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Concurrent Prevalence of Trypanosomes and Gastrointestinal Parasitism of Draught Camels in Selected District of the Eastern Amhara Regional State, Ethiopia

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Abstract: A cross-sectional study was conducted to determine the concurrent prevalence of camel trypanosomosis and gastrointestinal parasitism on draught camel in four localities of South wollo zone, Ethiopia from January 2012 to November 2012. A total of 872 samples were collected from 384 purposively selected camels. Serological and parasitological examination was conducted. Out of 384 blood smears examined, 15 (3.9 %) were positive for *Trypanosoma evansi*. On the other hand out of 104 camels examined using microhaematocrit centrifugation technique (MHCT), trypanosomosis was detected in 4 animals (3.8%). However the serological test results of formal gel and mercuric chloride test were 96.6 % and 85 %, respectively, for trypanosomosis protein. The linear correlation between PCV and parasitaemic animal was found to be ($r=0.54$, $p>0.05\%$), significant at the 0.05 level. A total of 384 camels were examined for GIT parasitism, of which 365 (95%) were diagnosed as harboring nematode, trematode, ceastode and protozoan eggs at varying levels. *Trichostrongylus* was the most prevalent (62%), followed by *Strongylus* spp. (46%), *Nematodirus* (41%), *Strongyloides* (44%) and *Trichuris* (8%). Other gastro-intestinal parasite eggs encountered include; trematodes (*Paramphistomum*, 19.5%), ceastodes (*Moniezia*, 10%) and protozoan oocysts (*Eimeria* spp, 24 %).

Key words: Concurrent Prevalence · Draught Camels · Egg Per-Gram of Faeces · Helmenth Parasite · Parasitaemia · Trypanosomes

INTRODUCTION

Camel (*Camelus dromedareus*) is a unique livestock species adapted and able to utilize hot and arid environment, which comprise a large part of the country. These animals used to transport people, transporting commodities like salt, cloth, water, transporting crops market to market for human consumption. Camel plough fertile crop lands and help to extract sesame oil in some parts of the region [1]. They are very reliable milk producers even during the dry season and drought years when milk from cattle and goat is scarce [2]. Camels being having a very wide variety of diet are also able to use plant species not used by other livestock species [3].

World camel population is estimated to be around 25.89 million across 47 countries. About 85% of the camel population inhabits mainly eastern and northern Africa and the rest in Indian subcontinent and Middle East countries [4]. In Ethiopia, camels represent a subset of major livestock resources with a population estimated at >2.4 million [5]. The Eastern Amhara Regional State has an estimated average camel population of 17519 [6]. All are males purchased from neighboring camels rearing area especially from Afar Regional State for draught (pack) purpose.

In Ethiopia, trypanosomes and gastrointestinal parasites are the major obstacles in the growth and development of animal health. Factors like constant exposure to parasitic infestation include variable geo-climatic condition, shortage of food and lack of knowledge of farmers in treating gastrointestinal parasites play an important role in proliferation of the parasites and their diseases [7]. A few studies had been conducted in terms of camel diseases; however they indicated that among other constraints, camel diseases were the major problems faced by camel producing communities throughout east Africa.

Camel trypanosomosis, also called surra, caused by *Trypanosoma evansi,* is the main disease prevalent in most areas where camels are found. Although other species of trypanosomes like *Trypanosoma congolense*, *Trypanosoma brucei* and *Trypanosoma vivax* have also

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been isolated from camels, their role in camel trypanosomosis is insignificant compared to *Trypanosoma evansi* [8]. Camel trypanosomosis is the most important single cause of morbidity and mortality in camels. The disease is endemic in Africa, Asia and South America and in addition to camels it is reported in other species of domesticated livestock [9].

Few reports indicated that animals including camel infected with trypanosomes show some degree of immune-suppression and are more susceptible to a number of gastrointestinal helminthes; mainly gastrointestinal nematodes infections. Therefore the gastrointestinal parasites induce a significant additive pathogenic effect on the health and considerably increase the mortality rate [10]. The concurrent infection with trypanosomosis and gastrointestinal parasitism impairs the overall productivity and working capacity of the packing camels herd. These clearly depicted the real economic significance of camel trypanosomosis and gastrointestinal parasites [11].

Among protozoan disease, trypanosomiasis (Surra) caused an infection of 15% in Ethiopia Boran area. Much higher internal parasites were found, 92% of the sampled camels were affected by gastrointestinal parasites [12, 13]. Generally the management of camel disease under specific economic use, understanding of endogenous disease control technique and assessment on camel disease require more investigation at national level. Thus as take of point, survey on camel disease was initiated. Therefore, the objective of this study was to determine the concurrent prevalence and species of trypanosomes and gastrointestinal parasitism of camels in the study area.

MATERIALS AND METHODS

Description of the Study Area: The study area is found in the Eastern Amhara Regional State at South Wollo Zone specifically Tehuledere, Kallu, Kemessie and Batti, where camel population is considered high. Altitude of the area ranges from 1200-2000 masl. The area experienced bimodal rainfall, temperature between 14-26°C in hotter months is over 20°C with a maximum in May and June. Precipitation over 1000 mm and the relative humidity of the area ranges from 28-78% (Meteorological data were collected from Kombolcha Meteorology station).

Study Population and Sampling Methods: The study populations were camel herds from four randomly selected kebeles/peasant associations (PAs), of four destricts of south wollo zone. Villages in each kebele were selected as sampling unit and villages' herds were selected and investigated. For the prevalence study, a total of 384 animals, (92 from Tewholedere, 43 from Kallu, 127 from Kemisse, 122 from Battie destricts) were randomly selected from different herds. The study animals were camels only male and these animal found in the study areas were not indigenous as other farm animals they owned, instead they brought from neighboring camel rearing regional state through purchasing for draught camels (Bagging) purpose.

Questionnaires were prepared to determine the overall situation of traditional camel management and disease specific to commodity transporting camels. These were supported with observation and photo-recording.

Sample Size Determination: The number of animals to be sampled for the epidemiological study was estimated by the formula described by Thrusfield [14]. Since there was no any previous study on concurrent trypanosomes and gastrointestinal parasites prevalence in the study area, 50% was used as expected prevalence of the disease. Accordingly, the estimated sample size was 384.

Sampling Procedure: Total camel population in the study area were considered to be 8555, expected proportion of positive is 50%, the population size in Tehuledere, Kallu, Kemessie and Batti district were 2048, 822, 2828 and 2827 respectively according to the data given by MoARD [6]. All the required samples (n=384) were proportionally distributed to purposively selected study district, based on their camel population 92, 43, 122 and 127 respectively, totally 384 camels were selected for sampling. For trypanosomes investigation, from 384 animals' 104 blood samples for serum and 384 blood smears were collected at the same time and 384 fecal samples from the same animals were sampled for gastrointestinal parasite. Totally 872 different samples were collected for this study.

Sample Collection and Examination: Fecal samples were collected directly from the rectum of all camels in separate polyethylene bags and examined for the presence of ova by using a simple test tube flotation and sedimentation techniques described by Woo [15]. Identification of eggs of each species of camel parasites was done according to the procedure described by Soulsby [16].

Collection of Blood Samples and Preparation: Blood smear were collected by pricking the ear vein of each animal with the help of a sterile lancet after disinfecting the site with 70% alcohol. The micro haematocrie

technique (MHCT) was employed by drawing up blood directly into 75x 1.5 mm heparinized capillary tubes in duplicate up to 3/4th of its length and one end was sealed with crystal seal. Thin blood smears were prepared from all 384 camels, while MHCT was employed for only 104 camels according to Boulange *et al*. [17]. Prepared smears were fixed for 5 minutes in absolute methanol on the day of preparation and transported to Kombolcha Regional animal health laboratory for laboratory investigation.

Examination of Blood Samples: Parasitological examination of blood samples was conducted using MHCT and stained blood smears [18]. MHCT was conducted immediately after collection to estimate the level of parasitemia and anemia at the site of collection. The sealed blood filled capillary tubes were centrifuged at 12,000 rpm for 5 minutes with a micro-haematocrit centrifuge. Packed cell volume (PCV) was determined by using a micro-haematocrit reader. The capillary tube was then cut at 1 mm below the buffy coat with a diamond tipped pencil. Contents of the capillary tube was then poured onto a clean slide and mixed and covered with a 22 × 22 mm cover slip. The preparation was then examined using a bright field microscope with the condenser top out and the diaphragm closed.

The fixed blood smears were immersed in upright position in Giemsa stain solution for 30 minutes. The stain was then poured off; the slide washed thoroughly in running tap water and allowed to drip-dry in an upright position before microscopic examination. The slides were examined with a microscope using oil immersion at 1000X magnification. Species identification was based on the morphological characteristics of trypanosomes depending on the size of the trypanosome, the shape of the posterior end, the size and position of kinetoplast and absence or presence of flagellum according to Bannai *et al* [19]. The proportions were compared by chi-square test.

Serology: To detect the presence of *T. evansi* proteins in each serum sample one drop was mixed with 1ml of mercuric chloride so as to look for precipitation Bannet's mercuric chloride test and Naper formol gel test, were 2 drops of formalin is mixed with 1ml of serum sample, the test is read after 24 hrs of incubation at room temperature [19]

Data Analysis: Results of the study will be analyzed using descriptive statistical analysis (Epidemiological rates, tables, graphs, etc.) and Logistic regression and Pearson's Chi-square test (x^2) were employed to see the association of trypanosomes and gastrointestinal parasitism and the associated risk factor with that of the disease. Pearson's correlation coefficient (r) was used to calculate the association between PCV and parasitaemia.

RESULTS

Questionnaires results describe in Table 1 were put on priority based on the desire of the owners, it must be clear that all of them were equally important as constraints in the camel production.

As indicated in Table 2, the prevalence rate of gastrointestinal parasite in camel was extremely higher 95% comparing with the prevalence rate of trypanosome infection 3.9%.

Table 1: Name of traditionally known disease and their control

No	Local name/Amharegna	Medical name	Priority mean	Seasonality	Traditional control
1	Sale	Pneumonia	1.3	May-june	Fresh milk
2	Kortem	Lameness (Tick)	1.5	Whole year	NA
3	Tekmat	Enteritis	2.0	January-July	NA
4	Ebach	Abcess	2.3	Whole year	Branding
5	Ekek	Mange	2.4	a/year round	b/
6	Nefat	Bloat	3.0	NA	Soap (foam) Zeyit
7	Sudden death	unidentified	3.0	NA	NA
8	Megagna	poisoning	3.0	May -september	c/
9	Kusil	Saddle wound	3.0	Year round	d/

NB. a/ major July- October

b/ haphazardly veterinary care

c/ milk

d/ Guloa (Castor oil tree), mashila (Sorghum seed), metekos (branding)

NA/ not applied

Table 2: Sample size and laboratory results

		Site and number of sample									
		Thuledere		Kallu		Kemisse		Battie		Total result	
No	Sample type	Sample size	Positive (%)	Sample size	Positive (%)	Sample size	Positive (%)	Sample size	Positive (%)	Sample	Positive (%)
1	Blood smear	92	3(3.2%)	43	2(4.6%)	122	3(2.4%)	127	7(5.5%)	384	15(3.9%)
2	Serum										
	mercuric	25	24 (96%)	12	10 (83%)	33	27 (82%)	34	28(82%)	104	89(85.5%)
	formalin		25(100%)		11(92%)		32(96.9%)		32(94%)		100(96.8%
3	feces	92	91(98.9%)	43	38(88%)	122	117(96%)	127	119(94%)	384	365(95%)
4	MHCT	11 1(9%)	25 0	34 1(2.8%)	34 2(5.8%)	104	4(3.8%)				

Table 3: Prevalence of *Trypanosoma evansi* using microscopic examination of blood smears and MHCT techniques

Technique applied	No of sample examined	No positive and prevalence
MHCT	104	4 (3.8%)
Blood smear	384	15 (3.9)

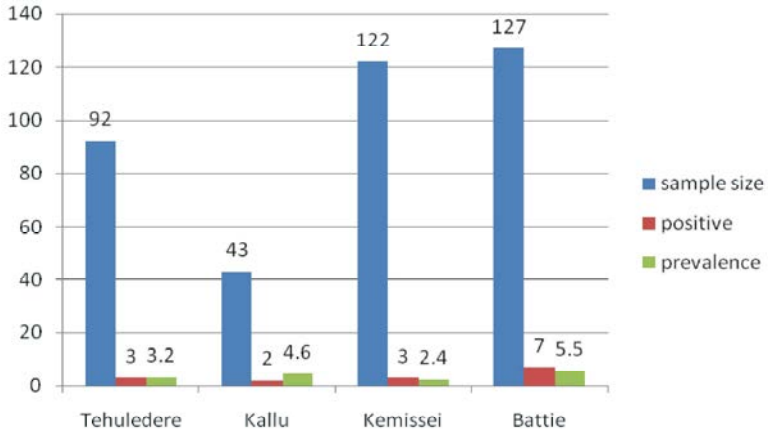

Fig. 1: Prevalence of Trypanosoma evansi at different localities of the study area determined by microscopic examination of blood smears

Out of 384 blood smears examined, 15 (3.9 %) were positive for *Trypanosoma evansi*. No other haemoparasites were detected (Table 3). On the other hand out of 104 camels examined using MHCT, *Trypanosoma evansi* was detected in 4 animals (3.8%).

The prevalence was found to be different among camels from different localities, the highest being 5.5% in Battie, 4.6% in Kallu, 3.2% in Tehulederei and 2.4% in Kemissei (Fig.1)

As shown in Table 4,the mean PCV of *Trypanosoma evansi* positive animals (17.9%) was significantly lower (r=0.54, p>0.05%) than, the mean PCV of negative animals (27%).

According to the work done, among both serological tests (Table 5) the positive results were higher for *T. evansi* protein (96%) when using the gel formal test than that of Mercuric chloride test (85%).

A comparison of the prevalence of *Trypanosoma evansi* between different age groups and body condition score was shown in Table 6. In terms of age, old age groups relatively were found to be more affected (4.7%) than adult (4%) and young (1.4%) camels. However, the difference in prevalence between the age groups was not statistically significant (P>0.05). Body condition score was not significantly associated with prevalence of *Trypanosoma evansi* (p>0.05).

As shown in Table 7, a total of 384 camels were examined, of which 365 (95%) were diagnosed as harboring nematode, trematode, ceastode and protozoan eggs at varying levels. The proportion of camels harboring nematode eggs was considerably high, in which *Trichostrongylus* is the most prevalent (62%), followed by *Strongylus* (46%), *Nematodirus* (41%), *Strongyloides* (44%) and *Trichuris* (8%). Other gastro-intestinal parasite

Table 4: Mean PCV of parasitaemic and aparasitaemic animals

Status	No of animals	Mean PCV	SD	SE
Parasitaemic	104	17.9	1.29	0.40
Aparasitaemic		27	2.87	0.79

Table 5: Serological test

			Degree of reaction					
No	Type of test	No of test sera	++++	+++	++	+	-	Total %
1	Gel formal	148	28	52	40	22	6	96%
2	Mercuric chloride		0	0	58	68	22	85%

Table 6: Effects of age and body condition score as risk factor on the prevalence of *Trypanosoma evansi* using microscopic examination of blood smears

Age	No. examined	No. positive	% prevalence	P-value
Young	71	1	1.4	0.436
Adult	125	5	4	
Old	188	9	4.7	
Total	384	15	3.9	
BCS				
Good	88	2	2.2	0.516
Medium	113	5	4.4	
Poor	183	8	4.3	
Total	384	15	3.9	

Table 7: Prevalence of individual GI parasites

Parasite class	Parasite spps	Number positive	Prevalence (%)
Nematodes	*Trichostrongylus*	239	62
	Strongylus	177	46
	Nematodirus	159	41
	Strongyloides	170	44
	Trichuris	31	8
Ceastode	*Moniezia*	40	10
Trematodes	*Paramphistomum*	75	19.5
Protozoan	*Eimeria*	94	24

Table 8: Degree of GI parasitic infestation in relation to age and BCS as risk factors

Age	Light	Moderate	Heavy	X^2	P –value
<3yrs (young)	16(15.73)	24(24.72)	31(31.46)		
3-6yrs(adult)	27(21.98)	41(42.86)	57(14.29)	20.1097	0.003*
>6yrs(old)	47(20.59)	63(31.37)	78(33.33)		
Total	80	127	167		
BCS					
Good	16(19.92)	41(33.83)	31(25.56)		
Medium	15(20.19)	67(27.88)	31(36.54)	6.0543	0.417
Poor	11(14.29)	101(42.86)	71(21.43)		
Total	42	209	133		

*= $p<0.05$; BCS= body condition score

Table 9: Prevalence of GIT parasites in association with origin of camels as risk factor

District	Total animal examined	No.of positive (prevalence)	X^2	P-value
Thehuledere	92	90 (97.8%)		
Kallu	43	40 (93%)		
Kemissei	122	119 (97.5%)	16.0423	0.001*
Batti	127	120 (94%)		
Total	384	369 (96%)		

*= $p<0.05$, PA= peasant association

Table 10: Average Fecal Egg Count in severely affected camels selected for EPG purpose.

Parasite	Number affected	Mean EPG	EPG (Range)
Trichostrongylus	5	900	4500 (100-20000)
Strongly Spps	2	15000	30000 (50-38000)
Nematodirus	6	1200	7200 (50-16550)
Strongyloides	4	2800	11200 (100-19400)
Mixed infection	17	72	1224(50 – 20000)

eggs encountered include; trematodes (*Paramphistomum*, 19.5%), ceastodes (*Moniezia*, 10%) and protozoan oocysts (*Eimeria* spp, 24 %).

Age was found to be a significant factor for the prevalence of GI parasites ($p<0.05$), with eggs/oocysts being detected more frequently in age categories >6 years than <3 years and 3-6 years (Table 8). Body condition score was significantly associated with prevalence of parasite infestation ($p<0.05$).

There was significant difference ($p<0.05$) between administrative location in severity of infection (EPG). Camels located in Batti and Kemisse district had significantly higher prevalence of helminth eggs than animals located in Tehuledere and Kallu ($p<0.05$) (Table 9).

DISCUSSION

Questionnaire survey revealed that ten types of camel diseases were identified. The local names given to each disease varied from country to country or language to language. However most of them were documented in other works [1]. Traditional medicines were used to treat four of the ten diseases. These included plants, mechanical methods and variety of these were practiced on different livestock species and diseases which the findings of the survey need verification. According to the weight of the problems and the desire to be controlled, commodity transporting camel owners gave pneumonia and lameness first priority. Nevertheless all were equally important by their wide distribution and presence on draught camel [20]

The present work revealed 3.9% of tested camels were infected with-*Trypanosoma evansi*. The prevalence was found to be different among camels from different localities, the highest was 5.5% in Battie, 4.6% in Kallu, 3.2% in Tehulederei and 2.4% in Kemissei and the only species identified was *Trypanosoma evansi*. This finding was more justified by the finding of 3.3% and 4% reported from parasitological and serological examinations respectively, in the Punjab region of Pakistan in camels [21].

The prevalence rate of *Trypanosome evansi* reported by different investigators ranged from 3.6% in Shinille Zone [22] which was comparable with our findings and to 20% at Errer vally [23] which was significantly higher than our findings and the species reported was *T. evansi*. This variation could be due to the fact that camels might contract such infection when traveling eastwards along the Dawa River and west to the Sagan River for browsing where the vector was more available or traveling in the tsetse-infested forest in the dry seasons and might also due to the fact that camels (Commodity transporting) travel from one place to another place to provide transportation service, so that they have a higher probability of acquiring an infection. Frequent travel could also compromise their immune response to infection due to the stress of fatigue [24]. In the present study, considering the prevalence rate of *Trypanosoma evansi* in district label particularly in Batti district a place near to or bordering Afare Regional State had a prevalence rate of 5.5% which was higher than the findings of Tekle and Abebe [25] in Shinille Zone 3.6% and comparable with the finding of Abebe [26] in Ogaden 6.5% and Bekele *et al*.

[27] (6.8%), however the prevalence in the current study was much lower than the findings by previous workers who reported a prevalence of 21% in eastern Ethiopia [28], 28% in Kenya [29] and 33% in Sudan [30].

The overall prevalence of *T.evansi* 3.9% was considering very low when comparing with the work of Zeleke and Bekele [31] in Shinille and Jijiga zone 7.79% and Abebe [32], South Eastern Ethiopia 6.8% and the most recent report from Pakistan indicated a prevalence rate of 11.5% [33] which was also higher than our findings. This might be due to the low level of the parasite load in the blood of infected camels or the available diagnostic methods used might not be satisfactory to detect chronic cases. Trypanosomes were most likely to be found in the blood by direct examination during the early stages of the infection. They were less likely to be detected in chronically ill animals and were almost never seen in healthy carriers. The use of trypanocidal drugs also decreased the probability of finding the parasites [34].

A study conducted in Somalia also showed a prevalence of 5.3% for *Trypanosoma evansi,* while only 0.06% was infected by *Trypanosoma congolense* and *Trypanosoma vivax* [35]. However, the prevalence in the current study was lower than the findings by previous workers who reported a prevalence of 21% in eastern Ethiopia [36] 28% in Kenya [37] and 33% in Sudan [38]. This type of discrepancy might be attributed to variations in the ecology of the study areas and seasons of the year when the studies were conducted which had a direct effect on the distribution of biting flies responsible for the mechanical transmission of *Trypanosoma evansi.* The presence of rainfall, moisture-retaining clay soil and surface water pools where *Acacia senegal* shrubs grow in abundance were suitable for the survival and propagation of the vector [39]. The current study was conducted during the dry season. The possible reason for the difference in prevalence among camel herds in different localities in the district could also be due to differences in the microclimates of the areas.

104 serum samples were collected for serological examination of trypanosomosis (Surra) from which 85% and 96% positive by mercuric chloride and gel-formol serological test respectively. There was a significant association ($p>0.05$) between district and serological findings of *T. evansi* protein. Both test had different results due to variation in specificity and need to be interpreted with caution. Nevertheless, the result can be considered when looking to 3.9% of the overall prevalence of trypanosomes. Now a day's these serological test is not widely used, but they are useful for screening test in areas where other means of serological test were not available. The test may have either to insensitive or lack the required specificity for routine use.

Trypanosomes can be difficult to find in the blood, especially in animals with chronic disease or healthy carriers. Detection can be improved with parasite concentration techniques including mini anion–exchange chromatography, hematocrit centrifugation, the quantitative buffy coat method or the dark-ground/phase-contrast buffy coat technique [19]. Based on this fact out of 104 camels examined using MHCT, *Trypanosoma evansi* was detected in 5(4.8%) of them, additionally 97 camels were found to be parasitaemic (65%). The mean PCV was significantly lower in parasitaemic camels (17.9%) than in aparasitaemic camels (27.0%).

The present work revealed an overall gastrointestinal parasites prevalence of 95% in camels. Eight different species of gastrointestinal tract worms and protozoa were identified in camels. They were broadly classified as Nematodes (6 species), Trematodes(1 species) and protozoan (1 species) and Ceastode (1 species) according to the egg morphology. There was a significant association between districts and the gastrointestinal parasites distribution concerned ($p>0.05$).This finding was in agreement with the prevalence rates in Jordan (98%) by Sharrif *et al*. [40] Eestern Ethiopia (96.92%) [41] and Nigeria (92.4%) [42] other workers also found out 93.6% [43] prevalence rate from camel of Ogaden plain and 91.5% was also reported in the Eastern low lands [35] which was in agreement with the current work (95%). However, it was relatively higher than that of 81.31% report by Kamani *et al*. [44] 75.1% by Anvari-Tafti *et al*. [45] and Borji *et al*. [46] (In Iranian camels and 75% by Bekele [35] (In Eastern Ethiopia) and 78.0% by Mahmud *et al*. [9] in Sokoto and significantly greater than the prevalence rate of 68.9% reported in Nigeria [42]. There was other works obtain 87% [46] which was relatively low when comparing with the present work. This might be due to seasonal variation of sampling and cannot show the real picture of helminthes parasites distribution

The country–to-country variation could be adequately attributed to variation between agro-climatic conditions, levels of hygiene and husbandry practices. Generally from various point of views considering the prevalence of the disease and its economic significance in different part of the nation one can strongly conclude that gastrointestinal parasite and trypanosomosis which imposes huge impact to the camels holder. All are blood sucking parasites and may have a role in low PCV value

and may be the cause of diarrheic (Enteritis) and pneumonic condition, seen in Ethiopia during the outbreak of newly immerged camel disease in 2004-2005.

CONCLUSION

Few reports indicated that animals including camel infected with trypanosomes show some degree of immune-suppression and are more susceptible to a number of gastrointestinal helminthes infections. Therefore the gastrointestinal parasites induce a significant additive pathogenic effect on the health and considerably increase the mortality rate. The concurrent infection with trypanosomosis and gastrointestinal parasitism impairs the overall productivity and working capacity of the packing camels herd. These clearly depicted the real economic significance of camel trypanosomosis and gastrointestinal parasites.

Because of the lack of detailed knowledge on the epidemiology of draught camel of *trypanosome evansi*, a number of camels were found to be seriously affected. Some of the camels with trypanosomes (with positive blood smears) receiving the appropriate drugs were not respond well and some others were found dead. However those camels which received both the trypanocidal and anthelmintics were recovered. On top of these faecal examinations also laid open the presence of significant number of parasite eggs per slide (though it is not determined by eggs per gram of faeces), in the trypanosomes infected and non-de-wormed than non trypanosomes infected and de wormed or none de-wormed camels. The probable reason for the death and delayed return to production in those trypanosomes infected camels might be the additive pathogenic effect of the gastrointestinal helminthes infections. Hence, the concurrent trypanosome and helminthes infection is a serious constraint of camel production and productivity. To understand the epidemiology of these diseases and to develop cost effective disease control strategy the following points are recommended.

The epidemiology of camel trypanosomosis reveal the roll of cattle, small ruminants and equine as a reservoir of infection, to study the vectors ecological position, seasonal dynamics, type of fly involved etc; to study seasonal prevalence of the disease in production and reproduction of camels should be given priority. The laboratory investigation should encompass modern diagnostic methods and treatment intervention should be subjected both for trypanosomes and gastrointestinal parasites (Combined methods of treatment). The information we have up to know on camel gastrointestinal parasites are short period survey reports. To get sufficient information a detailed study should be instituted on selected herds from different agro-ecology to assess the epidemiology of the disease, seasonal prevalence, factors associated with host, environmental influences, effect on production and identification of adult parasites

REFERENCES

1. Mukasa-Mugerwa, E., 1981. The camel (C. dromedaries) a babilographical review. ILCA monograph, 228: 50-71, 72-78.
2. Gebre, S. and G. Kaaya, 2008. Prevalence of camel ticks and haemoparasites in southern rangelands of Ethiopia, Discov. Innova, 20: 10-13.
3. Derakhshanfar, A., A. Mozaffari and A. Zadeh, 2010. An outbreak of Trypanosomiasis (Surra) in camels in the southern Fars province of Iran: Clinical, hemathological and pathological fi ndings. Res. J. Parasitol, 5: 23-26.
4. FAO (Food and Agriculture Organization of the United Nations), 2008. Production Yearbook, Volume56. Rome, Italy.
5. Central Statistical Authority, 2009. Agricultural sample survey (2008/2009) Statistical bulletin 302, Addis Ababa, Ethiopia.
6. MoARD, Ministry of Agriculture and Rural Development, 2008. The effect of Hide and skin quality on Domestic and export markets and evaluation of the campaign against Ectoparasites of sheep and goats in Amhara, Tigray and Afar Regions, official report to Regions and other sectors, Addis Ababa, Ethiopia
7. Tekle, T. and G. Abebe, 2001. Trypanosomes and helminthosis: Major health problems of camel (Camelus dromedarius) in the Southern Rangelands of Borana, Ethiopia. J. Camel Pract. Res., 8, 39-42.
8. Dirie, M. and O. Abdurahman, 2003. Observations on little known diseases of camels (Camelus dromedarius) in the Horn of Africa. Rev. Sci. Tech. Off. Int. Epiz., 22: 1043-1049.
9. Mahmud, A., A. Mohammed, M. Alayande, Y. Habila and M. Lawal, 2014. Prevalence and distribution of gastrointestinal parasites of working camels in Sokoto metropolis VeterinaryWorld, 7(3): 108-112.
10. Richard, D., 1976. The diseases of the dromedary (Camelus dromedarius) in Ethiopia. Ethiop.Vet. Bull., 2: 46-67.

11. Luckins, A. and A. Gray, 2008. An extravascular site of development of Trypanosoma congolense. Nature (Lond), 272: 613-614.
12. Tekle, T. and G. Abede, 2001. Trypanosomosis and helminthoses: major health problems of camels (Camelusdromedarius) in the Southern Rangelands of Borena, Ethiopia. Journal of Camel Practice and Research, 8(1): 39-42.
13. Bekele, T., 2002. Epidemiological studies ot an gastrointestinal helminths of dromedary in semi-arid lands of eastern Ethiopia. Veterinary Parasitology, 105: 139-152.
14. Thrusfield, M., 2005. Veterinary Epidemiology. (2nd edn), Blackwell Science Ltd, UK., pp: 234-238.
15. Woo, P., 2000. The haematocrit centrifuge technique for the diagnosis of African trypanosomiasis. Acta Trop, 27: 384-386.
16. Soulsby, E., 1982. Helminths arthropods and protozoa of domesticated animals.7 ed. London. BaillereTindall, pp: 231-250.
17. Boulange, A., J. Katende and E. Authie, 2002. Trypanosoma congolense expression of a heat shockprotein 70 and initial evaluation as a diagnosticantigen for bovine trypanosomosis. Exp, 100: 6-11.
18. Riviere, J. and M. Popich, 2009. Veterinary Pharmacology and therapeutics. 9ed. Blackwellcrosspp, pp: 1174-1175.
19. Banana, H., T. Sakurai, N. Inoue, C. Sugimoto and I. Igarashi, 2003. Cloning and expression ofmitochondrial heat shock protein 70 of Trypanosomacongolense and potential use as a diagnosticantigen. Clin Diagn Lab Immunol., 10: 926-933.
20. Mohammed, O., B. Megersa, R. Abebe, M. Abera and A. Regassa, 2011. Seroprevalence of Brucellosisin camelin and arowned Dere Dewa City, Eastern Ethiopia. J Anim Vet Adv, 10: 1177-1183.
21. Murtaz, U., M. Ghulam, G. Carlos, I. Zafar, S. Abdul and J. Adul, 2006. Prevalenceof Trypanosoma evansi infection in equines and camels in the Punjab Region, Pakistan. Ann. New York Acad. Sci., 1081: 322-324.
22. Murray, M., P. Murray and W. Mcintyre, 1977. An improved parasitological technique for the diagnosis of African Trypanosomiasis. Trans. R. Soc. Trop. Med. Hyg., 71: 325-326.
23. Yohannes, G., 1993. Prevalence of acute Trypanosomiasis in Ogaden camels, Report Submitted to Southeast Rangelands Project, Ethiopia, pp: 14.
24. ILRI., 2002. Food security in sub-Saharan Africa, Nairobi, Kenya. A paper reporting, pp: 148.
25. Tekle, T. and G. Abebe, 2001. Trypanosomes and helminthosis: Major health problems of camel (Camelus dromedarius) in the Southern Rangelands of Borana, Ethiopia. J. Camel Pract. Res., 8: 39-42
26. Abebe, W., 1991. Traditional Husbandry Practice and Major Health Problem of Camels in Ogaden, Nomadic people, 29: 21-31.
27. Bekele, M., H. Mohammed, M. Tefera and T. Tolosa, 2011. Small ruminant brucellosis and community perception in Jijiga District, Somali Regional State, Eastern Ethiopia. Trop Anim Health Prod, 43: 893-898.
28. Zeleke, M., 1998. Productivity, Reproductivity and health monitoring study on camel heard at Errer, Ethiopia (MSc, thesis, Alemaya University), pp: 96.
29. Njiru, Z., O. Bett, I. Ole-mapeny, J. Githiori and J. Ndung'u, 2002. Trypanosomosis and helminthosis in camels: comparison of ranch and traditional camel management systems in Kenya. J. Camel Pract. Res., 55: 67-71.
30. Elamin, E., E. Bashir and E. Saeed, 1998. Prevalence and infection pattern of Trypanosomaevansi in camels in mid-eastern Sudan. Trop. Anim. Health Prod., 30: 107-114.
31. Zeleke, M. and T. Bekele, 2001. Camel herd health and productivity in eastern Ethiopia selected semi-nomadic households. Revue Elev. Med. Vet. Pays. Trop., 55: 213-217.
32. Adam, K., J. Paul. and V. Zaman, 1971. Medical and veterinary Zoology, 185.
33. ITDG and ILRR, 1996. Intermediate Technology Development Group and International Institute of Rural Reconstruction
34. Magona, J., J. Mayende, W. Olaho-Mukani, P. Coleman, N. Jonsson, S. Welburn and M. Eisler, 2003. comparative study on the clinical, parasitological and molecular diagnosis of bovine trypanosomosis in Uganda.Onderstepoort J Vet Res, 70: 213-218.
35. Bekele, T., 1999. Studies on the respiratory disease 'Sonbobe' in camels in the eastern lowland of Ethiopia. Tropical animal Health and Production, 31(6): 333-345.
36. Bekele, T., 2002. Epidemiological studies on gastrointestinal helminths of dromedary in semi-arid lands of eastern Ethiopia. Veterinary Parasitology, 105: 139-152.

37. Njiru, Z., I. Ole-mapeny, J. Ouma, J. Ndung'u and W. Olaho-mukani, 2001. Prevalence of trypanosomosis in camel calves: a pilot study in Laikipia District of Kenya. Rev. Elev. Med. Vet. Pays. Trop., 34: 183-186.
38. Ahmed, A., A. Abdelaziz, S. Abusalab and M. Omer, 2007. Survey of brucelosi among sheep, goats, camels and cattle in Kassala Area, Eastern Sudan. J Anim Vet Adv, 6: 635-637.
39. Achenef, M. and B. Bekle, 2013. Drug and Drug Resisitance in Africa Animal Trypanomosis, European Journal of Applied Science, 5(3): 84-91.
40. Sharrif, L., K. Al-qudah and. F. Al-Ani, 1997. Prevalence of gastrointestinal helminthes in one-humped camel in Jordan. Journal of Camel Practices and Research, 41: 67-69.
41. Birhanu, A., 1986. Survey of camel helminthiasis in Harraghe Region, (Thesis, Faculity of Veterinary Medicine, Addis Ababa University)
42. Bamaiyi, P. and A. Kalu, 2011. Gastrointestinal parasites infection in one humped camels of Nigeria. Veterinary Research Forum, 2(4): 278-281.
43. Dirie, M. and O. Abdurahman, 2003. Observations on little known diseases of camels (Camelus dromedarius) in the Horn of Africa. Rev. Sci. Tech. Off. Int. Epiz., 22: 1043-1049.
44. Kamani, J.A. Turaki, G. Egwu A. Mani, S. Kida, J. Abdullahi and M. Damina, 2008. Prevalence of gastrointestinal parasites in camels (Camelus dromedaries) slaughtered in Maiduguri, Nigeria. Journal of Camel Practices and Res., 15(2): 181-182.
45. Anvari-Tafti, M., A. Sazmand, S. Hekmatimoghaddam and I. Moobedi, 2012. Department of Pathobiology, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
46. Borji, H., G. Razmi, A. Movassaghi, A. Naghibi and M. Maleki, 2010. A study on gastrointestinal helminths of camels in Mashhad Abattoir, Iran. Iranian Journal of Veterinary Research, 11: 174-179.