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Trace Minerals in Serum of Sheep Infected with *Trypanosoma congolense*

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Abstract: Yankassa sheep (20) were grouped into A and B and infected with *Trypanosoma congolense* isolated from a cow and maintained in mice. Two milliliter $\times 10^7$ parasites were used to infect group A. The course of the infection and serum trace minerals (Iron, (Fe) and Copper, (Cu) were studied and determined using Atomic Absorption Spectrophotometer (AAS). There was significant drop in concentration of iron ($p < 0.001$) Post Infection (pi) while that of copper, no significant change ($p > 0.05$). The values of the contemporaneously uninfected control sheep were significantly higher for iron and not for copper. Sheep are susceptible to isolate from cow and passaged in mice and with the fluctuating concentrations of Fe and consistency of Cu, it may suggest that these minerals may have a role in the pathogenesis of trypanosomiasis due to *T. congolense*.

Key words: Trypanosomiasis, Yankassa sheep, copper, iron, Nigeria

INTRODUCTION

Animal trypanosomiasis is still a serious threat to the livestock production in sub-Saharan Africa, especially where tsetse flies are predominantly found. Typical African Animal Trypanosomiasis (AAT) in Nigeria is caused by *T. brucei brucei*, *T. congolense*, *T. simae* and *T. vivax*, which infect major livestock (Losos and Ikede, 1972).

It has been estimated that the population of sheep in Nigeria is 22.1 million and 35 million goats (Afolayan *et al.*, 2001). Majority of sheep and goats in Nigeria are found in the Northern rural areas, reared either alongside cattle or with sedentary farmers.

Sheep and goats, however, are seldom found infected with trypanosomes under natural conditions but serve as alternate meals to the tsetse flies in an infested area (Yesufu and Mshelbwala, 1973). Though sheep and goats are said to be fairly resistant to trypanosomiasis (Losos and Ikede, 1972), recently Oniyah (1997) reported the increase in prevalence rates of 8.6 and 8.1% for sheep and goats, respectively.

Clinical manifestations of trypanosomiasis in small ruminants are mainly the acute and chronic forms of the disease where anaemia is the cardinal sign (Losos and Ikede, 1972) with no pathognomonic sign (Stephen, 1986). Various physiological factors can produce variation in the concentrations of Trace Minerals (TM) in the blood of healthy sheep and cattle (Tartour 1973; Moodie, 1975). Trypanosomes have been reported to cause depletion

of some microminerals in sheep (Joshua *et al.*, 1994; Neils *et al.*, 2006). Welde *et al.* (1989) reported that Serum Iron (SI) and Serum-iron Binding Capacity (SIBC) for cattle were decreased when infected with *T. congolense*. However, elevated levels of SI, Total Iron Binding Capacity (TIBC), Plasma Iron Turn over Rates (PITR) and Plasma Iron Clearance (PIC) were recorded. SI and TIBC were decreased while in treated animals, the level of SI returned to pre-infection level faster than TIBC. Dargie *et al.* (1979) reported trypanosomiasis due to *T. congolense* in cattle; there was decrease of 40-45% of iron in circulation. However, Sarror (1976) found neither Fe nor Cu played any important role in the pathogenesis of anaemia in cattle infected with *T. vivax*, there was no change in the concentrations of these minerals in the serum of cattle, though Cu fluctuated but was within normal limits (Anosa, 1988 and Joshua *et al.*, 1994).

This study was undertaken to find the effects of *T. congolense* on the concentration of Fe and Cu in the serum of sheep.

MATERIALS AND METHODS

Experimental design: Twenty Yankassa sheep were used for this study. The animals adapted to the new environment for 4 weeks, then grouped into A and B with 12 and 8 based on their PCV, respectively.

Trypanosoma congolense parasites: Parasites were isolated from a cow at Bodija abattoir (Ibadan) and

passed in mice for maintenance as described by Lumsden *et al.* (1973). The parasites were continually maintained in mice (Joshua, 1990).

Sheep inoculation: Sheep in group A were inoculated with $2 \text{ mL} \times 10^7$ parasites via the external jugular vein (Lumsden *et al.*, 1973).

Group B: This group served as uninfected controls.

Blood sampling: Two milliliter of blood was collected via the external jugular vein of each animal and transferred into a clean Bijou bottle with EDTA as the anticoagulant. This was used for parasitic determination. The bleeding was done twice a week.

Serum collection: Five milliliter of blood was collected along with that for parasitic examination. Blood was transferred into clean dry test tube and was allowed to clot at room temperature for a period sufficient to allow serum separation. Serum was harvested in another clean 2 mL serum vial and stored at -20°C until required.

Trace mineral determination

Iron and copper: The Atomic Absorption Spectrometry (AAS) was used for the determination of mineral concentrations in parts per million (mg kg^{-1}). Sera were digested with Hyperchloric (HClO_4) and diluted with deionized water to a factor of 5 and 1, respectively.

RESULTS AND DISCUSSION

All animals inoculated with trypanosomes developed patent parasitaemia between days 10-12 pi.

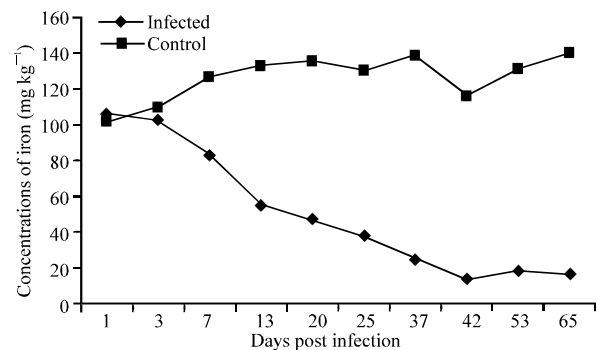


Fig. 1: Concentration of Fe in sheep infected with *T. congolense*

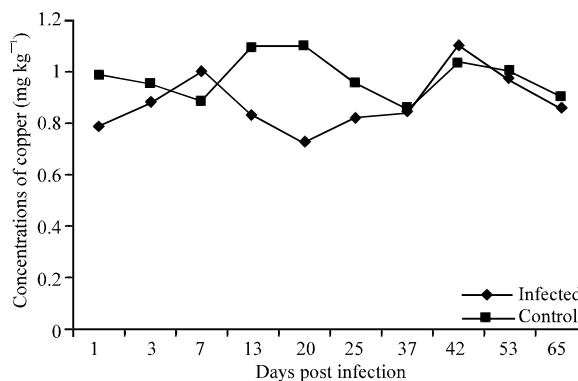


Fig. 2: Concentration of Cu in sheep infected with *T. congolense*

The concentration of iron (Fe) in sera of infected animals was found to have decreased from day 13 (pi) and continued until day 42 and thereafter, there was relative increase between days 53 and 65. There was significant ($p < 0.001$) decrease in concentration of Fe between days 20-42, the start decrease coincided with first peak of parasitaemia on day 20. The depletion continued even when the level of parasites was very low. The concentration of Fe in the uninfected controls was higher and relatively constant (Fig. 1).

Copper was consistently found to be low in both infected and controls. The concentration was found to increase on day 7 when some of the animals showed parasitaemia; however, the fluctuation continued but within a range along side that of uninfected controls (Fig. 2).

The investigation has shown that Yankassa sheep are very susceptible to *T. congolense* infection even when passaged severally in mice (Joshua, 1990). The prepatent period of infection in sheep was 10 days but parasitaemia in all infected animals was between days 10-12.

Iron concentration in this investigation was found to decrease as from day 13 to 42 while days 53 and 65 showed slight increase (Table 1). The increase between days 53 and 65 was similarly found by Welde *et al.* (1989) who also reported that Fe concentration returns to normal if the infection has long standing while the decrease corroborates the findings by Dargie *et al.* (1979) and Anosa (1988), where they reported iron loss and accelerated plasma iron turnover uptake in cattle infected with *T. congolense*. There was parasitaemia in all animals by day 12 and on day 13 there was depletion in Fe concentration with about 34.2% and by day 42, it was 83.4% (Table 1). The depletion looks tremendous and may

Table 1: Mean trace mineral concentrations in serum of sheep infected with *T. congolense*

TM (mg kg ⁻¹)	Days									
	1	3	7	13	20	25	37	42	53	65
Iron infected	105.6	101.9	82.5	54.1	46.6	37.8	23.8	13.7	18.3	16.5
Controls	101.4	108.8	126.3	132.5	135.4	129.4	138.1	115.6	130.6	139.4
Copper infected	0.79	0.88	1.0	0.83	0.72	0.82	0.84	1.1	0.97	0.86
Controls	0.99	0.95	0.88	1.1	1.1	0.95	0.85	1.03	1.0	0.90

not allow haematopoiesis thus possibly the anaemia seen in trypanosomiasis due to *T. congolense*.

However, in a long standing disease, there may be gradual release of Fe by the spleen and other storage organs thus the increase in the serum concentration (Wellde *et al.*, 1989). It is likely that parasites contribute to the breakage of the RBC, but because they are too few parasites in the blood, thus the release of Fe from the spleen shadows that of the RBC breakage. The decrease may also be attributive to the requirement of Fe by the parasites themselves during growth (Weinberg, 1999), it therefore means that a substantial quantity is used up by the parasites which leads to the depletion of Fe.

The importance of copper as an essential nutrient has been known since the 1920s, it is required for normal iron metabolism and in some enzymes like metalloporphyrin and non-enzyme metalloproteins in which copper is biologically active (Berger, 2002; Rogers, 2005).

Copper level was found to only moderately fluctuate with no significant difference ($p > 0.05$) between the infected and the controls. This corroborates Sarror (1976), Joshua *et al.* (1994) and Neils *et al.* (2006) who had earlier observed that there was no change in copper level in serum when cattle and sheep were infected with *T. vivax* or *T. congolense*. Though Cu is required in a very small (300 to 400 mg kg⁻¹) quantity, the major storage organ is the liver and it seems that when a little quantity of Cu is depleted, the store replaces it immediately, thus the concentration may not fall below the usual level (Berger, 2002).

CONCLUSIONS

Trypanosoma congolense was found to be highly pathogenic to sheep. The concentration of iron fluctuated and was depressed on days 13-42 and with a little increase between days 53-65. There was no significant increase or decrease in values of copper in the infected animals. These trace minerals are very essential in enzymatic reactions of RBC formation but Fe was found depleted during trypanosomiasis while Cu did not. Therefore, the actual roles played by Fe and Cu in the pathogenesis of trypanosomiasis need be investigated further.

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