1.6) (21-22) (19.9 ± 0.5)	Tumbleson, 1969 Wintrobe, 1934 Miller, 1961

Although the period of sampling the free-roaming hogs extended from February 1971, to December of that year, greater than 90% of the samples were obtained in the cold months and all of the pen-reared animals were sampled at the end of 1971. The assumption seems valid, therefore, that if seasonal influences do exist, their effects were negligible in this study.

Values for RBC counts, packed cell volumes and hemoglobin concentrations were significantly higher in subadult free-roaming hogs than in adults (Table 1). In a study of miniature swine these values increased from weaning to 9 to 12 months of age and then began to steadily decline, reaching a stable plateau at about three years (McClellan *et al.*, 1965). To explain why this difference does not maintain in the same parameters among the pen-reared animals, it is necessary to postulate from numerous observations. Hackett *et al.* (1956) reported a slight difference in hemoglobin levels of Palouse pigs between those individuals receiving "full-feed" and those receiving only 70% of full-feed, with the former having the higher values. Free-roaming hogs are rarely found in numbers exceeding a family group size and while competition for available food may exist, individuals normally are able to occupy adequate space in which to forage. Contrarily, it was noted that when pen-reared hogs were fed, the feed was deposited in a limited area. An obvious hierarchy of the dominance in the herd resulted in the older and larger animals obtaining most of the feed to the exclusion of younger "lower ranking" hogs. As has been mentioned, no attempts are made by the owners of the hogs to enforce management practices, rather a counter philosophy seems to exist and the aggressions of larger animals, sometimes fatal to subadults, is tolerated.

Conclusive statements concerning the leukocytic values obtained would seem to be unwarranted as normal domestic pigs are known to have highly variable total leukocyte values (Eikmeier and Mayer, 1965; Luke, 1953). Total WBC counts vary considerably within the same individual pig from day to day and even from hour to hour (Eikmeier and Mayer, 1965; Luke, 1953). Examining the results from the differential white blood cell counts in the present study, it may be noted that the pen-reared animals exhibited a definite lymphocytosis. Previous workers (Eikmeier and Mayer, 1965; Luke, 1953; Wirth *et al.*, 1939) found a relative lymphocytosis to be normal in domestic swine. The free-roaming hogs displayed a neutrophilic pattern, however, and no satisfactory explanation for difference is available. That the free-roaming animals routinely exhibited lower total WBC counts in all sex and age categories may be in part due to differences in the microbial milieus which the two groups inhabit. That is, free-roaming hogs wander throughout a relatively large home range and thus reduce the tendency for pathogens to become concentrated in a small area which could ultimately lead to dissemination among all animals in that area. Facile communication of low grade infections (especially respiratory) to a large number of individuals from one or a few is retarded, such not being the case with the relatively confined pen-reared hogs.

Examination of the stained blood smears at the time the differential counts were made indicated that polychromatophilia of erythrocytes was common among wild hogs. Polychromatic erythrocytes is characteristic of domestic pig blood (Wisecup and Crouch, 1962).

The effect of sex was not significant for any tested parameter. This is in accord with those studies previously cited on domestic swine which revealed no sex differences for blood values.

The significant effect of age upon several parameters is believed to be due, in large part, to the differences in stage of development and levels of activity of the hematopoietic systems of young and older hogs.

Although examination of Table 1 seems to indicate notable differences between hogs of comparable ages from opposing locations as well as between hogs from the same location but of different ages, statistical analysis of the data does not indicate that more than a few of these differences are significant. From Table 3, it is seen that platelet counts are the only parameter significantly influenced by age (also by location). This cannot be explained on the basis of differences in stages of development and levels of activity in the hematopoietic systems of young and old hogs because the ratios are reversed in age comparisons for the two locations. In normal, healthy animals, which all those hogs tested appeared to be, platelet values should not be highly variable and, thus, some as yet unknown factor must be assumed to be operating. Again, from Table 3, the only other parameters significantly affected by location are the lymphocytic picture of pen-reared versus the neutrophilic ratio for free-roaming wild hogs, previously discussed.

It is well known that blood values are highly variable and may be readily influenced by stress and disease and perhaps to a lesser extent by diet. Thus, single random samples of blood may appear to be somewhat unreliable relative to the true blood picture, yet these are the conditions which often prevail in field studies and the data indicate that little would be gained by trapping and confining the free-roaming animals for the purposes of blood testing.

TABLE 3: *The Relationship of Sex-Age and Location to Cellular Blood Values.*

Determination	Effect of Loca[a] on Comparable Sexes and Ages	Effect of Sex on Comparable Locas and Age	Effect of Age on Comparable Locas and Ages
Erythrocyte Count	n.s.	n.s.	n.s.
Leukocyte Count	n.s.	n.s.	n.s.
Packed Cell Volume	n.s.	n.s.	n.s.
Hemoglobin	n.s.	n.s.	n.s.
Platelet Counts	*	n.s.	*
Differential[b]			
Neutrophils	*	n.s.	n.s.
Lymphocytes	*	n.s.	n.s.
Monocytes	n.s.	n.s.	n.s.
Eosinophils	n.s.	n.s.	n.s.
Mean Corpuscular Volume	n.s.	n.s.	n.s.
Mean Corpuscular Hemoglobin	n.s.	n.s.	n.s.

[a] Loca = Location, i.e. Location 1 includes all of the free roaming animals and Location 2 includes the pen-reared hogs.

[b] Due to their extremely low frequency of occurrence, basophils were not included in the statistical analyses.

* Denotes significance at the 95% confidence level of F distribution.

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