PREVALENCE AND ASSOCIATED RISK FACTORS OF TRYPANOSOMOSIS IN CA MEIUS DROMEDARIES IN SELECTED DISTRICTS OF AFAR NATIONAL REGIONAL STATE, NORTH EASTERN ETHIOPIA

Authors:
Bekalu Gerem¹, Muhammed Hamid²*

Affiliation:
²College of Veterinary Medicine, Samara University, Samara, Ethiopia. P.O.Box 132

Correspondence:
*Corresponding author: Muhammed Hamid, College of Veterinary Medicine, Samara University, Samara, Ethiopia.
E-mail address: Muhammedhamid8@gmail.com
ABSTRACT

Camel trypanosomosis or surra, is a life-threatening disease caused by *Trypanosoma evansi*, with negative impacts on health, production and working efficiency of camels in different camel-rearing areas of the world including Ethiopia. A cross-sectional study was carried out from November 2016 to May 2017 with the aim of estimating the prevalence of camel trypanosomiasis (surra) and assessing of associated risk factors in Dubti and Asayita districts of Afar region, Ethiopia. Blood samples were collected from randomly selected 200 camels. Wet film blood smears and Giemsa-stain were used for the detection of trypanosomes. Out of 200 examined camels, 9 (4.5%) were positive for *Trypanosoma evansi*. The higher prevalence of the disease was recorded in Dubti (6.97%) than in Asayita (2.63%). Camels at the age of > 4 years were encountered highest infection (7.47%), followed by < 4 years old camels (1.07%), respectively. According to logistic regression analysis, previously aborted camels were found at high risk (p= 0.698; OR=5.11, 95% CI = 1.174-22.317). The Chi-square analysis showed that, there was no statistically significant difference between body condition categories and herd size of camels with the occurrence of the disease ($X^2$=3.839; p=0.147) and ($X^2$=0.718; p= 0.698) respectively. The mean PCV was lower (20.8%) in anemic animal as compared to non-anemic animals (27.4%). The result of this study revealed that camel trypanosomosis was prevalent in the study area. Thus, designing of the control and prevention strategies with further identifying risk factors is desirable.

**Key words:** Afar, Blood, Camel, Prevalence, Risk factors, *Trypanosoma evansi*. 
INTRODUCTION

The livestock sector support the food security and livelihood of almost a billion people and contributes up to 40% of the global values of agricultural output (Thornton, 2010). Livestock keeping is a multifunctional activity in many developing countries including Ethiopia. Beyond their direct role in generating food and income, livestock are a valuable asset, serving as a store of wealth, collateral for essential safety net and credit during times of crisis (FAO, 2009). Ethiopia is ranking first in Africa and ninth in the world by possessing largest number of livestock population (Yilma, 2016). The importance of the animal is increasing from time to time both at local and global markets in Ethiopia. Moreover, camel husbandry is the major source of living for millions of pastoralists in the arid and semi-arid areas of Ethiopia (MOA, 2013).

The Camels (Camelus dromedaries) are the most numerous species of animals in the arid areas of Africa and Asia, particularly in the arid lowlands of east African counties like Ethiopia, Sudan, Somalia, Djibouti and Kenya (Abera et al., 2015). In Ethiopia camels inhabit almost in all peripheral drier lowlands of the country that generally fall below 1,500 meters above sea level which includes the major parts of the Somali and Afar National Regional States and some parts of the Oromiya National Regional State (Tezera and Kassa, 2002). Ethiopia is estimated to be the third largest camel herd in the world after Somalia, and Sudan (FAO, 2013).

Comparatively Camels are believed less susceptible to many of the devastating diseases that affect different livestock species, such as foot and mouth disease, rinderpest and contagious pleuropneumonia but yet they are affected by many other diseases (Kassa et al., 2011). Among the diseases constraints, Parasitism is one of the major problems that affect the productivity of camels. Of these parasitic diseases camel trypanosmosis is the major problem in sub-Saharan African countries including Ethiopia (Donelson, 2003).

Camel trypanosmosis, also called Surra caused by Trypanosoma evansi, is the most important and serious pathogenic protozoan disease of camel. The disease is transmitted mechanically by haematophagous biting flies, especially tabanids (Bamaiyi et al., 2011). Trypanosoma evansi is the most widely spread of an endemic disease (surra) of camels and other different domestic animals throughout the world (Elhaig et al., 2013; Shahid et al., 2013). From the two strains of
T. evansi: type A and B; strain type A only is believed to be found in Ethiopia whereas, type B has been isolated only from Kenyan dromedary camels (Birhanu et al., 2015).

The disease is highly prevalent in Ethiopia (22%) and it is an important cause of economic losses, causing morbidity of around 30.0% and mortality of up to 3.0% in camels in Ethiopia (Abera et al., 2015). In camels, the disease induce fever, anemia, dullness, depression, weakness, nervous symptoms and these are responsible for major economic losses in terms of poor production (meat, milk, draught power, fertility, and manure) and sometimes death (Desquesnes et al., 2013). It may occur in both acute and chronic forms, the acute form of the disease is usually fatal within a few weeks, but the chronic form lasts for years and associated with secondary infection (Mihret and Mamo, 2007).

Even if camel trypanosomosis has its ecological, economic importance and significant role in the life of pastoral community, researchers and development planners were not given attention to studying about this disease in Afar region, Ethiopia. Moreover, limited documented information about camel trypanosomosis and associated risk factors in afar regional state, northern Ethiopia particularly in the study area, makes this study to focus on estimating the prevalence of camel trypanosomosis and assessing associated risk factors for camel trypanosomosis in the study area.

**MATERIALS AND METHODS**

**Description of study area**

The Afar national regional state is located in the Rift Valley, comprising semi-arid range land in northeastern Ethiopia. According to regional estimates the livestock population of Afar is about 10.12 million, from which about 859,580 (8.5%) are camels. The Afar national regional State has five administrative zones, which are further subdivided into 32 districts. Pastoralism and agro pastoralism are the major livelihood ways practiced in the region. The population of the region is estimated to be About 1.2 million of which 90% are pastoralists and 10% agro-pastoral (CSA, 2007). The study was carried out in two purposively selected districts of Afar region namely; Asayita and Dubti.
Study population

Study was carried out in indigenous one humped camels which vary with age, and body condition that reared under extensive husbandry system on different district. Herd size was classified into three categories as small (Up to 10 camels in a herd), medium (11-20 camels) and large (More than 20 camels in the herd) by considering both the minimum and maximum herd size presented in the study areas (Faye and Bengoumi, 2006). According to these authors, body condition score of dromedaries range from 5 (Excellent) to 0 (Very poor). Estimation of age was both on subjective basis and based on information obtained from the owner.

Study Design

Across-sectional study was carried out to estimate the prevalence of camel trypanosmosis and to assess the associated risk factors in Asayita and Dubti from November 2016 to May 2017. Semi structured questionnaire was prepared and subjected to the owner to obtain information about, physiological status (dry, lactating or pregnant) and previous abortion history of sampled animals in the herd.

Sampling Methods

A multi-stage cluster sampling approach was used. The representative zones, kebeles (Peasant Associations) were selected purposely based on accessibility, willingness of pastoralists and camel population. Zones and woredas were the primary and second sampling units respectively. Selection of kebelles, herds and individual camels within the herds was the 3rd, 4th and 5th sampling units, respectively. From the five administrative zones of Afar region, Zone one was selected and then, from zone one, two woredas (Asayita and Dubti from Zone 1), were selected purposively. Accordingly, 114 (57 %) and 86 (43%) camel were sampled from Asayita and Dubti district, respectively. camels were selected from a given herd by using simple random sampling method.

Sample Size Determination

Cluster sampling is the suitable method for this study as constructing sample frame for random sampling is not possible in pastoral production system. The required sample size was determined by Thrusfield (2007) formula within 95% Confidence Interval (CI) at 5% desired precision level.
\[ N = \frac{1.96^2 \times P_{ex} \times (1-P_{ex})}{d^2} \]

where: 
- \( N \) = sample size
- \( P_{ex} \) = Expected prevalence
- \( d^2 \) = desired level of precision

Expected prevalence was taken as 2% reported by Byikru et al. (2012).

\[ N = \frac{1.96^2 \times 0.02 \times (1-0.02)}{(0.05)^2} = 30.10 \]

Therefore, the minimum sample size required was 30, but in order to increase the precision 200 additional blood samples were collected.

**Sample collection method**

After physical restraining, the jugular furrow of 200 selected camels were cleaned with alcohol and dried well. Then Blood samples were collected by puncturing jugular vein using lancet needle in to 5ml ethylene tetra-acetic acid (EDTA) coated vacationer tubes and kept in cooler box and transported to Samara university multipurpose laboratory.

**Laboratory examination procedures**

**Hematological Examination**

Blood samples were drawn into paired heparinized microhaematocrit capillary tubes up to \( \frac{3}{4} \)th of their length. One end of the tubes were sealed with crista seal and symmetrically loaded in the hematocrits centrifuge, with the sealed end outwards, and then centrifuged at 12,000 rpm for 5 minutes. PCV levels of individual samples were determined on hematocrits reader (Hawaksly, England) and the values were expressed in percentages. Animals with Packed Cell Volume (PCV < 25%) were considered to be anaemic (Morag, 2002).

**Parasitological Examinations**

For wet film, a drop of blood was placed on a clean glass slide and it was covered with cover slip, to allow the blood to spread as a thin layer of cells and then examined under microscope to observe the motile trypanosomes. The air dried smears were fixed in absolute methylene alcohol
for 2 minutes. The slides were immersed in Geimsa stain for 20-25 minute and washed with tap water to remove excess stain. After air drying, the slides were examined under oil immersion objective lens (100x) for the detection and identification of trypanosome species based on their morphological characteristics (Murray et al., 1979).

Data analysis

The data obtained from the study was entered to the Microsoft excel spreadsheet and analyzed by SPSS version 20. The results of this study were taken as statistically significant when p-value is less than 0.05. A chi-square ($X^2$) test was employed to investigate associations between infection status and risk factors. To investigate the associations between *T. evansi* infections and associated risks, factors identified as significant were subsequently subjected to logistic regression analysis.

RESULTS

The parasitological examinations of collected samples revealed that camel trypanosomosis caused by *T. evansi* is widespread and a major threat to the well-being and productivity of the camel population in Asayta and Dubti districts of Awsi Rasu zone, Afar region, Ethiopia. Thin and thick blood smears revealed slender and flagellated trypomastigote forms that were morphologically compatible with *T. evansi*. It was detected in 9 (4.5%) of the 200 camels by at least one of the three/two (wet film, thin/thick smear) parasitological methods. The difference in prevalence between the two administrative districts was statistically not significant (p>0.05). But, the prevalence of trypanosome infection was slightly higher in Dubti (6.97%) than in Asayita (2.63%) (Table 1). Age wise analysis reveals that there was statistically significant (P=0.029). Higher prevalence (7.47%) was observed in age group >4 years old compared to <4 years age old category (Table 2). The prevalence trypanosome in body condition was not significant associated. However high prevalence was found in poor body condition scored camels (7.52%) Followed by medium and good body condition scored camels, (2.94%) and (1.36%) respectively (Table2). The prevalence of trypanosomes infection was different between herd categories, but not statistically significant (P>0.05) (Table 2). There were statistically significant association in the occurrence of the disease and physiological status and abortion history of came ls were (p=0.015) and (p=0.017) respectively.
### Table 1. Prevalence of camel trypanosomisis in study area

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Category</th>
<th>No tested</th>
<th>Positive (%)</th>
<th>Chi-square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Districts</td>
<td>Asayita</td>
<td>114</td>
<td>3 (2.63%)</td>
<td>2.154</td>
<td>0.142</td>
</tr>
<tr>
<td></td>
<td>Dubti</td>
<td>86</td>
<td>6 (6.97%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>200</td>
<td>9 (4.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Prevalence of camel trypanosomisis among associated risk factors.

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Category</th>
<th>No tested</th>
<th>Positive (%)</th>
<th>Chi-square</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Adult</td>
<td>107</td>
<td>8 (7.47%)</td>
<td>4.74</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>Young</td>
<td>93</td>
<td>1 (1.07%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Emaciated</td>
<td>93</td>
<td>7 (7.52%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>34</td>
<td>1 (2.94%)</td>
<td>3.839</td>
<td>0.147</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>73</td>
<td>1 (1.36%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herd Size</td>
<td>Small</td>
<td>40</td>
<td>1 (2.50%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>93</td>
<td>4 (4.30%)</td>
<td>0.718</td>
<td>0.698</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>67</td>
<td>4 (5.97%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of abortion</td>
<td>Previously Aborted</td>
<td>20</td>
<td>3 (15 %)</td>
<td>5.701</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>Not aborted</td>
<td>180</td>
<td>6 (3.33%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological status</td>
<td>Pregnant</td>
<td>67</td>
<td>7 (10.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lactating</td>
<td>86</td>
<td>1 (1.2%)</td>
<td>8.35</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>47</td>
<td>1(2.1%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Association between trypanosome infection status and mean PCV in camels

<table>
<thead>
<tr>
<th>Anemic status</th>
<th>No.Examined</th>
<th>No.Infected</th>
<th>Mean PCV</th>
<th>Prevalence%</th>
<th>chi-square (X2)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemic</td>
<td>98</td>
<td>5</td>
<td>20.8%</td>
<td>5.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not anemic</td>
<td>102</td>
<td>4</td>
<td>27.4%</td>
<td>3.9%</td>
<td>0.162</td>
<td>0.687</td>
</tr>
</tbody>
</table>
Table 4. Logistic regression analysis of risk factors and trypanosomosis prevalence

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>No. Examined</th>
<th>No. Infected</th>
<th>P-value</th>
<th>OR</th>
<th>95% CI for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>107</td>
<td>8</td>
<td>0.061</td>
<td>7.43</td>
<td>0.0912 - 60.59</td>
</tr>
<tr>
<td>young</td>
<td>93</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abortion history</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aborted</td>
<td>20</td>
<td>3</td>
<td>0.03</td>
<td>5.118</td>
<td>1.174- 22.317</td>
</tr>
<tr>
<td>Not Aborted</td>
<td>180</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant</td>
<td>67</td>
<td>7</td>
<td>0.047</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lactating</td>
<td>86</td>
<td>1</td>
<td>0.034</td>
<td>0.101</td>
<td>0.638-45.169</td>
</tr>
<tr>
<td>Dry</td>
<td>47</td>
<td>1</td>
<td>0.122</td>
<td>0.186</td>
<td>0.033-8.854</td>
</tr>
</tbody>
</table>

DISCUSSION

The overall prevalence of camel trypanosomiasis in the study area was found to be 9 (4.5%). Trypanosoma evansi was the only species identified during this study, and it is reported to be the cause for camel trypanosomosis from different parts of the world (Swai et al., 2011). This study result was higher as compared to the findings of (Tefera, 1985; Hailu, 2000 and Tadesse et al., 2012) who reported, (0.3%), (2%) and (3.9%) prevalence of *T. evansi* in Camel in, Issa (Afar), tigray and Jijiga Zone of Somalia respectively. On the other hand, the finding of this study is lower than the previous reports of (Bogale et al., 2012; Abera et al., 2014) who reported (72%) and (17.9%) prevalence of *T. evansi* in Camel in Bale Zone and Jijiga Administrative Zone respectively. This might be due to the difference in the ecology of the study areas and seasons of the year when the study was carryout. It is clear that season has direct effect on the distribution of biting flies, which are responsible for the mechanical transmission of *T. evansi* (Luckins, 1988).
Since the study conducted during dry period and the climatic condition of the study areas were similar, hence, the prevalence of trypanosomosis between the districts was not significantly (P =0.142) varied. However, higher parasitological prevalence was recorded in Dubti district (6.97%) compared to Asayita (2.63%). The higher prevalence observed in Dubti district could be due to the relative ecological variation, hence, in Dubti district there are numerous communal watering points and the existence of big and medium sized trees and shrubs along with a year round river called Awash River.

In this study, age-wise analysis showed that there was statistically significant difference between age groups and the occurrence of the disease (X²=4.74,P=0.029) in which higher infection rate was observed above 4 years old camels than bellow 4 years old camels(7.47%), (1.07%) respectively. This result is similar with other finding (Eshetu, 2011; Weldegebrial et al., 2012 and Tadesse et al., 2014). This may be due to heavy stress associated with their use for various purposes like transportation of goods and sub-optimal management practices may also have contributed to the higher prevalence of T. evansi infection noted in older camels (Pathak and Kapoor, 1992; Richard, 1979). In contrast to our results relatively higher prevalence of infection was recorded in young age groups than adult camels (Kassa et al., 2011).

In this study, body condition was investigated; higher prevalence of T. evansi infection was noted in 7.52% in Emaciated camels, 2.94% was in moderate and 1.3%was in good body condition camels. However, this risk factor was not statistical significant with disease. This result was in line with the report of Khalid, 2015.

In this study, Herd size analysis revealed that there was no statistically significant difference among herd group and the occurrence of the disease (X²=0.718, p-value=0.698).But, relatively larger herd size was identified as a major risk factor of trypanomiasis in camels. In other study this risk factor was found statistically significant (Khalid, 2015). Accordingly (Bhattu et al., 2009), set that infection rate according to herd size was highest prevalence in herds possessing more than 20 animals more than herds possessing 11 to 20, 6 to10 and 1 to5 animals, respectively. these could be attributed to that most of large herds size were located in area with insect species know as disease vector and more fly attack.
Also, previous history of abortion was investigated. The infection rate was 15% in camel having previous history of abortion, 3.3% was in camels without previous abortion history. Camels with history of abortion were more than 5 folds at risk (OR=5.11; 95% CI=0.045-.8521) to infection than camels with no history of reproductive disorder. This result agrees with (Schillinger and Rottcher, 1986) and (Yagil, 1982) who found that abortion could be due to the chronic form of trypanosomiasis.

Even though, there was no statistically significant difference observed between infection and PCV (P>0.05) (Table 3), several factors are responsible for causing anaemia; the production of haemolysin by trypanosomes resulting in extravascular destruction of RBCs, haemolysis of RBCs, the erythrophagocytosis, depression of erythropoiesis, immune mediated and non-specific factors, which increase red cell fragility, might be responsible for anaemia (Atarhouch et al., 2003). So, anemia is a major component of the pathology of surra (Enwezor and Sackey, 2005).

There was statistically significant difference between the prevalence of camel trypanosome and physiological status of camels. Pregnant camels were found with at high risk of infection by *T.evansi* followed by lactating and dry camels’ respectively. This could be due to the occurrence of stress during pregnancy and lactation which may decrease resistance in female and render them more susceptible to *T. evansi* infection (Basaznew, 2004). On the other hand, some studies on prevalence and associated risk factors trypanosomiasis due to *T.evansi* in camel have been published, but no information concerning to assessments of prevalence of trypanosomiasis and physiological status of camels.

**CONCLUSION AND RECOMMENDATIONS**

Even if disease is the major constrain, camel rearing have indispensable practice in Ethiopian pastoralists especially in afar, regional state as their way of life is depended on animal production. Camel trypanosomosis, also known as Surra caused by *Trypanosoma evansi*, is the most important and serious pathogenic protozoan disease of camel which is continued as to be the major problem in Ethiopia particularly in the study areas. The study revealed that camel trypanosomosis is prevalent in afar regional state particularly in the study area at relatively low levels during the study period in November to May, using parasitological techniques. The findings in this study might not reflect the real situation because the sensitivity of parasitological techniques in the diagnosis of *Trypanosoma evansi* has been reported to be low and most of the
time it the disease is under-diagnosed, so the present study provides useful baseline data on the prevalence of camel trypanosomosis in the study area. Thus, based on the findings and the above conclusion, the following points are recommended:

- Further studies should be carried out on trypanosomosis and associated risk factors in Afar region, Ethiopia
- Effective prevention and control plans should be designed and implemented against the parasite and their vectors to control the disease
- There should be expansion of veterinary services to serve the community in the study areas

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