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BLOOD PARAMETERS IN WILD RUMINANTS IN KENYA¹

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Abstract: Blood specimens from shot or drug-immobilized impala (*Aepyceros melampus*), Thomson's gazelle (*Gazella thomsonii*), Grant's gazelle (*Gazella granti*), mountain reed buck (*Redunca fulvorupula*), blue wildebeest (*Connochaetes taurinus*), Coke's hartebeest (*Alcelaphus buselaphus cokii*), topi (*Damaliscus korrigum*), eland (*Taurotragus oryx*), buffalo (*Syncerus caffer*) and giraffe (*Giraffa camelopardalis*) have been studied for the following parameters: erythrocyte and leukocyte counts, haematocrit and haemoglobin estimations, and serum calcium, inorganic phosphorus, magnesium and copper values. Both shot and drug-immobilized impala and shot wildebeest and topi had relatively high numbers of erythrocytes. The haematocrit and haemoglobin values were found to be comparatively low in the buffalo. Calcium and inorganic phosphorus values were low in the reed buck and inorganic phosphorus low in the topi, when compared to normal values for domestic ruminants.

When comparing data from shot and drug-immobilized impala, wildebeest and eland, statistically significantly higher values were found in erythrocyte counts, haematocrit and haemoglobin estimation in shot impala and wildebeest. Inorganic phosphorus was significantly higher in shot eland and wildebeest compared to immobilized animals of these species.

INTRODUCTION

There is little information on normal blood parameters for African wild animals. Some authors, for example Holman,^{1,5} have pointed out the difficulties in establishing useful clinical haematological standards. Nevertheless, there can be distinct changes, either in individuals or in a group of animals, which can give clues for further investigations into sickness and mortality. This paper is based on blood specimens taken during a wildlife disease survey carried out in Kenya during 1972 and 1973, and describes the blood characteristics routinely investigated. A comparison between shot and

drug-immobilized animals has been made for some of the species.

MATERIAL AND METHODS

Specimens were taken from both shot and drug-immobilized animals. None of the animals showed any clinical signs of disease. The blood was taken from a jugular vein within 1-2 min after the animal was shot or, when immobilized, immediately after the animal became recumbent. In captive animals, specimens were taken either at the time of capture or within 1 week after capture. The Cap Chur rifle or pistol and projectile syringes⁴ were used and the immobilization

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drugs were either 2% xylazine⁵ or xylazine in combination with etorphine and acepromazine.⁶ Five ml samples for red blood cell (RBC), white blood cell (WBC) and packed cell volume (PCV) determinations were taken into glass vials containing 10 mg ethylenediaminetetraacetic acid. Ten ml samples of blood for haemoglobin (Hb), inorganic phosphorus (P) and copper (Cu) determinations were taken into glass vials containing 6 mg sodium fluoride as anticoagulant and 1 mg Thiomersal as preservative.⁷ Twenty ml samples of blood, allowed to clot in glass bottles without anticoagulant, were centrifuged and the serum was taken for calcium (Ca) and magnesium (Mg) analysis. The specimens were stored on ice or in a refrigerator, if they could not be transferred to the laboratory for processing immediately. Usually the test procedures were carried out within 48 hours; however, serum for calcium and magnesium analyses was stored frozen and processed within 2 months. Erythrocyte and leukocyte counts were made in a Neubauer improved counting chamber. PCV was determined by the microhaematocrit method and Hb by using the cyanmethaemoglobin method.¹⁷ Inorganic phosphorus was measured according to Fiske and Subbarow.¹¹ Copper analysis was based on the method used by Eden and Green,⁹ as modified by Clare et al.,⁴ the method being further modified by drying the amyl alcohol extract by centrifugation over AR anhydrous sodium sulphate before measuring the absorbance, instead of filtering the extract through acid-extracted filter papers. Calcium and magnesium were determined by using a

Perkin-Elmer Atomic Absorption Spectrophotometer⁸ or by using the methods of Clark and Collip⁵ and Dennis,⁷ respectively. In the comparison of shot and drug-immobilized animals of the same species, Student's t-test was used.

RESULTS

The results are shown in Table 1 and Figure 1. Most values are within limits which can be found in cattle.¹⁴ However, the erythrocyte counts are very high in both shot and immobilized impala and high in shot wildebeest and topi. The RBC diameters in impala were between 3.5μ and 5.6μ , while the diameters in wildebeest and topi were approximately the same as in cattle. The haematocrit and haemoglobin values were found to be relatively low in buffalo, while the calcium and magnesium levels were low in reedbuck and inorganic phosphorus low in topi. All of these animals were taken by shooting.

The mean RBC values are significantly higher in shot impala, compared to drug-immobilized impala ($P < 0.05$). The mean PCV and Hb are also significantly higher in the shot animals, $P > 0.001$ and $P < 0.01$, respectively. In eland, both shot and drug-immobilized animals had a comparatively low mean PCV, while the mean value for inorganic phosphorus was significantly higher in the shot animals ($P < 0.001$). In shot wildebeest, significantly higher mean values occurred for RBC ($P < 0.001$), PCV ($P < 0.001$), Hb ($P < 0.05$) and inorganic phosphorus ($P < 0.01$), compared with the drug-immobilized animals.

⁵ Rompun—Bayer A. G., 509 Leverkusen, Bayerwerk, F.R. Germany.

⁶ Immobilon (etorphine and acepromazine)—Reckitt and Coleman, Hull, England.

⁷ Thiomersal—British Drug House Chemicals Ltd., Poole, England. Method developed by M. L. Burdin and D. A. Howard: Veterinary Research Laboratory, Kabete, Kenya.

⁸ Perkin-Elmer Corp., Norwalk, Conn., U.S.A.

FIGURE 1. Histogram comparing mean values for red blood cell counts (RBC), packed cell volume (PCV), haemoglobin (Hb), white blood cell counts (WBC), serum phosphorus (P), serum magnesium (Mg) and serum copper (Cu) in various wild animal species. (S) and (D) indicate whether the group of animals sampled was shot or drug-immobilized. The broken line indicates the standard deviation on the negative side of the mean.

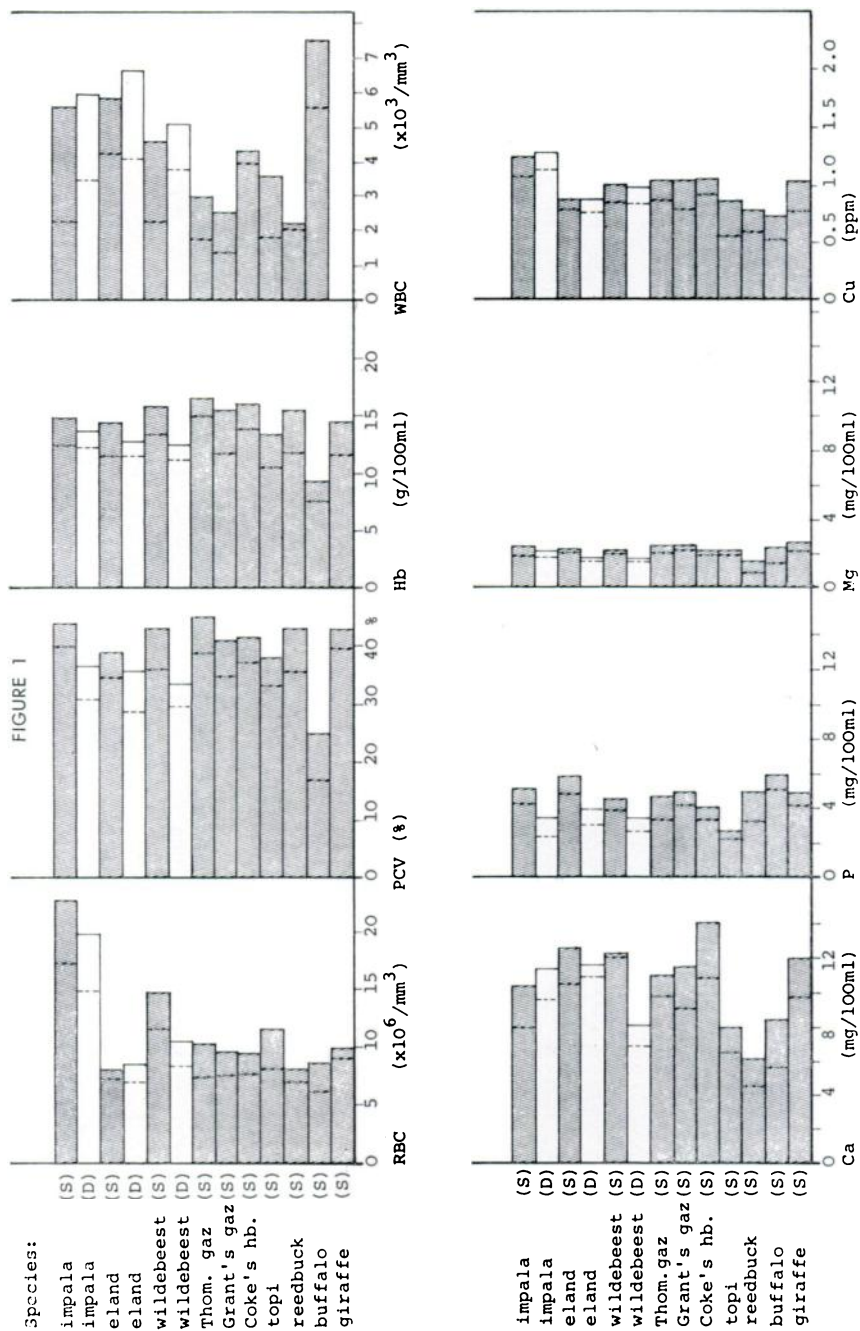


TABLE 1. Some Blood Data From Shot (S) and Drug-Immobilized (D) Wild Ruminants.

	RBC	WBC	PCV	Hb	Ca	P	Mg	Cu
	10 ⁶ /mm ³	10 ³ /mm ³	%	g/100 ml	mg/100 ml	mg/100 ml	mg/100 ml	ppm
Impala (S)	\bar{x}	5.60	44.2***	15.0**	10.3	5.2***	2.5	1.26
	S	3.40	4.3	2.6	2.4	1.0	0.7	0.20
	n	44	59	101	57	57	57	81
Impala (D)	\bar{x}	5.92	36.4	13.8	11.3	3.4	2.2	1.29
	S	2.49	5.6	1.6	1.9	1.1	0.5	0.18
	n	35	34	23	16	23	16	21
Eland (S)	\bar{x}	5.85	38.7	14.4	12.6	5.9***	2.3	0.89
	S	1.61	4.2	2.9	2.2	1.1	0.3	0.11
	n	4	10	12	12	11	12	10
Eland (D)	\bar{x}	6.69	35.7	12.9	11.5	4.0	1.9	0.89
	S	2.59	7.1	1.5	0.7	1.0	0.3	0.13
	n	10	10	11	10	11	10	9
Wildebeest (S)	\bar{x}	4.61	43.0***	15.9*	12.3	4.6**	2.3	1.01
	S	2.33	7.1	2.6	0.4	0.8	0.3	0.17
	n	29	28	7	11	7	11	6
Wildebeest (D)	\bar{x}	5.11	33.5	12.5	8.1	3.4	1.9	0.99
	S	1.04	4.1	1.3	1.4	0.8	0.3	0.16
	n	17	15	17	17	17	17	8
Thomson's Gazelle (S)	\bar{x}	3.03	44.9	16.7	11.0	4.8	2.7	1.04
	S	1.25	6.3	1.7	2.4	1.5	0.6	0.18
	n	18	40	99	60	93	61	89

TABLE 1. (continued)

	\bar{x}	S	n	2.58	40.9	15.7	11.4	5.0	2.7	1.04
Grant's Gazelle (S)	\bar{x}	9.64	2.58	40.9	15.7	11.4	5.0	2.7	1.04	
	S	2.02	1.23	5.1	4.0	2.5	0.9	0.5	0.25	
	n	22	9	22	23	20	22	20	18	
Coke's Hartbeest (S)	\bar{x}	9.49	4.33	41.5	16.1	14.1	4.1	2.3	1.05	
	S	1.80	0.37	4.6	2.3	3.4	0.8	0.4	0.14	
	n	16	4	16	20	20	20	20	19	
Topi (S)	\bar{x}	11.76	3.56	38.0	13.6	8.0	2.8	2.3	0.86	
	S	3.71	1.76	5.8	3.0	1.5	0.6	0.4	0.32	
	n	29	29	23	31	30	32	31	24	
Reedbuck (S)	\bar{x}	8.34	2.20	43.3	15.4	6.2	4.9	1.7	0.79	
	S	1.30	0.20	7.8	3.6	2.6	1.6	0.8	0.21	
	n	14	4	16	15	8	13	8	14	
Buffalo (S)	\bar{x}	8.76	7.51	25.0	9.6	8.4	6.0	2.5	0.74	
	S	2.79	2.05	8.3	2.0	2.9	0.9	1.1	0.21	
	n	12	12	12	12	17	12	18	11	
Giraffe (S)	\bar{x}	10.15	—	43.0	14.4	12.0	4.9	2.7	1.08	
	S	1.10	—	3.4	3.0	2.4	0.8	0.5	0.26	
	n	4	—	4	11	12	17	20	15	

\bar{x} :	mean value	*:	$P < 0.05$	RBC—erythrocytes	Ca—calcium
S:	Standard deviation	**:	$P < 0.01$	WBC—leukocytes	P—phosphorus
n:	number of animals tested	***:	$P < 0.001$	PCV—packed cell volume	Mg—magnesium
				Hb—haemoglobin	Cu—copper

DISCUSSION

There are very few reports published on blood data in game animals in Africa. Young^{28,29} Fay¹⁰ and Cooper⁶ recorded blood values for some game species, but the number of animals within each species is limited. One reason for the lack of data from many species is the difficulty in obtaining specimens and in establishing standardized blood collecting techniques. To obtain blood specimens from wild animals they must either be shot or immobilized. This investigation has been carried out with both shot free-ranging animals and animals drug-immobilized within a week after capture. Most data are within limits reported by Fay¹⁰ and also within limits normally found among cattle.¹⁵ However, the erythrocyte counts are higher in several species compared to the domestic cow. Impala had the highest erythrocyte counts, with a mean value for shot animals of almost $23 \times 10^6/\text{mm}^3$. The very high count in impala could be related to the small size of the cells, which also has been reported by Young.²⁸ The high erythrocyte count, haematocrit value and haemoglobin content in red hartebeest observed by Young²⁹ were not found in Coke's hartebeest in this study.

In both shot and drug-immobilized animals, wide variations in some parameters occurred. It is known from the work of many investigators, working with domestic animals, that certain blood constituents vary considerably. Individual variations are reported in cattle investigated under standardized conditions.^{15, 25, 26} The influence of many factors on the blood picture have been reported among domestic and also some wild animals. It is well-known that stress and excitement change certain parameters.^{12, 13, 19} By repeated daily sampling of range cattle it has been found that a decline of PCV and Hb occur during the first week followed by a stabilization during the second.¹³ The higher values in some parameters during stress and excitement could be caused by a mobilization of blood cell reservoirs such as the spleen, with an increase of red cells in the peripheral blood. Thus, it was shown that for any

degree of excitement, values were higher in intact than splenectomized animals,¹³ indicating that the spleen would be activated under certain conditions. On the contrary, Rosen and Bischoff²⁰ observed that the blood of mule deer that had run before or after being shot had much lower haemoglobin content, haematocrit values and red blood cell counts than animals that did not run and they suggested that the cause of these differences may have been haemodilution or expansion of plasma volume. Further, it has been reported that low haemoglobin content characterizes animals severely stressed prior to death.²¹ Other factors which could influence various blood constituents are: age,²⁷ sex,² pregnancy and lactation.²² Circadian and seasonal variations also have been reported.^{1, 16, 25, 26} In our investigation concerning wild free-ranging and captive animals, it was impossible to determine the influence of all these factors. For example, it is very difficult to estimate the degree of excitement of an animal before it is shot or immobilized, and to determine the effects of age, sex, pregnancy, lactation, as well as circadian and seasonal differences would require a very large number of samples.

Regarding the use of drugs, it is known that certain tranquilizers affect blood composition.^{12, 14, 16, 19, 21} In our data, statistically significant differences between shot and drug-immobilized impala and wildebeest are shown for erythrocyte counts, haematocrit values, haemoglobin content and inorganic phosphorus values, the shot animals having the higher values. These results are in agreement with Presidente et al.,¹⁹ who also used an etorphine-xylazine drug combination in white-tailed deer. The decrease in some blood constituents in tranquilized animals could be caused by decreased heart rate, low blood pressure^{14, 16, 19} and resultant haemodilution with interstitial fluids.^{10, 19, 21, 24} This opinion is also supported by Bond⁹ who found that general anaesthesia resulted in decrease in haemoglobin content as a result of increased plasma volume. The differences between shot and drug-immobilized animals in this

study could be influenced both by factors of excitement and the use of drugs. The differences are of such a magnitude that it may be valuable to establish blood standards for both shot and drug-immobilized animals.⁶ If this could be done and the sampling procedures are standardized, the value of haematology in

wild animals will increase considerably, and changes in blood parameters, either in a particular animal or in a group of animals, could be of great value in disease investigations. However, the variations caused by the other factors mentioned must always be kept in mind when interpreting the results.

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