Pyruvate Concentration in Serum of Sheep Infected with *Trypanosoma congoense*

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Abstract: The concentration change of pyruvate was studied in serum of uninfected and infected sheep with *T. congoense*. In the uninfected, the mean concentration of 61.23-76.63 mg L\(^{-1}\) of pyruvate was determined using the DNS method. There was a depressed concentration of pyruvate in the two infected groups (A and B); pyruvate level fell to 25.7 mg L\(^{-1}\) in gp A that was treated immediately after the first peak of parasitaemia while in gp B, the concentrations continued to fall (5.2 mg L\(^{-1}\)) until the termination of the experiment. The fall might have been as a result of the utilization of the pyruvate by either the host or its conversion to other compounds. It is therefore concluded that animals use the pyruvate or its converted to another compound during trypanosome infection. The decrease in pyruvate levels may be a possible cause of weakness and eventual death in infected animals.

Keywords: Yankassa sheep, pyruvate, weakness, glycolysis, *T. congoense*

INTRODUCTION

The sub-Saharan livestock have been ravaged by African Animal Trypanosomosis (AAT) and is continuing without way out at the moment. The cardinal sign is anaemia in most cases of the disease (Losos and Ikede, 1972; Stephen, 1986; Anosa, 1988) and it may be due to the major cause of death especially in small ruminants (Neils et al., 2006). The low packed cell volume (PCV, of less than 20%) have been recorded in small ruminants but the animals survived; exhibition of some degree of resistance (Wilson, 1991).

Trypanosomes when established in a host have to survive and cellular metabolism becomes inevitable for their continued survival in the host. Trypanosomes need energy and thus use the host’s available abundant glucose and oxygen to produce their required energy in an inefficient way of glycolysis, producing two molecules of pyruvate as end product (Nyindo, 1992; Hunt, 2004).

Pyruvate, a metabolic intermediate in carbohydrate, protein and Lipids (triacyl glycerides) metabolism and fermentations is the end product of glycolysis (Anonymous, 2006); also by trypanosomes.

The host gets its required energy through glycolysis, where the reduction of NAD\(^{+}\) to NADH is rapid and easily done to keep the TCA cycle going. Therefore, pyruvate is important and necessary for the continuation of the cycle for the production of energy (ATP) and subsequent survival of the animal host (Hunt, 2004).

Trypanosome has a large capacity to metabolize glucose, consuming the equivalent of its own dry weight in an hour. It lacks carbohydrate stores and oxidative phosphorylation and therefore is dependent on the continuous supply present in the blood and body fluids of host (Anonymous, 1996), trypanosome uses one molecule of glucose to produce two molecules of pyruvate which the parasite cannot further utilize (Nyindo, 1992; Hunt, 2004) but remain in the blood stream of the host.

However, despite the abundance of pyruvate in the plasma of the host, animals become weak and probably die due to lack of energy (Joshua et al., 1986).

This study was undertaken to determine pyruvate concentrations in the serum of sheep infected with *T. congoense*.

MATERIALS AND METHODS

Experimental animals: Three groups of six sheep were used in this experiment. Groups A and B were infected with 2 mL of blood containing \(10^{7}\) parasites (*T. congoense*). The external jugular vein was used to introduce the parasites while group C served as uninfected control.

Animals in group A were treated at first peak wave of parasitaemia with Berenil\(^{8}\) (3.5 mg kg\(^{-1}\)) while group B was allowed a full course of the disease.

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**Samples**

**Blood:** Blood samples of all groups were taken daily, 2 mL to monitor parasitaemia and 6 mL to harvest serum. Monitoring of parasitaemia was done through wet and thin stained smears (Lumsden *et al.*, 1973; Paris *et al.*, 1982).

**Serum:** Blood samples (6 mL) from all groups were taken in clean test tubes and allowed to stand at room temperature sufficiently enough for serum separation. Samples were centrifuged at 3 × 10^3 rpm for five minutes and the serum is harvested into a clean serum vial. Sera were stored at -20 °C until analyzed.

**Analysis:** Sera were analyzed using the Dinitrosaliclylic acid (DNS) method (Miller, 1959). The mixture of 3 mL of reagent and 1 mL serum of was incubated by boiling for five minutes and then allowed to cool at room temperature. Concentration of pyruvate was measured using the Jenway colorimeter (Jenway 6051 colorimeter, UK Essex) at 540 nm.

**RESULTS AND DISCUSSION**

The pyruvate during pre-infection period (week 5-1) of sheep showed a relatively constant concentration. Groups A and B had initial concentrations of 64.1 and 65.9 mg L^-1 while group C had 53.7 mg L^-1 and at week -1, the concentrations improved to 72.4 mg L^-1, 79.6 mg L^-1, and 68.9 mg L^-1, respectively. These concentrations gave a mean range of 61.23-73.63 mg L^-1 (Table 1).

During the infected period, the concentrations of pyruvate dropped. In group A, there was initial concentration of 72.4 mg L^-1 which dropped to 33.9 mg L^-1 and on day 23 the concentration was 25.7 mg L^-1 which coincided with the first peak of parasitaemia. Animals in this group were treated at week 3 and the concentration only started to rise from week 4 and by week 6, it rose to 34.3 mg L^-1 (Table 2).

Group B, although the concentrations pattern followed the same trend like that in group A; the animals were not treated and the concentrations continued to fall up to 5.2 mg L^-1 at week 6.

Group C, this is the uninfected control animals. The concentration of pyruvate remained relatively steady throughout the experimental period, between 61 and 76 mg L^-1.

We report the changes in concentrations of pyruvate in the serum of sheep before and when infected with *T. congolense*. Pyruvate is produced from glycolysis by trypanosomes in the hosts (Nyindo, 1992; Hunt, 2004). In this study, the concentration of pyruvate was analyzed; it was found to remain relatively constant with mean concentrations of 61.23-73.63 mg L^-1 % before animals were infected.

For the individual groups, group A, after infection the concentrations of pyruvate were depressed from 72.4 mg L^-1 to 33.9 mg L^-1, this indicates that despite the fact trypanosomes use the available glucose of host animals to produce their own energy, (Table 3) the pyruvate produced is either rapidly utilized by the host or converted to other products like acetyl co-A (Hunt, 2004), there by reducing the concentrations in the plasma/serum. When this group was treated at peak of parasitaemia and thereafter, the level of pyruvate rose from 25.7 (week 4) to 34.3 mg L^-1 (week 6). This is suggestive that the pyruvate produced by both parasites and host is not ghastly utilized as when the parasites were in the blood stream.

In group B, the pyruvate concentrations continue to fall up to the 6th week. This when compared to group A clearly shows that the presence of the parasites hasten the utilization of pyruvate. Because this group was not treated, the levels of pyruvate fell to 5.2 g L^-1 compared to group A where the pyruvate level rose after treatment. However, animals became very weak but not moribund (Table 3). Joshua *et al.* (1986) had earlier suggested that hypocglycaemia contributes to the death of animals infected with trypanosomes, in this study, glucose was not measured but may be true, since pyruvate is metabolite of glucose. Kadima *et al.* (2000) reported that the infusion of glucose in cattle infected with *T. vivax* assisted in the maintenance of parasites at a low level, although second peak of parasitaemia was seen, it was adduced to the plenty available glucose in the blood stream of the animal.

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Table 1: Mean pyruvate concentration in uninfected sheep

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Table 3: Group average of pyruvate in uninfected and infected sheep with T. congoense

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It is apparent from this study that the mean level of pyruvate found in host animals was reduced and may be the causes of weakness in animals since these animals also depend on the pyruvate for regular TCA cycle from which they derive their energy.

In conclusion, there were depressions in the concentrations of pyruvate in both groups A and B, but in group A, the levels of pyruvate increased after treatment. But in group B, the pyruvate continued to fall, indicating that pyruvate could be converted to other compounds thus lowering the concentrations. What exactly happened to the pyruvate in the animal host needs further investigations.

REFERENCES