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Original Research

Study On Prevalence of Bovine Trypanosomosis and Spatial Distribution of Tsetse Fly and Other Risk Factors In Darimu District, Ilu Aba Bora Zone, Western Ethiopia

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Abstract

Bovine trypanosomosis is one of the major impediments to livestock development and agricultural production in Ethiopia contributing negatively to the overall development in general and to food self-reliance efforts of the nation in particular. Darimu district is one of the areas with such problems. Therefore, a cross-sectional study was carried out to determine the prevalence of bovine trypanosomosis and tsetse apparent density using parasitological and entomological survey in Darimu district of Western Ethiopia from November 2016 to March 2016. The Parasitological survey was conducted on 614 randomly selected animals during the study period. The prevalence of bovine trypanosomosis was (8.6%) of which T. congolense was the most prevalent (71.69%) trypanosome species followed by T. vivax (22.64%), and mixed infection of T. congolense and T. vivax (5.6%). The highest prevalence was observed in the animals with poor body condition (11.5%) and animals with anemia (10.8%). There was statistically significant variation in the prevalence of trypanosomosis among different body conditions and anemic state of the animal (P<0.05). There was no statically significant difference between sex and age groups (p>0.05). The entomological survey showed that the apparent density of Glossina, were (4.6 flies/trap/day).Glossina. fuscipes, Glossina. pallidipes, Glossina morsitans and Glossina. tachinoides were identified to exist in the study area. The mean PCV value of the infected animals was lower (21.4) as compared to the mean PCV value of non-infected animals (23.5) and statistically, a significant difference was observed between the PCV value of infected and non-infected animals (P<0.05). The study revealed valuable information on the epidemiology of bovine trypanosomiasis in the study area. The present study shows higher prevalence so that implementing control of trypanosomosis with integrated approaches have paramount importance in the study sites.

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INTRODUCTION

Trypanosomiasis is a disease complex caused by several species of blood and tissue dwelling protozoan parasite of genus *Trypanosoma* (Taylor, 1998; Uilenberg, 1998; Tesfaye, 2002). It is a serious disease in domestic livestock of that causes a significant negative impact on food and economic growth in many parts of the world especially in sub-Saharan Africa (D'Ieteren, *et al*., 1998) It is distributed over approximately 10 million km^2 of Sub Saharan Africa between latitudes 140N and 290S (Urquhart, *et al*., 1991; Radostits, *et al*., 2007). The most important trypanosome species affecting domestic livestock in Africa are *Trypanosoma congolense*, *T. vivax*, and *T. bruicebruice* in cattle, sheep, and goats. *T, simiae* in pigs and *T. evansi* in camels (Aiello, 1998).

Tsetse fly species are restricted to various geographical areas according to habitat, the three main groups, named after the commonest species in each group, being *fusca*, *palpalis* and *morsitans,* found respectively in forest, riverine and savannah areas. The last two groups, because of their presence in the major livestock rearing areas, are the most from a veterinary standpoint (Urquhart, *et al*., 1991).

Infected tsetse inoculates metacyclic trypanosomes into the skin of animals, where the trypanosome grows for a few days and causes a localized swelling (chancres). They enter the lymph nodes, then the blood stream where they divided rapidly by binary fusion. In *T. congolense* infection the organism attaches to the endothelial cells and localize in capillaries and small blood vessels. *T. brucei* and *T. vivax* invade tissues and result in tissue damage in several organs (Aiello, 1998).

In the tsetse-infested areas of Africa, trypanosomiasis is well recognized and diagnosis is often based on history of the chronic wasting condition of cattle in contact with tsetse flies. Trypanosome can be confirmed parasitologically by demonstrating parasites in the blood of infected animals and various techniques are available. In practice, many field programs of monitoring cattle for infection is based on routine screening of stained thick and thin blood films, thick films are examined to detect infected animals and thin films determine the species of infecting trypanosomes (Andrews, *et al*., 2003). By Buffy coat examination the organism is well visualized (Smith, 2009). Among the various tests developed the IFAT and ELISA can be used to detect circulating trypanosome antigens and as well as antibodies (Andrews, *et al.,* 2003).

There are five economically important animal trypanosome species in Ethiopia. These are *Trypanosoma congolense*, *T. vivax, T. brucei*, *T. evansi* and *T. equiperdum* (Feyissa, *et al*., 2011). The closely related *T.brucei* subspecies *T. b. rhodensience* causes human sleeping sickness. The other trypanosome species of economic importance are *T. evansi* of camel and *T. equiperdum* of horse (Keno, 2005).

The tsetse flies in Ethiopia are confined southern and western regions between longitude 330 and 380 E and latitude 50 and 120 N which amounts to about 200,000 km2. Tsetse infested areas lied in lowlands and in river valley of Abay (Blue Nile), Baro, Akobo, Didessa, Ghibe and Omo. Out of the nine regions of Ethiopia five (Amhara, Benishangul-gumuz, Gambella, Oromia and SNNPR) are infested with more than one species of tsetse flies (Keno, 2005).

Chemotherapy and chemoprophylaxis by trypanocides are the most important aspect of control and eradication of trypanosomes (Peregrine *et al*., 1994). There is no vaccine against the disease and in spite of intensive research none appears likely in the near future because of the ability of trypanosomes to readily change their glycoprotein surface coat through a process called antigenic variation (Radostits, *et al*., 2007).

Trypanosomiasis in cattle, locally referred to as Gendi is a serious constraint to livestock production in areas of south-west Ethiopia at latitude lesser than 1700m above sea level (Chaka and Abebe, 2003).

In Ethiopia, trypanosomiasis was among the factors that hinder livestock production in most settlement areas. Therefore, the objectives of the study were:

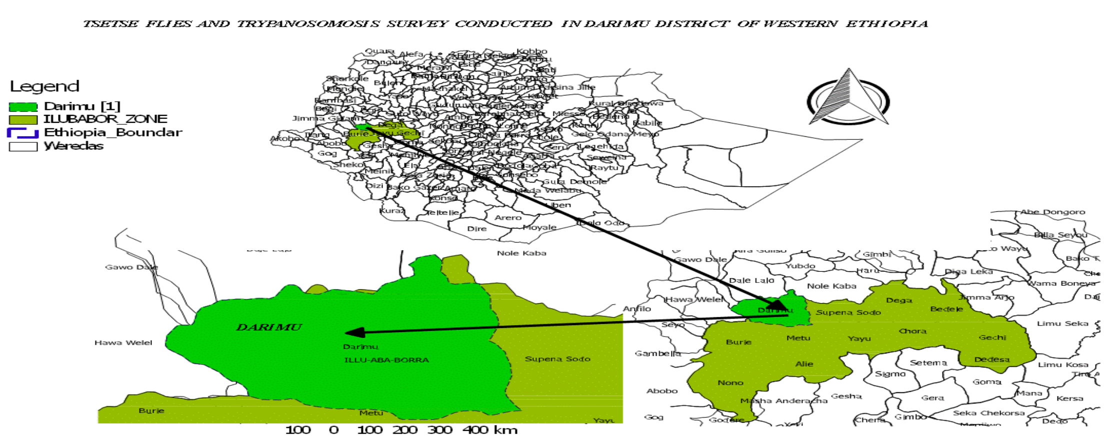
- To determine the prevalence of trypanosomosis and to identify trypanosome species infecting in cattle that found at the study area.
- To determine the associated risk factor of Trypanosomosis.

MATERIALS AND METHODS

Study Area

Darimu is located in IlluAbabora Zone of Oromia regional state, at 664 km from Addis Ababa. Darimu district is located at longitude 035°15°to 035°32°E,latitude of 08°30°-08°44°N north of equator, covering 1387.97 km^2 land with altitudes ranging from 792-1800m.a.s.l..The agro-climate of the area alternates with long summer rainfall (June-September) and winter dry season (December- March). The mean annual rainfall of the district is 1172-1740mm. The annual temperature in Darimu district ranges from 18-25°C. The district is divided into two ecological zones: 46% kola and 54% Woinadega.

The main rivers in Darimu district include Golol, Gurracha, Asas, Geba and many other tributaries that enter the big river, Birbir. There are many river basins and tributaries that flow to Baro Akobo. The distribution of tsetse is connected to with the presence or absence of large game animals' which serve as source of food for the flies and reservoir of Infection for trypanosomes. The areas have got a number of wild animals. The commonly found here are; African buffaloes (*Synceru scaffer*), Bush Pigs (*Potomacherus porcus*), warthog (*Potomacherus aethiopicus*), Bush buck (*Teragelapus scriplus*), lion, kudu, Hippopotamus, crocodiles, hyena, vervet monkey, antelopes, snakes, etc. Many of them serve as reservoirs of infection for trypanosomes. The areas have different vegetation: thickets, wooded grass lands and riparian. The dominant tress in both districts include; *Grewia bicolor, Albizia gummifera, Carissa edulis, Cordia Africana, Phoenix reclinata,Pilostigmathon ningii, Sterreospermum kunthianum, Acacia jacaranda, Juniperus procera, Erhrina abyssinca*, etc.



Study Design

A cross sectional study was conducted from November 2016 to March 2016 to determine the prevalence of trypanosomosis in study animals.

Study Population

The cattle in the district are indigenous African Zebu breeds that are kept under the traditional extensive husbandry systems with communal herding. Agriculture is the main stay of the lively hood of the society with mixed farming system and livestock play an integral role for agriculture. According to Darimu district Agricultural office (2014), the animal population of the district is estimated to be 88,098 cattle, 42,605 sheep, 32,283 goats, 8,914 Equines and 138,115 poultry.

Sample Size Determination and Sampling Methods

Purposively tsetse infested Peasant Association namely, Dede botoro, Bena 1, 2 and 3, Metti Kerebe and Hanna Ifa were selected from the districts while the study animals were selected by using simple random sampling method by taking age, sex, and body conditions in to account according to (De-lahunta and Habel, 1986). Nicholson and Butterworth, 1986) and all the animals in the selected areas had equal chances to be selected for this study. The number of animals required for the study was determined using the formula given by Thrusfield (2005) for simple random sampling. The size of sample size was determined by using 95% confidence level, 7.1% expected prevalence and 0.05 desired absolute precision. Therefore,

$$n = \frac{1.96^2(0.071)\ (1-071)}{0.0025} = 101 \text{ samples}$$

Where: n = required sample size

P_{exp}= expected prevalence

d = desired absolute precision (usually 0.05). Therefore, 101cattle were needed for the study; however a total of 615 animals were sampled to increase the precision.

Study Methods and Procedures

A total of 614 samples were collected during the study period from selected Peasant association by using simple random sampling in each PAs settlement.

Sample collection

Blood samples were collected in to heparinized microhematocrit tubes after puncturing of the ear vein using lancet and then one end of the is sealed by crystal sealant. On the other hand, for entomological survey baited mono pyramidal traps were deployed at 100-200 meters intervals.

Parasitological study

Blood samples were collected randomly from cattle of seven PAs into heparinized microhaematocrit tubes (capillary tubes). After piercing the ear vein using lancet, one end (the heparinized) of capillary tubes sealed with crystal sealant and centrifuged at 12000 rpm for 5 minutes to separate the blood cells and to concentrate trypanosomes using centrifugal forces, as Buffy coat. Then the PCV was calculated using haematocrit reader. The capillary tubes were then broken just below Buffy coat using diamond pen and expressed on microscope slide and covered with a cover slip. Then it was examined under x40 objective of microscope to detect the presence of the parasites using dark background buffy coat technique (Murray, *et al,* 1977). Trypanosome species were identified according to their morphological descriptions as well as movement in wet film preparations provided by (OIE, 2008).

Entomological study

A total of 78 baited different types of traps including Bioconical, Monoconical and mono pyramidal traps, out of which were deployed along suitable tsetse habitat to assess the apparent densities, distributions and species of tsetse flies and other biting flies in involving in transmission of trypanosomosis. All traps were baited with acetone, Octanol (1-3-Octanol) and cow urine filled in separated bottles and deployed at an interval of 100-200 meters. The coordination of each trap was recorded using a GPS. The vegetation type, the prominent feature within 100 meter radius and the canopy of each trap were recorded. After 48 hours of trap deployed time the cages were collected and captured flies were identified and sexed according to morphological characteristics and counted.

Data Analysis

The collected data was entered into Microsoft excel office and transported to statistical analysis soft ware, SPSS versions 20 for the statistical analysis. The prevalence of trypanosome infection was calculated as the number of positive animals as examined by Buffy coat divided by the total number of animals examined at a particular time multiplied by 100. Chi-square(x^2) test was used to determine association between explanatory variables and the prevalence of trypanosomosis. In all analyses confidence level of 95% and p –value of 0.05 was used for statistical test of significance. Finally, the density of fly population was calculated by dividing the number of flies caught by the number of traps deployed and number of days of deployment and expressed as fly/trap/day.

RESULT

Parasitological Findings

Parasitological study were conducted in Seven Peasant association found in Darimu district Namely Dade botoro, wachale, Bena1 , Bena2, Bena3, Metti kerebe and Hanna Ifa. Totally 614 animals blood were sampled for Trypanomosis investigation and Trypanasome species identification. Out of 614 animal 53 of them was Positive for Trypanomosis. Therefore, the overall prevalence of Trypanomosis in the study was 8.6% (53/614). The highest 16.7% (9/54) and the lowest 4.8% (8/167) prevalence were recorded in Metti kerebe and Wachale respectively. There was no statistically significant (P>0.05) variation in prevalence of trypanosomosis among different Peasant association (Table1).

Table1: Prevalence by different Peasant association.

PAs name	Positive	Negative	Total	Prevalence	X^2 (p-value)
Dade botoro	9	87	96	9.4%	
Wachale	8	159	167	4.8%	
Bena 1	10	85	95	10.5%	
Bena 2	8	64	72	11.1%	9.609(0.14)
Bena 3	3	57	60	5.0%	
Metti kerebe	9	45	54	16.7%	
Hanna ifa	9	45	70	8.6%	
Total	53	561	614	8.6%	

T. *congolense* was the most prevalent 71.69 %(38/53) trypanosome species followed by T. *vivax* 22.64 %.(12/53) While Mixed infection of T. *congolense* and T. *vivax were* seen only in three peasant association namely Wachale, bena 2 and Metti karebe. Overall prevalence of mixed infection was 5.6% (3/53) on those three mentioned Peasant association. (Table2).

Table2: Prevalence by different species of trypanosome.

PAs name	Tested Animal	*Trypanosoma congolense,*	*Trypanosoma vivax*	Mixed	Total	Prevalence	Chi square (X^2)
Dade botoro	96	6	3	0	9	9.4%	
Wachale	167	5	2	1	8	4.8%	
Bena 1	95	7	3	0	10	10.5%	17.7
Bena 2	72	5	2	1	8	11.1%	
Bena 3	60	2	1	0	3	5.0%	
Metti kerebe	54	7	1	1	9	16.7%	
Hanna ifa	70	6	0	0	6	8.6%	
Total	614	38	12	3	53	8.6%	

Hematological Findings

The normal PCV value of zebu cattle was 24 to 46 % according to Blood and Radostits (2007) but in this study the mean PCV value of whole examined animals was 23.36% which is below the normal range. The mean PCV value of the infected animals was lower (21.4%) as compared to the mean PCV value of non infected animals (23.5%) and Variation in PCV value and Prevalence of trypanosomosis was statistically significant ($P<0.05$).

Entomological findings

A total of 714 tsetse flies were caught by employing 78 traps during the study period from six different peasant associations. The apparent density of Glossina in the study area was 4.6 (f/t/d). Four tsetse species have been identified. The proportion of G. *fuscipes,* G.*pallidipes,* G.*morsitans* and G. *tachinoides* were (38.14%), (35.09%), (18.31%) and (8.46%) respectively. out of 714 tsetse flies captured, 416(58.26%) flies were females while the rest 298(41.73%) flies were males(Table:3). The apparent density of each Glossina species were (1.8 f/t/d), (1.6 f/t/d), (0.8 f/t/d), and (0.4 f/t/d) for G. *fuscipes,* G.*pallidipes,* G.*morsitans* and G. *tachinoides* respectively. (Table4). From overall the study sites, the highest (10.72 f/t/d) and lowest (0.58 f/t/d) tsetse fly density was recorded in Bena 2 and Wachale respectively.

Table3: Apparent tsetse density in different peasant associations.

PAs	No. Trap	M	F	Total	F/t/d
Dade Botoro	20	92	138	230	5.75
Wacale	19	10	12	22	0.58
Bena 1	10	71	86	157	7.85
Bena 2	9	90	103	193	10.72
Mettikerebe	10	35	76	111	5.53
Hanna Ifa	10		1	1	0.05
Total	78	301	420	714	4.6

Table 4: Apparent density of each Glossina species.

	Dade B.	Wacale	Bena 1	Bena 2	Metti. K	Hanna. I	Total	f/t/d
No. traps	20	19	10	10	9	10	78	
Gp		2	105	70	76	1	253	1.6
Gm	1			96	34		132	0.8
Gf	193	13	44	24	1		275	1.76
Gt	36	7	8				54	0.4
Total	230	22	157	193	111	1	714	4.6
f/t/d	5.8	0.58	7.85	10.72	5.5	0.05	4.6	4.6

Gm=Glossina morsitans submorsitans, Gp=Glossina pallidipes, Gt=Glossina tachinoides, Gf= Glossina fuscipes.

Prevalence according to Age, Sex, and Body conditions

The prevalence of trypanosomosis was higher in Female (9.1%) as compared to Male (7.9%) animals. However, the difference was not statistically significant (P> 0.05). The highest prevalence was observed in the Old animals greater than five years old (11.0%) and the variation in prevalence between the different age group was not statistically significant (P> 0.05). Statistically significant variation was observed in the prevalence of trypanosomosis (P<0.05) among those animals with different body condition and The highest prevalence was observed in the animals with poor body condition (11.5%).

Table5: Prevalence according to host risk factor.

Variable	No Of Animal	Positive	Prevalence	x^2 (P-Value)
Sex				
Male	253	20	7.9%	0.29(0.59)
Female	361	33	9.1%	
Age				
<2 year	117	10	8.5%	1.99(0.37)
2 ≤ 5 year	315	23	7.3%	
>5 year	182	20	11.0%	
Body Condition				
Good	94	40	11.5%	8.24(0.016)
Medium	171	8	4.7%	
Poor	349	5	5.3%	

DISCUSSION

The overall Trypanosomosis prevalence in Darimu district was 8.6% and the Present study finding was lower relative to previous research work in study area reports such as the average seasonal incidence of trypanosome by Mulgeta *et al*.,(2013) 21.66%, 10%, 13.79% and 17.24% during the late rainy, dry, early and wet seasons, respectively for Birbir and Baro valies of Ethiopia. Again higher prevalence report 12.41% were recorded in other country part of Ethiopia by Solomon and Fita(2010) in the Metekel and Awi zones of northwest Ethiopia; 23.0% in Daremello district, southwestern Ethiopia by Ayele, *et al*., (2012) and 7.1% in selected peasant associations of Darimu district Fedesa., *et al*. (2015);9.1% and 15.1% in Mada Talila and Gudina Wacho Kebeles of Hewa Gelan, Western Ethiopia Fentahun, *et al*., (2012)

Thus the study revealed that the result is lower than the average seasonal incidence of trypanosome reported by Mulugeta, *et al*., (2013) to be 21.66, 10, 13.79 and 17.24% during the late rainy, dry, early and wet seasons, respectively for Birbir and Baro valies of Ethiopia.

The lower prevalence of trypanosomosis in this study might be related to low tsetse distribution and low fly–animal contact in the area due to the ongoing parasite and vector control programs practiced in the area by NTTICC. However the result indicates that trypanosomes are still of much concern and represent a major obstacle to livestock production in the study area.

T. congolense was the predominate species 71.69% in the study areas as compared to other species of trypanosomes. This is in agreement with the previous results of Mulugeta, *et al*., (2013) for Birbir and Baro valies of Ethiopia (65.6%); NTTICC (2003) Frat Adanhegn peasant association 62.5%; Fedesa., *et al*., (2015). In selected Darimu district peasant association 82.61%. Rowland et al. (1993) in Ghibe valley, south west Ethiopia 84% had also shown higher results of *T. congolense*. It was found that in most cases the prevalence of *T. congolense* in cattle was higher than *T. vivax* when specific tsetse areas were considered separately because, sometimes investigations were made after the cattle were treated with trypanocidal drugs such as Diminazene aceturate. After such treatments *T. congolense* predominates over *T. v*ivax in prevalence.

According to Getachew (2005), *T. congolense* and *T. vivax* are the most prevalent trypanosomes that infect cattle in tsetse infested and tsetse free areas of the Ethiopia respectively. These suggest that the major cyclical vectors or Glossina species are more efficiently transmitters of *T. congolense* than *T. vivax* in east Africa (Langridge, 1976). Host's reaction to *T. vivax* may be more adverse than to *T. congolense* because *T. congolense* is more virulent to cattle than *T. v*ivax Fedesa., *et al*. (2015).

The prevalence of bovine trypanosomosis was studied according to sex of cattle and significant variation was not observed (P > 0.05). This might be because of an equal chance of exposure to the parasite. This result is in agreement with the previous researches reported by (Bekele and Nasir. 2011; Fedesa, *et al*. 2015). In the present study sex was not found to be the risk factor. This might be due to the fact that both sexes have virtually similar exposure to flies in grazing areas.

There was higher prevalence of the disease 11.0% in older animals >5 years as compared to those in younger 8.5% less than 2 years old and adult 7.3% 2≤5 years old. The difference observed in the prevalence of trypanosomosis among the age group was not statistically significant (P>0.05). In addition, Rowlands, *et al*., (1995) in Ghibe valley indicated that suckling calves are not allowed to go out with their dams until they are weaned off. Young animals are also naturally protected to some extent by maternal antibodies (Fimmen, *et al*., 1999). This could result in low prevalence of trypanosome that was observed in calves

The trypanosome infection in those animals with poor body condition were significantly higher (P<0.05) than those in good body condition. On one hand, the disease itself results in progressive emaciation of the infected animals; nevertheless, on the other hand non–infected animals under good body condition are with good immune status that can respond to any foreign protein better than those non–infected cattle with poor body condition which can be immune compromised due to other diseases or malnutrition, since malnutrition and concurrent infections depress the immune responsiveness in some cases (Collins, 1994).

The mean PCV value of the infected animals was found to be significantly lower 21.4% as compared to the mean PCV value of non infected animals 23.5%, which is similar to the results obtained by Habtamu *et al* (2014), SVRL (2006) and Chernet, *et al.*, (2006). Taking the PCV value 24 to 46% as normal for zebu cattle (Blood and Radostits, 2007), 73.6% of the parasitemic and 57.2% aparasitemic animals have registered PCV values less than 24%. These factors are likely risks for both parasitaemic and non parasitaemic animals. Therefore the difference in mean PCV value between parasitemic and aparasitemic animals indicates that trypanosomosis is involved in reducing the PCV values in the infected animals This suggest that even though anemia is characteristic of trypanosomosis, other factors can also cause reduced PCV yet some trypanosome infected animals can also keep their PCV within the normal range for a certain period of time. So, while diagnosing trypanosomosis on the basis of PCV, one should take various anaemia causing agents into consideration.

Conclusions and Recommendations

The study revealed that *T. congolense, and T. vivax* were the prevailing species of trypanosomes in the study area. In relation to the host risk factors, the prevalence of bovine trypanosomosis was highest in those animals with poor body condition. Finally, bovine trypanosomosis is an important disease and a potential threat affecting the health and productivity of cattle in the district. Hence, the necessary attention should be given to this disease so as to improve livestock production and agricultural development in the area.

Competing Interests

The authors declare that they have no competing interests.

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