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Prevalence and seasonal incidence of bovine trypanosomosis in Birbir valley, Baro Akobo River system, Western Ethiopia

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The study was conducted in Birbir valley of Oromia Regional State, Western Ethiopia from November 2009 to July 2010 to determine the prevalence and seasonal incidence of bovine trypanosomosis. Blood samples from 2219 randomly selected cattle of both sex and different age groups were collected and examined with conventional hematological and parasitological techniques. Out of the total examined animals, 195 (8.78%) cattle were infected with trypanosomes. Most of the infections were due to *Trypanosoma congolense* (65.6%) followed by *Trypanosoma vivax* (33.8%) and the rest were mixed infections of *T. congolense* and *T. vivax* (0.51%). There was no statistically significant difference (P>0.05) in infection between male and female, young and adult animals and altitude levels. However, higher proportion of the infection was detected in adult male animals, during wet season and in lowland areas; 9.03, 10.33, 10.11% respectively. Mean packed cell volume (PCV) value of parasitaemic and a parasitaemic animals was not significantly (P>0.05) different. The average seasonal incidence of trypanosome was 21.66, 10, 13.79 and 17.24% during the late rainy, dry, early and wet seasons, respectively. The relative higher incidence rate was observed during the wet seasons of the year. The study revealed that trypanosomosis is the main constraint to livestock production and agricultural activity in Birbir valley, Western Ethiopia. Hence, implementation of integrated tsetse and trypanosome control measures will save greater economic loss of the region in particular and the country in general.

Key words: Cattle, epidemiology, *T. congolense*, *T. vivax*, trypanosomosis, Western Ethiopia.

INTRODUCTION

Trypanosomes multiply in the tsetse fly and are injected into the host when the fly feeds on an animal through tsetse saliva. Tsetse-transmitted trypanosomosis (Nagana) is one of the most ubiquitous and important constraints to agricultural development in the sub-humid and humid zones of Africa including Western and South Western parts of Ethiopia (NTICC, 2004; Enwezor et al., 2006). African animal trypanosomosis (AAT) is, thus, one of the main constraints to livestock production on the African continent preventing full use of the land to feed the rapidly increasing human population (Murray et al., 1988). AAT is a disease complex caused by *Trypanosoma congolense*, *Trypanosoma vivax* or *Trypanosoma brucei* or simultaneous infection with one or more of these

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organisms. Infection with trypanosomes results in sub-acute, acute or chronic disease characterized by intermittent fever, anaemia, occasional diarrhoea and rapid loss of body condition and often terminates in death (Urquart et al., 1995). Cattle, particularly work oxen, are an integral part of farming in the Birbir valley Western Ethiopia. However, their productivity is severely hampered due to animal trypanosomosis. This study was undertaken in valley of Birbir, Baro Akobo river system from November 2009 to July 2010 to determine the prevalence and seasonal incidence of bovine trypanosomosis; assess the factors regulating the epidemiology of bovine trypanosomosis in Birbir valley and establish an appropriate strategy for its control in the study area.

MATERIALS AND METHODS

Study area

The study was conducted in two districts: Dalesadi and Dalewabera of Kellem Wollega Zone in Oromia Regional State in Birbir Valley Baro Akobo River system, Western Ethiopia (Figure 1). The agro-climatic condition of the areas alternates with long summer rainfall (June to September) and winter dry season (December to March) with an annual rainfall ranging from 1300 to 1600 mm. The annual mean minimum and maximum temperature ranges are 11.0 to 15.5 and 26.1 to 33.4°C respectively. The altitude ranges from 1300 to 1800 m.a.s.l. The natural vegetations have been degraded due to intensive cultivation. However, much of the cultivated lands have scattered tree covers and in some fields different vegetation types such as savanna woodland, forest, riverine and bush lands have been grown on soil bunds to provide soil protection. Both vegetation and wild life play very important roles in the transmission of trypanosomosis, the wild life serves as reservoir of the infection and the vegetation as a habitat for the tsetse fly and wild life (NTICC, 1996). The dominant livestock population in Birbir valley is cattle followed by goats and sheep and all of them are raised under traditional management system. Other animals such as equines, poultry and bees are also bred. Mixed livestock and crop farming is the dominant form of production in the livelihood of the people; hence cattle are used for draught power and milk production while sheep, goats, bees and poultry are raised both for household consumption and income generation.

Study animals

This study was carried out on 2219 local zebu selected by random sampling methods in the two districts of Birbir valley. Information on the sex, species, age of the cattle, and the altitude of the sites, packed cell volume (PCV) from collected blood samples were recorded.

Parasitological and haematological examinations

Paired blood samples were collected from the peripheral ear vein of each animal using heparinized microhaematocrit capillary tubes that filled 3/4 of the height and sealed with cristaseal. The sealed microhaematocrit capillary tubes containing 70 μl of blood were centrifuged immediately in microhaematocrit centrifuge for 5 min at 12000 rpm. After centrifugation, the pack cell volume (PCV) was read for estimation of anemia using haematocrit reader and the buffy-coat examination done as described in (Murray et al., 1983).

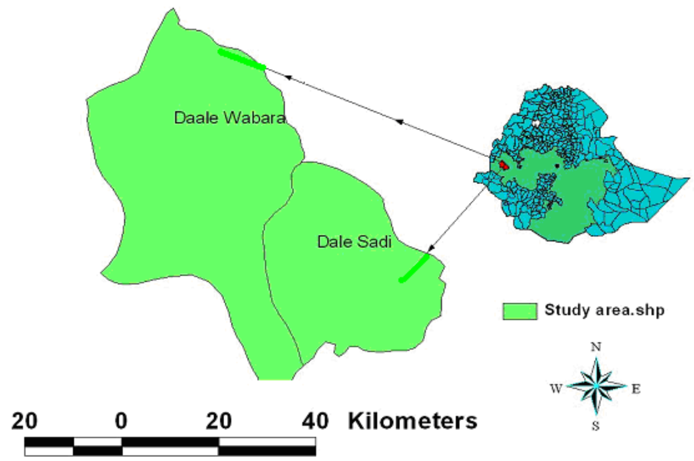

Figure 1. Location map of the study area.

The capillary tube was cut 1 mm below the buffy coat to include the top layer of red cells.

The content of the capillary tube was expressed onto a clean slide, mixed and covered with a 22 × 22 mm cover slip. Then the slide was examined for trypanosomes based on their type of motility in the microscopic field. Confirmations of trypanosome species by morphological characteristics were done after a thin blood smear was prepared from the buffy-coat examination and stained with Giemsa stain and examined under a microscope using oil immersion 100× objective (Murray et al., 1983).

Incidence rate

Before the treatment, baseline sampling was done to determine point prevalence of the disease (9.3%). The study was conducted by treating all selected cattle with diminazene aceturate at a dose rate of 3.5 mg/kg body weight. Starting after one month (day 0) all selected animals were examined for trypanosome parasite using buffy-coat techniques every 30 days interval until 8 months (December-June) while November is day minus 30 which was when block treatment was given.

Statistical analyses

The prevalence of trypanosome infection was calculated as the number of parasitological positive animals as examined by the buffy-coat method (Murray et al., 1983) divided by the total number of animals investigated at that particular time. Confidence intervals (95%) for the PCV of trypanosome-infected and non-infected animals were calculated. The prevalence of trypanosomosis under different variables (altitude levels, season, sex and age) was compared by chi-square test. A multivariate computation was conducted using logistic regression analysis in order to establish the effects of different risk factors (age, sex, altitude and season).

RESULTS

Parasitological findings

Out of a total of 2219 cattle examined, an overall prevalence rate of 195 (8.78%) was recorded. Relatively higher prevalence was observed during the late rainy and

Table 1. Seasonal prevalence of trypanosomosis and relative frequency of trypanosome species in different seasons.

Parameter	Late rainy	Dry	Early rainy	Wet	Total
Examined	701	549	485	484	2219
Infected	72	37	36	50	195
T. congolense	65	30	8	26	129(5.81)
T. vivax	6	7	28	24	65(2.92)
T. congolense and *T. vivax*	1	0	0	0	1(0.04)
Overall prevalence (%)	10.27	6.73	7.42	10.33	8.78

$\chi^2 = 2.77$, P>0.05.

Table 2. The overall prevalence of trypanosomosis in different sex, age and altitude levels during the study period in Birbir valley, Baro Akobo River system, Western Ethiopia.

Variable	N	Positive	Trypanosome species detected			Prevalence (%)	d.f	χ^2	*P*-value
			T.c	*T.v*	Mix				
Sex									
Male	1502	135	83	52	1	8.98	1	2.777	0.337
Female	717	60	46	13		8.36			
Age									
<1 year	133	8	8	0		6.01		1.567	0.252
1 to 3 years	492	43	28	13	-	8.7	2		
>3 years	1594	144	93	52		9.03			
Altitude (m)									
<1500	1266	128	101	26		10.11	1	4.150	0.791
≥1500	953	67	28	39	-	7.03			
Total	2219	195	129	65		8.78			

T.c = T. congolense, T.v =T. vivax, Mixed = *T. congolense* and *T. vivax.*

wet seasons at a rate of 10.27 and 10.33%, respectively, than the dry and early rainy seasons 6.73 and 7.42% (Table 1). However, statistically there was no significant (P>0.05) difference between the two. Trypanosome species encountered in the animals (cattle) examined in all seasons belong to the two species of *T. congolense* and *T. vivax. T. congolense* was the predominant trypanosome species detected during the study period (5.81%) compared to *T. vivax* (2.92%) (P<0.05).

No tested variables (sex age and altitude) had a significant effect on trypanosome infection rates. However higher proportion of infection was detected in older male animals in lowland areas. The prevalence rate in the lowland areas were 10.11% and in the midland areas 7.03%. The predominant trypanosome species in the lowland areas was *T. congolense* representing 78.9% of all infections (Table 2). *T. congolense* was the predominant tsetse transmitted trypanosome species that causes infection in both lowland and midland areas. The prevalence of trypanosome infection was more or less equal between the lowland and midland areas during the wet season of the study period. *T. vivax* was significantly dominant in midland areas while *T. congolense* was dominant in lowland areas.

The maximum herd prevalence of trypanosome was 35.8% during late rainy and 34.7% in wet season, respectively (Figure 2). The overall prevalence of sampled animals was 8.78%. All the sampled herds were positive for trypanosome infections. The relationship between herd prevalence of trypanosome infections and herd average PCV were examined by regression analysis using herd average PCV as the dependent variable and the prevalence of trypanosome infections in a herd as independent variable.

During the parasitological survey, animals with PCV≤ 24% were considered to be anemic. Mean trypanosome prevalence and PCV were negatively correlated but without statistical significance (r = -0.187; P>0.05).

Haematological findings

The mean PCV (%) values in parasitaemic and aparasitaemic animals during the late rain, dry, early rain

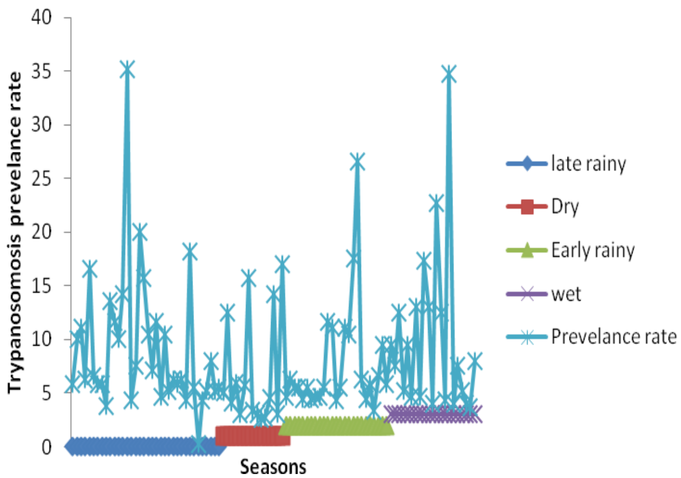

Figure 2. Comparison of average PCV value and herd trypanosome prevalence.

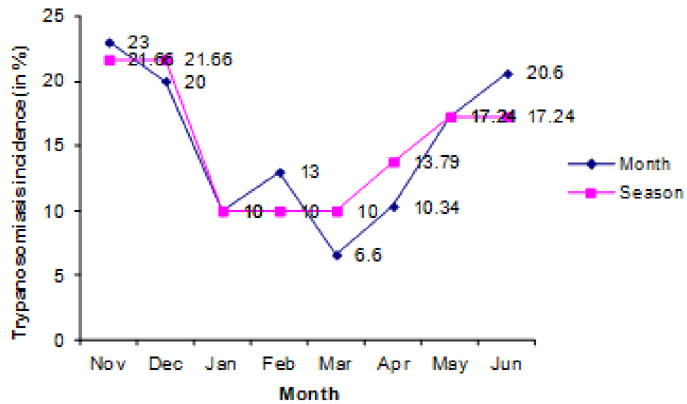

Figure 3. Monthly and seasonal incidence rate of trypanosomosis.

and wet seasons were 23.04 ± 2.59 in parasitaemic and 26.01 ± 4.16 in aparasitaemic, 22.10 ± 4.51 in parasitaemic and 25.12 ± 3.53 in aparasitaemic, 20.72 ± 3.59 in parasitaemic and 25.87 ± 3.86 in aparasitaemic, 19.84 ± 2.65 in parasitaemic and 25.42 ± 3.35 in aparasitaemic, respectively. The overall mean PCV values were also found to have lower difference between parasitaemic and aparasitaemic animals 21.61 and 25.63, respectively.

The mean PCV (%) of animals in the lowland and midland area was 25.26 ± 3.84 standard deviation (SD) (95% confidence interval (CI) = 24.91 - 25.62) and 26.55 ± 4.53 SD (95% CI = 25.97 - 27.12), 25.17 ± 3.82 SD (95% CI = 24.76 - 25.58) and 24.52 ± 3.36 SD (95% CI = 24.0 - 24.97), 25.32 ± 3.59 SD (95% CI = 24.85 - 25.87) and 25.61 ± 4.42 SD (95% CI = 25.06 - 26.16), and 24.67 ± 3.47 SD (95% CI = 24.23 - 25.10) and 25.03 ± 3.92 SD (95% CI = 24.52 - 25.53) during the late rainy, dry, early rainy and wet season respectively.

The range of PCV values in parasitaemic and aparasitaemic animals were from 17 to 29% and 20 to 36%; 13 to 34% and 19 to 38%; 14 to 28% and 20 to 38%; and 16 to 33% and 20 to 38%, during late rainy, dry, early rainy and wet seasons respectively. Generally the PCV of parasitaemic and aparasitaemic animals were within the range of 13 to 34 and 19 to 38, respectively.

Incidence rate

The result of monthly and seasonal trypanosome incidence rate are presented in (Figure 3). Thus the study of incidence rate revealed that the average seasonal incidence of trypanosome was 21.66, 10, 13.79 and 17.24% during the late rainy, dry, early and wet seasons, respectively. The relative higher incidence rate was observed during the wet seasons of the year.

DISCUSSION

The prevalence of positive samples by microscopical examination of the buffy-coat for the trypanosomes is within the range of other previous reports of studies conducted in Western Ethiopia by Rowland et al. (1993). *T. congolense* was the most prevalent trypanosome species in the study area that accounts for the overall percentage of about 66.15% (129/195). Similar studies indicate that the most prevalent trypanosome species in tsetse-infested areas of Ethiopia are *T. congolense* and *T. vivax;* Rowland et al. (1993) reported a prevalence rate of 37% for *T. congolense* in Southwest Ethiopia. Abebe and Jobre (1996) reported an infection rate of 58.5% for *T. congolense,* 31.2% for *T. vivax* and 3.5% for *T. brucei* in Southwest Ethiopia. The predominance of *T. congolense* infection in cattle may be due to the high number seroderms of *T. congolense* as compared to *T. vivax* and the development of better immune response to *T. vivax* infected animals (Leak et al., 1999; MacLennan, 1970). *T. congolense* has been incriminated to be the most prevalent species in tsetse area (Langridge, 1976). 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. vivax* in prevalence (Wilson et al., 1975). Host's reaction to *T. vivax* may be more adverse than to *T. congolense* because *T. congolense* is more virulent to cattle than *T. vivax*. Higher infection rates were observed in male animals in the present study but the difference was not significant. Similar results have been reported by different works (Afewerk, 1998; Muturi, 1999; Tewelde, 2001). The possible explanation from the present findings would be that male animals are more exposed to traction power and also cross in different vegetations for grazing and watering where tsetse challenge is very high than females. In this research work, age was not found to be a risk factor but higher infection rates were observed in adults and younger animals in both altitude levels and seasons. This is logically associated to the fact that suckling calves did not go out with their dams but graze at homesteaded until weaned off (Rowlands et al., 1993). And younger animals are naturally protected to some extent by maternal antibodies (Fimmen et al., 1982). On the other hand adult animals travel and cross-different vegetation types for grazing, watering as well as for draught and harvesting crops to tsetse high challenge areas. *T. congolense* infection is a chronic condition that increases infection rates with age. The difference in prevalence of trypanosomosis in lowland and midland areas might be attributed to the difference in tsetse apparent density in the two altitude levels. Trypanosomosis prevalence is influenced by tsetse apparent density and infection rates in tsetse flies (Riordan, 1977) demonstrated that a high tsetse apparent density and infection rates of 50% in tsetse results in 42% trypanosome prevalence in cattle exposed to tsetse flies.

The increase in tsetse apparent density during the wet season has been reported in Ethiopia (Msangi, 1999) in Somalia (Mohammed and Dairri, 1987) and Cote d' ivoire, Togo, Gabon and Zaire (Leak et al., 1988). The increase in apparent tsetse density led to an increase in trypanosome challenge to cattle in the study area, resulting in the observed difference in trypanosome prevalence during the four sampling seasons (in the late rainy season in November 2009, during the dry period in March 2010, in the early rainy season late May 2010 and during wet season late June and early July 2010. Even though relative higher infection was observed in the lowland areas, the mean PCV values between altitude levels did not show any significant difference. The moderate changes in the mean PCV values between altitude levels may be attributed to the higher infection rates observed in the lowland areas and the nutritional imbalance in the mid land areas during the study period. Rowlands et al. (2001) in Ghibe observed an increase in PCV value, as the proportions of positivity decreases and hence mean PCV was a good indicator for the health status of animals in an endemic area. There was lower mean PCV value in parasitaemic animals than is reported by several authors (Leak, 1987; Afewerk, 1998; Muturi, 1999; Tewelde, 2001). The development of anaemia is one of the most typical signs of trypanosomosis cased by *T. congolense* in the susceptible cattle breeds (Murray and Dexter, 1988). The level of anaemia or the PCV usually gives a reliable indication of the disease status and productive performance of an infected animal (Trail et al., 1991). Bovine trypanosomosis control scheme aims at reducing the prevalence of infection with a concomitant increase in the herd average PCV. Therefore, the knowledge of relationship between prevalence of trypanosome infection and herd average PCV could be a useful tool for the assessment of impact of control intervention. However, the herd average PCV is affected by different factors other than trypanosomosis (Conner, 1994). These different factors are not always identifiable but they are likely to affect both trypanosomosis positive and negative animals. Conner (1994) indicated that anaemia associated with trypanosomosis causes weakness, lethargy and lack of stamina which ultimately reduce efficiency of working animals. Swallow (2000) indicated that animals in tsetse infested area have lower calving rate, milk yield, higher calf mortality and require more treatment with trypanocidal drugs and that trypanosusceptible animal can be devastated by sudden exposure to high levels of trypanosome risk.

The result of parasitological survey revealed that *T. congolense* and *T. vivax* were the most prevalent trypanosome species in the Birbir valley, Baro Akobo River system, Western Ethiopia. Trypanosomosis caused by *T. congolense* and *T. vivax* have chronic and acute causes, respectively. Short-lived disease may have high incidence but low prevalence while lifelong disease has low incidence but high prevalence. In the parasitological survey of this finding, *T. vivax* was less prevalent than *T. congolense.* The chronic form of *T. congolense* was resulted in higher prevalence than *T. vivax* infections.

Conclusion

Trypanosomosis in domestic livestock is a very common disease in Birbir valley, Baro Akobo River system Western Ethiopia. It is one of the most important diseases which kill more working domestic ruminants. In all the study area whether they are lowland and midland the livestock were all infected with trypanosomosis; however, the infection rates depended on local ecological conditions, the infection rate in tsetse flies, the abundance and activity of the insect vector and cattle management of the individual cattle owners. Community based integrated tsetse and trypanosomosis control should be implemented using impregnated target with baited technology.

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