THE SEASONAL OCCURRENCE OF HAEMORRHAGIC ANAEMIA IN GOATS

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SUMMARY

Cross sectional haematological studies were conducted in goats on a small ruminant farm at Malya in Mwanza, Lake Victoria basin, Tanzania. The purpose was to determine the causes and magnitudes of anaemias in tropical ruminants and the seasonal occurrences. The number of helminth eggs per gram of faeces were parallel determined. The commonest cause of anaemia was observed to be helminthiasis, which occurred in the rainy months of February, March and April. The number of clinically sick goats increased in March and April, causing mortality rates of 30.5 %. Haematocrit, haemoglobin concentration and number of erythrocytes in goats infected with helminths were lowest in the rainy months of March, April and May. During these months packed cell volumes (PCV) were 0.24 ± 0.05, 0.22 ± 0.06 and 0.24 ± 0.03 l/l respectively. The respective erythrocyte counts in March and April were 9.76 ± 2.16 and 8.90 ± 2.69 and restored to 15.90 ± 1.55 in May. Haemoglobin concentrations were 4.50 ± 62, 4.00 ± 1.58 and 5.08 ± 0.55 mmol/l in March, April and May respectively. The number of worm eggs per gram of faeces in the same months were 6469 ± 3899, 577 ± 3495 and 3615 ± 1240 respectively. Total serum proteins and number of leukocytes were highest during the wet months of March, April and May. The protein levels were 114.2, 108.2 and 103.8 g/l respectively. The respective leukocyte counts in March to May were 20.1 ± 6.66, 32.8 ± 3.97 and 16.3 ± 6.10. These were lowest during the dry period in June, August and September. Protein concentration in these months were 75.4, 72.6 and 75.9 g/l respectively. The respective leukocyte counts were 13.9 ± 4.70, 14.3 ± 4.90 and 15.0 ± 2.46. Blood cells during anaemic phases in the rainy period were macrocytes, poikilocytes and acanthocytes while during the dry months they were normocytes and spherocytes. These findings unequivocally reveal that anaemia in tropical livestock occurs in wet months as a result of increases in internal parasitic burden.

INTRODUCTION

Great economic losses in food animals in the tropics are caused by subclinically manifesting diseases most of which cause anaemia. The various anaemias result from haemorrhage, erythrocyte death (haemolysis), hypoplasia or aplasia of bone marrow (depressive), and deficient or defective utilization of nutrients for erythrocyte production.

Haemorrhagic anaemias are caused by blood sucking parasites and trauma. Haemolytic anaemias are caused by blood cell parasites, bacterial, viral, and rickettsial agents, chemicals, drugs, poisonous plants, metabolic diseases, intraerythrocytic defects, immune-mediated disorders, inflammatory diseases and miscellaneous agents (Jain, 1986). Depression or hypoproliferative anaemias are caused by changes in microenvironment in the sites of erythrocyte production such as myeloproliferative disorders. Nutritional deficiency anaemia results from lack of iron, copper or cobalt, which are essential for haemoglobin synthesis.

Studies on tropical domestic animals under grazing conditions indicate many of them to have low erythrocyte counts or anaemia in certain months of the year (Mbassa and Poulsen, 1992). Furthermore

erythrocyte counts of some East African wild ungulates have been observed to be lower than those reported elsewhere (Sleeman and Widdowson, 1993). The causes of haemorrhagic and haemolytic anaemias are ubiquitous in the tropics, either haemoproliferative protozoa (Mbassa *et al.*, 1994) or helminths (Jain, 1986). Among these, helminth parasites cause haemorrhages, gastroenteropathy, hepatopathy and pneumonia, with heavy mortalities, loss of production and poor quality of milk, meat skins and hides (Njau, 1989). However, since nutrients are always inadequate a greater proportion of animals may become anaemic due to nutritional deficiencies. The magnitude of these causes of anaemia and the seasonal variations have not been investigated in East Africa. Availability of this information is prerequisite to improvement of animal health. This investigation was aimed at determining seasonal occurrence of anaemia and the level of other blood parameters in order to formulate corrective measures for improvement of animal health. The level of blood parameters are increasingly being used as diagnostic tools in clinical and subclinical diseases (Sherman and Robinson, 1983; Mbassa, 1990; Mbassa and Willeberg, 1991a 1991b).

MATERIALS AND METHODS

Cross sectional field studies were performed in a small ruminant farm at Malya, Lake Victoria basin, Tanzania. Frequent visits were made from August 1989 to August 1990 for monitoring of herd health by haematological evaluation. The more than 1000 goats and sheep in the farm did not receive any prophylactic anthelmintic treatments before and during the observation period. One unit with 154 goats at 3 - 6 months of age was selected for examination. During the visits, faeces and blood samples were collected from the goats.

The number of clinically sick animals on the days of visits was recorded; those with pale mucous membranes, weak, unthrift, dyspnoea, cough, diarrhoea, emaciation or dehydration. Postmortem examinations were conducted on dead animals. The causes of deaths was decided from the worm burden and the clinical signs. The cumulative number of goats dying of parasites within the group was recorded in order to obtain helminth caused mortality rates.

Blood samples were collected in vacuum tubes containing 0.34 ml of 0.12 mol/l potassium ethylene diamine tetraacetate (K_3EDTA- Becton-Dickinson, England) and clot activator for serum. The erythrocytes or red blood cells (RBC) were counted in an improved haemocytometer following dilution of 20 μl EDTA stabilized blood in 5 ml diluent containing 0.5 g mercuric chloride, 5.0 g sodium sulphate and 1.0 g sodium chloride in 200 ml water. Total leukocytes or white blood cells (WBC) were counted in an improved haemocytometer after dilution of 50 μl blood with 950 μl of 1 % HCl in which 1 ml of 1 % Gentian violet has been added. Haemoglobin concentration (Hb) was measured by the methaemoglobin method in a haemoglobinometer (Atago, Japan). A 20 μl stabilized blood sample was diluted with 5 ml solution containing sodium bicarbonate ($NaHCO_3$), 0.05 g potassium cyanide (KCN) and 0.02 g potassium ferricyanide ($K_3Fe(CN)_6$ dissolved in 1 l water.

Haematocrit or packed cell volumes (PCV) were determined in a microhaematocrit centrifuge (Osterode am, Hartz Germany) at 12000 G. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) were calculated using standard formulae. Total serum proteins were determined in a double beam spectrophotometer UV-150-02 (Shimadzu, Japan) at 550 nm wavelength using egg albumen pre-set concentration of 60 g/l as standard solution. Fecal worm eggs counts

standard solution. Fecal worm eggs counts were made by McMaster method. The monthly rainfall, 9 am and 3 pm relative humidity and minimum and maximum daily temperature were obtained from meteorological station.

RESULTS

Lake Victoria basin receives heavy rains during the rainy months of November, December, January, February, March, April and May each year. The rest of the days in June, July, August, September and part of October are dry. The mean monthly rainfall, minimum and maximum temperatures, relative humidity at 9 am and 3 pm were relatively constant (Fig. 1). Weather was observed to influence the health of animals.

Animals were in very poor condition during the heaviest rains of the rainy season. There were many sick goats, unthrifty, soiled with faeces and mud. Many were weak, had diarrhoea, pale mucous membranes and coughs. The number of sick goats increased in the time of heavy rains (Table 1). The worm eggs in faeces increased. Of the 154 goats 47 (30.5 %) died of parasitism. The goats were healthy in the dry season, without any deaths due to helminthiasis.

Erythrocyte counts, haematocrit and haemogolobin concentration were lower in wet months of March, April and May than in dry period in June, August and September (Fig. 2 a, b, c). In contrast, leukocyte counts, total serum protein concentration and mean corpuscular volumes (MCV) were greatly increased during the rainy season in March, April and May. These were low in June, August and September, which are dry (Fig. 2a, 3a, 3d, Table 1). The mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) varied greatly during the rainy season (Fig. 3b, 3c, Table 1). There were leukocytosis, eosinophilia, neutrophilia and lymphopenia. The decreased RBC counts, Hb and PCV, with increased MCV was due to hemorrhagic anemia.

Haematological analysis clearly identified animals showing effects of parasites, whereas worm egg counts were negative for some of the goats. This indicates that haemoglobin concentration, PCV, RBC, total and differential WBC counts are important complementary tests for anaemia, leukocytosis and eosinophilia. In presence of numerous worm eggs even without identification of individual goats blood parameters defined the time and severity of helminthiasis.

DISCUSSION

The information gathered in this study presented in table 1 and figures 1 - 3 indicate that the syndrome of anaemia in goats is caused mostly by helminths. Since weather affects the occurrence and survival of these parasites, dampness and high relative humidity being favourable it follows that anaemia occurs in the wet months of the year. Helminthiasis occurs cyclically, more severe during rainy months in the year. This is facilitated by the high humidity and soft soil consistence where infective larvae survive. The worms and worm eggs obtain the essential favorable temperatures, humidity and soil consistency (Chiejina *et al.*, 1989).

The sensitivity and specificity of diagnostic methods of helminthiasis by faecal egg counts are low because healthy animals also habour certain number of parasites. Indirect fluorescent antibody technique, enzyme linked immunosorbent assay and indirect haemagglutination (Walls and Schantz, 1986) yield good results only at certain peak effects of infection.

Table 1: The mean ± standard deviation ($\bar{x} \pm s$) of hematological values, number of healthy and sick goats and worm egg counts at different dates.

	14/8/89	25/9/89	5/3/90	12/4/90	23/5/90	17/6/90
Goats (n)	95	97	59	63	63	60
RBCx10^{12}/l	17.6±-5.09	13.5±-2.01	9.76±-2.16	8.90±-2.69	15.9±-1.55	15.4±-3.70
PCV 1/l	0.31±-0.03	0.25±-0.03	0.24±-0.05	0.22±-0.06	0.24±-0.03	0.30±-0.03
Hb mmol/l	7.21±-0.82	5.07±-0.49	4.50±-0.62	4.00±-1.58	5.80±-0.55	7.16±-0.77
MCV fl	18.4±-5.74	18.8±-2.54	24.9±-5.75	24.7±-2.23	15.1±-1.94	19.5±-0.94
MCH fmol	0.44±-0.12	0.39±-0.05	0.37±-0.09	0.45±-0.21	0.36±-0.03	0.47±-0.24
MCHC mmol/l	24.2±-2.51	20.7±-2.07	14.8±-2.72	18.2±-3.52	24.2±-1.83	23.9±-2.57
WBC x10^9/l	14.3±-4.97	15.0±-2.46	20.1±-6.66	32.8±-3.97	16.3±-6.10	13.9±-4.70
Lymphocyte %	51.4±-8.40	48.3±-5.66	40.9±-10.7	38.6±-5.11	44.2±-6.39	46.3±-7.44
Neutrophil %	47.1±-7.62	48.4±-6.61	53.1±-8.85	53.8±-7.30	51.7±-6.58	50.7±-8.22
Eosinophil %	0.29±-0.39	0.98±-0.98	4.17±-4.54	7.60±-6.90	2.50±-2.66	2.00±-1.98
Sick goats	0	1	25	15	3	0
epg	485±253	491±388	6469±3899	5977±-3495	3615±-1240	490 ±393

n= number of goats sampled.

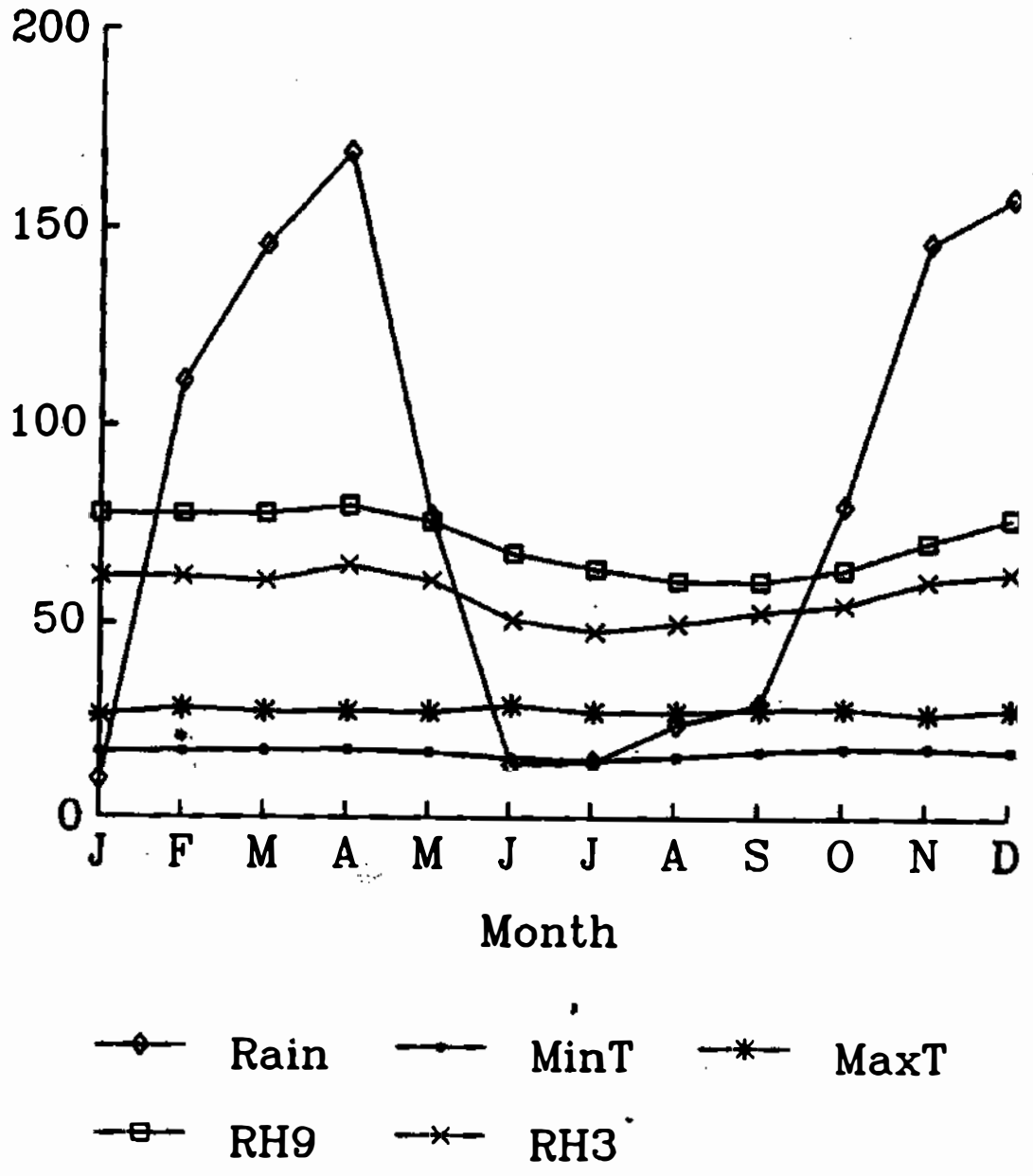

Figure 1: The mean monthly rainfall (mm), minimum (minT) and maximum (maxT) temperatures (°C), the 9 am (RH9) and 3 pm (RH3) values (%) of relative humidity in Mwanza, Lake Victoria basin up to and including 1990.

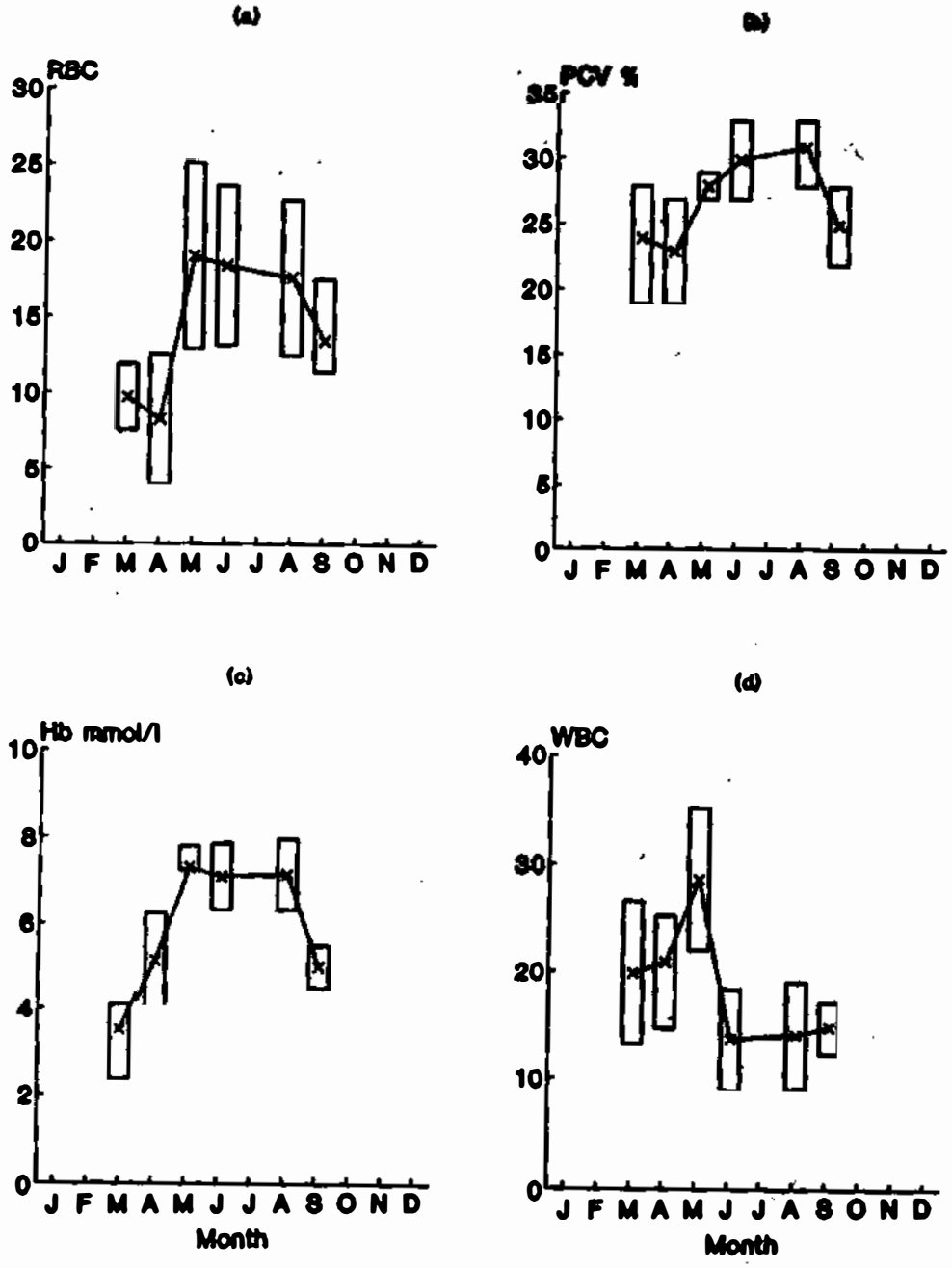

Figure 2: The erythrocyte (RBC) counts x 10^{12}/l (a), Haematocrit (PCV) (b), Haemoglobin concentration (Hb) mmol/l (c) and total leukocyte counts (WBC) x 10^{9}/l (d) in August and September 1989 and March, April, May and June 1990 in Malya, Mwanza, Lake Victoria basin, Tanzania.

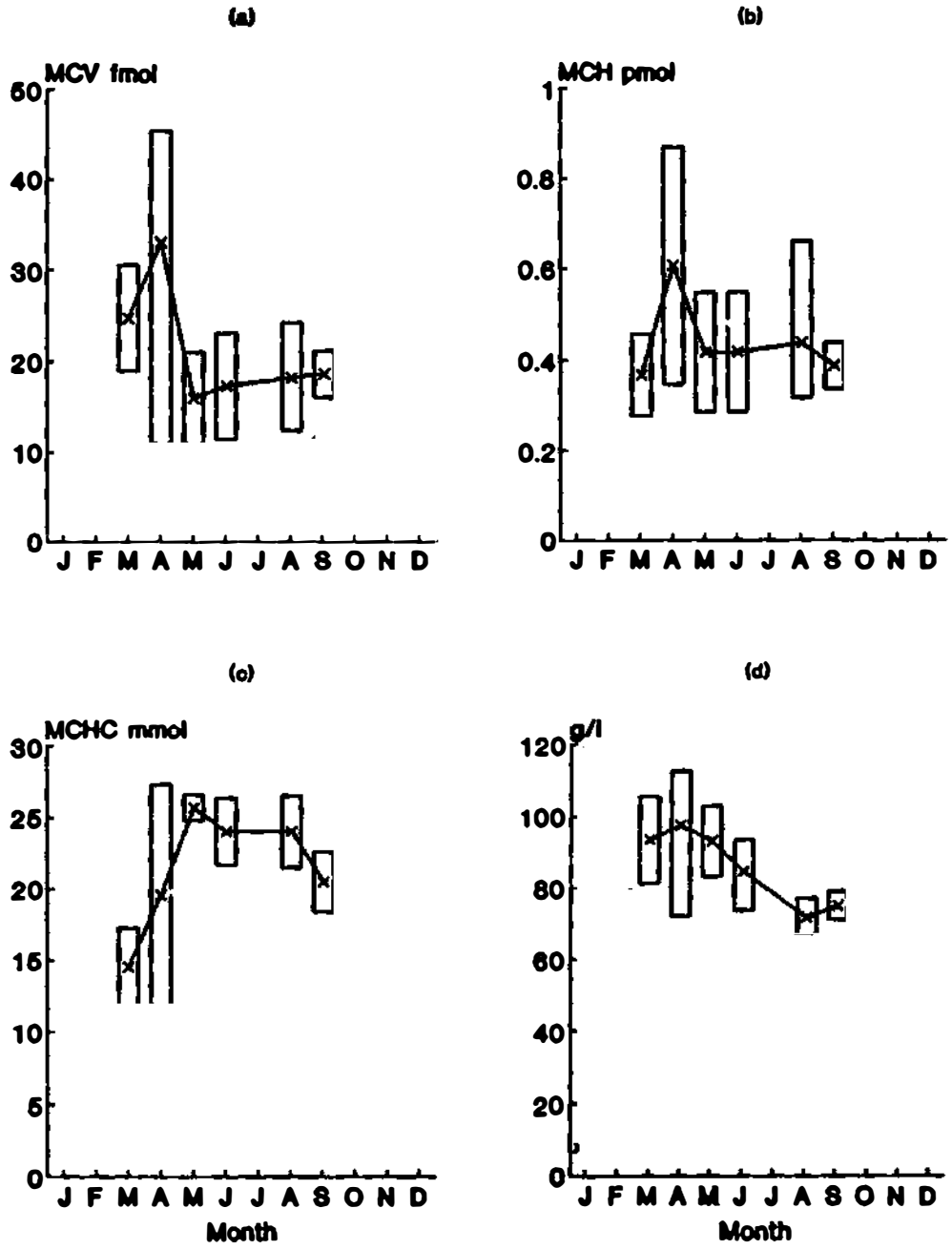

Figure 3: The mean corpuscular volume (MCV) fmol (a), mean corpuscular haemoglobin (MCH) pmol (b), mean corpuscular haemoglobin concentration (MCHC) mmol (c) and total serum proteins g/l (d) in August and September 1989 and March, April, May, June 1990 in Malya, Mwanza, Lake Victoria basin, Tanzania.

Beyond the peaks they pick many false negative (T-) or positive (T+) animals. This unreliability of tests requires application of a combination of diagnostic methods such as using anaemia as a test. Results of these tests could be interpreted serially for increasing the sensitivity or parallel for increasing specificity.

The references ranges for blood values in goats (Jain, 1986; Mbassa and Poulsen, 1993a, 1993b) were comparatively similar for observed leukocyte counts for the dry months of June, August and September. The values in wet months March, April and May revealed leukocytosis with neutrophilia and eosinophilia (Table 1). This is indicative of infection, the eosinophilia being suggestive of helminthiasis, which was actually confirmed by concomitant higher worm egg counts.

The reference values for RBC, PCV, haemoglobin concentration, MCV, MCH and MCHC in healthy goats show low RBC, PCV and Hb during the wet months, with concurrent elevation of MCV and variable MCH and MCHC, indicating anaemia. The levels rise to within reference ranges of healthy goats in the dry months, with adequate feeding (Biswas *et al.*, 1986; Mbassa and Poulsen, 1993b).

The decrease in RBC counts, Hb and PCV in the rainy period shows that this anaemia is caused by helminths, since there were also high worm eggs per gram of faeces. The increase in MCV shows macrocytosis, which actually occur in haemorrhagic anaemia.

Total serum proteins were increased in wet months compared with healthy goats (Mbassa and Poulsen, 1993a). This is probably hyperglobulinemia due to increases in IgE and IgM produced in response to nematode infections (Jain, 1986), and compensatory to hypoalbuminaemia of haemorrhages (Saad *et al.*, 1984).

The hyperproteinemia (values ranging form 93 to 134 g/l) was consistence with the finding that parasitism causes insidious blood loss, chronic hepatic and gastrointestinal lesions. Prolonged bleeding results in lowered plasma albumin (hypoalbuminemia), which disturbs blood vessel oncotic pressure, stimulating synthesis of globulins, resulting in hyperglobulinemia with overrall hyperproteinemia (Saad *et al.*, 1984).

In many goats the number of eggs per gram of faeces were few, in others many, hence the large standard deviation of egg counts. However, examination of PCV, RBC and Hb revealed parasite pathology. Blood parameters have been found to sensitively detect blood loss due low grade chronic gastrointestinal nematode infections (Mbassa, 1990; Mbassa and Willeberg, 1993a, b). The use of haematology and worm egg counts increases both the sensitivity and specificity of diagnosis of parasite infections.

The number of deaths were very high 47/154 (30.5 %) in the rainy season concomitant with the number of worm eggs per gram of faeces.

In conclusion haemorrhagic anaemia occurrence in goats in Lake Victoria basin varies between months, dependent on prevalence of parasites, which in turn depend on weather. The seasonal occurrence and severity is due to helminthiasis and is most prevalent in March, April and May.

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