International Journal of Biological Chemistry

ISSN 1819-155X

Academic Journals Inc.

www.academicjournals.com

International Journal of Biological Chemistry 5 (2): 136-142, 2011
ISSN 1819-155X / DOI: 10.3923/ijbc.2011.136.142

Serum Biochemical Changes in Nubian Goats, Nilotic Dwarf Goats and Garag Ewes Experimentally Infected with a Mechanically Transmitted *Trypanosoma vivax* Stock

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ABSTRACT

The present study was aimed at evaluating the effects of experimental *Trypanosoma vivax* infection on some serum biochemical parameters in Nubian and Nilotic Dwarf goats and in Garag ewes. Serum biochemical values were determined in two different types of goats one is derived of Northern Sudan (Nubian type) and the other of Southern Sudan (Nilotic Dwarf type) as well as ewes of Southern Sudan (Garag type) experimentally infected with *T. vivax* strain which was circulating outside tsetse area for a long time. The infection caused significant increases in total protein and total globulin in infected Nubian and infected Nilotic Dwarf goats compared to the control. Depressed albumin and urea concentrations were observed in Nubian goats when compared to the control but there were no alterations in these parameters in Nilotic Dwarf goats. No significant differences were observed in sodium and potassium values. The results suggested more resistance in Nilotic type towards infection. On the other hand infected Garag ewes showed significant increases in total protein and globulin and significant decrease in albumin values compared to the control. No significant differences in urea, sodium and potassium values were observed in Garag ewes compared to the control.

Key words: *Trypanosoma vivax*, mechanical transmission, trypanotolerance, sudanese goats and sheep types, serum biochemical changes

INTRODUCTION

Trypanosomosis transmitted by tsetse or by other biting flies is a major constraint for animal production in Sudan. Inside the tsetse belt the disease is mainly transmitted cyclically by tsetse flies (*Glossina* sp.) while outside that belt *Tabanids* and *Stomoxys* flies are known to be the main vectors of the disease.

Trypanosoma vivax are parasitic predominantly in wild and domestic ungulates in Africa and Latin America; they do not readily infect laboratory rodents. The development of *T. vivax* in *Glossina* sp. is confined entirely to the proboscis; however, it has been adapted to mechanically transmission by other biting flies like *Tabanids* and *Stomoxys*. The typical bloodstream form has clubshaped posterior end, tapers towards the anterior and large, generally terminally placed kinetoplast. Its movement in wet blood films is rapid and distinctive (Stevens and Brisse, 2004). Recent surveys conducted confirmed that *T. vivax* is enzootic in wide areas of Sudan causing subacute or chronic disease (Rahman, 2005; Abdalla *et al*., 2005).

Seven species of Glossina (Lewis, 1949) seventy species of *Tabanids* (Lewis, 1953) and six species of *Stomoxys* flies are known to exist in Sudan (Lewis, 1954).

The disease affects different body organs of infected animals which lead to alterations in serum biochemical parameters like liver enzymes, total proteins, urea, creatinine and minerals.

Total proteins and gamma globulins increase while serum albumin decreases in several Trypanosomes infections (Katunguka-Rwakishaya, 1996; Herrera *et al*., 2002). Nevertheless, Katunguka-Rwakishaya *et al*. (1999) and Osaer *et al*. (2000) reported significant decline in total protein due to decreased albumin in sheep and ewes experimentally infected with *T. congolense*. The later authors also reported significant increases in plasma urea, which might be related to the interaction between infection and diet. Akingbemi *et al*. (1995) reported significant increases in the concentration of globulins and urea in goats experimentally infected with *T. congolense* The present work is aimed at evaluating the effects of experimental *T. vivax* infection on some serum biochemical parameters in two Sudanese types of goats and in Garag ewes in order to assess the trypanotolerance phenomenon in small ruminants.

MATERIALS AND METHODS

Trypanosoma vivax parasite was isolated from blood of a confirmed naturally infected cattle found in Kenana district (White Nile State). The infected blood was inoculated intravenously in goats at site of collection and then transferred to Central Veterinary Research Laboratory in Khartoum. Blood samples were collected from infected goats and preserved in liquid nitrogen.

The present study was carried out in 2006, experimental animals were Nubian and Nilotic Dwarf types goats (twelve goats) their age was eleven to twelve months old, Nubian goats were purchased from Khartoum while Nilotic dwarf goats were purchased from Juba (Southern Sudan). In addition to Garag Ewes (Six animals) aged twelve to fifteen months which were purchased from upper Nile (Southern Sudan). All animals were transferred to the fly-proof premises of the Central Veterinary Research Laboratory at Soba, Khartoum. Animals were ear-tagged, examined for presence of trypanosomes and other blood parasites using wet blood smears, thin stained blood films and concentration methods. They were also examined for presence of internal parasites and external parasites. The animals were treated with albendazole (Vety Care pharmaceuticals Ltd., Pakistan), oxytetracycline hydrochloride (Formaceutici Gellini S.P.A, Italy) and sulpha diamidine sodium (Vetwic, Elnasr pharmaceutical chemicals Co, Egypt) and washed using an acarcide (Asuntol, Coumaphos, Bayer, A.G, Germany). Animals were fed dry sorghum hay and concentrates in addition to water.

Five Nubian goats, three Nilotic dwarf goats and three Garag ewes were experimentally infected *iv vivo* with *T. vivax* using 10^4 trypanosome mL^{-1}. Parasitaemia was estimated according to the method described by Paris *et al*. (1982). While four goats of both types and three ewes were served as un-infected control.

Experimental animals were bled twice weekly for 16 weeks post infection. Blood was collected from jugular vein for serum collection. Total proteins were determined using the Biuret reagent as described by Weichselbaum (1946), albumin (Dumas *et al*., 1971), urea nitrogen (Evans, 1968) while Sodium and potassium concentrations were determined by flame photometer (Dunmow Essex Jenway Ltd., England) according to the method described by Varley (1967).

Statistical analysis was performed using STATISTICA Programme Version 5. The level of significance was $p<0.05$.

RESULTS

Goats

Total proteins: In this experimental infection control goats had total protein values ranged from 65.8-79.5 g L^{-1} with a mean value of 70.23±3.55 g L^{-1}, infected Nubian goats had total protein ranged from 63.2-88 g L^{-1} with a mean value of 76.88±8.7 g L^{-1} while infected Nilotic dwarf goats had total protein ranged from 69.67-90.1 g L^{-1} with a mean value of 78.77±5.06 g L^{-1}. Significant differences were observed in total proteins values in both infected Nubian and Nilotic Dwarf type of goats when compared to the uninfected control goats ($p<0.05$). However, no significant differences were observed in total proteins values in infected Nubian goats compared to the Nilotic Dwarf type of goats (Table 1).

Globulins: Control goats had globulin values ranged from 15.5-40.4 g L^{-1} with a mean value of 31.29±7.54 g L^{-1}, infected Nubian goats had globulin ranged from 17.5-53.3 g L^{-1} with a mean value of 39.74±12.77 g L^{-1} while infected Nilotic dwarf goats had globulin ranged from 21.13-56.43 g L^{-1} with a mean value of 40.24±7.33 g L^{-1}. Significant differences were observed in globulin values in both infected Nubian and Nilotic Dwarf type of goats when compared to the uninfected control goats ($p<0.05$). No significant increases were observed in globulin values in infected Nubian goats compared to the Nilotic Dwarf type of goats (Table 1).

Albumins: Control goats had albumin values ranged from 33.3-50 g L^{-1} with a mean value of 38.94±5.14 g L^{-1}, infected Nubian goats had albumin ranged from 30.4-49.8 g L^{-1} with a mean value of 37.14±5.65 g L^{-1} while infected Nilotic dwarf goats had albumin ranged from 33-49.67 g L^{-1} with a mean value of 38.52±4.64 g L^{-1}. Significant reduction in albumin values were observed in infected Nubian goats when compared to the control ($p<0.05$) while no significant differences were observed in this parameter in infected Nubian goats compared to the Nilotic Dwarf type of goats (Table 1).

Urea: Control goats had urea ranged from 121.53-130.56 mmol L^{-1} with a mean value of 6.03±2.56 mmol L^{-1}, infected Nubian goats had total urea ranged from 122.2-129.13 mmol L^{-1} with a mean value of 4.90±2.61 mmol L^{-1} while infected Nilotic dwarf goats had urea ranged from 119.65-130.94 mmol L^{-1} with a mean value of 5.68±2.31 mmol L^{-1}. Significant reduction in urea values were observed in infected Nubian goats when compared to the control ($p<0.05$) while no significant differences were observed in this parameter in infected Nubian goats compared to the Nilotic Dwarf type of goats (Table 1).

Sodium: Control goats had sodium ranged from 121.53-130.56 mmol L^{-1} with a mean value of 126.69±1.99 mmol L^{-1}, infected Nubian goats had sodium ranged from 122.2-129.13 mmol L^{-1} with a mean value of 127.02±2.82 mmol L^{-1}, infected Nilotic dwarf goats had sodium ranged from 119.65-130.94 mmol L^{-1} with a mean value of 126.03±2.74 mmol L^{-1}. No significant differences in sodium values were observed among infected Nubian goats and Nilotic Dwarf type when compared to each other and the control (Table 1).

Potassium: Control goats had Potassium values ranged from 2.33-3.8 mmol L^{-1} with a mean value of 2.83±0.44 mmol L^{-1}, infected Nubian goats had Potassium ranged from 2.37-3.86 mmol L^{-1} with a mean value of 2.88±0.41 mmol L^{-1} while infected Nilotic dwarf goats had Potassium ranged from

Table 1: Serum biochemical parameters in goats experimentally infected with *Trypanosoma vivax*

	Control goats	Infected nubian goats	Infected nilotic dwarf goats
Total proteins (g L^{-1})	70.23±3.55^{a}	76.88±8.70^{b}	78.77±5.06^{b}
Globulins (g L^{-1})	31.29±7.54^{a}	39.74±12.77^{b}	40.24±7.33^{b}
Albumin (g L^{-1})	38.94±5.14^{a}	37.14±5.65^{b}	38.52±4.64^{a}
Urea (mmol L^{-1})	6.03±2.56^{a}	4.90±2.61^{b}	5.68±2.31^{ab}
Sodium (mmol L^{-1})	126.69±1.99^{a}	127.02±2.28^{a}	126.03±2.74^{a}
Potassium (mmol L^{-1})	2.83±0.44^{a}	2.88±0.41^{a}	2.83±0.40^{a}

Values in the same row followed by different letter(s) are significantly different, significant differences were observed at $p<0.05$, Values are shown as Mean±SD

2.38-3.77 mmol L^{-1} with a mean value of 2.83±0.40 mmol L^{-1}. No significant differences in potassium values were observed among infected Nubian goats and Nilotic Dwarf type when compared to each other and the control (Table 1).

Garag ewes

Total proteins: In this experimental infection control Garag ewes had total protein values ranged from 61-82.5 g L^{-1} with a mean value of 76.38±4.87 g L^{-1}, infected Garag ewes had total protein ranged from 67.33-90.33 g L^{-1} with a mean value of 80.83±7.38 g L^{-1}. Significant increases in total proteins values were observed in infected Garag ewes when compared to the control group ($p<0.05$) (Table 2).

Globulins: Control Garag ewes had globulin values ranged from 14-47 g L^{-1} with a mean value of 37.66±9.94 g L^{-1}, infected Garag ewes had globulins ranged from 17-64.33 g L^{-1} with a mean value of 47.94±12.83 g L^{-1}. Significant increases in globulin values were observed in infected Garag ewes when compared to the control group ($p<0.05$) (Table 2).

Albumins: Control Garag ewes had albumin values ranged from 29-56.5 g L^{-1} with a mean value of 38.72±7.59 g L^{-1}, infected Garag ewes had albumin ranged from 23-47.5 g L^{-1} with a mean value of 32.89±6.46 g L^{-1}. Significant decreases in albumin values were observed in infected Garag ewes when compared to the control group ($p<0.05$) (Table 2).

Urea: Control Garag ewes had urea values ranged from 1.49-10.04 mmol L^{-1} with a mean value of 4.84±2.6 mmol L^{-1}, infected Garag ewes had urea values ranged from 1.77-8.63 mmol L^{-1} with a mean value of 4.54±1.97 mmol L^{-1}. No significant difference was observed in urea values in infected ewes when compared to the control group (Table 2).

Sodium: Control Garag ewes had sodium values ranged from 123.41-133.95 mmol L^{-1} with a mean value of 127.27±2.60 mmol L^{-1}, infected Garag ewes had sodium values ranged from 121.15-129.93 mmol L^{-1} with a mean value of 126.39±2.24 mmol L^{-1}. No significance difference was observed in sodium values in infected ewes when compared to the control group (Table 2).

Potassium: Control Garag ewes had total potassium ranged from 2.40-3.23 mmol L^{-1} with a mean value of 2.78±0.25, infected Garag ewes had total potassium ranged from 2.48-4.02 with a mean value of 2.82±0.24. No significance difference was observed in potassium values in infected ewes when compared to the control group (Table 2).

Table 2: Serum biochemical changes in Garag ewe's experimentally infected with *Trypanosoma vivax*

	Control garag ewes	Infected garag ewes
Total proteins (g L^{-1})	76.38±4.87	80.83±7.38*
Globulins (g L^{-1})	37.66±9.94	47.94±12.83*
Albumin (g L^{-1})	38.72±7.59	32.89± 6.46*
Urea (mmol L^{-1})	4.84±2.6	4.54 ±1.97
Sodium (mmol L^{-1})	127.27± 2.60	126.39± 2.24
Potassium (mmol L^{-1})	2.78± 0.25	2.82± 0.24

*Significant differences were observed at $p<0.05$, Values are shown as Mean±SD

DISCUSSION

Significant increases in total protein and total globulin were observed in both infected goats types when compared to control ($p<0.05$). These findings were supported by the findings of Anosa and Isoun (1976) who reported that total serum protein and globulin increased in *T. vivax* infection in goats. There were no significant differences in these parameters between the two types. A significant decrease in the albumin was observed in infected Nubian compared to control goats; this agreed with the finding of Anosa and Isoun (1976) in *T. vivax* infection in goats and Faye *et al.* (2005) in *T. congolense* infection in West African Dwarf goats. However, they came at variance to the findings of Igbokwe and Mohammed (1992) who reported normal albumin levels in *T. brucei* infection in Sokoto Red goats which might be due to normal liver function in these goats. The results also showed significant decrease in urea values in Nubian goats when compared to the uninfected control this agreed with the finding of Isoun *et al.* (1978) who reported significant reduction in urea in sheep experimentally infected with *T. vivax,* Faye *et al.* (2005) reported that trypanosome infection tended to decrease plasma urea concentration in experimental *T. congolense* infection in west African Dwarf goats. On contrary Akingbemi *et al.* (1995) reported increases in the concentration of urea in experimental *T. congolense* infections in goats. No significance was observed in The Nilotic Dwarf goats in albumin and urea values. These changes in Nubian goats might be due to liver disease, Monica Cheesbrough (1999) reported that albumin and urea values were depressed in severe liver disease. Losos and Ikede (1972) reported that the liver has on occasion been regarded as the site of lesions considered characteristic for diseases caused by *T. vivax* and *T. congoIense*. Round cell infiltration accompanied by degeneration and necrosis of parenchymatous cells occurred and these changes were correlated to liver function. Erythrophagocytosis and haemosiderosis in the bone marrow, liver and spleen were the principal histopathogical features in infected goats with *T. vivax* (Saror, 1980).

No significant differences were observed in sodium and potassium values in both infected types when compared to the control, these results are in line with the results of Otesile *et al.* (1991) in *T. brucei* infection in boars and might indicate that experimental goats were in good nutritional status.

The above results showed that The Nilotic Dwarf goat type had a milder *T. vivax* infection with high globulins levels which raised the total proteins suggesting the ability of this type to resist infection by mounting a superior immunity.

Garag ewes showed high susceptibility to *T. vivax* experimental infection, this was indicated by the significant rise in total protein and globulin and significant decrease in albumin values in infected ewes compared to the control ($p<0.05$), this finding is in accordance with that of Anosa and

Isoun (1976) and Ogunsanmi *et al.* (1994) in sheep and ewes experimentally infected with *T. vivax* and *T. congolense,* respectively, however, it partially differs with the findings of Osaer *et al.* (2000) who reported hypalbuminaemia and hypoproteinaemia following *T. congolense* in Djallonke ewes. Results also revealed no significant differences in urea in infected and uninfected ewes, this finding is in agreement with Katunguka-Rwakishaya *et al.* (1999) who reported that no significant differences in urea in sheep experimentally infected with *T. congolense* and oppose with the findings of Ogunsanmi *et al.* (1994) who reported increases in urea values in sheep experimentally infected with *T. congolense* and Isoun *et al.* (1978) who reported significant decreases in urea in infected sheep with *T. vivax*. No significant differences were observed in sodium and potassium values in infected ewes compared to the control, these findings are in agreement with Otesile *et al.* (1991) in *T. brucei* infection in boars.

As realized from this study hyperproteinaemia and hyperglobulinaemia were major signs of the infection in infected goats and ewes which indicates immune reponses due to the infection.

On the other hand the hypoalbuminaemia which was realized in Nubian goats and Garag ewes experimentally infected with *T. vivax* might be due to haemodilution, this is in agreement with the finding of Anosa and Isoun (1976). Finally the results of the present study have clearly indicated that Nubian goats have great susceptibility to *T. vivax* compared to nilotic dwarf goats which showed more tolerance to the infection. The desert ewe's breeds showed susceptibility to the infection however more investigations on the susceptibility of different sheep and goat's breeds to trypanosomes and their role in disease epidemiology should be initiated.

ACKNOWLEDGMENT

This study was funded by the Central Veterinary Research Laboratories (CVRL), Khartoum, Sudan. The assistance received from colleagues in tsetse and trypanosomosis control department at CVRL is greatly appreciated.

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