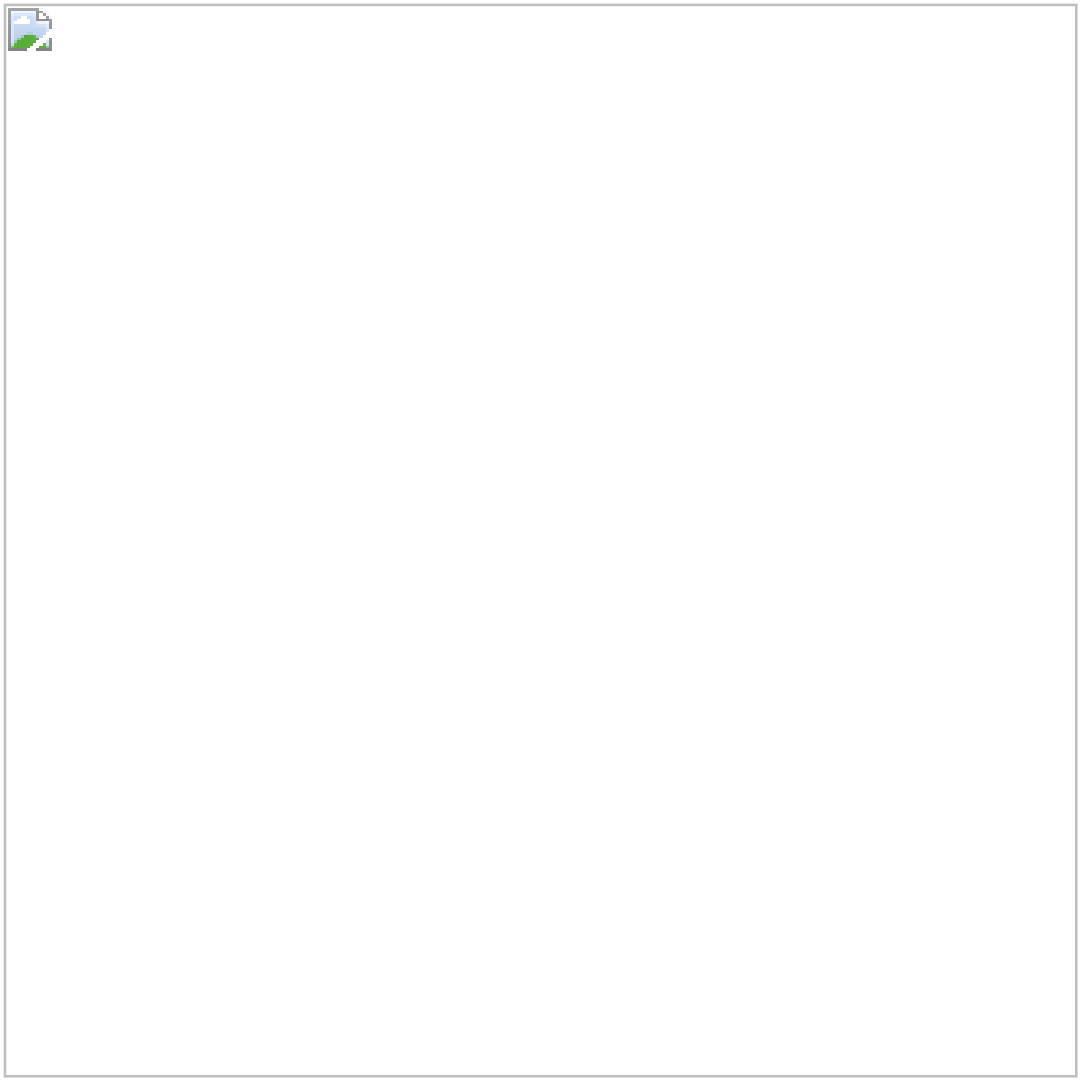

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BLOOD PARAMETERS IN WILD RUMINANTS IN KENYA[1]

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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 reedbuck (*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 reedbuck 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,[15] 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 syringes[4] were used and the immobilization

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drugs were either 2% xylazine[5] or xylazine in combination with etorphine and acepromazine.[6,8] 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 ethylenediamintetraacetic 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 Spectrophotometer[8] or by using the methods of Clark and Collip[5] 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 weldebeest, 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.

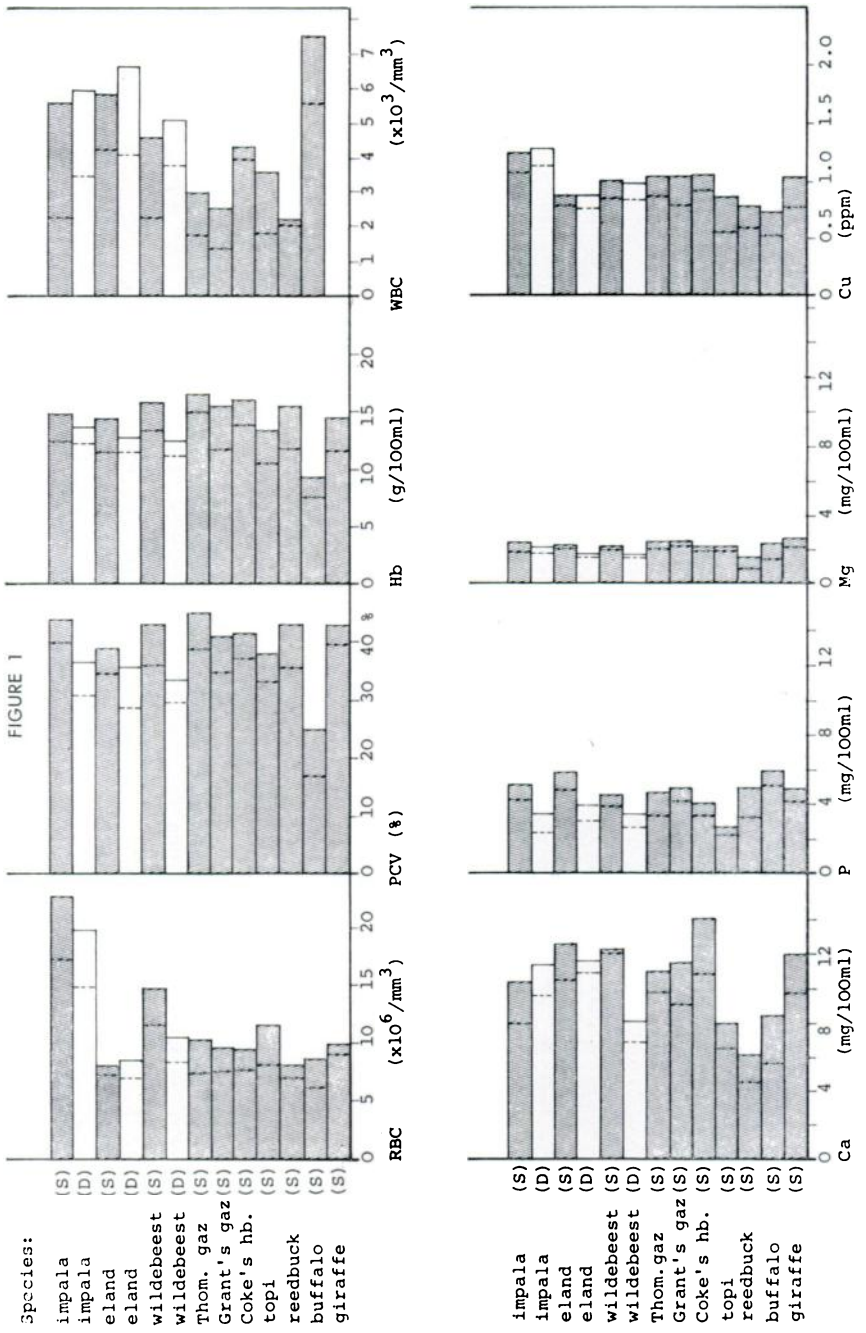

FIGURE 1

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

		RBC 10^6/mm³	WBC 10^3/mm³	PCV %	Hb g/100 ml	Ca mg/100 ml	P mg/100 ml	Mg mg/100 ml	Cu ppm
Impala (S)	$\bar{x}$	22.89*	5.60	44.2***	15.0**	10.3	5.2***	2.5	1.26
	S	5.51	3.40	4.3	2.6	2.4	1.0	0.7	0.20
	n	33	44	59	101	57	57	57	81
Impala (D)	$\bar{x}$	19.98	5.92	36.4	13.8	11.3	3.4	2.2	1.29
	S	4.96	2.49	5.6	1.6	1.9	1.1	0.5	0.18
	n	35	35	34	23	16	23	16	21
Eland (S)	$\bar{x}$	8.11	5.85	38.7	14.4	12.6	5.9***	2.3	0.89
	S	0.90	1.61	4.2	2.9	2.2	1.1	0.3	0.11
	n	10	4	10	12	12	11	12	10
Eland (D)	$\bar{x}$	8.57	6.69	35.7	12.9	11.5	4.0	1.9	0.89
	S	1.46	2.59	7.1	1.5	0.7	1.0	0.3	0.13
	n	10	10	10	11	10	11	10	9
Wildebeest (S)	$\bar{x}$	14.96***	4.61	43.0***	15.9*	12.3	4.6**	2.3	1.01
	S	3.28	2.33	7.1	2.6	0.4	0.8	0.3	0.17
	n	29	29	28	7	11	7	11	6
Wildebeest (D)	$\bar{x}$	10.66	5.11	33.5	12.5	8.1	3.4	1.9	0.99
	S	2.38	1.04	4.1	1.3	1.4	0.8	0.3	0.16
	n	17	17	15	17	17	17	17	8
Thomson's Gazelle (S)	$\bar{x}$	10.22	3.03	44.9	16.7	11.0	4.8	2.7	1.04
	S	2.81	1.25	6.3	1.7	2.4	1.5	0.6	0.18
	n	37	18	40	99	60	93	61	89

TABLE 1. (continued)

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 Hartebeest (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
S: Standard deviation
n: number of animals tested

*: $P < 0.05$
**: $P < 0.01$
***: $P < 0.001$

RBC—erythrocytes
WBC—leukocytes
PCV—packed cell volume
Hb—haemoglobin

Ca—calcium
P—phosphorus
Mg—magnesium
Cu—copper

DISCUSSION

There are very few reports published on blood data in game animals in Africa. Young[28,29] Fay[10] and Cooper[6] 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 Fay[9] 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 $23 \times 10^6/mm^3$. 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 Young[29] 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.[18, 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 Bischoff[20] observed that the blood of mule deer that had run before or after being shot had much lower haemoglobin content, haemotocrit 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.[1,18,25,26] 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 tranquillizers 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 tranquillized animals could be caused by decreased heart rate, low blood pressure[14,16,19] and resultant haemodilution with interstitial fluids.[16,19,21,24] This opinion is also supported by Bond[3] 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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LITERATURE CITED

1. ABT, D. A., J. IPSEN, W. C. D. HARE, R.R. MARSHAK and J. SAHL. 1966. Circadian and seasonal variations in the hemogram of mature dairy cattle. Cornell Vet. 56: 479-520.
2. BARAKAT, M. Z. and M. ABDEL-FATTAH. 1971. Seasonal and sexual variations of certain constituents of normal camel blood. Zentbl. Vet. Med. 18 A. 174-178.
3. BOND, A. G. 1969. Variability of haemoglobin concentration during anaesthesia. J. Anaesth. 41: 947-951.
4. CLARE, N. T., J. J. CUNNINGHAM and D. D. PERRIN. 1945. The determination of copper in pastures and livers N.Z.J. Sci. Tech. 26: 340-350.
5. CLARK, E. P. and J. B. COLLIP. 1925. A study of the Tisdall method for the determination of blood serum calcium with a suggested modification. J. biol. Chem. 63: 461-464.
6. COOPER, A. C. D. 1972. Some haematological values in five species of game. J. S. Afr. vet. med. Ass. 43: 169-174.
7. DENNIS, W. 1922. The determination of magnesium in blood, plasma and serum. J. biol. Chem. 52: 411-415.
8. DREVEMO, S. and L. KARSTAD. 1974. The effect of xylazine and xylazine-etorphine-acepromazine combination on some clinical and haematological parameters in impala and eland. J. Wildl. Dis. 10: 377-383.
9. EDEN, A. and H. H. GREEN. 1940. Micro-determination of copper in biological material. Biochem. J. 34: 1202-1208.
10. FAY, L. D. 1972. Report to the Government of Kenya on wildlife disease research. Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy. Report No. TA 3049.
11. FISKE, C. H. and Y. SUBBAROW. 1925. The colorimetric determination of phosphorus. J. biol. Chem. 66: 375-400.
12. GARTNER, R. J. W., J. W. RYLEY and A. W. BEATTIE. 1965. The influence of degree of excitement on certain blood constituents in beef cattle. Aust. J. exp. Biol. med. Sci. 43: 713-724.

13. GARTNER, R. J. W., L. L. CALLOW, C. K. GRANZIEN and P. M. PEPPER. 1969. Variations in the concentration of blood constituents in relation to the handling of cattle. Sci. 10: 7-12.

14. GORANOV, S., ON. NEITSCHEV and KR. KOITSCHEV. 1971. Experimentelle und Klinische Untersuchung der Wirkung des Preparates Rompun beim Rind. Dt. tierärztl. Wschr. 78: 520-523. English summary pp. 522-523.

15. HOLMAN, H. H. 1955. The blood picture of the cow. Br. vet. J. III: 440-457.

16. KHAMIS, M. Y. and M. S. SALEH. 1970. Contribution to use of the preparation Bay Va 1470 (Rompun) in the buffalo. Vet. Med. Rev. 70: 263-273.

17. KING, E. J. and J. D. P. WOOTON. 1959. *Micro-analysis in Medical Biochemistry*. Churchill. London. 1959. p. 37.

18. KIRK, W. G. and G. K. DAVIS. 1970. Blood components of range cattle: phosphorus, calcium, hemoglobin and hematocrit. J. Range Mgmt. 23: 239-243.

19. PRESIDENTE, P. J. A., J. H. LUMSDEN, K. R. PRESNELL, W. A. RAPLEY and B. M. McCRAW. 1973. Combination of etorphine and xylazine in captive white-tailed deer. II. Effects on hematologic, serum biochemical and blood gas values. J. Wildl. Dis. 9: 342-348.

20. ROSEN, M. N. and A. J. BISCHOFF. 1952. The relation of hematology to condition in California deer. Trans. N. Am. Wildl. Conf. 17: 482-495.

21. SEAL, U. S., J. J. OZAGA, A. W. ERICKSON and L. J. VERME. 1972. Effects of immobilization on blood analyses of white-tailed deer. J. Wildl. Mgmt. 36: 1034-1040.

22. SEIDEL, H. and J. SCHROETER. 1970. Changes in the concentration of sodium, potassium, calcium, magnesium and phosphorus in the serum of pregnant and lactating cows. Arch. exp. Vet. Med. 24: 873-882.

23. TURNER, A. W. and E. V. HODGETTS. 1959. The dynamic red cell storage function of the spleen in sheep. I. Relationship to fluctuations in jugular haematocrit. Aust. J. exp. Biol. med. Sci. 37: 399-419.

24. TURNER, A. W. and E. V. HODGETTS. 1960. The dynamic red cell storage function in sheep. II. Jugular hematocrit fall after some tranquillizing agents, particularly chlorpromazine. Aust. J. exp. Biol. med. Sci. 38: 79-90.

25. UNSHELM, J. and W. H. RAPPEN. 1968. Individual, daily and hourly variations in the blood constituents of cattle. I. Sodium, potassium, calcium, magnesium and inorganic phosphorus. Zentbl. Vet. Med. 15A: 418-437.

26. UNSHELM, J. 1968. Individual, daily and hourly changes in the blood constituents in cattle. III. The behaviour of erythrocytes, haemoglobin content and haematocrit. Zentbl. Vet. Med. 15 A: 66-672.

27. WINGFIELD, W. E. and M. E. TUMBLESON. 1973. Hematologic parameters as a function of age in female dairy cattle. Cornell Vet. 63: 72-80.

28. YOUNG, E. 1966. A preliminary report on blood findings in twenty species of wild mammals. J.S. Afr. vet. med. Ass. 37: 95-98.

29. YOUNG, E. 1966. Notes on the blood composition of the red hartebeest (*Alcelaphus buselaphus*). Int. Zoo. Yb. 6: 291-292.

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