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Prevalence, risk factors and species' diversity of ixodid ticks that parasitize dromedary camel in Yabello District of Borana Zone, Southern Ethiopia

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A cross sectional study was carried out to investigate the prevalence and species' diversity of ixodid ticks that parasitize dromedary camel since October 2016 to March 2017. A total of 384 dromedary camels from five peasant association in Yabello District were examined. A total of 4417 ticks were collected from 374 camels. The average burden of the tick was 11.8 per camel while a male to female ratio was 1.9 to 1. Four genera: *Rhipicephalus* (85.6%) *Ambylomma* (3.65%), *Hyalomma* (5.57%) and *Boophilus* (1.34%) and eight species: *Rh. pulchellus, Rh. pravus, A. gemma, A. lepidium*, *A. variegatum, H.m. rufipes, H. dromedary* and *B. decoloratus* were identified with prevalence of 90.6, 28.4, 27.1, 2.9, 4.7, 18.5, 27.9 and 10.4%, respectively. *Rh. pulchellus* has preference for sternum, ana-vuval, head, udder/scrotum and inguinal, *Rh. pravus* for head, sternum and anal or and vulva; *A. gemma* for udder/scrotum and *B. decoloratus* in different body parts. *H. rufipes* preferred head, sternum and anal/vulva and *H. dromedary* preferred head, sternum, anal/vulva and udder/scrotum regions. Except *B. decoloratus*, all tick species had higher number of males than females. There was statistically significant difference in prevalence and level of tick infestation between pastoral associations (PAs) groups of Yabello District and herd size ($p<0.05$). Tick infestation was found to be among serious health problem of dromedary camel in the study area with higher risk of exposure of these animals to tick-borne diseases. Therefore, this problem observed in the study area warrants immediate professional intervention through implementation of community based sustainable control strategies.

Key words: Camel, ixodid tick, borana, Ethiopia

INTRODUCTION

Ethiopia is one of the largest camel populated countries in the world. In Africa, it ranks third next to Somalia and Sudan(Jilo, 2016). Its ability to withstand torrid heat and extreme desiccation are of paramount importance in determining its distribution. The normal distribution of camel is inthe Africa and Asian subtropical dry areas (Wilson et al., 1990). About 1.06 million of camels are found in Ethiopia distributed in Southern, Eastern, North Eastern arid and semi-arid regions of the country mainly in Borana, Ogaden and Afar region (FAO, 1993); 16.16% is reported in Borana zone (Workneh, 2002).

The camel plays an important role in the culture and

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agriculture of many countries. It is an important working animal of the arid and semi-arid ecosystem because of its unique adaptive physiological characteristics (Rabana et al., 2011). According to Dereje et al. (2015), camels were kept for different purposes. Likely the study of Amin (1984) reported that there are five main areas where camels can contribute under the Borana pastoral setting: milk and meat production, transportation service, wealth status indication and source of income generation. High milk and meat production was reported to be the primary purpose of camel production in the area followed by income generation, and transportation. Camel as back animals was reported in wide ranges of communities (Schwartz and Walsh, 1992; Melaku and Feseha, 2001; Raza et al., 2004). However, camel production is conversely affected by the occurrence of various diseases, in-adequate veterinary services and feed shortage (Bekele, 2010).

Besides various internal and external parasitic diseases, ticks are one of the major constraints to world livestock industry (Singh et al*.,* 2000; Dabasa et al., 2017; Mata et al., 2018). Ticks exert a major hindrance to improving animal production in the tropical and sub-tropical regions of the world by transmitting devastating often fatal livestock pathogens, causing blood loss, damage to hides and udder and paralysis (Zeleke and Bekele, 2004; Sumbria et al*.,* 2018). In Ethiopia, tick and tick borne diseases caused considerable losses to the livestock economy, ranked third among major parasitic diseases after trypanosomosis and endoparasitism (Pegram et al., 1981).

In Ethiopia, reports on camel ticks is scanty, despite the vital role that camels play in livelihood of Ethiopian nomadic society and the likely impact of tick on their productivity. In Yabello District PAs, camels are always under the risk of tick infestation and tick born disease challenges. There are different methods for controlling of ticks infestation in the area. These include removal of ticks and acaricides treatments. But still the challenge of tick on animals is still observed because the control methods practiced in the area have not covered wide area of the households.Hence, this study was attempted with the objectives to determine the prevalence, identify the genera and tick species circulating in the area and to know the abundance of dromedary camel Ixodidticks in selected PAs of Yabello District in Borana zone.

MATERIALS AND METHODS

Study area

The study was conducted in and around Yabello District, Southern Ethiopia from November 2016 to April 2017. The area is located in Oromia regional state situated at 565 km south of Addis Ababa and geographically located at 50 23’49 N latitude 390 31’52 E longitudes with elevation of 1857 meters. The study region is characterized by bimodal rainfall with 60% occurring in the long rainy season extending from mid-March to May and erratic short rain season from mid-September through mid-November. The cool dry season extends from June to August and the major dry season from December to February. The farming system comprises mainly pastoral area and seldom agro-pastoral areas. The region has predominantly a semi-arid climate. The annual temperature varies between 21 and 38°C and the rainfall ranges from350 to 900mm, with considerable spatial and temporal variability in quantities and distribution (BZPADO, 2010).

Study animals

The study was conducted on camels (*dromedarius*) from randomly selected five peasant associations, namely Jijidu, Didayabello, Bake, Cholkasa and Darito. The number of livestock of Boranazone on the basis of species are 1,052,277 cattle, 878,355 goats, 439,082 Sheep, 106,366 Camels, 651,351 Chicken,1,750 Mules and 61,699 Donkeys (CSA,2016).Whereas livestock population of Yabello District is composed of 83,717 cattle,42,591 sheep,84,159 goats and 18,613 camels (YWPDO,2016).

Sample size determination

The sample size was determined based on the formula recommended by Thrusfield (2007) as follows:

$$N = \frac{1.96^2 \, Pexp \, (1-Pexp)}{d^2}$$

Where, N= required sample size,Pexp = expected prevalence,d = desired absolute precision, 1.96^2 =z- value for 95% confidence interval.

There was no previously published and documented prevalence in the study area; therefore, sample size was calculated using expected prevalence of 50% by substituting the value. The required sample size was calculated to be 384.

Study design and methodology

A cross sectional study design was conducted to identify important tick species infesting camel in five randomly selected PAs of Yabello District. Age, sex and body condition and herd size of the animal were considered as variables on the prevalence and infestation rate of ticks. Based on body condition score the animals were classified as poor, medium and good according Faye et al. (2001).

This study was conducted during dry season from October 2016 to March 2017.Prior to tick collection, camels were randomly selected from the five PAs and restrained manually by the owners. Docile animals were restrained by massaging rear part or ventral to anal/vulva but for aggressive animals grasping of neck by rope by one person and the second person ties one of its front legs (forelegs bend tie).

Ethical consideration

Before the commencement of the research, it was reviewed and approved by Addis Ababa University Research and Ethics Review Board (REB). Animals involvedin this research were handled with good animal handling practice and consent was obtained from the owners of the animals to conduct the study.

Table 1. Prevalence of ixodid tick of camel among PAs.

PAs	Number of animal examined	Prevalence
Jijidu	32	29(90.6%)
DidaYabello	82	77(93.3)
Bake	75	75(100%)
Cholkasa	33	31(93.9%)
Darito	162	162(100%)
Total	384	374(97.4%)

x^2=17.621, p-value=0.001.

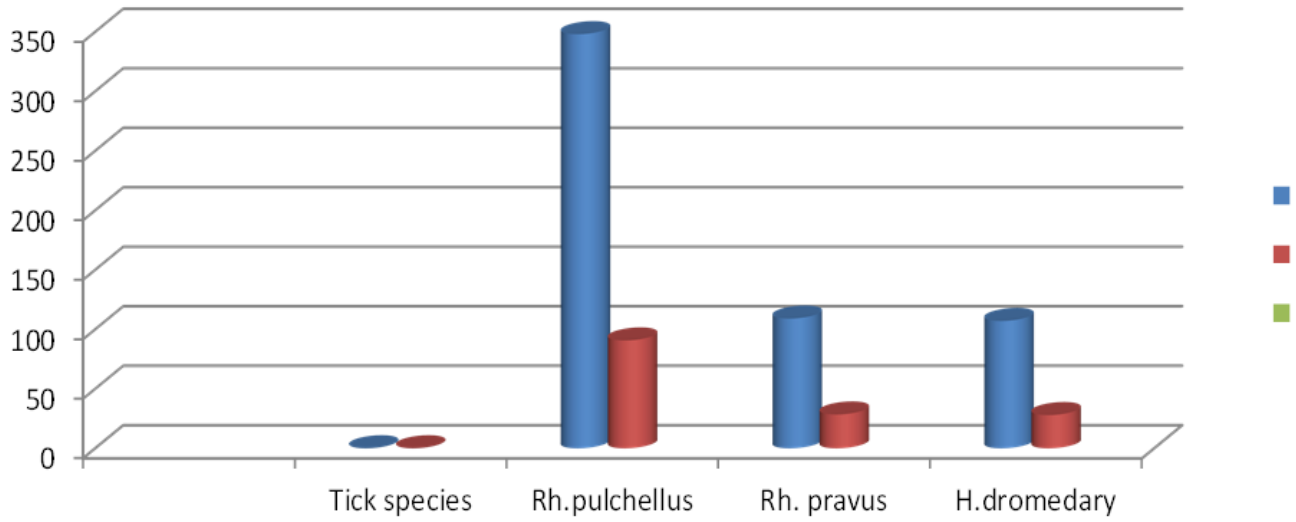

Figure 1. Summary prevalence in PAs.

Tick collection and examination

Tick collection techniques

All visible attached adult ticks were collected carefully and gently removed exerting a horizontal pull to the body surface by rotating the tick not to damage the host by the tick's mouth parts. The ticks were preserved in properly labelled plastic container containing 80% ethanol and 15% water with 5% glycerine. The host body regions that were used for ticks collections were: head, back, inguinal, tip of tail, sternum, udder/scrotum and anal/vulva body region of the animals. Collected ticks were put in universal bottle according to their predilection sites and labelled with date, place, sex and age. The ticks were transported to Yabello Regional Veterinary diagnostic laboratory for acaroscopy.

Tick identification

The ticks collected from each container were placed onto Petri dishes and examined under stereomicroscope to identify the species level using tick identification keys (Annex1) described by Onkello-Onen et al. (2006) and Walker et al. (2003). Briefly the main identification features of the ticks used were length of mouth part, eyes or eyeless, conscutum ornate or inornate, colour of legs, festoons or no festoons and anal plates or no anal plates.

Data analysis

All raw data collected were uploaded into Microsoft Excel 2007 computer program, then data analyzed by SPSS version 20 and summarized by using tables. Many attribute data that were imported to database system include sex, age, body condition, herd size and site (PAs).The prevalence was calculated as percent of infested animals from the total number of animals examined; differences in the relative proportions of tick species were analyzed by using Chi-square test.Logistic regression was applied to assess association of risk factors.P- value less than 0.05 at 95% confidence interval was considered for significance.

RESULTS

Overall prevalence of ixodid ticks

Ixodid ticks of camel were found highly prevalent in Yabello District with overall prevalence of 97.4% (374/384); and 100, 100, 93.3, 93.9 and 90.6% in prevalence of ticks was recorded in Bake, Darito, Cholkasa, Dida Yabello and Jijidu, respectively. There was a statistical significant variation ($p<0.05$) in prevalence of ticks between different PAs (Table 1 and Figure 1).

Table 2. Prevalence of tick species in Yabello district.

Tick species	Number of camels infested	Prevalence (%)
Rh.pulchellus	348	90.6
Rh. pravus	109	28.4
H. dromedary	107	27.9
A. gemma	104	27.1
H.m. rufipes	71	18.5
B. decoloratus	40	10.4
A. variegatum	18	4.7
A. lepidium	11	2.9

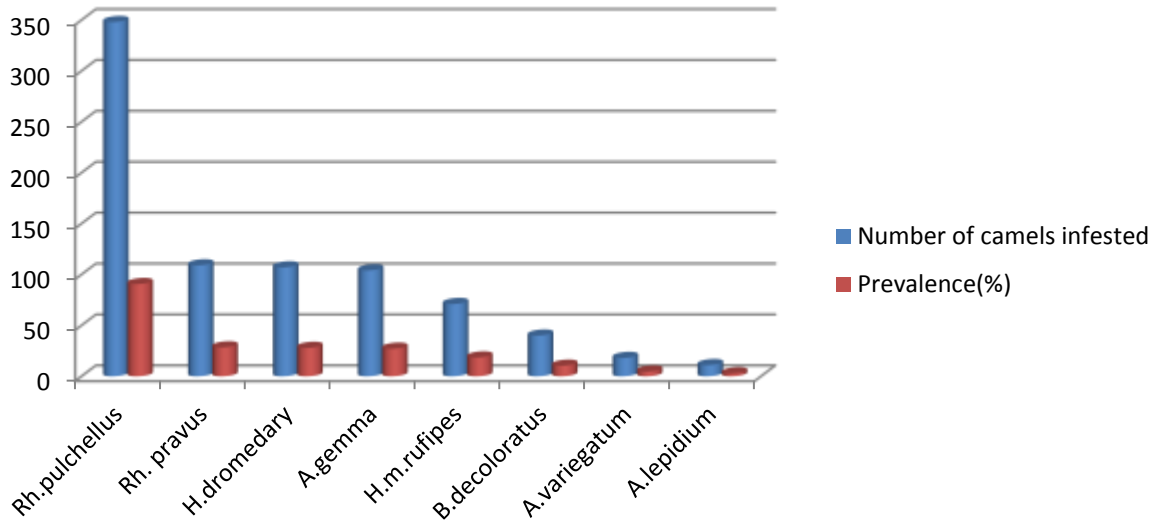

Figure 2. Prevalence of tick species in Yabello district.

Prevalence of tick genera and species in Yabello District

The four genera of ticks encountered were *Amblyomma*, *Rhipicephalus, Hyalomma* and *Boophilus*with prevalence of 3.65, 85.6, 5.57 and 1.34% respectively. While eight species of ticks *Rh. pulchellus, Rh. pravus, A. gemma, A. lepidium, A. variegatum, B.decoloratus, H.m.rufipes* and *H.dromedary*had a prevalence of90.6, 28.4, 27.1, 2.9, 4.7, 18.5, 27.9, and10.4%, respectively (Table 2 and Figure 2).

Proportion of tick species and male to female ratio

A total of 4417 hard ticks comprising four genera and eight different species were collected from 374 camels that were found to be positive for tick infestation. Generally, four Ixodide ticks genera and eight species were identified from the study area. The genera *Rhipicephalus* (85.6%) 1.34%, *B. decoloratus, Ambyloma* (3.6%) and *Hyalomma* (9.4%) (Table 3).The most predominant species in this study was *Rh.Pulchellus*with a proportion of 79%. The proportion of each tick species identified is indicated in Table 3.At species level, the male to female ratio of ticks was *Rh.Pulchellus*(1.8:0.4) *Rh.Pravus*(3.8:1.1), *A. gemma* (3.03**:**1.4), *A. lepidium* (1.4:1), *A. variegatum* (3:1), *H.m. rufipes* (5.2**:**1), *H. dromedary* (3.3**:**1.5) and *B. decoloratus* (1.5**:**6). The result indicated that there were more males than females in all the tickspecies except *B. decoloratus* and which had more females than males (Table 3).

Number and species of ticks collected in relation to attachment sites on the host and mean burden

This survey clearly figured out that every tick species prefers different attachment sites. Among those ticks attachment site, under anus/vulva, (34%) was the most preferred site, followed by sternum (33.8%), udder/scrotum (17.6%), head (12.36%), inguinal (0.84%),

Table 3. The Proportion of tick species and male to female ratio.

Tick species	No of collected ticks				
	Male	Female	Total	Proportion (%)	Male to female ratio
Rh.pulchellus	2215	1273	3488	79	1.8:0.4
Rh .pravus	228	64	292	6.6	3.8:1.1
A.gemma	91	41	132	2.9	3.03:1.4
A.lepedium	7	5	12	0.3	1.4:1
A.variegtum	15	5	20	0.45	3:1
H.m.rufipes	157	30	187	4.23	5.2:1`
H.dromedary	156	71	227	5.14	3.3:1.5
B.decolortus	9	50	59	1.34	1:5.6
Total	2878	1539	4417		1.9:1

Table 4. Number and species of ticks collected in relation to attachment sites on the host and mean burden.

Site of attachment	Type of tick species collected										
	RPU	RPR	AG	AL	AV	HR	HD	BD	Total	Mean burden	RP (%)
A/v	1081	51	102	-	8	115	134	11	1502	6.91	34
Sternum	1383	53	4	8	3	19	20	4	1494	6.25	33.8
Udder/scrotum	625	11	26	-	9	-	15	20	776	5.7	17.6
Head	271	176	-	-	-	45	54	-	546	5.6	12.36
Inguinal	28	1	-	-	-	8	-	-	37	3.7	0.84
Back	10	-	-	4	-	-	-	17	31	2.5	0.38
Tip of tail	20	-	-	-	-	-	4	7	31	2.5	0.38
Total	3488	292	132	12	20	187	227	59	4417	11.8	
Mean burden	10	2.67	1.26	0.11	1	2.63	2.12	1.5		11.8	

RPU= *Rh. pulchellus,* RPR = *Rh.pravus,* AG = *A.gemma,* AV = *A. variegatum,* HR=*H.m.rufipes,* HD = *H. dromedary,* BD=*B. decoloratus*,*RP= Relative prevalence.

back (0.38%),tip of tail (0.38%) (Table 4).The mean burden of ticks was found to be 11.8 ticks per head of camel and based on attachment sites it was found 5.6/head ticks on head,2.5 ticks/head on back, 6.3ticks/head on sternum,6.9ticks/head on anal/vulva, 3.7ticks/head on inguinal, 1.8ticks/head on tip of tail and 5.7ticks/head on udder/scrotum (Table4).

Major risk factors of ixodidtick infestation of camel in Yabello District

Based on risk factor assessment, sex, age and body condition scores were found to be statistically insignificant ($p>0.05$) and statistically significant variation ($p<0.05$) was only found between herd size (Table 5).

DISCUSSION

The result of the current study demonstrated that out of 384 camels examined, 374 (97.4%) were found to be infested with one or more species of ticks. This finding was higher than that of Yacob et al. (2010) who reported a prevalence of 61.6% of camel tick infestation in Eastern Ethiopia.Comparative findingsof camels' ticks were reported by Kiros et al. (2014) who revealed the prevalence of 96.6% in Southern zone of Tigray and from Nigeria Lawal et al. (2007) who reported a prevalence of 92.7%. The higher prevalence in the current study area could be largely due to the presence of wide cracking range of soil that helps larvae of ticks to stay long and survive the dry season of the year.

In this study, there is significant difference ($p<0.05$) of tick infestation within five PAs of the district. The high number of prevalence of tick infestation in study areas might be due to different factors. Geography and climate of the area are among those factors which are linked with variables such as:temperature, rainfall, humidity, vegetation, landscape and altitude and the role of these factors in leading to a higher abundance of ticks has been reported (Estrada-Pena, 2003)

In thisstudy, *Rh. pulchellus* was the top most prevalent tick species (90.6%) of the examined camels and

Table 5. Logistic regression analysis of prevalence of tick infestation against associated variables.

Variable		No. examined	No. positive (%)	X^2	p-value
Sex	Male	78	76(20.3)	0.001	0.980
	Female	306	298(79.8)		
Age	Young	101	98(26.2)	0.072	0.788
	Adult	283	276(73.8)		
BCS	Poor	5	5(1.3)	0.136	0.934
	Medium	77	75(20.1)		
	Good	302	294(78.6)		
Herd size	Small	150	145(38.8)	11.015	0.004
	Medium	67	62(16.6)		
	Large	167	167(44.7)		

constituted 79% of collected ticks. The result of this study was greater than the previous works of different researchers including Zelalem (1994), Abebe (2001), Zeleke and Bekele (2004) and Yacob et al. (2010) who reported prevalence of 52.63, 70.47, 85.2 and 27.86%, respectively but lower than previous work of kiros et al. (2014) who reported a prevalence of 92.7%.The high prevalence of these ticks in current study might be due to the fact that *Rh. Pulchellus* prefers savannah steppe and desert climatic regions.It is also among the commonest tick species present in North east Africa and Rift valley areas (Walker et al., 2003). *Rh. Pravus* (28.4%) was the second most abundant tick species found on camel in the study area and constituted 6.6% of collected ticks. This species so far has not been reported from camel but Regassa (2001) reported *Rh. pravus* (about 8%) on bovine from Southern Ethiopia (Borana) which disagrees with current result of *Rh. Pravus*.

Similarly, *H.dromedary* (27.9%) was also amongst the most abundant tick species in the study areaand constituted 5.14% of collected ticks. This result is in line with findings of Taddese and Mustefa (2013) and Abebe (2001) who reported 26.85 and 20.44% prevalence, respectively but lower than the findings of Kiros et al. (2014) and Lawal et al.(2007) who reported prevalence of 42.7 and 46.9%, respectively. There was slight difference with finding of Yacobet al. (2010) who reported 15.36% prevalence; however, much greater than the finding of Bekele(2010) in Boranalow land and Zeleke and Bekele (2004) with prevalence of 1.2 and 3.87% respectively.Thefact that *H.dromedary* has adaptation to extreme dryness and desert on camel hosts was confirmed by Walker et al. (2003).

A. gemma accounted for prevalence of 27.1% in the studyand constituted 2.9% of collected ticks.Similar finding has also been reported by kiroset al. (2014) with a prevalence of 22.9% in Northern Ethiopia.In contrast, it was greater than the finding of Abebe (2001), Zelalem (1994) Zeleke and Bekele (2004), Taddese and Mustefa (2013), and Yacob et al. (2010) who reported 5.7, 9, 7.1, 4.10, 11.35 and 15.10%,respectively. *A. gemma*, which has long mouth parts, is more important in inflicting udder damage and is of a risk factor for mastitis in camel (Bekele, 2010). The least tick species detected was *A. lepidium with* prevalence of 2.9 per cent.In line with this Kiros et al. (2014) reported a prevalence of 3.4%. *A. lepidium* is limited by semi-desert conditions (Morel, 1980). It is also known as East African ‘bonttick’;it adapts to dry habitats and occurs in arid and semi-arid areas (Walker et al., 2003).

The number of male ticks was higher than the number of females in all tick species except *B. decoloratus*in which the number of females was higher than the number of male ticks. This finding agrees with the reports of Abdisa (2012) and Badaso et al. (2014) who reported comparative results. This high number of male ticks may be attributed to the fact that fully engorged female tick drops off the host to lay eggs while males tend to remain on the host up to several months to continue feeding and mating with other females on the host before dropping (Solomon et al., 2001).

Camels in this study were affected by mean burden of11.8 ticks per animal.This finding is less than that of Kiros et al. (2014) who reported 42.4 ticks and others who also reported high numbers (Zeleke and Bekele, 2004; Bekele, 2010; Nazifi et al., 2011).This study finding also contradicts with the statements of Pegram(1981) that says ‘tick densities are usually greater in lowlands than highland areas’. The much lower tick burden recorded in our study could be due to extreme dry season with lower moisture in the environment adversely affecting the biology of tick.

Regarding the attachment sites of ticks on the host body, different tick species were found to be having preference for predilection sites in this study. Accordingly, *Rh*. *pulchellus* and *Rh. Pravus* had strong preference for

anal/vulva, sternum, udder/scrotum and head region while *A. gemma* for anal/vulva and udder/;*H. dromedary* and *H.m. rufipes* showed preference for anal/vulva, sternum and udder/scrotum. The *Boophilus* was distributed on anal/vulva, back, udder/scrotum and tip of the tail according to this study. This result is in line with the results of Stachurski (2000) and Tesgera et al*.* (2017) who stated that species like *Rhipicephalus* with short hypostomes usually prefer soft tissue like ear (head region according to this study), while ticks like *Ambylomma* and *Hyalomma* with longhypostome attach to lower parts of the animal body.

In the present study, among the considered variables as a factor for tick prevalence, only herd size had significant association ($p< 0.05$) with prevalence of tick. Animals in large herd size showed higher tick infestation than animals in medium and small herd size. In thiscontextthis may be due to the fact that in this study area constant feed scarcity to high population in large sized herd may favour close contact of these animals at available communal watering and grazing sites(contact point) favouring the establishment of tick infestation.

There was no significant variation in prevalence rate of tick infestation between age groups, sexes and different body condition score of animals. This result is in line with reports of Yacob et al. (2010) who reported age and sex of animal to be statistically insignificant ($p>0.05$). This might be due tohusbandry practiceswhich are also correlated with tick abundance and distribution. In this context, mixed grazing of different animal species on the same pasture and/or mixed housing provides maximum opportunity to ticks to infest a large population at one time

In conclusion, camel population in the study area is highly suffering from tick infestation. Even though our study was conducted in a very dry season, the tick challenge was higher. This might be due to the absence of strategic and community based tick control program which warrants due attention.

Recommendations

Ixodid ticks of camel were found highly prevalent (97.4%) in Yabello District. Camels were found to be infested with one or more tick species at the same time. Four genera of ticks namely, *Rhipicephalus, Ambylomma, Hyalomma* and *Boophilus* were identified and found highly prevalent. Eight species of Ixidid tick that were less abundant in other areas were encountered in this study area. Lack of programmed tick control, insufficient veterinary extension service combined with extensive management system may have contributed to high prevalence of Ixodid ticks.Based on the above conclusive remarks, the following recommendations are forwarded:

(i) Control strategies should be instituted immediately

(ii) Animal breeders and farmers must be educated about impact of ticks infestation on the health and productivity of animals

(iii) Traditional methods of tick control in the study area should be investigated

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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