Global Journal of Medical Research: G
Veterinary Science and Veterinary Medicine
Volume 14 Issue 2 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Prevalence of Bovine Trypanasomosis in Guto Gida District of East Wollega Zone, Oromia Regional State, Ethiopia

By Dano Takile, Benti Deresa & Mukarim Abdurahaman
Jimma University, Ethiopia

Abstract- A cross sectional study was carried out to determine the prevalence of bovine trypanosomosis in five peasant associations of Guto Gida District of East Wollega Zone, Ethiopia from October 2013 to March 2014. From five peasant association, 384 cattle were randomly selected and examined for trypanosomosis. The overall prevalence of bovine trypanosomosis was 7.81% of which Trypanosoma congolense infection was 53.33%, Trypanosoma vivax infection was 30% and Trypanosoma brucei was 16.66% with statistically significant difference (P=0.00). A significant association was observed (P<0.05) between the disease positivity and body condition score. When the mean packed cell volume of trypanosome infected animals was compared with that of non- infected animals, it was significantly lower (P<0.05) in the infected animals. In conclusion, trypanosomosis caused by T. congolense, T. vivax and T.brucei with more prevalence of T. congolense remained the main constraint to animal production and agricultural development in study area.

Keywords: *bovine, guto gida, PCV, prevalence, trypanosome.*

GJMR-G Classification : *NLMC Code: WA 360*

Strictly as per the compliance and regulations of:

Prevalence of Bovine Trypanasomosis in Guto Gida District of East Wollega Zone, Oromia Regional State, Ethiopia

Dano Takile [α], Benti Deresa [σ] & Mukarim Abdurahaman [ρ]

Abstract- A cross sectional study was carried out to determine the prevalence of bovine trypanosomosis in five peasant associations of Guto Gida District of East Wollega Zone, Ethiopia from October 2013 to March 2014. From five peasant association, 384 cattle were randomly selected and examined for trypanosomosis. The overall prevalence of bovine trypanosomosis was 7.81% of which *Trypanosoma congolense* infection was 53.33%, *Trypanosoma vivax* infection was 30% and *Trypanosoma brucei* was 16.66% with statistically significant difference (P=0.00). A significant association was observed (P<0.05) between the disease positivity and body condition score. When the mean packed cell volume of trypanosome infected animals was compared with that of non- infected animals, it was significantly lower (P<0.05) in the infected animals. In conclusion, trypanosomosis caused by *T. congolense, T. vivax and T.brucei* with more prevalence of *T. congolense* remained the main constraint to animal production and agricultural development in study area.

Keywords: bovine, guto gida, PCV, prevalence, trypanosome.

I. Introduction

African animal trypanasomiasis (AAT) is a parasitic disease that causes serious economic losses in livestock from anemia, loss of condition and emaciation. Many untreated cases are fatal. AAT is found mainly in those regions of Africa where its biological vector (tsetse fly) exists (CFSPH, 2009). Bovine trypanasomosis continued to be the major constraints of livestock production in Sub-Saharan Africa, jeopardizing the lives of 55 million people. The risk of infection in humans as well as in domestic animals has greatly affected social, economical and agricultural development of communities within tsetse infested areas which roughly constitutes more than a third (10 million km^2) of Africa between 14°N and 29°S of the continent (FAO, 2002).

In Ethiopia, Trypanosomosis is widespread 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) (MoA, 1995). In (Afework *et al.*, 1998) and (Tewelde *et al.,* 2001) studies, farmers strongly recognized trypanosomosis as the primary problem for livestock productivity and agricultural development in the northwestern and western parts of Ethiopia, respectively.

Trypanosomosis in cattle locally referred, as "Gendi" is a serious constraint to livestock production in areas of the north and southwest Ethiopia at an altitude of below 2000 meters above sea level (masl). Currently about 220,000 Km^2 areas of the above mentioned regions are infested with five species of tsetse flies namely *Glossina pallidipes*, *G .morsitans, G. fuscipes, G. tachinoides and G. longipennis* (NTTIC, 2004).

Trypanosomosis is mainly restricted to areas in which the vector, tsetse fly (*Glossina* species) can survive. The disease is also found outside the tsetse belt areas transmitted mechanically by biting flies of the genus *Tabanus*, *Hematopota*, *Chrysops*, and *Stomxys*. A number of trypanosome species are important in bovine trypanosomiasis (*T. brucei brucei, T. congolense* and *T. vivax*) that differ from those causing the human form of the disease, sleeping sickness (*T. b. gambiense, T. b. rhodesiense)*. Economically the tsetse-transmitted trypanosomes (*Trypanosoma congolense, T. vivax*, and *T. brucei*) are most important in cattle with 14 million heads at risk in Ethiopia (Getachew , 2005). In Ethiopia, five species of trypanosomes are recorded and the most important trypanosomes in terms of economic loss in domestic livestock are tsetse transmitted species: *T.congolense*, *T.vivax* and *T. brucei* (Abebe, 2005).

Trypanasomosis control is a long-term fight and therefore requires the involvement of decision makers, researchers and farmers. Until now, the use of trypanocidal drugs to treat or to prevent susceptible livestock against trypanosomosis remains the only control measure for most of the farmers. Very limited trypanocidal compounds are available and they have been used for many years. This long-term use of the same molecules selected drug resistant strains of trypanosomes in many African countries (Geerts *et al.,* 2001).

In order to improve the welfare and security of rural communities, particularly Ethiopia, rapid method for assessing risk and diagnosing urgent problems are needed for the control of animal diseases. Although

Author α ρ: Jimma University, College of Agriculture and Veterinary Medicine (JUCAVM), P.O. Box 307. e-mail: danotekle@gmail.com, batijidu@yahoo.com

Author σ: Mukarim Abdurahaman (DVM, MVPH, Assistant Professor of Veterinary Public Health) Jimma University, College of agriculture and veterinary medicine. e-mail: mukevet@yahoo.com.

bovine trypanosomosis is considered an important livestock disease in Guto Gida District of East Wollega Zone, there is no information in the literature about the disease situation in the study area. The present study was, therefore, conducted in the district with objective of determining the prevalence of the disease, identifying the species of *Trypanosoma* and assessing of risk factors of the disease.

II. Material and Methods

a) Study Area

The study was conducted in Guto Gida District of East Wollega Zone, Oromia Regional State, Ethiopia. Guto Gida woreda is located at 331 Km West of Addis Ababa. It is situated at latitude and longitude of 9°5′N 36°33′E/9.083°N 36.550°E and at an altitude of 1350-2400 meters above sea level (Masl). The climatic condition of the area was highland (dega) (0.26%), midland (woyna dega) (46.74%) and lowland (bereha) (53%) with the mean annual rainfall range from 1800-2200 mm and average temperature 14-26^{0}c. The area receives bimodal rainfalls that were long rainy season (June to September) and short rainy season (March, April and May). The Guto Gida people practice mixed framing system that is crop production and livestock rearing and own large number of livestock. The livestock population in the area includes 86,724 cattle; 8,589 equine; 14,171 sheep; 11,821 goats and 57,695 poultry (CSA, 2009).

b) Study animals

The study animals were indigenous zebu cattle of all age group (*Bos indicus*). Animals were allowed to graze freely during the day and housed at night (extensively managed). The age of animals was determined by dentition (Delahunta and Hable, 1986) and categorized into three age groups. The body condition of animals was also grouped based on criteria described by (Nicholson and Butterworth,1986) but grouped in to two broad group good (G^+ to M) or poor (M^- To P^-).

c) Sampling method and Sample size

Random and purposive sampling methods were followed to select the study animals and study sites respectively. Since there was no previous study conducted in Guto Gida District to establish the prevalence, the sample size was determined by taking 50% expected prevalence of trypanasomosis using the formula given by (Thrusfield, 1995).

$$n = \frac{(1.96)^2 . P_{exp} (1 - P_{exp})}{d^2}$$

Where: n = required sample size
P_{exp} = expected prevalence = 50%
d = desired absolute precision = 5%
Hence, the sample size required as per the above formula was 384 heads of cattle.

d) Study Design

A cross sectional study was carried out to determine the prevalence of bovine trypanosomosis in five peasant association (Tolera, Eba, Muleta, Gari and Abdeta) of Guto Gida District of East Wollega Zone, Western Ethiopia from October 2013 to March 2014.

e) Study Methodology

i. Parasitological Study

A total of 384 blood samples were collected from ear veins of cattle. Samples were collected to heparanized capillary tube. During blood collection the necessary bio-data of each animal was recorded. The Buffy coat technique using phase contrast microscope was used for the detection of trypanosomes in the blood. Species identification was done by morphological examination of trypanosomes on Giemsa stained thin blood smears prepared from the positive animals and examined under a microscope using the oil immersion 100 × objectives (Murray *et al.,* 1977).

ii. Hematological Examination

Blood samples for packed cell volume (PCV) were collected from animals using heparinized capillary tubes. The packed cell volume (PCV) was measured after the heparinized capillary tubes containing blood were centrifuged for 5 min at 12,000 rpm in microhematocrit centrifuge and the results were observed using microhaematocrit reader following the standard procedure described by (Murray *et al.,* 1977).

f) Data Analysis and Management

Data collected were entered into Microsoft Excel spread sheet and descriptive statistics was applied to calculate the prevalence of trypanosomosis using SPSS version 16. ANOVA was used to determine the mean values of PCV and variation in the mean PCV between infected and non-infected animals was determined. The Percentages (%) were used to measure prevalence and chi-square (x^2) to measure significance of association among variables considered in this study. In all analysis, confidence level was held at 95% and $P < 0.05$ was set for significance.

III. Results

a) Parasitological Findings

From the total of 384 cattle examined with a Buffy coat technique, 30 were Positive for trypanosomes giving an overall prevalence of 7.81%. The prevalence of bovine trypanosomosis between different peasant associations (PA) was 11.39% in Abdeta, 9.89% in Gari, 6.52% in Muleta, 5.40% in Tolera and 5.31% in Eba with no statistically significant difference ($p>0.05$) (Table 1).

Trypnosoma congolense, Trypnosoma vivax, and *Trypnosoma brucie* were the *Trypnosoma* Species identified by Giemsa stained thin blood smear examination. Among the total of 30 cases of trypanosome infections detected 16(53.33%) of the

infections were due to *T. Congolese, 9(30%)* were due to *T. Vivax* and the rest (16.66 %) were due to *T. brucie* with statistical significance difference (Table 2). Sex wise prevalence of trypanosome infection was slightly higher for female (8.37%) than for male (7.18%) animals (Table 3). However, statistical significant difference ($P > 0.05$) was not observed between sexes. With respect to body condition score, the prevalence was 2.65%, and 19.67% in good, and poor body condition score, respectively with a significant variation ($P < 0.05$) between them (Table 3). Age based prevalence was 9.21%, 7.42% and 3.33% for animal > 6 years, 1-6 years and < 1 year of age respectively. Although adult cattle have higher infection rate statistical significant difference ($P > 0.05$) was not observed between age group (Table 3).

b) Hematological Findings

The PCV of individual animals was measured for the assessment of degree of anemia. A mean PCV of 20.23% and 27.98% was found for infected animals and non-infected animals respectively (Table 4). The difference was statistically Significant ($P = 0.000$).

Table 1 : Origin based prevalence of bovine trypanasomosis

PA	Number of animal examined	Number of animal positive	Prevalence (%)	*T.congolense*	*T.vivax*	*T.brucie*	X^2 (P value
Tolera	74	4	5.40	2(2.70)	1(1.35)	1(1.35)	3.464 (0.44)
Eba	94	5	5.31	3(3.19)	1(1.06)	1(1.06)	
Muleta	46	3	6.52	2(4.34)	1(2.17)		
Gari	91	9	9.89	5(5.49)	3(3.29)	1(1.09)	
Abdeta	79	9	11.39	4(4.16)	3(3.78)	2(1.30)	
Total	384	30	7.81	16(4.17)	9(2.34)	5(1.30)	

Table 2 : Species based prevalence of bovine trypanasomosis

Species	Number of animal positive	Prevalence (%)	X^2	P- value
T.congolense	16	53.33	384	0.00
T.vivax	9	30		
T.brucie	5	16.66		
Total	30	100		

Table 3 : Prevalence of trypanosomosis infection with different potential risk factors

Potential risk factors	Nomber of animals examined	Infected animals (prevalence)	X^2	P- Value
Age			1.29	0.178
< 1year	30	1(3.33)		
1-6year	202	15(7.42)		
> 6year	152	14(9.21)		
sex			1.92	0.405
Male	181	13(7.18)		
Female	203	17(8.37)		
Body condition			34.92	0.000
Good	262	6(2.65)		
Poor	122	24 (19.67)		
Total	384	30(7.81)		

Table 4 : Mean PCV of infected and non – infected animals in the study sites

Animal	Number of animal	Mean PCV (%)	X^2	p-value
Infected	30	21.23	110.51	P=0.001
Non-infected	354	27.98		
Total	384	27.45		

IV. Discussion

The distribution of the most common species of trypanasomes infesting cattle in Ethiopia varies greatly from one area to another. Considering this the present study revealed the overall prevalence of 7.81% in the study area, this prevalence of trypanosomes concord with prevalence of 8.55% of Sasiga and Diga district of East Wellega (Tefese *et al*., 2012) and 5.85%, in Diga District of Eastern Wollega (Dinsa *et al*., 2012). The similarity of prevalence between these studies might be due to similarity in altitude. In contrast, the result is low when compared with previous reports, 40% in the Wolyta and Dawero zones of southern Ethiopia (Miruk *et al.,* 2008), (24.7%) in Maokomo special district of Benshangul Gumz regional state (Daud and Molalegn, 2011) and 25.7% in the tsetse-infested zones of the Amhara region of northwestern Ethiopia (Cherenet *et al.,* 2006). The relatively low prevalence of trypanosomosis in this report may be due to the differences in agro ecology, which less favors tsetse flies growth and multiplication. And also prevalence rate of 29% along the escarpment of the Upper Didessa Valley (NTTICC, 1998), 25% in Gawo Dale district of Kelem Wollega zone (NTTICC, 2004) were reported.

The associations of the disease with different peasant associations were also assessed. No significance association was observed between prevalence of the disease among the different peasant associations (Table1). This may be due to the result of uncontrolled animal movements between the areas. The sex wise prevalence of trypanosome infection was 7.18% in male and 8.37% in female.Though prevalence a slightly higher among the females, statistically there was no significant difference. Daya and Abebe, (2008), Tefese *et al*. (2012) report similar results where they observed no significant difference in trypanosome infection between males and females. Onyiah, (1997) and Quadeer *et al.* (2008), in separate studies added that no statistically significant difference in the prevalence bovine trypanosomosis between sex groups. Therefore, they have equal chance of coming in contact with the flies and allowed in the same ecology having comparable degree to acquire infection.

T.vivax and *T. congolense* and *T.brucei* were the species detected from infected animal with statistically significant difference in the prevalence of trypanosome species (P=0.00) (Table 2). This result agreed with work of (Abebe and Jobre, 1996) who reported an infection rate of 58.5% for *T. congolense*, 31.2% for *T. vivax* and 3.5% for *T. brucei* in Southwest Ethiopia, which is similar with current situation in Guto Gida District. The dominant trypanosomes species in the present study was *T. congolense*. This agreed with work of Tewelde *et al*., (2001) and (Afewerk, 1998) who reported a prevalence rate of 17.2% and 21% in Upper Didessa of tsetse infested region and in Metekel district respectively. The dominant species was *T. congolense* which is similar with the current result in Guto Gida District. Additionally, 71.8% prevalence of *T. congolense* in the Gawo Dale district was reported (Waktole *et al*., 2008). The predominance of *T. congolense* infection in cattle may be due to the high number of serodams of cattle as compared to *T. vivax* and development of better immune response to *T. vivax* by the infected animal (Leak *et al*., 1999). Langridge *et al*., (1976) also reported, *G. pallidipes* and *G.m. Sub-morsitans* are efficient in the transmission of *T. congolense* than *T. vivax* in Africa that support the present study in Guto Gida District. In contrast, in areas of East Wollega Zone (Sibu Sire) the respective ratios between *T.congolense (*36%) and *T.vivax* (64%) infections were reported (Shimelis and Sisay, 2011), because of the abundance of mechanical vectors also known to be effective transmitters of *T. vivax* (Desquesnes and Dia, 2004).

The association of the disease with age was also assessed. No significance difference was observed with respect to age. The result agreed with report of (Daud and Molalegne, 2011) in Mao-komo Special District of Benishangul Gumuz Regional State, (Molalegne *et al.,* 2010) in Jabi Tehenan district of West Gojjam Amhara regional state (Tefese *et al*., 2012) in Sasiga and Diga District of western Oromia region, (Efrem *et al*., 2013) in Lalo kile District of kelem Wollega. Similar findings were also reported by (Cherenet *et al.,* 2006) and (Habtamu, 2009), in tsetse infested region of Amhara and in the Jawi district of the Amhara region respectively. This can be associated to the fact that adult animals travel long distance for feed and water as well as for drought to tsetse high challenge areas. There is also evidence that *T. congolense* infection was chronic diseases that increase infection rates with age, (McDermott *et al*., 2003). According to (Torr *et al.,* 2000), tsetse flies are attracted significantly more by odor of large animals. Rowlands *et al.,* (2001) in Ghibe valley indicated that suckling calves did not go out with their dams but graze at home until weaned off. Additionally young animals are naturally protected to some extent by maternal antibodies (Fimmen *et al*., 1982). These could be the reason for lower prevalence of trypanosomosis that was observed in calves.

We also tried to assess the relationship of infection with body condition score of sampled animals (Table 3). In this study, there was a significant difference in the prevalence of trypanosomosis between animals with good and poor body conditions. This is in agreement with (Mussa, 2002) and (Molalegne *et al.,* 2010). This may be related to the debilitating nature of the disease (Radostits *et al.,* 2007). However, it would be difficult to conclude either poor body condition predispose to trypanosome infection or trypanosome infection cause loss of body condition based on such

cross-sectional study (Dohoo *et al.,* 2003) and it should be verified by using a longitudinal study designs. The disease itself results in progressive emaciation of the infected animals; nevertheless, non–infected animals under good body condition have well developed 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 responsive-ness in some cases (Collins, 1994).

A significant decrease in PCV was observed in the trypanosome infected animals signifying anemia to be one of the important consequence of infection (Table 4). It was in agreement to the work done by Tafese *et al.*, (2012) mean PCV value of infected animals (21.45%) was significantly lower ($P < 0.05$) than that of non-infected animals (26.6%). Daud and Molalegne, (2011); Molalegne *et al.* (2010) also reported lower mean PCV value in infected animals than the non-infected animals. Rowlands *et al*. (2001) in also reported in an increase in PCV value, the proportion of positivity decreases and hence mean PCV was a good indicator for the health status of herds in an endemic area.

V. Conclusion

Trypanosomosis caused by *T. congolense, T. vivax and T.brucei* with more prevalence of *T. congolense* was remains the main constraint to animal production and agricultural development in Guto Gida woreda. This dominance of *T.congolense* suggest presence of biologically (tsetse fly) transmitted trypanosome and the presence of *T. vivax* in the area indicated the importance of mechanically transmitted trypanosome in the study area. The observed association between reduction in PCV and body condition with infection showed the impact of the disease on productivity of infected animals. Nevertheless, trypanocidal drugs remain the main control tools used by livestock owners.

VI. Acknowledgments

The authors acknowledge Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) for financing the study.

References Références Referencias

1. Abebe, G. and Jobre, Y., (1996): Trypanosomosis: A threat to cattle production in Ethiopia. *Rev. Med. Vet.*, **147:** 897-902.
2. Afework, Y., (1998): Field investigation on the appearance of drug resistant population of trypanosomes in Metekel District, North-West Ethiopia. Msc thesis, Addis Ababa University and Freiuniverstat Berlin, Faculty of veterinary medicine, Ethiopia. Pp:32-36.
3. CFSPH (2009): African animal trypanosomiasis. The Center for Food Security and Public Health (CFSPH), Iowa State University.www.cfsph.iastate.edu.
4. Cherenet, T., Sani, R.A., Speybroeck, N., Panandam, J.M., Nadzr,S., Van den Bossche, P., (2006): A comparative longitudinal study of bovine trypanosomiasis in tsetse-free and tsetse-infested zones of the Amhara Region, northwest Ethiopia. *Veterinary Parasitology*, **140**: 251–258.
5. Collins, F.M., (1994): The immune response to mycobacterium infection, development of new vaccine. Veterinary *Microbiol.***40:** 95-110.
6. CSA (2009): Central statistical agency, Federal democratic republic of Ethiopia, agricultural sample survey. Statistical Bulletin **446**:.Addis Ababa. Pp: 1-72.
7. Daud, A. and B. Molalegne, (2011): Epidemiological study of Bovine Trypanosmosis in Mao-komo Special District, Benishangul Gumuz Regional State, Western Ethiopia. *Global Veterinaria*, **6:** 402-408.
8. Daya, T. and Abebe, G. (2008): Seasonal dynamics of tsetse and trypanosomosis in selected sites of southern nation, nationalities and peoples regional state, Ethiopia. *Ethiopian Veterinary Journal*, **12:** 77-92.
9. DeLahunta, A. and Habel, R.E., (1986): 'Teeth', in A. DeLahunt and R.E. Habel (eds.), *Applied veterinary anatomy*, n.p., W.B. Saunders Company, Philadelphia
10. Desquesnes M, Dia ML (2004): Mechanical transmission of Trypanosoma vivax in cattle by the African tabanid Atylotus fuscipes. *Vet Parasitol.* **119**(1)**:** 9-19.
11. Dinsa B., M. Yohannes, H.D. and M.W.(2012): C ross sectional study of bovine trypanosomosis and major clinical signs observed in Diga District, Western Ethiopia, African Journal of Agricultural ResearchVol.**8**(6):500-506.
12. Dohoo, I., Martin, W., Stryhn, H., (2003): Veterinary Epidemiologic Research. AVC inc., charlottetown, price Edwards island, Canada. Pp: 145
13. Efrem, D., B. F., B.B., A. Hunde and M. Duguma, (2013): Prevalence of Bovine Trypanosomosis in Lalo Kile District, Kelem Wollega Zone, Oromia Regional State, Western Ethiopia.Wollega University, *Acta Parasitologica Globalis* **4** (2)**:** 34-40.
14. Fimmen, H.O., D. Mehlitz, F. Horchiner and E. Korb, (1992): Colostral antibodies and *Trypanosomacon golense* infection in calves. Trypanotolerance research and application. GTZ, No. **116**, Germany, pp: 173-187.
15. Getachew, A. (2005): Review article trypanasomia sis in Ethiopia. *Journal of Biological Science*, **27**:1-8
16. Food and Agriculture Organization (FAO), (2002): Program Against African Trypanosomiasis (PAAT).

Twenty second Regional Conference for Africa, Cairo, Egypt, 4–8 February 2002.
17. Geerts, S., Holmes, P.H., Diall, O., Eisler, M.C., (2001): African bovine trypanosomiasis: the problem of drug resistance. *Trends Parasitol.* **17**:25–28.
18. Habtamu, G., (2009): Current status of tsetse transmitted trypanosomes in Jawi district of Amhara region, north-west Ethiopia', DVM thesis, Faculty of Veterinary Medicine, Gondar University. Pp: 36-53.
19. Langridge, W.P. (1976): A tsetse and trypanosomiasis survey of Ethiopia. Addis Ababa, Ethiopia, Ministry of Overseas Development of British and Ministry of Agriculture of Ethiopia, Pp:1-40.
20. 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.
21. McDermott, J., B. Bauer, B. Diarra, M. Kamuanga,A. Peregrine, K.H. Eisler, D. Mehlitz and P.H. Clausen, (2003): Field studies of drug-resistant cattle trypanosomes in Kenedougou province, Burkina Faso. *Acta Trop.,* **86**: 93-103.
22. Miruk, A., Hagos, A., Yacob, H.T., Asnake, F. and Basu, A.K., (2008): Prevalence of bovine trypanosomosis and trypanocidal drug sensitivity studies on *Trypanosoma congolense* in Wolyta and Dawerozones of southern Ethiopia',*Veteri nary Parasitology.,***152**:141–147
23. MoA (Ministry of Agricultural), (1995): Ethiopian ruminant livestock development strategy. Addis Ababa, Ethiopia, Ministry of Agricultural, Pp: 112-113.
24. Molalegne B, Yshitila Amedie and Asmamaw Abebe, (2010): Prevalence of Bovine trypanosomo sis in Selected Areas of Jabi Tehenan District, West Gojjam of Amhara Regional State, North western *Ethiopia Global Veterinaria* **5** (5): 243-247.
25. Murray M, Murray PK, and McIntyre WI. (1977): An improved parasitological technique for the diagnosis of African trypanosomiasis. *Trans R Soc Trop Med Hyg*, **71**:325-6.
26. Mussa A (2002): Prevalence of bovine Trypano-somosis in Goro Worda South west Ethiopia .DVM Thesis. Addis Ababa University, Debre Zeit, Ethiopia. Pp:23-26.
27. Nicholson, J.M. and M.H. Butterworth, (1986): A guide to condition scoring of zebu cattle. ILCA, Addis Ababa, Ethiopia.Pp:36,
28. NTTICC (1998): Annual Report, Ministry of Agriculture, National Tsetse and Trypanosomosis Investigation and Control Center (NTTICC). Bedelle, Illubabor, Ethiopia. Pp: 28.
29. NTTICC (2004): Annual report, National Tsetse and Trypanosomosis Investigation and Control Centre. NTTICC Bedele, Ethiopia. Pp:30.
30. Onyiah, J.A. (1997): African animal trypanosomosis, an overview of the current status in Nigeria. *Tropical Veteteri- nary Journal*, **15**:1-16.
31. Quadeer, M.A., Danbirni, S., Usman, M., Akogun, O.B., Gundiri, M.A. and Bobbo, A.G. (2008): Prevalence of bo-vine trypanosomosis in Bassa local government area, Plateau State, Nigeria. *Nigeria Journal of Parasitology*, **29**:136-139.
32. Radostitis, OM., Gay, CC., Hinchcliff KW (2007):Veterinary Medicine, A text book of the disease of Cattle, Horses, Sheep, Pigs and Goats, tenth Ed. Saunders Elsevier, Baillier Tindall, London, Philadelphia, New York.
33. Rowlands, G.J., S.G.A., Leak, A.S., Peregrine, S.M., Nagda, W. Mulatu and G.D.M. D'ieteren, (2001): The incidence of new and the prevalence and persistence of recurrent trypanosome infections in cattle in south-west Ethiopia exposed to a high challenge with drug-resistant parasites. *Acta. Trop.,* **79**:149-163.
34. Shimelis D. and Sisay S., (2011): Prevalence and vector distributions of bovine trypanosomosis in control (Sibu Sire) and no control (Guto Gida) districts bordering upper Anger valley of East Wollega Zone, Western Ethiopia. *Ethiop. Vet. J.*, **15:** 77-86.
35. Tafese, W., Melaku, A. and Fentahun, T., (2012): 'Prevalence of bovine trypanosomosis and its vectors in two districts of East Wollega Zone, Ethiopia', *Onderstepoort Journal of Veterinary Research* **79**(1):385,
36. Tewolde, N., (2001): Study on the occurrence of drug resistant trypanosomes in cattle in the farming in tsetse control areas (FITCA) project in Western Ethiopia. MSc thesis, Addis Ababa University, Faculty of veterinary medicine, Ethiopia. Pp:42-49.
37. Thrusfield, M. V. (1995): Veterinary Epidemiology. 2nd Ed.Black Well Science, Oxford. Pp: 183-198
38. Torr, S.J. and Mangwiro, T.N.C. (2000): Interactions between cattle and biting flies: Effects on the feeding rate of tsetse. *Medical and Veterinary Entomology.*, **14**:400-409.
39. Upadhyaya, A. (2005): Text of preventive Veterinary Medicine 1st ed., International book distributing co.(publishing Division), Army printing press ,33 Nuhru Road, saddart contt. Lucknow-226002.
40. Waktole, T.E., (2008): Studies on bovine trypano-somosis and therapeutic efficacy of selected trypanocidal drugs in Birbir valley of Gawo-Dalledistrict, West Oromia, rd th MSc Thesis. Addis Ababa University, Faculty of Veterinary Medicine DebreZeit, Ethiopia.Pp:26-30.