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Review

Review on prevalence of bovine trypanosomosis in Ethiopia

Semayat Oyda[1*] and Maireg Hailu[2]

[1]Department of Livestock and Fishery Husbandry, Dawuro zone, Southern Ethiopia, Ethiopia.
[2]Department of Livestock and Fishery Husbandry, Sidama zone, Southern Ethiopia, Hawassa Ethiopia.

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Ethiopia is one of African country with nine regions and two city administration of which five regions were infected with more than one species of tsetse flies. Known species in Ethiopia are five in number namely *Glossina pallidipes*, *G .morsitans, G. fuscipes, G. tachinoides* and *G. longipennis.* Most tsetse transmission is cyclic and begins when blood from a trypanosome-infected animal is ingested by the fly. The clinical feature of the disease follows the level or burdens of tsetse challenge species. The main feature is anemia results in a progressive drop in packed cell volume, a non-specific but useful indicator in endemic areas. The most sensitive rapid method is examining a wet mount of the buffy coat area of a PCV tube after centrifugation, looking for motile parasites. The prevalence of trypanosomosis in enzootic area can be reduced by parasite control, vector control, host resistance protection prophylactic treatment and good husbandry management system. The methods of tsetse fly control involved bush clearing, elimination of game animals on which tsetse feed, and the sterile male technique (sterile insect techniques). Since female tsetse only mates once in a lifetime, this technique is theoretically able to eradicate a targeted tsetse species. Trypanotolerant animals are very important in tsetse fly challenging areas, but most countries did not accept them due to their low production of milk than indigenous breed. In conclusion, prevalence of trypanosomosis is devastating diseases of cattle in Ethiopia with both direct and indirect economic losses.

Key words: Bovine, trypanosomosis, nagana, tsetse fly, protozoa.

INTRODUCTION

Trypanosomosis has long been recognized as a massive constraint on animal husbandry, livestock production and mixed farming in vast areas of rural sub-Saharan Africa (Oluwafemi, 2014). Ethiopia is known for its large and diverse livestock resource endowments. Livestock is primarily kept on small holdings where it provide drought power for crop production, manure for soil fertility and fuels, serves as a sources family diet and sources of cash income (from livestock and livestock products). Despite large livestock population, Ethiopia fails to optimally utilize this resource due to different constrains facing the livestock subsector (Bezabih et al., 2015).

*Corresponding author. E-mail: drsemayat@gmail.com. Tel: +251926089330, +251916863500.

Since more than 90% of crop production in Ethiopia are dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to lack of these animals in trypanosomiasis infested area (Kenaw et al*.,* 2015), which worsen the food supply and living conditions in affected areas.

Trypanosomes are flagellated protozoan parasites that live in the blood and other body fluids of vertebrate hosts (OIE, 2013). Bovine trypanosome is one of the diseases that are caused by this flagellated protozoal parasite belonging to the genus trypanosome (Jember et al*.,* 2013). This group of diseases caused by protozoa of the genus Trypanosoma affects all domestic animals. The major veterinary species are *Trypanosoma congolense, Trypanosoma vivax, Trypanosoma bruceibrucei, and Trypanosoma simiae. Trypanosoma bruceirhodesiense and Trypanosoma bruceigambiense* are zoonotic, with people as the predominant host. Animals are mainly affected by tsetse-transmitted trypanosomes and in geographic areas where tsetse-transmitted trypanosomiasis occurs (Merck, 2005).

In Ethiopia, trypanosomosis is widespread in domestic livestock in the Western, South and South-western lowland regions and the associated river systems (that I, Abay, Ghibe Omo and Baro/Akobo) (Tekle, 2012; Langridge, 1976). The tsetse flies in Ethiopia are confined to the southern and western regions between longitude 33° and 38°E and latitude 5° and 12° N (Langridge, 1976). The infested area extends from the southern part of the Rift Valley, around the south-western corner of the country and along the western lowlands and escarpments to the Blue Nile (Bezabih et al*.,* 2015; Getachew, 2005).

Out of the nine region of Ethiopia, five (Amhara area, Benshangul-Gumuzs, Gambella, Oromia and Southern Nations Nationalities and Peoples' Regional State) are infected with more than one species of tsetse flies (Bitew et al*.,* 2011). Currently about 220,000 km^2 areas of the above mentioned regions are infested with five species of tsetse flies namely *Glossina pallidipes*, *Glossina morsitans, Glossina fuscipes, Glossina tachinoides* and *Glossina longipennis* (NTTICC, 2004; Abebe, 2005). Locally in Amharic language trypanosomosis in cattle referred, as "Gendi" is a serious constraint to livestock production in areas of the north and southwest Ethiopia at an altitude of below 2000 m.a.s.l (Tadesse, 2010). The most prevalent trypanosome species in tsetse infested areas of Southern region of Ethiopia (Tadesse, 2010) and south west Oromia are *T. congolense, T. vivax* by Denu et al*,* 2012. The objective of this paper is to summarize the available research evidence on trypanosomosis in cattle and reveals the gap that needs future research attention

Trypanosomosis in Ethiopia

In Ethiopia, trypanosomosis is widespread in domestic livestock in the Western, South and South-western lowland regions and the associated river systems (Tekle, 2012). Tsetse infested areas lie in the lowlands and in river valley of Abbay (Blue Nile), Baro, Akobo, Didessa, Ghibe and Omo. Out of the nine regions of Ethiopia five (Oromia, SNNPR, Amhara, Beninshangul Gumuz, and Gambella) are infested with more than one species of tsetse flies (NTTICC, 2004; Keno, 2005; Abebe, 2005). The most important trypanosome species affecting cattle in Ethiopia are *T. congolense, T. vivax*and *T. brucei (*Alemayehu et al*.,* 2012). Cattle bitten by tsetse flies develop fever, anaemia, lose weight, and progressively become weak and unproductive. Breeding animals frequently abort or may become infertile. Several affected cattle die of anaemia, congestive heart failure or inter-current bacterial infections that frequently take advantage of the weakened immune system (Chaka and Abebe, 2005).

Bovine trypanosomiasis

Bovine trypanosomosis is a disease that affects cattle resulting from infection with protozoa of the genus Trypanosoma transmitted primarily by tsetse fly and also by other haematophagous fly (Urquart et al*.,* 1995). *T. vivax, T. congoiense, T. bruceibrucei* and *T. simiae* are the four main species responsible for African trypanosomoses affecting virtually all domestic mammals. *T. vivax and T. congoiense* are the main pathogens of cattle (Radostitis et al., 2007).

Epidemiology of trypanosomosis

Modes of transmission, vectors and ecological preference

The epidemiology of African trypanosomosis is determined mainly by the ecology of the tsetse fly which is found only in tropical Africa (Radostitis et al*.*, 2007). Most tsetse-fly transmission is cyclic and begins when blood from a trypanosome-infected animal is ingested by the fly. The trypanosome alters its surface coat, multiplies in the fly, then alters its surface coat again, and becomes infective (Merck, 2005). Tsetse flies (genus *Glossina*) are restricted to Africa from about latitude 15° N to 29° S. The three main species that inhabit relatively distinct environments are: *G. morsitans* usually found in savanna country, *G. palpalis* prefers areas around rivers and lakes, and *G. fusca* lives in high forest areas. All three species transmit trypanosomes, and all feed on various mammals (Merck, 2005). The riverine species (*G. palpalis, G. tachinoides*, and *G. fuscipes*) (Honigberg, 1986) are important as vectors of bovine (Radostitis et al*.*, 2007). Trypanosomosis is an important disease of livestock in Ethiopia (Alemayehu et al*.,* 2012). There are six pathogenic *T. equiperdum* and *T. rhodesiense* but the most species of trypanosomes are discovered in

Ethiopia, which are namely *T.vivax, T. congolense, T. brucei, T. evansi*, and important trypanosomes which are found in country are *T. vivax and T. congelense* (Abebe, 2005; Eticha and Aki, 2016).

Vector and parasitic survey

Monoconical standard traps were to be deployed in the study area for tsetse fly trapping. All the traps were baited uniformly with octenol (1-oct-3-nel), acetone and three weeks old cow urine. All odors were placed on the ground about 30 cm upwind of the trap. The apparent density of the tsetse fly was calculated as the number of tsetse catch/trap/day (Desta, 2014). Blood sample was collected by puncturing of the marginal ear vein of each animal with a lancet and drawn directly into heparinized capillary tube and centrifuged with capillary hematocrit centrifuge. Positive samples were further processed for thin blood smear for confirmation of trypanosome species using their morphological characteristics with Giemsa staining techniques (Tekle, 2012; Fayisa et al*.,* 2015).

Biology of tsetse fly

Tsetse-fly, in general adult tsetse, are narrow, yellow to dark brown flies (Veterinary Entomology, 2015) 6 to 15 mm in length and have along, rigid, forward projection proboscis. The thorax is a dull greenish brown color and is marked with inconspicuous stripes and spots (FEAV, 2015). The 23 known species of tsetse flies can be divided into three groups, each with different habits and requirements. *G. palpalis* group are riverine species which feed primarily reptiles and ungulates. Flies of the *G. morsitans* group are savannah and dry thorn-bush species which is mainly on large animals. Members of *G. fusca* group occur in rainforest, preferring dense shade and riverine thickets (FEAV, 2015). Life cycle of both male and female flies suck blood and although the various species of tsetse may have some host preferences, generally they will freedom a wide variety of animals (Urqhart et al., 1995). The puparial period can range from 20 days (at 30°C) to 47 days (at 20°C) (on average 30 days at 24°C). Development in the puparium is generally unsuccessful below about 17°C and above about 32°C. The entire life cycle from egg to adult usually takes about 30 days (Leak, 1999).

Pathogenesis

Infected tsetse inoculate metacyclic trypanosomes into the skin of animals, where the trypanosomes reside for a few days and cause localized inflammation (chancres).They enter the lymph and lymph nodes, then the bloodstream, where they divide rapidly by binary fission. In *T congolense* infection, the organisms attach to endothelial cells and localize in capillaries and small blood vessels. *T brucei* species and *T vivax* invade tissues and cause tissue damage in several organs (Merck, 2005; Radostitis et al., 2007). African animal trypanosomosis or nagana ("nagana") which is a Zulu word that means "powerless (useless"‘, “to be in low or depressed spirits”) is caused by *T. congolense*, *T. vivax* and *T. brucei* spp. (Steverding, 2008). Antibody developed to the glycoprotein coat of the trypanosome kills the trypanosome and results in the development of immune complexes. Antibody, however, does not clear the infection, for the trypanosome has genes that can code for many different surface-coat glycoproteins and change its surface glycoprotein to evade the antibody (Eshetu and Begejo, 2015).

Diagnosis of trypanosomosis

Clinical findings and lesions

The general clinical picture is as follows but there are many variations determined by the level of tsetse-fly challenge, the species and strain of the trypanosome, and the breed and management of the host (Radostitis et al*,* 2007). Severity of disease varies with species, age of the animal infected and the species of trypanosome involved. The incubation period is usually 1 to 4 week. The primary clinical signs are intermittent fever, anemia, and weight loss. Cattle usually have a chronic course with high mortality, especially if there is poor nutrition or other stress factors (Merck, 2005). The anemia results in a progressive drop in packed cell volume, a non-specific but useful indicator in endemic areas (Radostitis et al., 2007). Necropsy findings vary and are nonspecific. In acute and fatal cases, extensive petechiation of the serosal membranes, especially in the peritoneal cavity, may occur. Also, the lymph nodes and spleen are usually swollen (Merck, 2005). Definitive diagnosis of the disease is ultimately dependent on the detection of the trypanosome in blood samples from infected animals (Diseases of Cattle, 1981; Abebe, 2005).

Parasitological diagnosis

A presumptive diagnosis is based on finding an anemic animal in poor condition in an endemic area. The most sensitive rapid method is to examine a wet mount of the buffy coat area of a Packed Cell Volume (PCV) tube after centrifugation, looking for motile parasites. Other infections that cause anemia and weight loss, such as babesiosis, anaplasmosis, theileriosis, and haemonchosis, should be excluded by examining a stained blood smear (Merck, 2005).

Serological diagnosis

Various serologic tests measure antibody to

trypanosomes, but their use is more suitable for herd and area screening than for individual diagnosis. Rapid agglutination tests to detect circulating trypanosome species-specific antigens in peripheral blood are available for both individual and herd diagnosis, although their reliability remains varied (Merck, 2005). Another alternative is a series of standard serological tests to detect anti-trypanosome antibodies in sera or other body fluids. The three tests used most often are the indirect immuno-fluorescent antibody test (IFAT), the capillary agglutination test (CAT), and the ELISA (Radostitis et al., 2007).

Molecular technique

Molecular techniques for trypanosome detection and differentiation have been developed, but they are not generally available for routine field use (Merck, 2005). Dried blood spots on filter papers are also a useful source of DNA for the detection of *T. congolense* and *T. brucei* by Trypanosome and Trypanosomiasis (2014) PCR But the test is expensive and can only be done in specialized laboratories (Radostitis et al., 2007).

Control of trypanosomosis

Parasite control

The control of trypanosomosis in enzootic countries involves control of tsetse fly population, prophylactic treatment, good husbandry of animals at risk, and use of trypano-tolerant animals (Radostitis et al*.,* 2007). Most have a narrow therapeutic index, which makes administration of the correct dose essential (Merck, 2005). Therapeutic drugs for the treatment of trypanosomosis includes diminazenum aceturate, homidium bromide and homidium chloride. Prophylactic drugs for cattle include homidiumbromide, homidium chloride and isometamidium (Ayisheshim et al., 2015).

Vector control

Till date five species of *Glossina namely G. morsitans submorsitans, G. pallidipes, G. fuscipes fuscipes, G. tachinoides,* and *G. longipennis* are known to exist in Ethiopia. These vectors cyclically transmit four species of trypanosomes (*T. congolense, T. vivax, and T. brucei* of livestock and *T. rhodesiense* of human). The occurrence of trypanosomosis in the region was attributed to the existence of cyclical vectors, *G. pallidipes* and *G. f. fuscipes*. However*, G. pallidipes* was the predominant and most widely distributed vector (Abebe et al*.,* 2017). Control of tsetse has been successfully attempted in some African countries, but reinvasion is frequent if the land is not properly utilized. The earliest methods involved bush clearing and elimination of game animals on which tsetse feed (Radostitis et al., 2007). Another method is the sterile male technique. Since the female tsetse only mates once in a lifetime, this technique is theoretically able to eradicate a targeted tsetse species in areas where other methods have been used to reduce its density, but it is expensive (Urqhart et al*.,* 1995).

Host resistance protection

Trypano-tolerant animals are being used to establish ranches in areas where tsetse challenge is not too heavy, but they have not been readily accepted in some countries, supposedly because they are smaller in size and they produce less milk than other indigenous breeds and crosses with exotic breeds (Radostitis et al., 2007). They are infected by tsetse flies but do not show clinical disease. However, these breeds have not been readily accepted because they are small in size and low in milk producing. Cross breeding is however a common practice (OIE, 2013). The four Ethiopian cattle breeds Abigar, Gurage, Horro and Sheko in aspects are related to trypano-tolerance (Eshetu and Begejo, 2015).

Over view of economic Impacts

Tsetse flies infest 10 million square kilometers of Africa involving 37 countries. Hence, nagana is today the most important disease of livestock in the continent (Disease of Cattle, 1981). Since nagana is a wasting disease, affected animals are chronically unproductive in terms of milk, meat, manure, and traction and the mortality rate can be high (Jano, 2016; Radostitis, et al., 2007). The disease in Africa costs livestock producers and consumers an estimated US$1340 million each year (Ayisheshim et al., 2015).

DISCUSSION

In African Animal Trypanosomosis (AAT), some cattle breeds like the West African Taurine such as N'Dama, have the ability to control the development of the disease better than Zebu and exotic taurine breeds (Dagnachew et al., 2015). This capacity to better control the infection and disease in cattle which is demonstrated to have major genetic components, was called trypano-tolerant and defined as the traits that confers the capacity to survive and remain productive despite a still active trypanosome transmission in endemic areas.

Trypano-tolerance occurs in some African bovine breeds (Bos Taurus) such as longhorn (N'Dama) and shorthorn (Baoule) cattle, which entered into African continent before Zebu cattle (Courtin et al., 2008). According to literatures, the most prevalent trypanosome species of Bovine in tsetse-fly infested areas in different parts of Ethiopia were *T. congolense* and *T. vivax*

(Abebe, 2005). The risk of infection with trypanosomes during the dry season was lower than the late rainy season, with a statistically significant difference for *T. congolense* infection in both seasons as reported by Ayele et al. 2012. The prevalence of trypanosomosis was affected by agro-climatic zone.

Higher prevalence in lowland areas is related to the fact that animals in lowland areas are more challenged by vectors than higher altitudes. This is related to the temperature difference between these areas as temperature is one of the most important biotic factors that limit the distribution of vectors. A number of studies have shown the effect of age on the prevalence of trypanosome infections in cattle. The highest prevalence was observed in middle age group (2<x<4 years). The lower prevalence in younger group may be related to the husbandry system in which young animals were usually kept around their house with lower fly challenge (Melaku and Abebe, 2012).

The high ratio of *T. congolense* in tsetse-infested area may be ascribed to the more efficient transmission of *T. congolense (*Aki and Godeso, 2016*)* by major cyclical vectors than *T. vivax* in East Africa. An increased prevalence of *T. vivax* infections in cattle has been noted during rainy season which is attributed to higher density of tsetse flies and/or the abundant presence of mechanical vectors, such as tabanids and stomoxys spp (Mulaw et al., 2011). The high proportion infection rate of *T. congolense* in cattle might be attributable to the high number of serodems of *T. congolense* relative to *T. vivax* which could also be due to the possible development of better immune response to *T. vivax* by the infected animals.

Further, it might be attributed to the efficient transmission of *T. Congolense* by cyclical vectors than *T. vivax* in tsetse-infested areas*.* Previous reports indicated that *T. congolense* and *T. vivax* are the most prevalent trypanosomes that infect cattle in tsetse infested and tsetse free areas of Ethiopia, respectively (Aki and Godeso, 2016). Ecological conditions for tsetse on the edge of a fly belt are usually less favorable resulting in a high mortality rate of tsetse and favoring the transmission of trypanosome species with a short developmental cycle such as *T. vivax* (Cherenet et al*.,* 2010).

CONCLUSSION AND RECOMMENDATIONS

Bovine trypanosomosis caused by *T. congolense* and *T. vivax* was found to be an important disease of cattle in rift valley basin in South, South West, West and North West of Ethiopia. Prevalence of trypanosomosis progress is high in bovine and impact of the disease on productivity of infected animals. Since trypanosomosis is worldwide problem and causes great economic lose due to infectious and death of animals as well as medication costs, agricultural and loss of production. To reduce its effects, the following measures are recommended:

1. Improve management practices such as rearing, feeding, housing, medication and restriction movement density population of tsetse
2. Increase awareness creation those animal rearing society especially pastoral community
3. Importing modern and latest drugs for trypanosomosis.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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