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BLOOD PARAMETERS OF GOATS, ARTESIA
VILLAGE, KGATLENG AGRICULTURAL DISTRICT,
BOTSWANA

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PREFACE

This study was made by personnel from the Department of Agricultural Research (Agricultural Technology Improvement Project, Francistown) and Department of Veterinary Services (National Veterinary Laboratory, Gaborone). The authors wish to express their appreciation to the Director of the Department of Agricultural Research and Director of the Department of Veterinary Services for their support. The field and laboratory work was done by the National Veterinary Laboratory and the Agricultural Technology Improvement Project did the computer analysis of the data and drafted this report since other personnel from the National Veterinary Laboratory were no longer in Botswana.

The authors express their appreciation to the farmers in Artesia Village who allowed their animals to be used in the study, to the veterinary assistants who assisted with blood collections, and the laboratory technicians at the National Veterinary Laboratory who performed the chemical analyses.

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**BLOOD PARAMETERS OF GOATS, ARTESIA VILLAGE,
KGATLENG AGRICULTURAL DISTRICT, BOTSWANA**

1. ABSTRACT

Blood levels of P, Ca, Mg, total protein, urea and red and white blood cell counts were examined monthly for two years in Botswana goats in an attempt to establish normal values and to evaluate the effect of supplementation with drought relief cubes. Overall mean levels observed for the parameters were: Ca 9.19 ± 1.77 mg/100 ml, P 5.35 ± 1.55 mg/100 ml, Mg $2.58 \pm .71$ mg/100 ml, Cu 149.94 ± 71.14 ug/100 ml, total protein 7.49 ± 1.12 g/100 ml, urea 44.45 ± 17.15 mg/100 ml, RBC count 11.65 ± 1.98 millions/cu mm and WBC count 12.07 ± 3.15 thousands/cu mm. Supplemented goats showed significantly higher levels of Ca. P levels were unchanged. Supplemented goats also showed significantly lower levels of total protein and higher levels of WBC's than did the control animals. All observations fell within the normal ranges quoted in the literature with the exception of total protein and urea which were a bit high. Condition scores of control and treated goats did not differ significantly, indicating that supplemental feeding of this kind was of minimal value under the environmental conditions imposed upon them in this study.

2. INTRODUCTION

Prior to 1987, little was known of normal blood parameters in goats in Botswana. This made it difficult to interpret findings from clinical material since figures obtained from Europe, South Africa and the United States were used for normal values. Two studies were undertaken as a cooperative project between the National Veterinary Laboratory, Gaborone and the Agricultural Technology Improvement Project, Department of Agricultural Research, Francistown. A previous report [ATIP Working Paper WP-9, February 1987] reported on a study which was made in Methangwene Village, Tutume Agricultural District which was conducted in 1984-86. This report covers work which was done in the Village of Artesia, Kgatleng Agricultural District, Botswana.

3. OBJECTIVES

The objectives of this study were as follows:

- (a). To determine normal values in goat blood for the levels of phosphorus, magnesium, calcium, copper, total protein, urea, red blood cells and white blood cells.
- (b). To determine if these parameters differ in animals receiving supplementary feeding of drought relief cubes.

4. METHODOLOGY

Blood samples were taken monthly from ear-tagged animals in five goat herds receiving supplemental feeding of 30 g/head/day of drought relief cubes in Artesia Village, Kgatleng Agricultural District, Botswana. Ear-tagged animals in seven goat herds not receiving supplemental feed served as controls. The chemical analysis of drought relief cubes is given in Table 1. Collection of blood samples began in July 1985 and was completed in June 1987. Goats were bled on the first Tuesday of the month. A total of 55 adult goats were included in the initial bleeding, but numbers declined during the years due to deaths, sale of animals and failure of farmers to present animals on the designated bleeding dates. A total of 916 blood samples were included in the analyses.

TABLE 1: CHEMICAL ANALYSIS OF DROUGHT RELIEF CUBES

COMPOUND	G/KG
Protein	100 Min.
Fat	25 Min.
Calcium	15 Max.
Phosphorus	4 Min.
Fibre	120 Max.

Subjective scores for condition were placed on each animal at the time of bleeding. Animals were scored as being in good, fair or poor condition.

Whole blood and heparin blood samples were sent to the National Veterinary Laboratory, Gaborone by overnight train packed on ice in an insulated container. At the laboratory the serum was taken off and examined for phosphorus, copper, urea and total protein by spectrophotometry and for calcium and magnesium by atomic absorption spectrophotometry. Red and white blood cell counts were done with the heparin blood using a Coulter counter.

Tests for statistical differences were made using Student's "T" test with the Daisy Professional Program on the Apple IIe Computer.

5. RESULTS

Results are presented in Table 2 for control and treated (supplementation with 30 g/head/day of drought relief cubes) goats by years and overall. Values were obtained by taking an average of all values of all goats bled during both years.

5.1 Condition : Condition scores of control and treated animals averaged $2.82 \pm .40$ and $2.77 \pm .46$, respectively, and did not differ significantly. On the average, the animals were in fairly good condition.

5.2 Calcium : Mean blood plasma calcium levels of control and treated goats were 9.01 ± 1.58 and 9.40 ± 1.95 mg/100 ml, respectively, and differed significantly ($P < .01$). Blood plasma calcium levels for 1986-87 were significantly ($p < .01$) higher than levels for 1985-86. The overall mean was 9.19 ± 1.77 mg/100 ml, which is above the critical level of 8 mg/100 ml for adult ruminants (McDowall, et al, 1983). Rushton (1981) quotes a range of 8.02-12.02 mg/100 ml while Merck (1986) gives a range of 9.0-11.6 mg/100 ml. In the previous study in Botswana, Gray et al (1987)

reported a mean blood plasma calcium value of 8.66 ± 1.40 mg/100 ml.

5.3 Phosphorus : Mean blood plasma phosphorus levels for control and treated goats were 5.35 ± 1.52 and 5.36 ± 1.80 mg/100 ml, respectively, and did not differ significantly. There was no significant difference between the two years for the means of all goats. The overall mean was 5.35 ± 1.55 mg/100 ml and falls within the range of normal values which are stated to be between 4-6 mg/100 ml for adult ruminant animals (Conrad, 1978). Rushton (1981) states a range of 4.66-7.90 mg/100 ml and Merck (1986) gives a range of 3.7-9.7 mg/100 ml. Gray et al (1987) reported a mean blood plasma calcium value of 4.96 ± 1.46 mg/100 ml.

TABLE 2: BLOOD PARAMETERS OF GOATS, MATHANGWANE VILLAGE, KGATLENG AGRICULTURAL DISTRICT, BOTSWANA

VARIABLE/YEAR	CONTROL			TREATED			OVERALL		
	NO.	MEAN	S.D.	NO.	MEAN	S.D.	NO.	MEAN	S.D.
<u>Condition/b</u>									
1985-86	180	2.05	.35	138	2.91	.26	318	2.88a	.31
1986-87	195	2.79	.44	168	2.65	.55	363	2.73t	.50
Overall	375	2.82	.50	306	2.77	.46	681	2.80	.43
<u>Calcium (mg/100 ml)</u>									
1985-86	282	8.78	1.55	225	8.77	1.74	507	8.78s	1.67
1986-87	170	9.39	1.57	154	10.34	1.86	324	9.83t	1.78
Overall	452	9.01x	1.58	379	9.40y	1.95	831	9.19	1.77
<u>Phosphorus (mg/100 ml)</u>									
1985-86	291	5.43	1.68	228	5.26	1.82	519	5.35	1.74
1986-87	199	5.23	1.24	169	5.50	1.24	368	5.36	1.25
Overall	490	5.35	1.52	397	5.36	1.60	887	5.35	1.55
<u>Magnesium (mg/100 ml)</u>									
1985-86	285	2.48	.73	225	2.44	.65	510	2.46s	.70
1986-87	170	2.76	.65	153	2.76	.76	323	2.76t	.70
Overall	455	2.58	.71	378	2.57	.71	833	2.58	.71
<u>Copper (ug/100 ml)</u>									
1985-86	283	127.90	55.56	228	129.38	85.49	509	128.58s	60.12
1986-87	187	184.47	70.19	157	178.16	79.23	344	181.59t	74.41
Overall	470	150.41	67.65	383	149.38	75.28	853	149.94	71.14
<u>Total Protein (g/100 ml)</u>									
1985-86	291	7.98	1.19	228	7.47	1.21	519	7.75s	1.23
1986-87	178	7.08	.81	158	7.07	.75	336	7.08t	.78
Overall	469	7.64x	1.15	388	7.30y	1.06	855	7.49	.12
<u>Urea (mg/100 ml)</u>									
1985-86	264	49.48	19.14	221	48.44	20.11	485	49.01s	19.58
1986-87	174	38.28	9.74	156	37.15	9.00	330	37.75t	9.40
Overall	438	45.03	16.97	377	43.77	17.35	815	44.45	17.15
<u>Red Blood Cells (millions/cu mm)</u>									
1985-86	281	11.97	2.18	212	11.69	1.91	493	11.85	2.07
1986-87	199	11.20	1.55	176	11.10	1.80	375	11.15	1.67
Overall	480	11.65	1.98	388	11.42	1.88	868	11.55	1.94
<u>White Blood Cells (thousands/cu mm)</u>									
1985-86	286	12.54	2.92	221	13.03	3.06	507	12.78s	2.99
1986-87	199	10.85	2.82	176	11.70	3.35	375	11.14t	3.12
Overall	485	11.77x	3.02	397	12.44y	3.25	882	12.07	3.15

a. Means in the same row followed by different letters (x and y) differ significantly ($P < .01$) while means in the same column followed by other different letters (s and t) differ significantly ($P < .01$).

b. 1 = Poor 2 = Fair 3 = Good

5.4 Magnesium : Mean blood plasma magnesium levels of control and treated goats were $2.58 \pm .71$ and $2.57 \pm .71$ mg/100 ml, respectively, and did not differ significantly. The difference between years was significant ($P < .01$). The overall mean of $2.58 \pm .71$ mg/100 ml was well above the critical level of 1-2 mg/100 ml [McDowall, et al, 1983]. Rushton (1981) gives a normal range of 1.7-2.92 mg/100 ml and Merck (1986) gives a normal range of 2.10-2.90 mg/100 ml. Gray et al (1987) previously reported a value of $2.57 \pm .71$ g./100 ml for mean blood plasma magnesium level.

5.5 Copper : Mean blood plasma copper levels for control and treated goats were 150.41 ± 87.66 and 149.38 ± 75.28 ug/100 ml, respectively, and did not differ significantly. Yearly values of 128.55 and 181.59 ug/100 ml differed significantly ($P < .01$). The overall mean value of 149.94 ± 71.10 was well above the level of 65 ug/100 ml which is considered critical [McDowall, et al, 1983]. Rushton (1981) lists normal values of 59.89-120.65 ug/100 ml. Gray et al (1987) previously reported a mean blood plasma copper value of 120.91 ± 65.70 ug/100 ml. There is no explanation for the high levels which occurred during the second year of the study.

5.6 Total Protein : Mean blood serum total protein levels for control and treated goats were 7.64 ± 1.15 and 7.31 ± 1.08 g/100 ml respectively and differed significantly ($P < .01$). The overall mean was 7.49 ± 1.12 g/100 ml. Values appear to be on the high side of the expected range. Rushton (1981) lists normal values of 6.6-7.5 g/100 ml and Merck (1986) reports 6.1-7.4 g/100 ml while Gray et al (1987) reported a value of 8.13 ± 1.49 g/100 ml.

5.7 Urea : Mean blood serum urea levels for control and treated goats were 45.03 ± 16.79 and 43.77 ± 17.36 mg/100 ml, respectively, and did not differ significantly. A plot of the data showed a clear seasonal trend with lower levels occurring as the dry season progressed as would be expected with decreased protein intake in the diet. The blood serum urea level for 1985-86 was significantly ($P < .01$) higher than that for 1986-87. The year of 1987 was characterized by extreme drought conditions and lack of feed may explain this difference. The overall mean was 44.44 ± 17.15 mg/100 ml. Rushton (1981) lists values of 27.04-55.29 mg/100 ml while Merck (1986) lists values of 27.04-55.29 mg/100 ml. Howard (1986) gives a range of 13-28 mg/100 ml. Gray et al (1987) reported a value of 44.39 ± 17.47 mg/100 ml. Thus, the values found in this study agree closely with previous findings for Botswana.

5.8 Red Blood Cells : Red blood cell counts of control and treated goats were 11.65 ± 1.98 and 11.42 ± 1.88 millions/cu mm, respectively, and did not differ significantly. The difference between years was significant ($P < .01$). The overall mean of 11.54 ± 1.94 millions/cu mm was in the normal range of values. Rushton (1981) lists normal values from 5-10 millions/cu mm while Merck (1986) lists values from 8-18 millions/cu mm. Gray et al (1987) reported a red blood cell value of 11.14 ± 2.21 millions/cu mm which was somewhat lower than those reported in this study.

5.9 White Blood Cells : The white blood cell counts of control and treated goats were 11.77 ± 3.02 and 12.44 ± 3.25 thousands/cu mm, respectively, and differed significantly ($P < .01$). White blood cell counts during the first year of the study were significantly ($P < .01$) higher than the second year. The overall mean value was 12.07 ± 3.15 thousands/cu mm and was on the high side of values quoted in the literature. Rushton (1981) quotes values of 4.0-10.0 thousands/cu mm and Merck (1986) quotes values of 4.0-13.0 thousands/cu mm in normal goats.

Gray et al (1987) reported a white blood cell count of 14.42 ± 4.24 thousands/cu mm which was much higher than values found in this study.

6. CONCLUSIONS

The blood parameters of goats in this study were in the normal range of values reported in the literature. Values for phosphorus and calcium were well above levels considered critical. Blood levels of calcium and total protein were significantly affected by supplemental feeding. Red blood cell counts were not changed and white blood cell counts were increased with supplemental feeding. The supplemental feeding did not enhance the condition of the trestler goats. This finding is not surprising since previous work with goats in Botswana had shown that the diet of goats under normal range conditions had a mean calcium content of .87 percent (range of monthly values from .48-1.20 percent) and a mean phosphorus content of .75 percent (range of monthly values from .63-1.10 percent (Animal Production Research Unit, 1983-84). Dietary calcium and phosphorus values above .36 percent are adequate for nutrition of ruminants, thus the goats in that study consumed approximately twice their requirements.

As reported earlier by Gray et al (1987), the high urea value is interesting with regard to the disease "pizzle or sheath rot" which is not uncommon in smallstock in Botswana. High protein diet and consequent high urea content of the urine is considered to be of etiological significance (Blood et al, 1983). The crude protein in the diet of goats in the APRU study ranged from 11.2-13.8 percent. These values are far above the 7 percent level which is the critical level for adequate utilization of dietary energy (Animal Production Research Unit 1983-84). The high blood urea, total protein and urea values found in this study are consistent with the dietary intake findings of that study.

The feeding of 30 g/head/day of drought relief cubes only supplied .45 g Ca and .65 g P per head per day compared to a daily requirement of 4 g Ca and 2.3 g P for a 40 kg goat. Thus, it is concluded that supplementation of this kind was of minimal value under the environmental conditions imposed upon them in this study.

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