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Research Article

Prevalence of Bovine Trypanosomosis and Apparent Density of Tsetse Flies in Selected Districts of Dawuro Zone, Southern Ethiopia

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Abstract

Trypanosomosis is a parasitic disease that causes serious economic losses in livestock in sub-Saharan African countries. A cross sectional study was conducted from April 2019 up to November 2019 in selected districts of Dawuro Zone, Southern Ethiopia to determine the prevalence of bovine Trypanosomosis and apparent density of tsetse flies. A total of 384 blood samples were collected from randomly selected animals for prevalence study. The determined Packed Cell Volume (PCV) was examined for the presence of trypanosomes using the buffy coat technique. Forty two [42 (10.94%)] of the samples were tested positive for trypanosomes. Among which, 25 (59.52%) found to be infected by *T. congolense* while 9 (21.43%) was infected by *T. vivax* and 8 (19.04%) was also infected by mixed species. The prevalence difference between the study PAs was statistically significant ($p < 0.05$). The mean PCV value of non-anemic animals (28.24%) was significantly higher than that of anemic animals (20.68%). From a total 65 deployed monopyramidal traps, 139 tsetse flies were collected. From the total caught tsetse flies in the study sites, 47.48% were *G. pallidipes,* 48.20% *G. fuscipes* and 7.19% *G. m. submorsitans*. An overall apparent density of tsetse flies was 2.37 flies per trap per day. The final result of this finding was revealed that trypanosomes and their vectors are prevalent and imitate a huge threat to cattle production in selected districts of Dawuro Zone. Hence, appropriate intervention strategies should be implemented to minimize the burden of the disease.

Keywords: Apparent Density; Cattle; Dawuro; Prevalence; PCV, Trypanosomosis

Introduction

Trypanosomosis is a disease complex caused by several species of blood and tissue dwelling protozoan parasites of the genus *Trypanosoma* [25]. It is a disease of domestic livestock that causes a significant negative impact on food and economic growth in many tropical and subtropical countries of the world including sub-Saharan Africa. The course of the disease may run from an acute and rapidly fatal to a chronic long lasting one depending on the vector-parasite host interactions. It is characterized mainly by intermittent fever, progressive anaemia and loss of condition of susceptible hosts which if untreated leads to high mortality rates [2,6].

The disease is distributed over approximately 10 million km^2 of Sub Saharan Africa between latitudes 14°N and 29°S which directly coincide with distributions of tsetse flies [27]. In Ethiopia, the most important tsetse born trypanosomes inflicting economic losses in domestic livestock are *T. congolense*, *T. vivax* and *T. brucei* [1]. The distribution of tsetse flies is determined principally by climate and influenced by altitude, vegetation and presence of suitable hosts. Five species of tsetse flies, *G. m. submorsitans*, *G. pallidipes*, *G. tachinoides*, *G. f. fuscipes* and *G. longipennis* have been recorded in Ethiopia. Tsetse infested areas lie in lowlands and in the valleys of Abay (Blue Nile), Baro, Akobo, Didessa, Ghibe and Omo Rivers. The infestation is confined to the southern and western regions of Ethiopia between 33° - 38° E and 5° - 12° N which amounts to about 200,000 km^2 [15]. Out of the nine administrative regions of Ethiopia, five i.e. (Gambella, Benishangul-Gumuz, Amhara, Oromia and Southern Nations and Nationalities and People Regional State (SNNPRS) are infested with more than one species of tsetse fly. The Dawuro zone is one of the Zones in the SNNPRS which is surrounded by Omo river basins mostly and the artificial dam which is formed due to the building of Gilgel Ghibe III hydroelectric power in Southwestern Ethiopia. This constructed artificial dam on Gilgel Ghibe III is favourable for the high tsetse fly population density in the area. This leads the four woreda (Zaba gazo, Loma bossa

and Gena and Tarcha zuria) of Dawuro zone to be affected by the tsetse fly and Trypanosomosis seriously.

Although few studies were conducted in Southwest Ethiopia, no more published study was conducted in selected districts of Dawuro Zone. Owing to the fact that, tsetse and Trypanosomosis fronts in many places in Ethiopia are unstable and tsetse animal interface is constantly moving, studies on the epidemiology of Trypanosomosis are crucial to plan and implement evidence based interventions. It is intended to fill the information gap occurred on Trypanosomosis and tsetse flies in selected districts of Dawuro Zone Southern Ethiopia. It was conducted to determine the prevalence of Trypanosomosis, identify trypanosome and tsetse species in cattle in the study areas.

Materials and Methods

Study area description

Dawuro Zone is one of the Zones in Southern Nations Nationalities and People's Regional state (SNNPRS). Geographically, it is roughly lies between 6°59' - 7°35' North Latitude and 36°6' - 37°53' East Longitude. It is bordered with Oromia region in the North West, Kembata Tembaro Zone in the North East, Wolaita Zone in the East, Gamo Gofa Zone in the South, and Konta Special Woreda in the West. The total area of the zone is estimated to be 4436 square km which shares 4.07% of the total area of the region and the population size is 617,897 accounting nearly 3.3% of the total population of the region. Based on the geographic administration relativity, the Zone divided into ten districts and one Town administration. The zone is located at about 497 km far from Addis Ababa, capital city of Ethiopia and 319 km South West, capital city of the SNNP regional state, Hawassa. The area geographically lies within 07°00' to 7°25' North latitude and 35°55' to 36°37' East longitude and altitude of 1300 - 3500 m.a.s.l [7].

The present study was conducted from April 2019 up to September 2019 in Southern Nations Nationalities and People's Regional state (SNNPRS), in the four selected study districts (Gena, Tercha Zuria, Loma bossa and Zaba gazo districts) of Dawuro zone, the Southwest part of Ethiopia. The zone has a total of 185 PAs of which 21%, 41% and 38% accounts highland, midland and lowland respectively. The livestock population consists of 1,968,348 cattle, 900,764 sheep, 864,407 goats, 61,342 horses, 96,741 donkeys, 62,765 mule and 1,638,733 poultry. In study area, Cattle are managed under traditional management system [9].

The study was conducted in 6 Peasant associations (lowest administrative units in Ethiopia): Garada bachra, Garada intela (Zaba gazo), Mela galda (Tarcha zuria), Zima waruma and Subo tulema (Loma) and Baza shota (Genna) districts of Dawuro Zone. Mixed farming system is the main stay of the livelihood of the society where crop and livestock production play integral roles. The average annual low and high temperatures are 28°C and 36°C respectively and the mean annual rainfall ranges from 600 to 1800 ml. The main crop types cultivated in this area are teff, bean, pea, sesame, maize, peanut and sorghum. The commonly found wild animals are buffalos, antelopes, ape, monkeys, deer, leopard, lion, hyena and elephants [9].

Study animals

The study population constituted of indigenous zebu cattle managed under smallholder mixed farming system. The animals are kept under traditional extensive husbandry system which had common grazing and watering points.

Study design

A cross sectional study was conducted from April 2019 to September 2019. The study animals were classified in different age groups as calf hood age of less than 1 year, the young of 1 - 4 years and the adult age group greater than 4 years of old including the sex factors to assess the trypanosome infection in cattle population of the study areas [19].

Sampling and sample size determination

The study was conducted in rainy season (April 2019 up to November 2019) to estimate the prevalence of Trypanosomosis in cattle in the area. The study peasant associations (PAs) were selected based on their suitability to the production tsetse flies and accessibility to transport. Sample size determination was done based on the cattle population of the respective PAs. Cattle owners were informed one day a head of sample collection to gather their animals at one place and simple random sampling technique was employed to select the study animals from the population. The sample size required was calculated at 50% prevalence with level of precision at 5% and 95% confidence interval using the formula described by Thrusfield [31]. As the actual prevalence was unknown, 50% was used to produce the largest sample size possible. Totally, 384 animals were sampled for this study. Age, sex and body condition score of the studied animals were recorded during sampling. The age was estimated by means of their dentition [21]. The body condition status of selected animals was assessed and ranked as good, medium and poor [19].

Parasitological and hematological data

Blood samples were collected from superficial ear veins using sterilized lancet and heparinized micro-haematocrit capillary tubes. Immediately after blood collection, the tubes were sealed on

one side with Crista seal (Hawksley Ltd, Lancing, UK). The capillary tube was then transferred to a hematocrit centrifuge and spun for 4 minutes at 2500 revolutions per minute. The centrifuged capillary tube was measured on a hematocrit reader to estimate the Packed Cell Volume (PCV) as an indicator of anaemia. Then, the capillary tube was cut using a diamond tipped pen 1 mm below the buffy coat to include the uppermost layers of the red blood cells. The content of the capillary tube was expressed on to slide, homogenized onto a clean glass slide and covered with a 22 × 22 mm cover slip. The slide was examined using the 40 × objective for the movement of parasites. Then Packed Cell Volume (PCV) was calculated using micro-haematocrit reader. For the purpose of species identification, thin blood smears were made and fixed with methanol for 3 minutes, stained with Giemsa stain for 30 minutes and examined under a microscope using the oil immersion 100 x objectives [23].

Entomological data

A total of 65 monopyramidal traps including 15, 10, 10, 10, 15 and 5 were deployed in the riverside and wooded grassland areas of Garada bachra, Garada intela, Mela galda, Zima waruma, Subo tulema and Baza shota respectively. The density and species of tsetse flies were assessed using odour-baited monopyramidal traps deployed at 200 - 250m intervals. The odour baits used contained acetone, octanol and cow urine with appropriate apertures in order to release the necessary amounts of attractants. After 48 hours of trapping, the trap cage was collected [4]. The species and sex of the captured flies were identified based on morphological characteristics [31]. The apparent density of tsetse flies was determined based on the daily mean number of flies captured in baited traps and recorded as fly per trap per day (F/T/D) [11].

Data analysis

Raw data were entered into a Microsoft Excel spreadsheet and descriptive statistics were used to summarize the data. SPSS version 23.0 statistical software programs were used to analyze the data. The point prevalence was calculated for all data as the number of infected individuals divided by the number of individuals examined and multiplied by 100. The association between the prevalence of trypanosome infection and risk factors were assessed by chi-square test (χ^2), whereas the two sample student's t-test was used to assess the difference in mean PCV between trypanosome positive and negative animals. The test result was considered significant when the calculated p-value was less than 0.05 at 95% confidence interval.

Results

Parasitological results

A total of 384 animals were sampled including 63, 48, 47, 91, 58 and 77 from Garada bachra, Garada intela, Mela galda, Zima waruma, Baza shota and Subo tulema respectively. From the total sampled animals, 42 (10.94%) were infected with trypanosomes. The most (59.52%) of trypanosome species identified was *T. congolense* and 21.43% was *T. vivax* and 19.04% was mixed species. Statistically different variation was observed in the infection status among different PAs (Table 1, p = 0.001). The prevalence of trypanosome in different age groups was 7.15%, 10.82% and 11.26% in young, adult and old animals respectively (Table 2). The prevalence of Trypanosomosis was not significantly different among age and sex groups. Of the 384 cattle examined, 153 (39.84%), 187 (48.70%) and 44 (11.46%) were in poor, medium and good body conditions, respectively. Higher proportion (16.34%) of cattle ranked as having poor body conditions were significantly more infected compared to those ranked as medium (8.57%) and good (2.27%) body conditions (Table 3, p = 0.001). The mean PCV value of the parasitemic animals (22.6%) was lower compared to the mean PCV value of aparastemic animals (26.9%) as indicated (Table 4). There was a statistically significant difference in mean PCV among parasitemic and aparasitemic animals (p = 0.02). Besides, a total of 139 tsetse flies were caught (Table 5). The majorities (50.32%) of the flies were *G. fuscipes*, 39.31% was *G. pallidipes* and the remaining 10.39% were *G. m. submorsitans.*

Discussion

During in the current study, an overall prevalence of bovine Trypanosomosis was 10.94% (95% CI = 7.82 - 14.06) reported. The result of the present study was similar to the findings reported from different parts of Ethiopia. Earlier studies indicated that the prevalence of bovine Trypanosomosis ranging from 8.6 to 9% and from 6.6 to 11.3% in southwestern and north western parts of the country respectively [7,28].

However, this finding was higher than previous reports from districts in southern part of Ethiopia that showed the diseases prevalence ranging from 4.2 to 4.4% [27,29]. In these districts tsetse control has been carried out by the southern tsetse and Trypanosomosis control project for many years which significantly reduced the prevalence. On the other hand, the current finding is lower than other reports of earlier studies in Ethiopia where the prevalence ranging from 17.3% to 28.1% was reported [1,3,28]. These variations could be attributed to seasonal differences during sampling periods and methods employed for the studies. The

Names of woreda	Names of PAs	No. of animals examined	No of positive animals	Prevalence N (%)	95% CI
Zaba gazo	G/bachra	63	20	31.75%	20.25 - 43.24
	G/intela	48	14	29.17%	16.31 - 42.03
Gena	Baza Shota	58	7	12.07%	3.69 - 20.45
Loma bossa	Zima waruma	91	0	0.00%	0.00 - 4.05
	Subo tulema	77	0	0.00%	0.00 - 4.75
T/Zuria	Mela galda	47	1	2.13%	0.38 - 11.11
Total		384	42	10.94%	7.82 - 14.06

Table 1: Prevalence of trypanosomes in different PA in selected.

Variables	Category	No. of animals examined	Prevalence N (%)	95% CI
Sex	Male	211	18 (8.53%)	5.46 - 13.08
	Female	173	24 (13.87%)	8.72 - 19.02
Age group	Calf	14	1 (7.15%)	6.35 - 20.63
	Young	148	16 (10.82%)	5.81 - 15.81
	Old	222	25 (11.26%)	7.10 - 15.42
Color	White	51	2 (3.92%)	0.26 - 12.22
	Red	266	14 (5.26%)	2.42 - 15.64
	Black	67	26 (38.81%)	1.09 - 7.06

Table 2: Prevalence of Trypanosomosis in association with sex, color and age groups.

PAs	No of examined	Prevalence of trypanosome species identified			Total
		T. congolense	*T. vivax*	Mixed	
G/bachra	63	12 (19.05%)	4 (6.35%)	4 (6.35%)	20 (31.75%)
G/intela	48	8 (16.67%)	4 (8.33%)	2 (4.17%)	14 (29.17%)
Baza Shota	58	4 (6.90%)	1 (1.72%)	2 (3.45%)	7 (12.07%)
Zima waruma	91	0	0	0	0
Subo tulema	77	0	0	0	0
Mela galda	47	1 (2.13%)	0	0	1 (2.13%)
Total	384	25 (6.51%)	9 (2.34%)	8 (2.08%)	42 (10.94%)

Table 3: Prevalence of trypanosome species infection in different PAs

Body condition score	No. of animals examined	No of positive animals	Prevalence N (%)	95% CI
Poor	153	25	16.34%	8.64 - 24.00
Medium	187	16	8.57%	4.55 - 12.57
Good	44	1	2.27%	2.13 - 6.68
Total	384	42	10.94%	7.82 - 14.06

Table 4: Relationship between infection and body condition of cattle in selected districts.

Infection status	No of animals examined	Mean PCV (%)	t-test	P-value
PCV < 25 (Anaemic)	42	19.4	6.8	0.002
PCV ≥ 25 (Non anaemic)	342	26.7		
	384	23.05		

Table 5: Association between trypanosome infection and PCV value of cattle.

Pas	Altitude (m.a.s.l)	No of traps	Glossina species caught						Total	F/T/D
			G. pallidipes		*G. fuscipes*		*G. morsitans*			
			M	F	M	F	M	F		
G/bachra	954	15	22	28	12	6	0	0	68	2.27
G/intela	961	10	0	5	8	11	0	0	24	1.2
M/galda	1637	10	19	33	15	16	8	0	91	4.55
Z/waruma	1021	10	0	0	18	29	0	0	47	2.35
Subo tulema	1072	15	0	0	13	12	0	0	25	0.83
Baza shota	1705	5	8	6	9	6	15	9	53	5.3
Total		65	49	72	75	80	23	9	308	2.37

Table 6: Species and sex of tsetse flies caught in selected PAs of Dawuro Zone.

present study showed that the majority (59.52%) of the infections is caused by *T. congolense* and the remaining 21.43% is caused by *T. vivax* and 19.04% is caused by *T. brucei*. The predominance of *T. congolense* in tsetse infested areas of Ethiopia has been reported by many authors. In Southwest Ethiopia, Abebe and Jobre reported an infection rate of 58%, 31.2% and 3.5% for *T. congolense*, *T. brucei* and *T. Vivax*, respectively [7] also in the same place Abera., *et al*. reported an infection rate of 64%, 23% and 13% for *T. congolense*, *T. vivax* and *T. brucei* respectively [3]. Another study in southern Ethiopia recorded an infection rate of 64% for *T. congolense* [3]. The present finding is also supported by earlier works done in which 82.4% *T. congolense* and 5.9% *T. vivax* infections in Arba Minch, southern Ethiopia has been reported [30]. The predominance of *T. congolense* infection in cattle in the study area suggests that *Glossina* species are more efficient transmitters of *T. congolense* than *T. vivax* in East Africa and also due to the high number of serodems of *T. congolense* as compared to *T. vivax* and the development of better immune response to *T. vivax* by the infected animal [11].

The trypanosome infection in male animals is slightly higher than in the female animals, but the variation was not statistically significant ($p > 0.05$); showing that both male and female cattle were equally susceptible to Trypanosomosis infection. This is in line with previous studies in Ethiopia [3,8,17].

There was a significant difference in trypanosome prevalence between the study kebeles ($p = 0.001$). The high prevalence of the disease in Garada bachra might have been attributed to the presence of relatively more suitable habitats (denser grassland, bush coverage and it is near to artificial dam which is built due to Gilgel Ghibe III hydroelectric power construction) for the vectors compared to other areas. However, in Zima waruma and Subo tulema kebeles had lower disease prevalence was observed despite a dense tsetse fly population, this due to continuous application of deltametrin 1% pour on animals back; continuous control of the area by using trap and targets and use of trypanocidal drugs. Also, this could be attributed to the proximity of this Kebeles to a veterinary clinic where the community has more easily access to animal health care compared to other areas and also the community people were aware about the impact the tsetse fly and Trypanosomosis. Treating animals with prophylactic drugs against the disease minimizes the prevalence of Trypanosomosis in high tsetse fly population densities [19].

This study also showed that there is strong association between the body condition of cattle and trypanosome infection. The occurrence of infection was 2.27%, 8.57% and 16.34% in cattle with good, medium and poor body conditions, respectively. Thus, the majority of the infected animals manifest poor body conditions because of the effect of the disease. However, poor body condition could also be the consequence of other pathogens and nutritional stress [30]. The finding agrees with the reports of earlier studies in Ethiopia [3,6,26]. In this study, strong associations existed between the mean PCV value of the animals and occurrence of parasitaemia. The mean PCV value of non anaemic (26.7%) was significantly higher than that of parastaemic animals (19.4%). The lower mean PCV value in anaemic animals than that of non anaemic ones was well recorded in previous studies in Ethiopia [3,30]. Another study conducted in southwestern Ethiopia indicated that in an increase in PCV value, the proportion of positivity decreases and hence mean PCV is a good indicator for the health status of the herd in endemic areas [34]. As anaemia is the classical sign of the disease pathogenicity [23], the low PCV in parasitaemic animals could have contributed in reducing the mean PCV of the cattle.

The 10.94% overall prevalence of bovine Trypanosomosis recorded in this study might not fully express the true extent of the disease burden because of the very low sensitivity and high variability of the parasite detection methods. Even though relatively high in acute state of infection, the sensitivity of buffy coat tech-

nique decreases over the course of the infection and becomes very low in chronic state of the disease [20]. However, the authors suggested that, the PCV-value of an individual animal is a good indicator of the presence of a Trypanosomal infection. Therefore, the apparent parasitological prevalence of Trypanosomosis is a little or much lower than the true parasitological prevalence in endemic areas. Hence, in endemic areas, it is necessary to complement the parasitological detection methods with PCR/RFLP and other sensitive molecular techniques to better understand the epidemiology of Trypanosomosis and institute appropriate interventions.

There was significant difference in prevalence among three hair-coat colored animals at the present study area. The highest prevalence was recorded in black hair-coat animals (38.81%) whereas the least prevalence rate was recorded in white hair-coat animals (3.92%). This may be due to the preference of flies towards some color. In general tsetse flies are attracted from a distance by blue and black colors, with blue being slightly more attractive than black. However, tsetse will land on a black surface in preference to a blue one and they also land on horizontal oblongs in preference to vertical one. So, tsetse flies prefer dark-colored animals. This finding in line with the which was reported at Damot Woyde district by Takele and Gechere [11] and at Konta special Woreda by Abera., *et al.* [3] who reported the prevalence of black (20%), red (1.98%) and white (0.00%) and black (33.93%), red (16.67%) and white (8.06%) hair coat animals respectively.

In current finding, the entomological survey revealed that tsetse fly species in the selected districts of Dawuro Zone are *G. m. submorsitans*, *G. fuscipes and G. pallidipes*. In the study area, there is a typical habitat pattern for riverine species along the rivers surrounded by savannah habitats suitable for *G. m. submorsitans*. Both of the identified fly species in the present study are among the five *Glossina* species recorded in Ethiopia [23]. The overall apparent density of tsetse flies was 2.37 F/T/D. Earlier studies in the western part of the country, reported the apparent density of *Glossina* species ranging from 0.3 to 24.4 F/T/D [24,29]. Such wide variations could have been resulted from differences in season and density of vegetation cover and types of traps deployed, type and volume of odour attractants utilized during the studies. The low density of tsetse in the study area may have been due to the expansion of settlements and farmlands in the area. It may also be explained by the migration of the game as a result of climate and habitat changes [6]. The relative abundance of *G. fuscipes* (50.32%) than *G. pallidipes* (39.31%) might have been due to ability of this species to adapt to unsuitable habitats. Riverine flies appear to be largely unaffected by human population density and can even adapt to human-made environments [21].

Conclusion

The most predominant species of trypanosome in the study area is *Trypanosoma congolense* and although *T. vivax* and mixed infections were present. The Tsetse fly species caught in the study area were *G. pallidipes, G. f. fuscipes* and *G. m. submorsitans*. This study also indicated that infection with Trypanosomosis negatively affects the body condition and PCV profile of animals. Taken together, tsetse borne Trypanosomosis is posing a considerable threat to cattle production in selected districts of Dawuro Zone, Southern Ethiopia. Therefore, it is imperative to extend and strengthen the national tsetse and Trypanosomosis control scheme in tsetse infested areas in Ethiopia particularly in Dawuro Zone to minimize the burden of the disease.

Competing Interests

The author has declared that no competing interests exist.

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