

## CONTRIBUTIONS TO THE STUDY OF BLOOD CONSTITUENTS IN DOMESTIC ANIMALS IN SOUTH AFRICA. 4. NORMAL VALUES FOR HAEMOGLOBIN AND PLASMA CALCIUM, INORGANIC PHOSPHATE, MAGNESIUM, IRON AND COPPER IN THE BLOOD OF ANGORA GOATS IN THE CAPE MIDLANDS

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### INTRODUCTION

Abortions amongst Angora goats in the Cape Midlands have assumed alarming proportions during the last ten years and the losses suffered by many farmers have been serious. The nature and scope of the problem have been well defined by Van Heerden (1963) in a recent thesis on the subject. Part of the general studies conducted at this Institute embraced a study of the chemical pathology shown by aborting animals at, before, or after the time of abortion and a comparison of the results obtained with those from animals on farms where the condition was either unknown or its incidence was extremely low (Brown & De Wet, 1963; Brown, Van Rensburg & Gray, 1963).

In order to interpret the results obtained from the published studies, it was essential that sets of "normal values" for the various estimations performed be compiled. This was necessary for a number of reasons, not the least being a dearth of information on the possible ranges of the blood constituents of Angora goats, particularly under South African farming conditions.

The initial studies on the chemical pathology of the abortion syndrome were conducted in the field under the intensely cold conditions of winter in the Cape Midlands. Conditions such as these may not only affect many of the chemical methods to a certain extent, but also induce profound disturbances in animals generally taken to be clinically normal. Wagner (1964) has emphasized the differences which may be present between population groups of a single species from different geographical areas and has pointed out the hazards inherent in accepting so-called "normal values" for a species regardless of environmental influences. The compilation of the sets of "normal values" presented in this paper, therefore, proceeded concurrently with the major investigation reported by Brown & De Wet (1963).

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## MATERIALS AND METHODS

Blood samples were drawn from four hundred Angora ewes, the population being as homogeneous as possible in respect to age, condition, management, nutrition, intercurrent infections and parasitic infestations. Ages ranged from 2 to 4 years. The majority of the ewes were in different stages of pregnancy ranging from early to advanced gestation and all were maintained on veld typical of the Cape Midlands.

Anticoagulants used were either heparin or potassium oxalate as the methods demanded. The following procedures were employed in this study:—

- (a) Total plasma calcium—Ferro & Ham (1957).
- (b) Plasma inorganic phosphate—King & Wootton (1956).
- (c) Total plasma magnesium—Neill & Neely (1956).
- (d) Total plasma iron—Marrack (1956).
- (e) Total plasma copper—Cartwright *et al.* (1945).
- (f) Whole-blood haemoglobin—King & Wootton (1956).

No attempt was made to estimate free and protein bound fractions of plasma calcium, or magnesium, since the methods were impractical for routine use and such results of no consequence to the investigation as a whole.

The results obtained were analysed statistically according to the recommendations of King & Wootton (1956) for the compilation of clinical chemical data. Normal values were taken from cumulative relative frequency polygons constructed from the data obtained as was done by Wagner (1964) in her studies on the normal values for some blood constituents of sheep in South Africa.

## RESULTS

The cumulative relative frequency curves and histograms constructed from the results obtained from the various determinations performed are presented below. The conclusions drawn are shown in Table 1.

TABLE 1.—*Ranges found for the various blood estimations which were performed*

Determinations	Figure shown by median (50%)	Ranges		
		80%	10% Lower	10% Upper
Blood haemoglobin.....	7.1 (n = 386)	5.6-9.0	2.9-5.5	9.1-14.4
Plasma calcium.....	9.0 (n = 397)	7.8-10.2	6.85-7.9	10.3-16.57
Plasma inorg. phosphate.....	5.6 (n = 398)	3.6-8.1	2.7-3.5	8.2-12.8
Plasma magnesium.....	1.75 (n = 393)	0.75-2.8	0.70	2.85-5.82
Plasma iron.....	150 (n = 376)	97.5-217.5	62.5-95.0	220-500
Plasma copper.....	0.14 (n = 366)	0.085-0.21	0.075-0.080	0.215-0.37

NOTE.—Units are as given in the original procedures used or as stated in the text of this paper

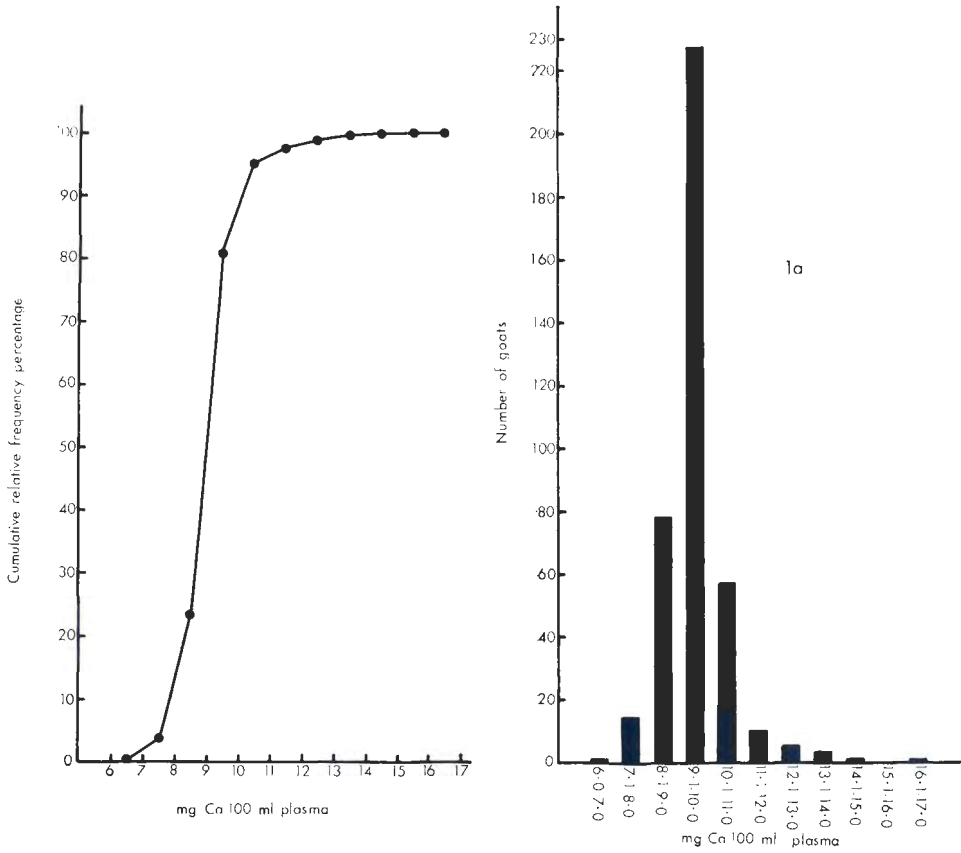


FIG. 1.—Plasma calcium

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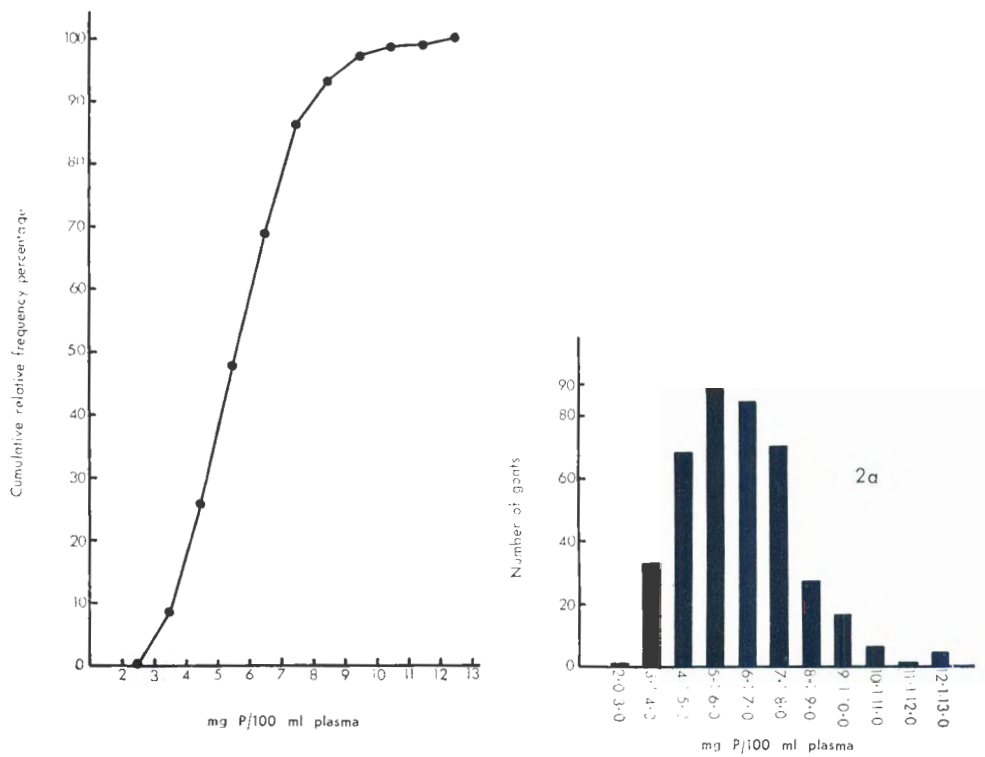


FIG. 2.—Plasma inorganic phosphate

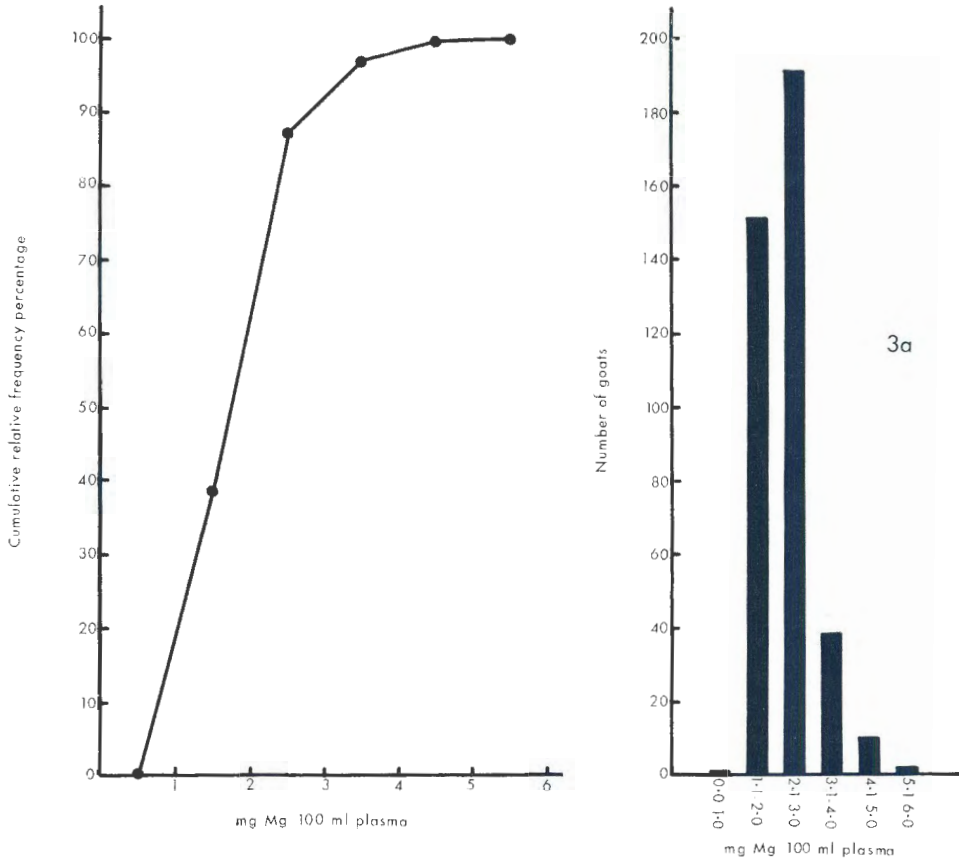


FIG. 3.—Plasma magnesium

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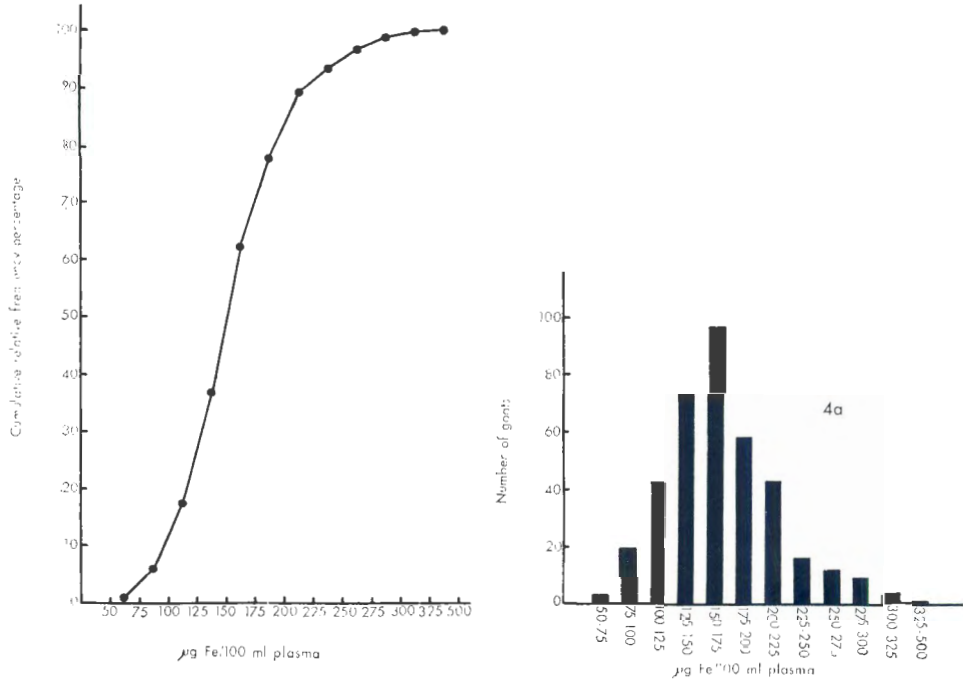


FIG. 4.—Plasma iron

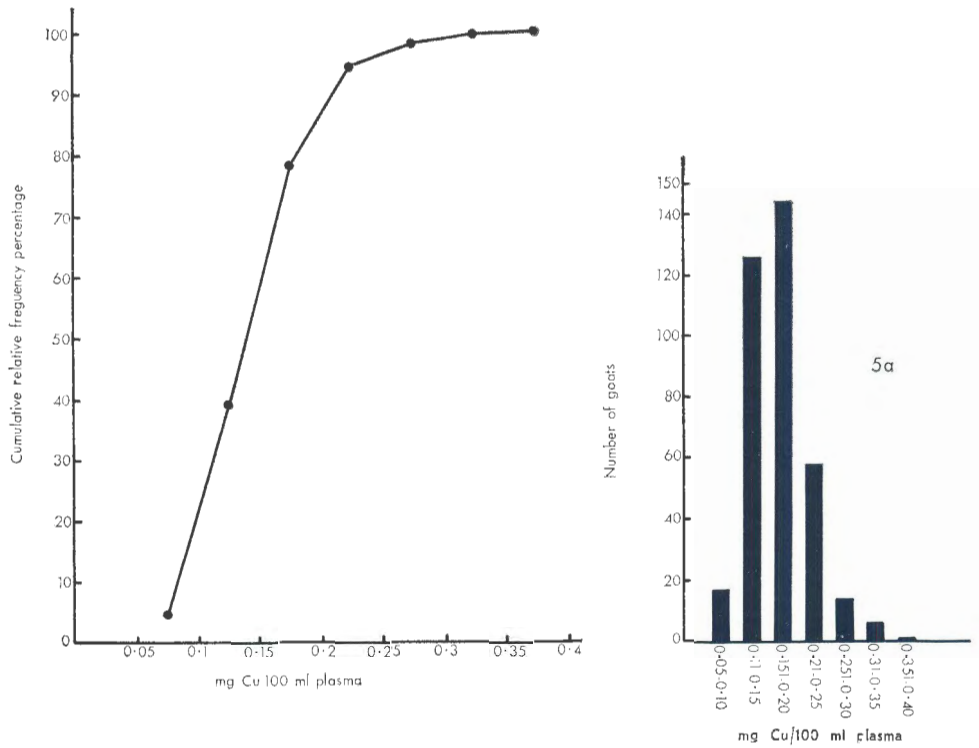


FIG. 5.—Plasma copper

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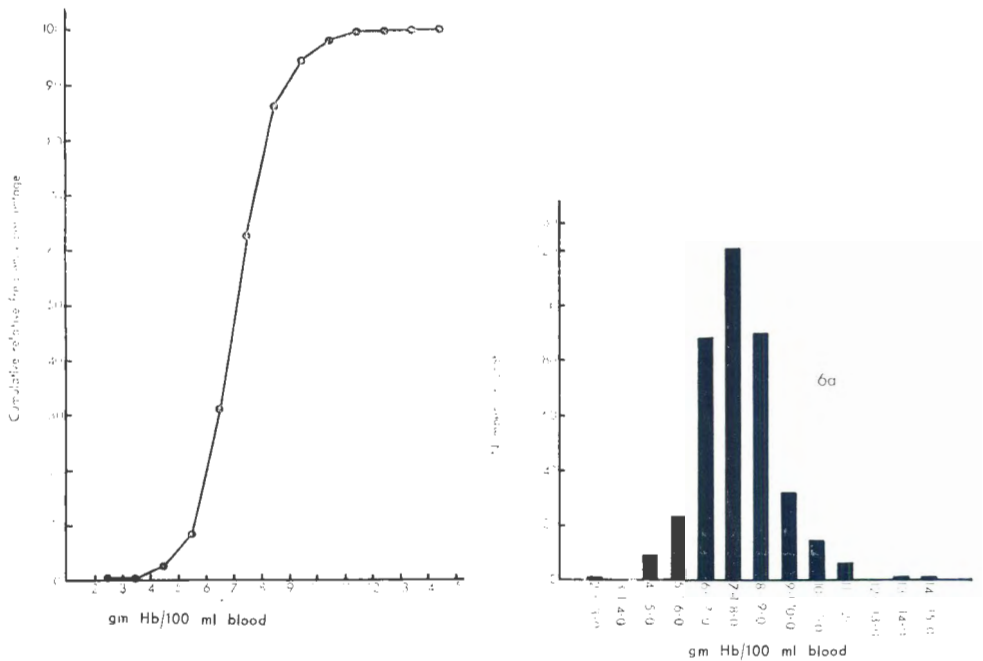


FIG. 6.—Blood haemoglobin

DISCUSSION

As can be seen from the histograms, the figures found for the various determinations on the blood of the population mentioned earlier, present slightly to considerably skewed distribution curves, with the possible exception of the values obtained for haemoglobin. This is a common finding with determinations of this nature and has been noted particularly by King & Wootton (1956) and Wagner (1964) in their studies. For this reason the use of standard deviations or the expression of such figures as a normal range with a mean value is not only hazardous but quite unacceptable. The practices suggested by King & Wootton (1956) and Wagner (1964) for the analysis of data such as these give figures which are not only reliable but also greatly facilitate the interpretation of data obtained from pathological material or suspect animals.

The upper and lower 1 per cent limits of the "normal values" found are not included in Table 2, since in clinical practice any single result falling outside the 10 per cent limits is considered suspicious and results which are outside the 1 per cent limit are almost certainly abnormal (King & Wootton, 1956). The 1 per cent limits are readily determined by inspection of the cumulative relative frequency curves.



SUMMARY

Normal values have been established for haemoglobin and plasma calcium, inorganic phosphate, magnesium, iron and copper in the blood of Angora goats maintained in the Cape Midlands of South Africa. With the exception of the values obtained for haemoglobin, the data collected for these determinations present slightly to considerably skewed distribution curves. Normal values have been established by using cumulative relative frequency polygons constructed from these data.

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