

Prevalence of Bovine Trypanosomosis, and it's Associated Risk Factors in Abaya District, Borena Zone, Ethiopia

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Abstract: A cross sectional study was conducted in Dibicha, Gololcha and Ledo districts of Abaya district Borena Zone of Southern Ethiopia to determine the prevalence and associated risk factors of bovine trypanosomosis using parasitological and entomological study from December, 2014 to March, 2015. Blood samples from randomly selected 385 cattle of both sex and different age groups were collected and examined with conventional hematological and parasitological techniques. Out of the total examined cattle, 14(3.7%) were infected with trypanosomes. Most of the infections were due to *Trypanosoma congolense* (2.6%) followed by *Trypanosoma vivax* (1.1%) and no mixed (0%) infections detected. More 2.9% prevalence of the disease was recorded in females. There were no statistically significant difference among age and sex groups ($p>0.05$). The overall mean PCV values were significantly different between aparasitaemic and parasitaemic animals with ($P<0.05$). *Glossina pallidipes* were caught during the study period and the entomological monitoring showed that the apparent density of *Glossina Pallidipes* in the study area were 0.016fly/trap/day, 0.46fly/trap/day, 0.02fly/trap/day, at Gololcha, Dibicha, and Ledo PAS respectively with the overall apparent density of 0.5 F/T/D. The study revealed that trypanosomosis is the main constraint to livestock production and agricultural activity in Abaya districts. Hence, creation of the awareness to the arable and pastoral communities with the relation of parasite and vector and their impact on livestock production and implementation of integrated tsetse and trypanosome control measures will save greater economic loss of the region in particular and the country in general.

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Introduction

Trypanosomosis, an important protozoan disease caused by the genus *Trypanosoma* transmitted through bites by different species of *Glossina* and mechanically by a number of biting flies such as *Tabanus* and *Stomoxys* spp. It is a serious disease in domestic livestock that causes a significant negative impact in food production and economic growth of many part of the world, particularly in Sub-Saharan Africa (Tesfaye, 2002). Tsetse-transmitted Trypanosomosis is one of the most important constraints to agricultural development in the sub-humid and humid zones of Africa. The rural community, which occupies 70% of the human population in Africa, has suffered severely from animal and human diseases transmitted by tsetse fly. Trypanosomosis is also among the well-known constraints to livestock production in Africa as it causes 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 (Awoke, 2000; Vreysen, 2006).

The 31 species of tsetse flies that invade one-third of Africa through the Trypanosomes, hence they transmit to humans and animals and darken the public health and agriculture sector in 38 African countries via exposing 160 million cattle for the risk of anemia, emaciation and death. Not only had these but also exposed 60 million people to the risk of sleeping sickness (Jordan, 1996).

In Ethiopia, Trypanosomosis is wide spread in domestic livestock in the Western, South and South-western lowland regions and the associated river systems (i.e. Abay, Ghibe Omo and Baro/Akobo). About 220,000 Km² of this regions are infested with five species of tsetse flies namely *Glossina pallidipes*, *G. morsitans*, *G. fuscipes*, *G. tachinoides* and *G. longipennis* (MoA, 1995; Abebe, 2005). Economically the tsetse transmitted trypanosomes (*T. congolense*, *T. vivax*, and *T. brucei*) are most important in cattle with 14 million heads at risk in Ethiopia (Upadhaya, 2005).

Trypanosomosis is one of the most livestock problems in Abaya district. For the district inhabitants, it is potentially productive place for agricultural activities and rearing livestock but the district is

infested with tsetse flies. As a result, the people suffer from low level of draught power and productivity that compromise the socio-economic and nutritional status of inhabitants. Thus, knowing the current status of trypanosomosis and its vectors are crucial to integrate all efforts towards combating the disease and reducing economic losses. Even though this is so, there is scant report from Southern tsetse belt of the country as it is constrained by in adequate study and accessibility where experts, resources and facilities are largely accumulated. Thus, Understanding the distribution of vectors in relation to the trypanosomosis status in tsetse endemic area of the Southern oromiya region of Ethiopia is important to integrate control strategies in the future.

Therefore, the objectives of the study were:

- ❖ To determine the prevalence of bovine trypanosomosis and its associated risk factors.
- ❖ To determine the species and relative distribution of vectors of Trypanosomosis in Abaya district.

Materials And Methods

Study Area

The study was carried out from December, 2014 to March, 2015 on the prevalence and associated risk factors bovine trypanosomosis in Abaya district PAs namely: Dibicha, Gololcha and Ledo of Borena zone of Oromia Regional state. The area is located at about 373 km south east of Addis Ababa. The area lies between 06°11' 56" - 06°25'06"Latitude(N) and 38°06'00"Longitude (E) in the southern rift valley of Ethiopia, 373km south of Addis Ababa. It has bimodal rain fall pattern, with annual average rain fall of 700-1200mm; daily mean temperature ranges 27°C and the area is covered with the forest, wood grass land, bush land (ADBOA, 2014).

Study population

Study animals were zebu cattle kept under extensive traditional husbandry condition. The animals graze the communally owned pasture land throughout the year. They are managed under the same agro-ecology without any additional supplementary feedings. Most of the migratory herds exposed to tsetse fly causing trypanosomosis on the low lands of river banks and near to lake abaya where there is grazing land and water abundant (AHC,2010).

In the study area live stock population has bovine 151158 , ovine 25400, caprine 64900 , equine 13800 and 121,000 poultry and bee hives of 95,601 and large amount of wild animals (ADBOA, 2014)

Study design

Cross-sectional study was conducted to determine the prevalence of bovine trypanosomosis and associated risk factors of the disease. The methods used in this study include entomological and

parasitological study to assess the prevalence and associated risk factors.

Sample size determination

Sample sizes were calculated using Thrustfield formula 1995.

$$N = \frac{1.96^2 [p_{exp} - (1 - P_{exp})]}{d^2}$$

Where N is the required sample size, P exp is the expected prevalence and d is the desired absolute precision. An expected prevalence of the given study area was 4.46% so; considering a 5% absolute precision and at 95% confidence level gave us 70 sample sizes; however this number cannot represent the animal population of the study area, so multiplying the above sample size five times a total of 385 animals were sampled to increase precision.

Study method and sample collection

Parasitological study

The sampling method applied were simple random sampling for the examined animals and purposive method for districts and kebeles depend on livestock population and infestation of parasite. Blood was taken from each animal into heparinized hematocrit tubes from the cattle ear vein after piercing the ear vein using lancet. Then, the tube was sealed and heparinized capillary tube containing blood was centrifuged for 5 minutes at 12,000 revolutions per minute. After the centrifugation, tubes were then placed in hematocrit reader and recorded for each sample. Then, the readings were expressed as a percentage of packed red cells to the total volume of whole blood. Animals with PCV < 25% were considered to be anemic. Trypanosomes were usually found in or just above Buffy coat layer. So, capillary tube was cut using a diamond tipped pen 1 mm below the Buffy coat to include the upper most layers of the red blood cells and 3 mm above to include the plasma. The content of the capillary tube was expressed on to slide, homogenized on to a clean glass slide and covered with cover slip. The slide was examined under 40x objective and 10x eye pieces for the movement of parasite (Paris *et al.*, 1982).

Entomological study

During the study 50 baited traps were deployed along livestock grazing areas, watering points, wild game reserve areas of Woody grass land and Bush land areas of the Districts. Out of 50 traps, 20 were deployed in Gololcha, 20 were deployed in Ledo and 10 were deployed in Dibicha PAs. NGU- traps were baited with acetone or cow urine where each deployed at an interval of about 100-200 meters along riparian vegetation to assess the fly density. The underneath of each trap pole was smeared with grease in order to prevent the ants climbing up the pole towards the collecting cage that could damage the tsetse flies and the area was located by Global Positioning System.

The trap deployment time was 72 hours. After the flies captured in the collecting cage, they were then sorted by sex, species and sites. In *Glossina pallidipes* the last two tarsal segments of the hind leg has dark color, all tarsal segments of the front leg had pale colour. Tsetse flies were identified as male or female by examining the posterior end side of the abdomen (hypopygium) at the posterior end in male but not in the female flies (Bright well *et al.*, 1992). The coordinates of each trap position were recorded. The Species of tsetse were identified based on the characteristic morphology and were also separated according to their morphological characteristics such as size, color, proboscis and wing venation structures at genus level (Fisher and San, 1989; Bekele *et al.*, 2008).

Data Management and Analysis

Entomological data collected for vector fly, parasitological data for trypanosome infection study, data collected for risk factors for prevalence of bovine trypanosomosis and that collected from cattle for body

condition, sex, age, and PCV level was entered in to Ms excel spread sheet program to create data base. For the analysis of data statistical software program (SPSSV20) was used. In all cases differences between parameters were tested for significance at probability levels of 0.05. From different sites on tsetse (tsetse species, count) was used to analyze flies trapped per trap per day.

Results

Parasitological findings

The overall prevalence of bovine trypanosomosis in the study area was 3.7%. The prevalence of bovine trypanosomosis in the three PAs was determined, among those three PAs, Gololcha showed the highest prevalence rate 1.8% but the lowest being in Ledo PAs with the prevalence rate of 0.8%. Table 3 summarized the prevalence of bovine trypanosomosis and the corresponding infection rate in three selected PAs in the study area.

Table 1. The prevalence of bovine trypanosomosis in the three PAs of Abaya districts

Study Site(PAs)	Total	Prevalence rate (%)	X ²	P-value	Odd ratio (B)	95% (C.I)
Dibicha	127	1.1	0.48	0.00	0.775	0.170-3.537
Gololcha	136	1.8		0.74	0.117	0.117-1.838
Ledo	122	0.8		0.27		
Total	385	3.7				

Prevalence of trypanosomosis was varies within the species. *T. congolense* was found to be more prevalent at study area.

Table 4: Species of trypanosome and their prevalence at four PAs of Abaya districts

Pas	No of animal Examined	Species of parasite and its prevalence per kebele			
		T.Vivax(%)	T.Congolense(%)	Mixed	Prevalence rate (%)
Dibicha	127	1(0.3)	3(0.8)	0	1.1
Gololcha	136	3(0.8)	4(1.0)	0	1.8
Ledo	122	0(0.0)	4(0.8)	0	0.8
Total	385	4(1.1)	10(2.6)	0	3.7

Note: (T. =*Trypanosoma*, Mixed=*T.vivax* and *T.congolens* per microscopic field)

Prevalence Bovine Trypanosomosis in Association to Risk Factors

The assumed risk factors were analyzed against trypanosome prevalence. Accordingly, PCV, age, sex, Trypanosome species, PAs, and body condition score were observed. Among those PCV showed statistical significant difference in disease distribution (P < 0.05).

Of the total animals examined, 1(0.3%), 11(2.9%) and 2(0.5%) prevalence was observed in good, medium and poor body condition respectively. From total animals examined of both sex the prevalence rate of infection in female and male were 2.9% and 0.8% respectively (Table 5).

Entomological findings

In all study sites a total of 50 baited traps were deployed early in the morning and maintained in position at three different peasant associations (PAs) for 72 hrs. The cages from these traps were emptied. Caught tsetse flies were counted, identified and sexed according to their morphological characteristics such as size, color, wing venation structure and proboscis at the genus level. A total of 57 tsetse flies were trapped during the study period and all of them were *Glossina pallidipes*. The apparent densities of *G. pallidipes* in the three PAS of the study area were 0.46F/T/D Dibicha, 0.02F/T/D Ledo and 0.016F/T/D Gololcha PAS recorded. A total of 57 tsetse flies caught during

the study period were subjected for sexing. Accordingly, 33.3% (19/57) males and 66.6% (38/57)

were females. In each PAs female tsetse flies were trapped than males (Table 6).

Table 5: Prevalence rate of bovine trypanosomosis on the basis of age, body condition and sex of the animal at study site

Variables	Category	Total examined animals	Prevalence N (%)	X ²	P- value	Odd ratio (B)	95 % (C.I)
Sex	Male	144	3(0.8)	0.2	0.22	0.44	0.12-1.62
	Female	241	11(2.9)				
BCS	Good	37	1(0.3)	0.9	0.94	1.14	0.10-13.05
	Medium	283	11(2.9)				
	Poor	65	2(0.5)				
Age	≤2	103	6(1.6)	0.5	0.17	2.11	0.72-6.26
	>2	282	8(2.1)				
PCV	<25	154	13(3.4)	0.0	0.03	21.2	2.74-16.85
	≥25	231	1(0.3)				

Table 6: Distribution, Sex identification and apparent density of tsetse flies trapped from the study area in Abaya districts, southern Ethiopia.

Study Site	No of traps deployed	Vegetation Type		Tsetse Flies Caught				A.D(F/T/D)
		WGL	BUL	Species	Male	Female	Total	
Gololcha	20	20	0	G.P	5	13	18	0.016
Dibicha	10	5	5	»	5	9	14	0.46
Ledo	20	12	8	»	9	16	25	0.02
Total	50	37	13	»	19	38	57	0.5

Note: A.D=Apparent density (fly per trap per day), WGL=Grass Land, BUL=Bush Land, G.P=*Glossina Pallidipes*

Discussion

The present study revealed that from a total of 385 randomly selected cattle in study area, 14(3.6%) of them were positive for trypanosome, of which 4(1%) in Dibicha, 7(1.8%) in Gololcha and 3(0.8%) in Ledo was recorded. Generally, more prevalence of the disease was found in place where highest tsetse fly density is present (Table-6). This result is agreement with previous result obtained by (Girma *et al.*, 2014) who reported that both the apparent density and prevalence of trypanosomes are positively correlated and (Soud, 2008), who reported that both the apparent density and prevalence of trypanosomes are positively correlated.

The apparent density of *G. pallidipes* in the three PAS of the study area was 0.46F/T/D Dibicha, 0.02F/T/D Ledo and 0.016F/T/D Gololcha PAS were recorded with the overall density of 0.5 F/T/D. This result is also agreement with the study of Muturi *et al.* (2000) who reported about 1.4 flies/trap/day in the southern rift valley of Ethiopia and the apparent tsetse fly density obtained in the study was 0.3125 and 29.625 flies/trap/day in Fura and Eligo village, respectively.

This study revealed 3.7% trypanosome infection which is lower when compared to that of 8.2% at Eastern Gojam Adane, (1995) and 16.9% in western Ethiopia Siyum *et al.*, (2014) they justify that high prevalence of the disease is due to high vector density

in the study areas. The possible suggestions disagreement of current study might be frequent controlling intervention of tsetse fly by Southern tsetse eradication project (STEP). The project applies variety of tsetse fly control methods, such as 1% deltamethrin pour on, traps insecticide impregnated targets ground spraying and air plane spray which significantly reduces the prevalence of disease in the study area. Another possible reason for the low prevalence of the disease might be the prophylactic treatments with trypanocidal drugs, which obviously mask the epidemiological situation of the disease; it appeared that farmers treat their animals often themselves with drugs that are freely available on the market.

In the current study the species of trypanosome, the higher (2.6%) *T. congolense* and lower (1.1%) *T. vivax* was recorded. This is relatively agreement with (Sinshaw *et al.*, 2006) indicated a prevalence of trypanosomosis ranging from 4% to 9.6% due to *T. vivax* in the three highland districts bordering Lake Tana. This prevalence of *T. congolense* infection in cattle may be due to high number of serodemes (serological variation) of *T. congolense* as compared with *T. vivax* and the development of better immune response to *T. vivax* by infected animal (Sinshaw *et al.*, 2006). Moreover Muturi *et al.*, (2000) who reported 66.86% *T. congolense* and 20.75% *T. vivax* infection, respectively. Furthermore, *T. congolense*

was dominant species with a proportion of (69.7%) and followed by *T. vivax* (19.2%), *T. brucei* (9.1%) and *T. vivax* and *T. congolense* mixed infection (2.0%) in western Ethiopia (Siyum *et al.*, 2014).

The present results showed that most of the parasitemic animals 13(96.4%) were found to be anemic with (PCV<25%) compared with aparasitemic animals 1(3.6%) with (PCV> 25%). This finding was agrees with the works of Yibrah ,(2012) who reported lower PCV of (20.2%±3.0) in infected animals as compared to non-infected animals (26.5%±5.1) from Humbo districts of Southern Ethiopia. Likewise (Thrust field., 1995) stated that average PCV of parasitologically negative animals was significantly higher than those of parasitologically positive animals. Therefore, trypanosomosis may adversely lowering PCV value of infected animals even though other diseases such as helminthosis, thick borne disease and nutritional imbalances contribute to the low PCV values.

During the study period, the prevalence of bovine trypanosomosis was assessed between sexes of animals and among 14 trypanosome positive animals; 11(2.9%) of them were female animals and 3(0.8%) of them were male animals; but not statistically significance difference and the possible suggestion an increases of prevalence in females in this finding could be that female animals are used for milking purposes, travel long distances to an area of tsetse challenge for grazing thus, stressed by tsetse flies and by other biting flies and because of shortage of feed, female animals in study area were allowed to graze together with males.. As a result, the risk of contracting trypanosomosis is high. This result is agreement with previous results of (Muturi, 1999; Leak., 1999; Getachew, 1993; Adane., 1995; Daya and Abebe., 2008; Tefera., 1994) who obtained no significant difference in susceptibility between the two sexes. Therefore, they have equal chance of coming in contact with flies and eventually with the disease. In contrast (Muturi, 1999) reported that males had a significant higher prevalence of trypanosomosis than females.

During the study the prevalence of bovine trypanosomosis was assessed in three different body conditions (poor, medium and good). Animals' shows the highest prevalence in medium body condition (2.9%) followed by poor (0.5) and good body condition (0.3%). Due to poor body condition; animals are highly susceptible to diseases. This result is slightly consistent with the report made by (Basazinew *et al.*,2012) in which they reported 55.7%, 6.7% and 0 prevalence in poor, medium and good body condition score respectively.

The animals examined were categorized in two age groups as young (less than or equal 2years old)

and adults (greater than 2 years old). The trypanosome infection prevalence was found to be 1.6% in the young age group and 2.1% in the adult animals as indicated in (Table 4). However, statistically there is no significant difference in infection rate among the different age groups ($p>0.05$). These results agree with that of (Dagnachew and Shibeshi; 2006) as a higher prevalence was observed in adult animals (>2 years) and but lower in animals 2years of age. This could be associated to animals with the different body conditions, age, sex and distance travel for grazing as well as for draught in areas of high tsetse challenge. This is in agreement Fimmen *et al.*, (1992) who stated that calves and young animals have low prevalence.

In this study there is no marked variation in tsetse density between sampled PAS. From the study of Leak *et al.*, (1987) it is known that the variation in tsetse density appeared to be the main factor for variation in the prevalence of trypanosomosis. The possible reasons for this may be the prophylactic treatment of cattle by Southern rift valley tsetse eradication project (STEP). Regarding the sex composition of the flies, female flies constitute 66.6% and male flies constitute only 33.3% so, this was in agreement with (Siyum *et al.*, 2014; Msangi, 1999 and Teka *et al.*, 2012) who reported female flies to comprise majority of the population.

Conclusion And Recommendations

Trypanosomosis is most important constraint for livestock production of the study area. The results of the present study revealed that the existence of *T. congolense* and *T.vivax*, were responsible for bovine trypanosomosis in study area. The occurrence of trypanosomosis was mainly associated to the tsetse flies namely *G. Pallidipes*. The prevalence of the disease and the catch of tsetse fly in all cases showed the seriousness of the problem for the livestock production and productivity unless the eradication program is strengthened in the future. Trypanosomosis is still the major constraint in the area, although different control measures were applied by Southern rift valley Tsetse Eradication Project (STEP). Situation is getting worse because of the movement of the infected animals and the control and prevention of trypanosomosis is facing a challenge due to the lack of the awareness of the arable and pastoral community about the parasite, vector and their impact on livestock production and drug resistance. Therefore, a progressive control campaign should be aimed at reducing the burden of tsetse fly to minimize the impact of trypanosomosis.

Therefore, based on the above conclusion, the following recommendations were forwarded:

❖ All available, acceptable and conventional technologies should be used effectively to control and eradicate the parasite and vector.

❖ Creation of the awareness to the arable and pastoral communities with the relation of parasite and vector and their impact on livestock production.

❖ Extension service implemented by MoARD should have to incorporate participatory packages on public awareness creation in the control of tsetse flies and trypanosomosis.

❖ Laboratory facility and skilled veterinary professionals should be fulfilled in the clinic to avoid tentative diagnosis which is a challenge for drug resistance.

❖ The survey of tsetse flies and trypanosomosis done by STEP should be continued to challenge the intervention prematurely.

❖ Restriction of the movement of the infected animals (migratory animals) and the effective campaign against parasite control.

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References

1. Tesfaye, M. (2002): Report of Trypanosome infection rate in *G. m. morsitans* and *G. tachninoidea* in Didessa Valley from July 29 to Sept.26/2002. Bedele, Ethiopia.
2. Awoke, K. (2000): Study of Trypanosomosis and its Vectors in Humbo and Mereb Districts. *Ethiop. Vet. J.*, 4(1): 61-63.
3. Vreysen, M.J.B. (2006): Prospects for area-wide integrated control of tsetse flies of (Diptera: Glossinidae) and trypanosomosis in sub-Saharan Africa. *Revista de la Sociedad Entomológica Argentina*.65:1-21.
4. Jordan, A. M. (1996): Trypanosomiasis Control and Africa development, O.D.S University of Bristol, Tsetse res. Lab, Bristol.13-19.
5. MoA (1995): Federal Democratic Republic of Ethiopia, Ruminant livestock development strategy, Addis Ababa.
6. Abebe, G. and Jobre, Y. (1996): A threat to cattle production in Ethiopia. *Rev. Med. Vet.*, 147: 896-902.
7. Upadhyaya, A. (2005): Text of preventive Veterinary Medicine 1sted., International book distributing co. (publishing Division), Army printing press, 33 Nuhru Road, saddart cont. Lucknow 226002.
8. ADBOA, (2014): Abaya district bureau of agriculture. Annual report, pp: 5-20.
9. AHC, (2010): Abaya woreda Animal health clinic, pp: 11-25.
10. Thrufield, M. (1995): Veterinary Epidemiology, 3rd ed. Black well publishing, Garsington road, Oxford, UK, pp: 233-250.
11. Paris, J., Murray, M and Mcodimba, F. (1982): A comparative evaluation of the parasitological technique available for the diagnosis of Trypanosomosis in Cattle. *Acta Trop*, 39: 1-11.
12. Bright well, R., Dransfield, R.D., Korku, C.A., Golder, T.K., Tarimo, S.A and Mugnai, D. (1992): A new trap for Glossina pallidipes. *Trop. pes.t manag.* 33: 151-159.
13. Fisher, M.S and San, D.R.R. (1989): Manual of tropical veterinary phraseology. 1st ed. UK: C.A.B.I. Pp.181-278.
14. Bekele, J., Asmare, K and Abebe, G. (2008): Evaluation of deltamethrin applications in control of tsetse and trypanosomosis in southern rift valley of Ethiopia. *Ethiopian veterinary journal* 129:1-9.
15. Girma *et al.*, 2014.
16. Soud, M. 2008. Efficacy of deltamethrin treated cattle on the control of tsetse and Trypanosomosis at Genta Murchie village, Gamo Gofa district of SNNPR. DVM Thesis, Mekelle University, Mekelle, Ethiopia., pp: 14.
17. Muturi, K.S., S. Msangi, S. Munstermann, P. Clausen, A. Getachew, T. Getachew, B. Bergeine and M. Assefa, 2000. Trypanosomosis risk assessment in selected sites of the southern rift valley of Ethiopia. In: International Scientific Council for Trypanosomosis Research and Control (ISCTRC). Proceedings of the 25th meeting held in Mombassa, Kenya. OAU/STRC Publication, pp: 120.
18. Adane, M., (1995). Survey on the prevalence of bovine trypanosomosis in and around Bahir Dar. DVM Thesis, AAU, FVM, Debre Zeit, Ethiopia.
19. *Siyum Getachew, Tadele Kabeta, Zelalem Abera and Benti Deressa 2014*. Epidemiological Survey of Bovine Trypanosomosis in Sayo District of Kellem Wollega Zone, Western Ethiopia *Am-Euras. J. Sci. Res.*, 9 (3): 67-75.
20. Sinshaw, A., (2006) G. Abebe, Desquesnes and W. Yoni. Biting flies and *Trypanosoma vivax* infection in three highland districts bordering Lake Tana, Ethiopia. *Vet. Parasitol.*, 142: 35-46.
21. Yibrah T., 2012. Prevalence Of Bovine trypanosomosis in Tsetse Controlled and Uncontrolled Areas Of Eastern Wollega, Southern Agricultural Research Institute, Hawassa, Ethiopia. P. O. Box. 1445.
22. Muturi, K.S. (1999): Epidemiology of bovine trypanosomosis in selected sites of Southern Rift

- valley of Ethiopia, MSc thesis, Faculty of veterinary medicine, Addis Ababa University.
23. Leak, S.G.A. (1999): Tsetse Biology and Ecology: Their role in the epidemiology and control of trypanosomosis. CABI Publishing in association with the ILRI, pp: 152-210.
 24. Getachew, T., (1993). Prevalence of bovine trypanosomosis in two districts of western Gojjam province. DVM Thesis AAU, FVM, Debre Zeit, Ethiopia.
 25. Daya, T. and G. Abebe, (2008). Seasonal Dynamics of Tsetse and Trypanosomosis in selected sites of Southern Nation, Nationalities and Peoples regional State, Ethiopia. *Ethiop. Vet J.*, 12(2): 77-92.
 26. Tefera, 1994). Prevalence of bovine trypanosomosis in Arba Minch districts. DVM Thesis. AAU, FVM, Debre Zeit, Ethiopia.
 27. Basaznew, (2012). Ch. Mersha and Chemirew Arega. Hematopathology and Hematological Paramet Alterations in Indigenous Cattle Due to Trypanosomosis. *Global Veterinaria*, 9(5): 546-551.
 28. Dagnachew, S. and S. Shibeshi, 2006. Prevalence and vector distributions of bovine trypanosomosis in control (Sibu Sire) and non-control (Guto Gida) districts bordering upper Anger valley in East Wollega Zone, Western Ethiopia. *Ethiopian Veterinary Journal*, 15: 77-86.
 29. Fimmen, (1992). H.O., D. Mehlitz, F. Horchiner and E. Korb. Colostral antibodies and *Trypanosoma congolense* infection in calves. Trypanotolerance research and application. GTZ, No.116, Germany, pp: 173-187.
 30. Leak, (1987). S.K.A., K.A. Woume, C. Collardelle, W. Duffera, A. Feron, M. Mulingo, G. Tikubet, M. Toure and G. Yangari,. Determination of tsetse challenge and its relationship with trypanosomosis prevalence. Livestock production in tsetse infested areas of Africa, ATLN and Nairobi, Kenya, pp:43-52.
 31. Msangi, S., 1999. Distribution, density and infection rates of tsetse in selected sites of Southern Rift valley.
 32. Teka, Dechasa Terefe² and Anteneh Wondimu (2012). Prevalence study of bovine trypanosomosis and tsetse density in selected villages of Arbaminch Ethiopia Department of Veterinary Epidemiology, College of Veterinary Medicine, Microbiology and Public Health Haramaya University, Ethiopia. Department of Parasitology and Pathology, College of Veterinary Medicine, Haramaya University, Ethiopia. Department of Clinical Studies, College of Veterinary Medicine, Haramaya University, Ethiopia. Pp.39.

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