INFECTION RATES OF BOVINE TRYPANOSOMOSIS IN SOME AREAS OF SUDAN

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المستخلص

اجري مسح لدراسة نسبة انتشار داء المثقبيات فى الابقار فى الخرطوم , نيالا (ولاية جنوب دارفور) ,ودمدنى (ولاية الجزيرة),القضارف, الابيض (ولاية شمال كردفان) و ولاية الوحدة و ولاية النيل الازرق خلال الفترة من 2007-2010 . تم جمع عدد 1852 عينة من المناطق المذكورة اعلاه. اظهرت النتائج ان 156 حيوان كان مصابا بأنواع مختلفة من الطفيل بنسبة اصابة% 8.42. فى كل المناطق التى تم اجراء المسح فيها ما عدا النيل الازرق كانت اقل نسبة اصابة % 0.42 فى ود مدنى (ولاية الجزيرة). واعلى نسبة للاصابة % 57.28. بنيالا (ولاية جنوب دارفور) باختلاف معنوى فى نسبة الاصابة بين المنطقتين و كان مجمل عدد الاصابات فى هذه المناطق 51 اصابة. (مثقبية فيفاكس وجدت بنسبة 72.7% اما مثقبية ثيليراي فبنسبة 27.3%) .نسبة حجم مكداس الدم فى الحيوانات المصابة تتروح بين 32.7%-20.3% بمتوسط 26. 63% اما فى الحيوانات غير المصابة فالنسبة تتروح بين 33.1%-26.25% بمتوسط 28. 49% فى منطقة النيل الازرق كانت اقل نسبة اصابة 0 %فى ابريل 2009 و اعلى نسبة اصابة 43.3 %فى يونيو 2010. ليس هناك اختلاف معنوى فى نسبة الاصابة بين المسوحات. تم رصد 105 اصابة السائدة منها هى مثقبية فيفاكس وجدت بنسبة 71.4%, مثقبية كونقولينز وجدت بنسبة 25.71% اما مثقبية ثيليراي فقد وجدت بنسبة 2.86% فى ديسمبر 2008. نسبة حجم مكداس الدم فى الحيوانات المصابة تتروح بين 25%-18.5 بمتوسط 22. 8% اما فى الحيوانات غير المصابة فالنسبة بين33.34 %-20.2 بمتوسط 25. 5%.

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Abstract

A survey on bovine trypanosomosis was conducted in different areas of Sudan including Khartoum (Khartoum state), Nyala (South Darfur State), Obeid (North Kordofan state), Gedaref (Gedaref state), Wad Madani (Gazira state), Unity and Blue Nile States.

Trypanosomes infections were found in all the seven states surveyed. Out of 1852 cattle, 156 were infected with various species of trypanosomes (105 in Blue Nile and 51 in the other states), with the total infection rate of 8.42%.

In the different areas surveyed except the Blue Nile state the lowest infection rate (0.42%) was recorded in Wad Madani while the highest (28.57%) was recorded in Nyala with a significant ($P<0.05$) difference. In these areas, the most common trypanosome species detected were *T. vivax* (72.7%) followed by *T. theileri* (27.3%). The infected animals had PCV range of 20.3%-32.7% with a mean of 26.63%, while uninfected animals had PCV range of 26.25%-33.1% with a mean of 28.49 %. In Blue Nile area, the lowest infection rate (0%) was recorded in April, 2009 while the highest 43.3% was in June 2010. The most common trypanosome species in Blue Nile were *T. vivax* (71.4%) followed by *T. congolense* (25.71%). The prevalence of *T. vivax* was significantly ($P<0.05$) higher than the other trypanosome species. *T theileri* (2.86%) was, also reported in December 2008, while *T. brucei* infection was not found. Infected animals had PCV range of 18.5%-25% with a mean average of 22.8%, while in uninfected animals the range was 20.2%-33.34% with a mean average of 25.5%, with no significant difference between infected and uninfected cattle.

Introduction

Bovine Trypanosomosis is one of the major constraints to livestock productivity in Sub-Saharan Africa and is one of the important diseases that hampered the production of Sudanese cattle (A/Rahamn, 2002).

The first annual report in 1904, testified to the widespread occurrence of trypanosomes in cattle (Karib, 1961). Studies on trypanosomosis in different parts of Sudan, have been conducted by a number of workers who have reported different rates of trypanosome infections (A/Rahman, 2002, Hassan, 2003, Adam, 2005, Salih, 2010). This wide variation in the prevalence of trypanosomes is a major feature of the epidemiology of the disease in Sudan. Infection in cattle was found to vary from the tsetse-free to tsetse infested areas of the country. The disease usually showed consistence with the correlation between tsetse and other biting flies' apparent density and the risk of trypanosomes (A/Rahman, 2005).

In Central Sudan, Abdalla *et al*. (2005) reported that in Singa area, Sennar State the average parasitological prevalence was 50.3%. All infected animals were infected with *Trypanosoma vivax* compared 4.4% at AbuHajar 22 out of 500 animals were found to be infected with trypanosomes; the average parasitological prevalence was. The infected animals were, also, found harbouring *Trypanosoma vivax* (Abdalla *et al.*, 2008)· In South Kordofan, A/Rahman *et al*. (1991), reported that in 2956 heads of migratory cattle; trypanosome infection rate was 1.9%. *T. vivax* was the predominated species followed by *T. brucei* and *T. congolense*. During 2001-2002, bovine trypanosomosis surveys were conducted in Blue Nile, White Nile, West Kordofan and South Darfur States. These areas are the major cattle producing areas of the country where

trypanosomosis is believed to be endemic. The results of these surveys revealed rates that ranged between 0.23% and 11.0% (A/Rahman, 2008). In Eastern Sudan, Gumaa *et al*, (2011) reported prevalence of 1.58% of bovine trypanosomosis in Kassala state; the prevalence rate was higher in winter.

In Blue Nile state, Kheir *et al.*, (1992), reported 1.9% infection rate in blood samples of migratory cattle from Ethiopia examined during dry season of 1983, most of the animals were found infected with *T. congolense*, followed by *T. brucei* and then *T. vivax*. Salih (2010) stated that bovine trypanosomosis is a major parasitic disease and serious problem in the blue Nile state.

In South Darfur, the prevalence of bovine trypanosomosis inside the tsetse belt was 6.36% and 1.94% outside the tsetse belt (Hassan, 2003); The prevalence of bovine trypanosomosis outside the tsetse belt is attributed to mechanical transmission by biting flies mainly *Tabanidae* and *Stomoxys* spp and *Trypanosome vivax* is the dominant trypanosome species (A/Rahman, 2005). Obaid (2010) carried out a study in Eldiain and Bahr Alarab localities. South Darfur State during January 2009. Prevalence rate of bovine trypanosomiasis in the study area was 10.7%. Only two pathogenic trypanosomes species were identified (*Trypanosoma congolense*) 8% and (*Trypanosoma vivax*) 2.7%.

Tsetse flies infested land in the Sudan is estimated at 50,000 Km^2 and is found in two areas: South Eastern Sudan: *G. morsitans submorsitans* and *G. f. fuscipes* are the only tsetse species that exist in Kurmuk district, Blue Nile State while In South Darfur the only tsetse fly species found was *G. morsitans Submorsitans* (A/Rahman *et al.*, 2010).

This study is intended to determine the infection rates of bovine trypanosomosis in various localities in Sudan.

Materials and Methods

Study areas

Surveys were conducted in cattle during the period 2007-2010- the location included Nyala, AlObied, Khartoum, Gedaref, Damazin and

Unity (Map 1). The bases of operations for these surveys were the Regional Veterinary Research Laboratories.

The surveys were conducted in different areas where people traditionally keep cattle. The areas chosen were based on previous history of bovine trypanosomosis in each area.

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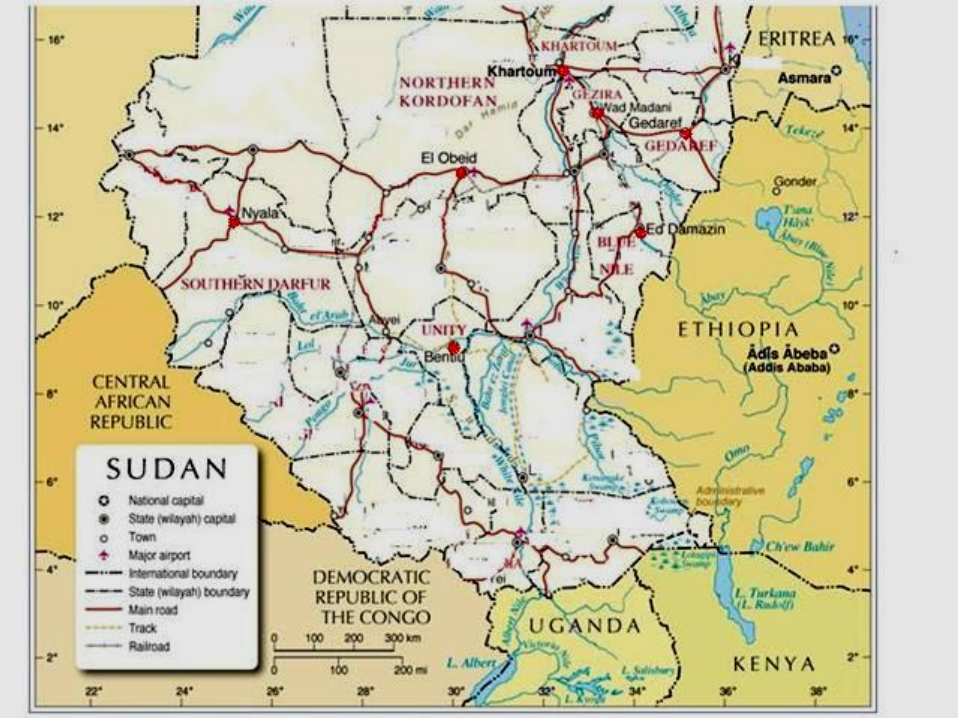

Figure 1: Map showing areas of bovine trypanosomosis surveys conducted during the study period of 2007-2010

● Surveyed areas

Sampling:

Blood samples were collected from the jugular vein of cattle. Blood was usually either collected in the morning (07.30-11.30AM) or the early evening (4.30-6.30PM)

In all areas, samples were taken once except in Blue Nile state, South eastern Sudan where sampling visits were repeated several times.

Cattle examined in Nyala, Obeid, Unity and Blue Nile states were migratory females as the livestock owners tend to keep females while the males were usually sold. The cattle investigated in Gedaref, Wad Madani and Khartoum and Blue Nile (April, 2009) states except April, 2009 were mainly sedentary cattle owned by the villagers living in and around the towns. Cattle in Khartoum and Wad Madani were crosses between imported Friesians and local breeds.

Parasitological examination:

A total of 1852 blood samples of cattle aged 2-5 years were collected and examined for the presence of trypanosomes. Three ml of blood were collected from the jugular veins of each animal into heparinized vacuatiners. The collected samples were then examined by the haematocrit centrifugation technique (HCT) using capillary tubes (Woo, 1970) to detect parasites and to determine the packed cell volume (PCV).

Packed cell volume (PCV) determination:

PCV was measured in a micro-haematocrit centrifuge (Hawksley and Sons, UK). Blood was collected in capillary tubes. The tubes were, then, sealed at one end with crystaseal. The capillary tubes were placed in microhaematocrit centrifuge with sealed end outer most. The specimens were centrifuged at 12,000 rpm for 5 min. And read in a haematocrit reader. The length of the packed red blood cells column is expressed as a percentage of the total volume of blood. Animals with PCV less than 24% were considered to be anaemic (OIE, 2008).

Statistical analysis

Statistical analysis was performed. Infection rates and total PCVs were analysed using SPSS 14. The level of significance was $P \leq 0.05$.

Results

Clinical signs of trypanosomosis

The common clinical signs in infected animals with trypanosomosis were rough coat, poor condition, weakness, pale mucus membrane, enlargement of the lymph node, alopecia of the tail and

emaciation (plate. 1) in addition to abortions and death were reported in some cases.

Trypanosome Infection rates:

Out of 1852 cattle examined in the seven areas, 156 cattle were infected with various species of trypanosomes, with the total infection rate of 8.42%.

Trypanosomes infections were found in all the seven areas surveyed. The results of the trypanosome infection rates are shown in Tables 1 and 2.

As shown in table 1, the lowest Infection rate (0.42%) was recorded in Wad Madani while the highest (28.57%) was recorded in Nyala. There was statistical significant difference ($P \leq 0.05$) in infection rate of trypanosomosis between the two areas.

In Blue Nile area (Table 2), the lowest Infection rate (0) was recorded in April, 2009 while the highest (43.3%) in June 2010. There was no statistically significant difference ($P \geq 0.05$) in infection rates of trypanosomosis in the two surveys.

Parasitological Findings:

Of the 51 infected animals in table 1, 18 samples were trypanosome positive however, trypanosome species were not identified, in the remaining 33 positive samples, the most common trypanosome species detected were *T. vivax* (24/33, 72.7%) followed by *T. theileri* (9/33, 27.3%).

While in Blue Nile (Table 2), out of the 105 infected animals, the most common trypanosome species detected were *T. vivax* (75/105, 71.4%) followed by *T. congolense* (27/105, 25.71%). The prevalence of *T. vivax* was significantly higher ($P \leq 0.05$) than the other trypanosome species. *T. theileri* (3/105, 2.86%) was also reported in December 2008. While no *T. brucei* infections were observed in Blue Nile area.

Plate 1: A cow in Yabous area, Blue Nile State infected with *T. congolense* showing severe emaciation.

Table 1: Bovine trypanosomosis infection rate among cattle in different areas of Sudan during 2009-2010.

Areas	Total Number of animals examined	Number of animals identified positive	Infection rate %	*T. vivax*	*T. congolense*	*T. brucei*	*T. theileri*
Obeid	**122**	**11**	**9.02***	**10**	**0**	**0**	**1**
Gedaref	**115**	**3**	**2.61 NS**	**3**	**0**	**0**	**0**
Nyala	**63**	**18**	**28.57***	**NI**	**NI**	**NI**	**NI**
Unity	**219**	**7**	**3.2 NS**	**7**	**0**	**0**	**0**
Khartoum	**214**	**11**	**5.14***	**4**	**0**	**0**	**7**
Wad Madani	**240**	**1**	**0.42***	**0**	**0**	**0**	**1**
Total	**973**	**51**	**5.24 NS**				

NS=Not significant

* Significant at $P \leq 0.05$

Table 2: Bovine trypanosomosis Infection rate in the Blue Nile state during 2007-2010.

Month	Total Number of Animals examined	Number of animals identified positive	Infection rate %	*T. vivax*	*T. congolense*	*T. brucei*	*T. theileri*
July 2007	**103**	**2**	**1.94** Ns	**0**	**2**	**0**	**0**
May 2008	**50**	**4**	**8** Ns	**2**	**2**	**0**	**0**
August 2008	**75**	**4**	**5.3** Ns	**1**	**0**	**0**	**3**
December 2008	**86**	**4**	**4.65** Ns	**2**	**2**	**0**	**0**
April 2009	**355**	**0**	**0** Ns	**0**	**0**	**0**	**0**
June 2010	**210**	**91**	**43.3** Ns	**70**	**21**	**0**	**0**
Total	**879**	**105**	**11.95** Ns	**75***	**27***	**0**	**3***

Ns: No significant difference is observed

* Significant at $P \leq 0.05$

Packed cell volume:

Infected animals have PCV range between 20.3%-32.7% with a mean of 26.76%, while uninfected animals has PCV range between 26.25%-33.1% with a mean of 28.53%.

In Blue Nile state**,** infected animals have PCV range between 18.5%-25% with a mean of 22.8%, while uninfected animals have PCV range between 20.2%-33.34% with a mean of 25.5%. The overall mean PCV value was not significantly different ($P \geq 0.05$) between infected and uninfected cattle.

Discussion

In This study Blue Nile State showed high infection rate (11.95%). This is most likely due to high tsetse challenge in the southern part of this state. This could, also, be due to poor pastures conditions that force animals to move long distances seeking grazing, thus become subjected to high stress. The low level of nutrition together with the stress affects the health of these herds and makes them more prone to several diseases such as bovine trypanosomosis (Holmes *et al*., 2000). In Blue Nile state the two main pathogenic species of trypanosomes, *T. congolense* and *T. vivax*, were found with a pre-dominance of *T. vivax* whereas *T. brucei* was not detected. *T. theileri* was also found infecting some cattle. This organism is considered non-pathogenic. Although tsetse flies exist in the southern part of Blue Nile state (Yabous area), *T. brucei* was not detected in the samples. The low prevalence of *T. brucei brucei* has been observed in other regions of Sudan in cattle (Hall *et al*., 1983, Salih, 2010).

Of the 355 animals examined in April, 2009 in Blue Nile state, no trypanosomes infections were detected; this may be due to the fact that owners usually treat their animals with Diminazene aceturate (Berenil) in addition to the good pastures at that time. Most of those animals were also sedentary herds that had no contact with the migratory herds at that time of the year. In the Blue Nile area, during the rainy season the nomads who move with their herds from the tsetse areas in Ethiopia and Khor Yabous slowly following rains and avoiding the numerous biting flies of the south, usually camp around Damazin area in the rainy season. Previous studies conducted in those migratory herds showed that trypanosome prevalence is high among those animals. Those animals are source of infection to sedentary cattle during the rainy season when biting flies are increasing (Salih, 2010). This may explain the higher infection rate during the early rainy season in cattle in Blue Nile state (June, 2010).

The adaptation of *T. vivax* to mechanical transmission has been identified as a factor responsible for the spread of the parasite in many parts of Sudan outside tsetse belts, as realized in Khartoum, Gedaref , Obeid and Unity, this is ongoing with the previous findings of

A/Rahman *et al*. (1991) in south Kordofan and A/Rahman (2002, 2005) in Khartoum and central Sudan who reported the predominance of *T. vivax* in cattle herds. Only *T. theileri* was reported in Wad Madani, although an outbreak of *T. vivax* was reported in 2007 (Anonymous, 2007). Infected animals were successfully treated using Diminazene aceturate which suggested the effectiveness of this drug in this area.

In Khartoum, breeding sites of biting flies in form of water surfaces provided by the canals network of the passive gravity irrigation in the farms, in addition to the availability of the host (farm animals), resting sites, suitable temperature and humidity made dairy farms very suitable habitats for tabanids and might be the reason for the presence of high density of those flies in these farms (Sayed, 1997, Eltahir, 2011). So when an infected animal is added to the herd, these flies will have a major role in the spread of the disease within the herd, A/Rahman, (2002) advised that mixing of cattle from trypanosomosis endemic areas with sedentary cattle in dairy farms should not be allowed before examining and treating the newly introduced animals.

High infection rates are likely to be detected if suitable serological or molecular techniques were used as such techniques have superiority over parasitological diagnostic methods in detection of trypanosomes in animals. This agrees with the remarks of Abdalla *et al.*, (2005) who reported that taking into account the low sensitivity of the parasitological diagnostic methods and the uncontrolled use of trypanocidal drugs, the real prevalence of infection is probably substantially higher.

One of the undeniable effects of trypanosome infections in cattle is the occurrence of anaemia, measured by a significant decline of PCV (Murray and Dexter, 1988). Some differences were observed between the average PCV of animals parasitologically positive and animals parasitologically negative, however no significant change was observed in mean PCV between infected and uninfected animals in both tables, these findings disagree with the studies done by Van den Bossche and Rowlands (2001), who observed a decrease in average PCV in association with an increasing prevalence of trypanosomal infections in cattle in Zambia and Ethiopia, respectively.

Higher PCVs were realized in Khartoum and Wad Madani which may not be surprising as *T. theileri* infections is found in these areas and this species usually doesn't affect PCVs. Hoare, (1972) reported that generally, infection with *T. theileri* is cryptic and is usually detected by blood culture; there is no evidence of any specific pathological changes attributable to *T. theileri* and its effect on the bovine host is controversial. These high PCVs also go with the findings of Hall *et al*., (1983) and A/Rahman *et al*., (1991) who realized no difference in mean PCV of infected and non-infected cattle during their trypanosomosis surveys among western Darfur and South Kordofan cattle respectively.

This study suggests that trypanosomosis in cattle is still prevalent in Sudan and constitutes a threat to meat and milk production. The prevalence of the disease varies from site to site. Results showed that trypanosomosis remains one of the main sanitary constraints to cattle development in some areas of Sudan, especially in south eastern Sudan and South Darfur where the disease prevalence is high and the cattle keepers have to regularly treat their animals. Further studies on the occurrence of the disease and its vectors at different seasons of the year, at different altitude and different species of animals should be conducted.

Although trypanosome infections needs to be interpreted with caution due to limitations of the parasitological tests used in this study, however these findings are valuable for understanding and appreciating the importance of tsetse and trypanosomosis control. Trypanosomosis control measures which are practical to Sudan such as tsetse control should be applied.

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