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Study on the Prevalence of Major Trypanosomes Affecting Bovine in Tsetse Infested Asosa District of Benishangul Gumuz Regional State, Western Ethiopia

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Abstract: The study was conducted in Asosa district of Benishangul Gumuz Regional State to determine the prevalence and identify different species of trypanosomes affecting cattle in the area known to be infested with tsetse flies. From a total of 384 randomly selected and examined cattle in six of the study area, 108 (28.1%) were positive. The prevalence was significantly higher (P<0.05) in older and poor body conditioned animals but didn't vary between sexes and peasant associations. The most common trypanosome species identified were *T. congolense* (72/108, 66.7%) followed by mixed *T. vivax* and *T. congolense* (21/108, 19.4%), *T. vivax* (10/108, 9.3%) and *T. brucei* (5/108, 4.6%). The proportional prevalence of *T. congolense* is significantly higher (P=0.000) than the other trypanosome species. The mean PCV values recorded were 20.6% in parasitaemic and 25% in aparasitaemic animals with a statistical significant difference (P<0.05). The notorious impact of bovine trypanosomosis on cattle productivity and the recorded high prevalence of the disease in the area with more pathogenic *T. congolense* as the dominant species validate the need for application of integrated control utilizing insecticide pour-on, odor-baited and insecticide impregnated targets and traps kindred with curative and prophylactic treatments of livestock with trypanocidal drugs.

Key words: Trypanosomosis · Trypanosome · Prevalence · Cattle

INTRODUCTION

Trypanosomosis is among the well-known constraints to livestock production in Africa as it causes a serious and often fatal disease of livestock mainly in the rural poor community and rightfully considered as a root cause of poverty in the continent [1]. The overall economic loss due to the disease was estimated between US $1408 and 1540 million per annum [2]. Most African trypanosomes are transmitted by tsetse flies, which inhabit many parts of the continent that extend about 15°N and 20°S of the equator [3,4]. Ethiopia is situated at the East end of the African tsetse belt. In Ethiopia, tsetse flies are confined to southwestern and northwestern regions between longitude 33°and 38°E and latitude 5°and 12°N an area covers 220000 km² [5]. Five species of Glossina including *G. m. submorsitans, G. pallidipes, G. tachinoides, G.f. fuscipes* and *G. longipennis* have been recorded in Ethiopia [6]. In Asosa Zone, the cyclical vector, *G. morsitans submorsitans* and the mechanical vectors, horse flies (Tabanus) and stable flies (Stomoxys) were recorded [7]. According to NTTICC [2] tsetse infested area of the Benishagul Gumuz Regional State is around 31,000 km^2. Previously calculated figures showed that about 38.5% of the national herd of cattle is vulnerable to trypanosomiasis at any time [8]. The most important trypanosomes affecting cattle in Ethiopia and Benishangul Gumuz Regional State are *Trypanosoma congolense, T. vivax and T. brcei* [6, 8-10].

The presence of animal trypanosomosis is a major constraint to the introduction of highly productive exotic dairy animals and draught oxen to lowland settlement and resettlement areas for the utilization of large land resources [6,11]. Since more than 90 per cent of crop production in Ethiopia is dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to a lack of these animals in trypanosomosis infested area, which worsens the food supply and living conditions in affected areas [12]. Moreover new areas are being invaded and settled communities are being continually evicted by the advancing tsetse [13].

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Ethiopia has acknowledged that trypanosomosis is a major constraint for the reduction of poverty, improved food security and for sustainable agriculture and rural development with consequent implementation of a joint Ethiopian science and technology commission and IAEA tsetse and trypanosomes eradication project through the introduction of a sterile insect technique (SIT) currently limited in the southern rift valley of Ethiopia [1,10]. This area was prioritized because it is believed to be infested with only one Glossina species *(Glossina pallidipes)* and its apparent spread from one drainage system to another is prevented by natural barriers such as mountains enabling eradication to be carried out from one drainage system at a time [8,10]. It is obvious that the future plan is to extend the eradication project to all tsetse infested areas after concocting all the good results and experiences of the ongoing eradication project. Therefore, baseline data collection and regular investigation on the prevalence of the parasites is essential to know the burden of the disease at different geographic locations and to enable the measurement of the impact of any control options that will be introduced later. For determination of trypanosome infection status in rural African settings, microscopy-based techniques using direct observation of wet blood films, microscopic examination of Giemsa stained blood smears and concentration techniques such as the Buffy Coat Technique (BCT) or the Haematocrit Centrifugation Technique (HCT) are the most common parasite detection methods available [14]. However, except a recent study on Equine trypanosomosis from Asosa [7] and cattle trypanosomosis from Mao-Komo special district [9] current data on cattle trypanosomosis from Asosa Zone is lacking. Therefore, the study was conducted to determine the prevalence and identify the different species of cattle trypanosomes prevailing in Asosa district.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2009 to March 2010 in Asosa Zone of Benishangul Gumz Regional State (Fig. 1), that stretches over 2313 sq km in a major tsetse and tsetse born trypanosomosis belt area characterized by low land plane with altitude range of 580-1544 meter above sea level. Asosa is located between 8°30"and 40°27" N and 34°21" and 39°1" E. According to National Meteorological Service [15], the average annual rainfall is 1316 mm with uni-modal type of rainfall that occurs between April and October. Its mean annual temperature ranges between 16.75°C and 27.9°C. Asosa zone has 35.6% of the livestock population of the region constituting 81,939 cattle, 73,181 goats, 10,231 sheep, 14,089 donkeys, 40, 3153 poultry, 29 horses and 59,695 beehives [16].

Study Animals and Sampling Strategy: A total of 384 cattle were selected from indigenous cattle breed kept under extensive husbandry management system using systematic random sampling technique considering 95% confidence interval, 5% desired absolute precision and

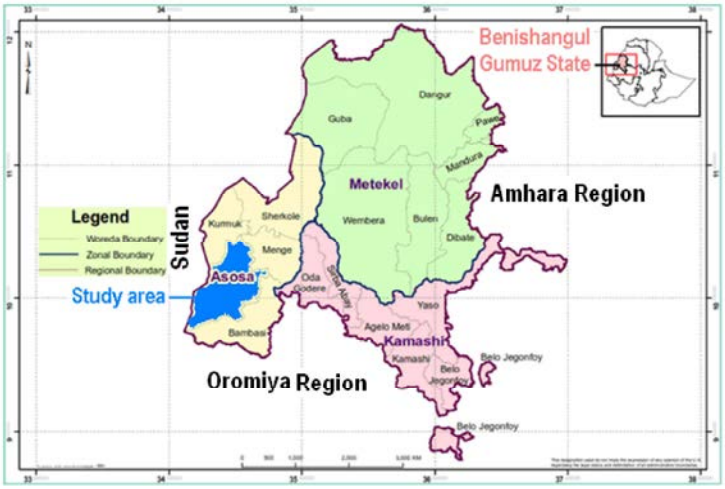

Fig. I: Map of the study area showing the relative location of Asosa in Benshangul Gumuz Regional State (Source: http://www.ocha-eth.org/Maps/downloadables/BENESHANGUL.pdf)

50% expected prevalence based on Pfeiffer [17]. The studied cattle were herded together during the day time and return to their individual owner's farmstead each evening. Age, sex and body condition score of the studied animals were recorded during sampling. The age was estimated by means of their dentition as described by Pasquini *et al*., [18]. The body condition score was done as per Nicholson and Butterworth [19] but categorized in to two broad groups: good (body condition score of M and fatter) and poor (body condition score of M-and thinner).

Parasitological Examination: Blood samples were collected from the ear veins of the study animals into heparinized capillary tubes. The collected samples were then examined by the capillary microhematocrit centrifugation method to estimate the packed cell volume (PCV) followed by the buffy coat (BC) examination using phase contrast microscope for the detection of trypanosomes in the blood [20]. Species identification was done based on movement in wet films and Giemsa stained thin blood smear prepared from the BC of positive animals and examined under a microscope using the oil immersion 100× objective [20].

Statistical Analyses: Percentages (%) were calculated to determine prevalence and chi-square ($\chi 2$) to measure association. Confidence level was held at 95% and 5% significance.

RESULT

Prevalence of Trypanosome Infection: From a total of 384 cattle examined in the six PAs, 108 (28.1%) were positive. Trypanosome infection was found in all the six PAs surveyed. The lowest prevalence (12%) was recorded in Amba-8 while the highest (34.8%) in Asosa. There was no statistically significant difference (P>0.05) in prevalence of trypanosomosis between the PAs. The prevalence of trypanosomosis was 14.8% in female and 13.3% in male whereas it was 1.56% in young (<2 years old) and 26.56% in old (> 2years cattle). Likewise 1.8% of animals with good and 26.3% with poor body conditions were positive for trypanosomosis. There was no significant difference between the sex of animals and trypanosoma infection (p>0.05) whereas body condition and age were found to be statistically significantly associated (P <0.05) with trypanosoma infection (Table 1).

Hematological Findings: In the 108 infected animals, the most common trypanosome species detected were *T. congolense* (72/108, 66.7%) followed by mixed infection with *T. vivax* and *T. congolense* (21/108, 19.4%), *T. vivax* (10/108, 9.3%) and *T. brucei* (5/108, 4.6%). The prevalence of *T. congolense* is significantly higher (P=0.000) in cattle in the study area than the other trypanosome species (Table 2). The mean PCV values recorded in infected and non infected cattle were 20.6 % and 25.0% respectively. The mean PCV value was significantly lower in infected than uninfected cattle (X^2 = 1.109, P = 0.000) (Table 3).

Table 1: The prevalence of trypanosomosis and its association with various risk factors in Asosa district

Risk factor	No examined	No. positive	% positive ± = 95% CI	$\chi 2$ (P value)
Pas				
Amba-4	56	15	26.8±11.6	4.460 (P > 0.05)
Amba-12	66	16	24.2±10.3	
Asosa	89	31	34.8±9.9	
Megele-29	49	16	32.7±13.1	
Amba-8	61	13	12.0±8.2	
Amba-3	63	17	27.0±11	
Sex				
Male	185	51	13.3±4.9	0.055 (P>0.05)
Female	199	57	14.8±4.9	
Age group				
>2years	343	102	26.6±4.7	(P<0.05)
<2 years	41	6	1.6±1.6	
Body condition				
Good	268	7	1.8±1.6	2.857 (P<0.05)
Poor	116	101	26.3±8.0	
Total	384	108	28.1±4.5	

Table 2: The prevalence of single and mixed trypanosome infection in Asosa district

Species	No. positive	% positive ± = 95% CI	χ2 (*P*-value)
T. congolense	72	18.8±3.9	3.352 (*P*=0.000)
Mixed *T. congolense and T. vivax*	21	5.5±2.3	
T. vivax	10	2.6±1.6	
T. brucei	5	1.3±1.1	
Total	108	28.1±4.5	

Table 3: Mean PCV in parasitemic and aparasitemic cattle in Asosa district

Condition	No examined	Mean PCV (%) ± = 95% CI	χ^2 (P-value)
Infected	108	20.6±1.5	1.109 (P =0.000)
Non-infected	276	25.0±1.0	

DISCUSSION

This study was conducted in the major tsetse and tsetse born trypanosomosis belt area and recorded an overall prevalence of 28.1% bovine trypanosomosis. This result concords with the reported prevalence of 24.7% from the neighboring Mao-Komo special district [9] and an average monthly incidences of 25.7% reported from tsetse-infested zones than the 20.9% from the tsetse free zones of the neighboring Amhara Regional State of Ethiopia[11]. The similarity of the prevalence between these studies might be ascribed to similar altitudes and fly density of the study areas. Significant differences were observed in areas with differing altitude but not in areas with similar elevations[10]. High trypanosomosis prevalence of 20% was reported from tsetse belt area as compared to 13% from the vicinage and much less 5.2% from the highlands of Cameroon [21].

But lower overall prevalence of 10.1% from Awi Zone [22], 9.63% from Awi and 20.74% from Metekel zones [10] and 4.4% from Bench Maji Zone [25] were also reported. The higher prevalence of trypanososmosis registered in the current study area compared to these places may be imputed to the co-existence of Glossina (tsetse fly) and other biting flies belonging to the family of Stomoxys, Tabanus and Haematopota [7] and/or to insufficient or lack of intervention in parasite and vector control. Abdalla *et al*., [24] had reported a lower prevalence of 4.4% bovine trypanosomosis caused by *T. vivax* from tsetse free area that was infested with biting flies such as *Tabanus, Hippobosca and Stomoxys spp*. The difference could also be associated to the difference in the breeds of animals reared in different areas. Difference in susceptibility of different breeds to trypanosome infection was previously documented [25].

In this study, prevalence of trypanosome infection was not found to differ with the sex of animals and the Peasant Associations. Previous reports also showed no statistically significant difference between sex of animals for trypanosome infection prevalence [10]. Cherenet *et al*., [11] reported no difference in the incidence of trypanosome infections in sentinel herds or locality in both tsetse-free and tsetse-infested zones. This could be due to the similarity in the ecosystems of the study locations that supported proliferation of both the tsetse and biting flies that feed on both sexes of cattle indiscriminately.

This study has also shown that *T. congolense* was the dominant species with a proportion of (72/108, 66.7%) followed by *T. vivax* and *T. congolense* mixed infection (21/108, 19.4%), *T. vivax* (10/108, 9.3%) and *T. brucei* (5/108, 4.6%).This result concords with the reported proportion of 63.2% *T. congolense,* 13.6% *T. vivax, 11.6% T. brucei* and 11.6% mixed infection in cattle from the neighboring Mao-Komo special district [9]. This result is also in consonance with the reported proportions of *T. congolense* (77.6%) followed by *T. vivax* (14.9%), *T. brucei* (6.0%) and *T. congolense* and *T. vivax* mixed infection (1.5%) from Metekel and Awi zones [10]. Prevalence of *T. congolense* (36.1%), *T. vivax* (36.1%), *T. brucei* (10.8%) and *T. congolense and T. vivax* mixed infection (17.0%) from tsetse-infested area but *T. vivax* (90.9%) followed by *T. congolense* (9.1%) from tsetse-free zone were reported previously[11]. Kebede and Animut [22] reported *T. vivax* (54.1%), *T. congolense* (35.7%), *T. brucei* (1.9%) and *T. congolense and T. vivax* mixed infection (8.4%) from Awi zone. The high ratio of *T. congolense* in tsetse-infested area may be ascribed to the more efficient transmission of *T. congolense* by major cyclical vectors than *T. vivax* in East Africa [26]. The lower relative prevalence of *T. vivax* in the current study area as compared to the tsetse-infested area of Amhara region could be due to the difference in the climate and altitude that affect the vegetation, rainfall and temperature which in turn are known to be the primary determinants for proliferation of the flies. An increased

prevalence of *T. vivax* infections in cattle has been noted during rainy season attributed to higher density of tsetse flies and/or the abundant presence of mechanical vectors, such as tabanids and Stomoxys spp [27,22,24]. It was also reported that *Trypanosoma vivax* is found in the entire country except in the highlands, which are 2500 meters above sea level as the acyclical transmission of the disease is effected by means of blood sucking flies which include Glossina, Tabanus, Haematopota, Chrysops, Hippobosca and Stomoxys species [8]. Abdalla *et al*., [24] also found only *Trypanosoma vivax* in infected cattle from tsetse free areas of the Sudan. The difference might have also been associated with the difference in the breed of cattle reared in each area. The reported occurrence of *T. congolense* in the tsetse-free zone by Cherenet *et al*., [11] may be attributed to the presence of tsetse flies in areas that were considered to be tsetse-free or to uncontrolled movement of cattle from neighboring areas of tsetse fly belt. It was long been known that the distribution of *T. congolense* and *T. brucei* is limited nearly to the area of the cyclical vector due to the fact that both species of trypanosomes are not adapted to acyclical transmission [8].

Trypanosome infection as a cause of anaemia was evidenced by the decrease in packed cell volume of the infected animal [11,28]. The mean PCV value recorded in this study was also significantly lower (P = 0.000) in parasitaemic (20.6%) than in aparasitaemic (25.0%) animals. This is in agreement with previously reported mean PCV values in parasitaemic than in aparasitaemic animals of 21.16% than 25.4% [29], 22.1 % than 29.1 [24], 24.6% than 29.16% [27], 21.1% than 26% [22], 21.8% than 27.7% [23], 19.42% than 24.13% [10] and 18.1% than 25.8% [9]. It is also opined that anemia is one of the most indicators of trypanosomes in cattle [30] and the level of anemia or PCV usually gives a reliable indication of the disease state and productive performance of infected animals [31].

In this study, the prevalence of 26.56% recorded in old animals (> 2years cattle) was significantly higher than the prevalence of 1.56% recorded in young animals (<2 years old). This finding is in line with previous reports that recorded significantly higher incidence of trypanosome infections in older animals (P = 0.037) in tsetse-infested zone [11] but not in the tsetse-free zone [11]. The study conducted on donkeys at similar region with this study also showed that all of the donkeys infected were above 2 years of age [7]. This may be most likely a result of the tsetse's feeding preference for older animals [32] or may be due to restricted grazing of young animals near homestead where there are less number of tsetse flies. However, the exact reason for this is not clearly known and requires further investigation. Infection rate in poor body condition animals was significantly (P<0.05) higher than in good body condition animals. This is also in agreement with the reports of [9] and [10]. Abebe and Wolde [7] also reported significantly higher prevalence of trypanosomosis in donkeys with poor body condition than with good body condition animals. This is due to the chronic nature of the disease that result in anaemia and depletion of body condition and/or the predisposition of trypanosome infected cattle to other concurrent infections that further aggravate the emaciation.

Considering the lower sensitivity of the direct parasitological technique of buffy coat method for the diagnosis of trypanosomosis, the overall prevalence of 28.1% observed in this study can be considered high. Direct parasitological techniques are mainly feasible in the acute state of the illness, when the blood is colonized by a large number of parasites but not in the chronic state, which is characterized by low parasitemia that proved difficult for parasitological diagnosis. Very low sensitivity of buffy coat method was reported where 50% of infected animals remained undetected using parasitological diagnostic tools as compared to the molecular analysis [33]. Deliberation of the ascertained impact of trypanosomosis on productivity and the recorded high prevalence of bovine trypanosomosis with more pathogenic *T. congolense* as the dominant species in the study area should validate the need for application of integrated disease control through insecticide pour-on, odor-baited and insecticide impregnated targets and traps coupled with curative and prophylactic treatments of livestock with trypanocidal drugs.

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