

Full Length Research Paper

Study on prevalence and identification of ixodid ticks in cattle in Gursum district, East Hararghe Zone of Oromia Regional State, Ethiopia

Takele Tesgera*, Fikru Regassa, Bulto Giro and Abdinur Mohammed

National Veterinary Institute, Addis Ababa University College of Veterinary Medicine and Agriculture, Ethiopia.

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The current study on prevalence and identification of ixodid ticks in cattle was carried out in Gursum district, East Hararghe Zone of Oromia regional state, from November 2015 to April 2016. A total of 1447 ticks were collected from nine body parts of 384 cattle kept under extensive management system. Out of 384 cattle examined, 232 were found harbor one or more tick species. The identified tick species were *Amblyomma variegatum*, *Rhipicephalus evertsi*, *Rhipicephalus (Boophilus) decoloratus*, *Rhipicephalus pulchellus*, *Hyalomma marginatum* and *Amblyomma gemma*. The risk factors such as sex and age of animals, seasonal and agro ecological variation of tick infestation, predilection sites and male to female ratio of ticks were considered in this study. Among the risk factors considered, gender and age of animals did not show significant difference but predilection sites, seasonal and agro-ecological variation of tick infestation showed significant difference. Tick infestation was higher in wet season than in dry season. This study also indicated higher prevalence of ticks in mid-altitude and lowland areas than in highland areas. As to attachment sites, *A. variegatum* had preference for axillae, udder or scrotum; *R. evertsi* for base of tail and anus; *B. decoloratus* for different body parts; *R. pulchellus* for ear, tail, anus and scrotum/udder and *H. marginatum* for tail and ano-vulval areas. In case of male to female ratio, all the tick species had higher number of males than females except *B. decoloratus* which had higher number of females than males. With the occurrence of such degree of tick infestation in the area, the economic impact of ticks and tick-borne diseases in Gursum district and the country as a whole should be given a high priority in devising effective and sustainable control strategies of ticks.

Key words: Age, agro-ecology, Gursum, prevalence ratio, season, sex, species.

INTRODUCTION

Infestation of domestic animals by external parasites is one of the major challenges in the process of delivering

effective animal healthcare services in Ethiopia (Bekele, 2002). Ticks are among economically important

*Corresponding author. E-mail: takele.tesgera@gmail.com

ectoparasites losses to the livestock keepers and to the country as a whole through reduction of products and productivity of animals, serving as vectors of disease, damaging hide and skins and consequently resulting in rejection of hide and skins at industrial level (Bekele, 2002).

Besides being important vectors of animal diseases such as theileriosis, anaplasmosis, babesiosis and cowdriosis, ticks also cause nonspecific symptoms like anemia, dermatitis, toxicosis, and paralysis in animals (Gebre et al., 2007). Ticks are obligate blood feeding ectoparasites (Rajput et al., 2006). They occur worldwide in distribution, but principally occur in tropical and subtropical regions with warm and humid climate which are suitable to undergo metamorphosis (Kilpatrick et al., 2007).

In Ethiopia, there are 47 species of ticks affecting the livestock and most of them have importance as vectors of disease causing agents in addition to their damaging effects on hide and skins (Kassa, 2005). Even though a number of researchers have reported the distribution and abundance of different tick species in different parts of Ethiopia, no study has been carried out in and around Gursum district to determine the prevalence and type of tick species affecting cattle in the area. Therefore, the current study is conducted to identify the prevalence and type of tick species of cattle in the study area in order to plan effective and relevant control strategies on ticks and tick borne diseases.

METHODOLOGY

Study area

The study was conducted in Gursum district in East Hararghe zone of Oromia Regional State from November 2015 to April 2016. The district capital, Funyan bira town, is located at 600 km East of Addis Ababa, the capital city of Ethiopia. Geographically, the district lies between 9° 07' and 9° 32' North latitudes and 42° 17' and 42° 38' E longitudes. The total area coverage of the district is estimated at 76 to 261 hectares of land. The altitude of the district ranges from 1200 to 2938 m above sea level with the annual rain fall of 650 to 750 mm and the mean annual minimum and maximum temperature of 18 and 25°C, respectively. Gursum is bordered in the east by Somali regional state, in the west by Harari regional state, in the north by Jarso district and in the south by Babile district. It is inhabited by a human population of about 168476 people (CSA, 2013). The district is divided into 3 agro-ecological zones: highland (5%), midland (45%), and lowland (50%). The area has short rainy season (March to April) and long rainy season (June to August) According to GLFDO (2015).

Study population

The livestock population in the study area is estimated to be 116699 cattle, 73331 goats, 33474 sheep, 8735 camels, 18012 donkeys, 52881 chickens and 6625 beehives (2016). A total of sample population of 384 heads of cattle was examined out of the source population of 116699 heads of cattle in the district to determine the prevalence and species of ticks in the area. All the

cattle sampled were local breeds kept under extensive production system.

Study design

A cross-sectional type of study method was used to determine the prevalence and species of ticks in the area, their predilection sites on the animals, tick burden among different age groups and sexes, and seasonal and agro-ecological variation of tick infestation. The ages of animals were grouped into young (1 to 2 years), adult (3 to 7 years), and old (>8 years) according to Gaten (1991).

Sample size determination

Since there was no previous study conducted on ticks in cattle in the area, sample size was determined by assuming 50% prevalence of tick infestation in the area. The desired sample size for the study was calculated by the formula given by Thrusfield (2007). Therefore, if 95% confidence interval is required with 5% margin of error, the sample size (n) is determined by the formula:

$$n = z^2 p (1-p) / w^2$$

where n = sample size, p = prevalence, W = margin of error and z is a constant from normal distribution table.

Accordingly, the sample size (n) in this case was determined as follows:

$$n = (1.96)^2 \times 0.5(1-0.5) / (0.05)^2 = 384.$$

Therefore, sample size of 384 cattle was examined in the study.

Collection of ticks

The whole body surface of the animals were examined for the presence or absence of ticks and half body tick collection methods on the alternate sides were used to collect ticks from the animals and the result doubled to assess the overall burden of ticks (Keiser, 1987; Walker et al., 2003). Ticks were collected from different body sites such as ear, neck, axillae, leg, tail, anus, vulva, udder, scrotum and the belly after proper physical restraining of the animals. During collection, ticks were removed manually from different attachment sites of the animal body by a rotating manner to retain their body parts for identification (Wall and Shearer, 2001).

Data collection format was used to register the data during tick collection and proper labeling was made on universal bottles with permanent marker. Date of collection, address, species, sex, age, code of animal and sites of attachment were included in the labeling. Ticks collected from different body sites were preserved in different universal bottles, pre-filled with 70% ethanol, for each animal. Then, transported to Hirna Regional Veterinary Laboratory for further identification of the ticks at genera and species level.

Identification of ticks

Stereomicroscope was used to identify the ticks based on their morphological features such as mouthparts, scutum, color of legs, festoons, interstitial punctations, presence or absence of adanal shields, posterior groove and marginal spots. The taxonomic keys of Hoogstraal (1956), Walker (1974), Kaiser (1987) and Walker et al. (2003) were used to identify the ticks under stereomicroscope by manipulating each tick with wire loop.

Table 1. Overall prevalence of tick infestation.

Sex	Total Number of animals examined	Positive	Negative
Male	170	105 (61.8%)	65 (38.2%)
Female	214	127 (59.3%)	87 (40.7%)
Total	384	60.41667	152 (39.583)

Table 2. Number and species of ticks collected in relation to attachment sites on the host

Site of attachments	Type of tick species collected					
	<i>R. pulchellus</i>	<i>R. eversti</i>	<i>H. marginatum</i>	<i>B. decoloratus</i>	<i>A. variegatum</i>	<i>A. gemma</i>
Ear	25	1	-	-	-	-
Neck	-	-	-	52	7	-
Tail	20	103	40	-	-	-
Anus	16	83	13	-	-	-
Vulva	2	10	5	-	-	-
Axillae	2	2	3	37	355	2
Leg	-	-	2	18	5	0
Scrotum/Udder	22	3	5	41	563	8
Belly	-	-	-	2	-	0
Total	87	202	68	150	930	10

Data analysis

All the data recorded in this study was first entered into Microsoft excel and later analyzed by using SPSS software. Descriptive statistics was also used to analyze predilection sites of ticks on the animals. Chi-square test was used to determine the variation in tick burden among different age groups, sexes, agro-ecological zones, and seasons. 95% Confidence interval and 5% precision level was set for significance level.

RESULTS

A total of 384 cattle were examined out of which 170 (44.2%) were males and 214 (55.73%) were females (Table 1). 232 cattle (60.4%) were positive for one or more tick species. A total of 1447 ticks were collected which included *Amblyomma variegatum* 64.27% (930), *Rhipicephalus eversti* 13.96% (202), *Boophilus decoloratus* 10.37% (150), *Rhipicephalus pulchellus* 6.01% (87), *Hyalomma marginatum* 4.7% (68) and *Amblyomma gemma* 0.69% (10).

A. variegatum was recorded as the most prevalent tick species in the current study area followed by *R. eversti*, *B. decoloratus*, *R. pulchellus*, *H. marginatum* and *A. gemma* in descending order. Accordingly, *A. gemma* was found to be the least prevalent species out of the ticks identified (Table 3).

In this study, there was no statistically significant difference ($\chi^2=0.23$, $P>0.05$) in prevalence of tick infestation between male and female animals (Table 1).

It was revealed in this study that different tick species

have different predilection sites (Table 2). According to this result, *A. variegatum* had strong preference for axillae, udder or scrotum, *R. eversti* for base of tail and anus, *B. decoloratus* more or less for different body parts, *R. pulchellus* for ear, tail, anus and scrotum/udder, and *H. marginatum* for base of tail and ano-vulval areas.

At species level, the male to female ratio of ticks was *A. variegatum* (2.5:1), *R. eversti* (2:1), *B. decoloratus* (0.5:1), *H. marginatum* (2:1), and that of *R. pulchellus* was recorded as 1.4:1. The male to female ratio of *A. gemma* was not possible to figure-out, because there were no any female ticks identified in the counting. The result indicated that there were more males than females in all the ticks except in *B. decoloratus* which had more females than males.

Based on seasonal variation of tick infestation, the result indicated that there was statistically significant variation ($\chi^2=9.9$, $P<0.05$) between dry and wet seasons of the year. In dry season, prevalence of tick infestation was 50.3%; but the prevalence in wet season was higher which was recorded as 66.5% (Table 4).

In relation to agro-climatic distribution of ticks, the result of this study showed that there was high prevalence of ticks in the mid-altitude, 67.3% (152) and the lowland areas, 68.4% (54) compared to less prevalence of 32.9% (26) in highland areas. According to this analysis, there was statistically significant variation ($\chi^2=34.5$, $P<0.05$) among the three agro-ecological zones with the least prevalence recorded in highland areas (Table 5).

In terms of tick infestation in association with age

Table 3. Overall prevalence of tick species and male to female ratio.

Tick species	No. of ticks collected				
	Male	Female	total	Prevalence (%)	Male to female ratio
<i>Rhipicephalus pulchellus</i>	51	36	87	6.01	1.4:1
<i>Rhipicephalus evertsi</i>	134	68	202	13.96	2:1
<i>Boophilus decoloratus</i>	50	100	150	10.37	0.5:1
<i>Hyalomma marginatum</i>	46	22	68	4.7	2:1
<i>Amblyomma variegatum</i>	665	265	930	64.27	2.5:1
<i>Amblyomma gemma</i>	10	-	10	0.69	-
Total	956	491	1447	-	2:1

Table 4. Seasonal variation of tick infestation.

Season	Total number of animals examined	Positive (%)	Negative (%)
Dry	145	73 (50.3)	72 (49.7)
Wet	239	159 (66.5)	80 (33.5)
Total	384	232 (60.4)	152 (39.6)

Table 5. Agro ecological variation of tick infestation.

Agro-ecology	Total animal examined	Positive (%)	Negative (%)
Highland	79	26 (32.9)	53 (67.1)
Mid altitude	226	152 (67.3)	74 (32.7)
Lowland	79	54 (68.4)	25 (31.6)

Table 6. Prevalence of tick infestation in relation to age group of animals.

Age	Total animal examined	Positive (%)	Negative (%)
Young	142	78 (54.9)	64 (45.1)
Adult	220	141 (64.1)	79 (35.9)
Old	22	13 (59.1)	9 (40.9)

groups of animals (young, adult and old categories), the result indicated that there was no statistically significant difference (Table 6). The results recorded were that 54.9% (78) in the young, 64.1% (141) in the adult and 59.1% (13) in the old animals.

DISCUSSION

Different tick species are widely distributed in Ethiopia and a number of researchers reported the distribution and abundance of tick species in different parts of the country (Solomon et al., 2001; Goshu et al., 2007). In the current study, the overall prevalence of tick infestation was found to be 60.4%. This finding is in line with the

reports of Tadesse and Sultan (2004) with overall prevalence of 59.5%. However, the results of this study is lower than reports of Alemu et al. (2014) and Gedlu et al. (2014) who reported the overall prevalence of 81.5 and 74%, respectively. On the other hand, various research works have found less prevalence of tick infestation than the current study including the reports of Addis (2011) and Onu and Shiferaw (2013) who indicated tick prevalence of 25.64 and 14.5%, respectively.

At species level, *A. variegatum* was the most abundant tick species with prevalence of 64.27%. The result of this study was greater than the previous works of different researchers including Onu and Shiferaw (2013), Abebe et al. (2010), Tadesse and Sultan (2014), and Bedaso et al.

(2014) with prevalence of 4.75, 4.2, 32.2, and 41%, respectively. But this result is lower than the result of Messele (1989) in Bahir Dar with prevalence of 75.91%. The difference could be due to the difference in the agro-climatic condition of the study areas, because tick activity is influenced by rainfall, altitude and atmospheric relative humidity according to Pegram et al. (1981).

A. variegatum is the most widely distributed cattle tick in Ethiopia (Morel, 1980; Pegram et al., 1981) and has a great economic importance, because it is an efficient vector of *Cowdria ruminantium*, the causative agent of cowdriosis or heart-water in cattle (Morel, 1980). *A. variegatum* also causes the greatest damage to hides and skin because of its long mouthparts which downgrades the value of these products on world market if infestation is high (Solomon et al., 2001). Furthermore, trauma caused by tick-bite becomes favorable site for secondary bacterial infection.

R. evertsi was the second abundant tick species according to this study with prevalence of 13.96%. This result is in agreement with the previous work reported by Tamerat et al. (2015) and Alemu et al. (2014) with prevalence of 13.5 and 11.5%, respectively, but it is lower than the results of Abdisa (2012) and Huruma et al. (2015) who reported 50.9 and 53.4%, respectively.

B. decoloratus was the third abundant tick species in the area with prevalence of 10.37%. This result is slightly in agreement with the report of Tamiru et al. (2010) who indicated 15.4% prevalence. But this result is in disagreement with the report of Bossena and Abdu (2012) who reported higher prevalence in Assosa region. This difference might be due to *B. decoloratus* being abundant in wetter highlands and sub-highlands receiving more than 800 mm rainfall annually according to Pegram et al. (1981).

R. pulchellus was the fourth abundant tick in this study with prevalence of 6.01%. The result in this study is in agreement with the results of Wallaga (1997) who reported infestation of 6.97% in and around Debre Zeit.

H. marginatum was the fifth tick species reported in this study with prevalence of 4.7%. This result is also in agreement with the result of Kalil (2010) who reported prevalence of 5.05% in Goba and Robe districts of Bale zone. But the result of this study disagrees with the report of Meaza et al. (2014) who reported 33.13% prevalence in Bahir Dar which is much higher than our current result. On the other hand, the result of this study is higher than the reports of Hussen (2009) in Bako, Tamiru (2008) in Assela, and Tiki and Addis (2011) in and around Holeta who reported 1.2, 2.5 and 1.86%, respectively. The low prevalence of this tick species could be due to altitude difference between study areas as stated by Pegram et al. (1981).

A. gemma was the least abundant tick species identified in the area (0.69%). This result is in line with the previous result of Yitbarek (2004) who reported infestation of a single animal with 12 ticks of *A. gemma* in

Jimma areas similar to our current study which indicated 0.69% out of the total tick counts.

In the current study, the difference in prevalence of ticks was found to be statistically insignificant ($X^2=0.23$, $P>0.05$) between sexes of cattle. This result is in agreement with the results of Tesfaheywet and Simeon (2013) but disagrees with the previous works in Assosa by Bossena and Abdu (2012) who reported statistically significant difference between sex groups.

In association with age groups of animals, there was no difference in infestation level among age groups according to the current study. This result is actually in agreement with the reports of Tamiru et al. (2010) and the reports of Kalil (2010) who reported that the effect of age on the burden of ticks was not significant but disagrees with other reports by Gurmessa et al. (2015) who reported high degree of variation in tick infestation among age group of animals indicating that adult animals are more affected than young animals.

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 similar 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). The reason that female *B. decoloratus* outnumber the males could be due to the small size of males which may not be seen during collection (Tessema and Gashaw, 2010).

In this study, there was significant difference ($\chi^2=34.5$, $P<0.05$) in prevalence of tick infestation among the agro ecologies where significantly higher prevalence was recorded in mid-altitude and lowland areas (67.3 and 68.4%, respectively) compared to the situation in highland areas where 32.9% prevalence was recorded. This study result is in agreement with the work of Tedla (1991) who indicated that there was difference in infestation rate in different climatic zones showing high prevalence in lowland and mid-altitude areas compared to less prevalence in highland areas.

There was statistically significant difference ($\chi^2=9.9$, $p<0.05$) in seasonal infestation of ticks between dry and wet seasons of the year in the current study. According to the current result, infestation was higher in wet season, especially after the onset of short rainy season, than in dry season of the year. This result is very much in agreement with the previous results of Tedla (1991) who reported seasonal variation of tick prevalence indicating that the number of ticks on livestock decreases in dry season and increases after the short rainy season in eastern Hararghe region.

In relation to the attachment sites of ticks on the host body, different tick species were found to be having

different predilection sites in this study. Accordingly, *A. variegatum* had strong preference for axillae, udder or scrotum; *R. evertsi* for base of tail and anus; *B. decoloratus* more or less for different body parts; *R. pulchellus* for ear, tail, anus and scrotum/udder and *H. marginatum* for base of the tail and ano-vulval areas. The result of this study is in line with the results of Stachurski (2000) who stated that short hypostome ticks like *Rhipicephalus* usually prefer upper body parts including nape of neck and margin of anus and under tail, while long hypostome ticks like *Amblyomma* attaches to lower parts of the animal body which is also the case in the current study.

CONCLUSION AND RECOMMENDATIONS

In this study, high prevalence of *A. variegatum*, which has great economic impact due to its effects of disease transmission and physical trauma to animals, was identified along with other tick species such as *R. evertsi* and *B. decoloratus* which also have role in disease transmission and other effects on the health of animals. Even though prevalence of ticks is high in the area, proper policies and strategies are not yet in place to control external parasites including ticks. Awareness of livestock owners on the impact of ticks on their livelihoods is low. Furthermore, financial and material support from public sector to animal healthcare system is not sufficient to promote control programs on ticks.

Therefore, sustainable tick control program should be put in place in order to reduce the current trend of prevalence to lower level. In the consequence of this conclusion, the following recommendations are suggested:

- (1) Awareness campaign on tick control should be promoted among livestock owners
- (2) All stakeholders concerned with livestock production and healthcare programs should make concerted effort to plan and implement effective control programs on ticks and other external parasites.
- (3) Sufficient budget should be allocated for the purchase of chemical sprays and spraying equipment on yearly basis.
- (4) Varieties of drug choices should be used alternately in order to reduce the potential of drug resistance.
- (5) Animal healthcare education should be provided to livestock owners to have know-how on how to prevent their animals from tick infestation.
- (6) Environmentally friendly acaricide products and injectable drugs should be used.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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