

Prevalence and risk factors of ticks infesting cattle reared on the main campus of Haramaya University, Eastern Ethiopia

Adem Abdella, Yimer Muktar and Adem Hiko*

College of Veterinary Medicine, Haramaya University, P.O. Box. 138 Dire Dawa, Ethiopia

*Corresponding Author: E. mail: adex.2010ph@gmail.com

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Abstract

Tick infestation is a major problem constraining animal production and productivity in Ethiopia showing the need for tackling the situation. A cross-sectional study was carried out to determine tick prevalence and associated risk factors among cattle reared on dairy, beef and free-range grazing farms of Haramaya University from November 2014 to April 2015. A total of 519 animals were randomly selected. Ticks were collected and identified under stereomicroscopic examination. A total of 384 (73.9%) animals were positive for tick infestation which was higher on both beef (79.2%) and dairy (82.3%) than on free-range grazing (32.4%) cattle with OR = 8 (95% CI 4.2-16.9) and OR= 9 (95% CI 5.0-18.8) in beef and dairy animals, respectively. Infestation was significantly lower on Borana breed (20%; 95% OR CI 0.5-1.99) than on others. Difference in infestation between sexes and among the age groups of animals were not observed ($p > 0.05$). Of positive cattle, 52.9%, 12.8%, 7.0% and 27.3% were infested with single, two, three and four genera of ticks, respectively. In positive animals, subgenus *Boophilus* (51.0%), *Amblyomma* (58.3%), *Hyalomma* (48.2%) and *Rhipicephalus* (53.1%) tick genera were observed. Multiple tick genera infestation were more frequent in cattle managed under both beef (34.7 to 62.9%) and dairy (22.2 to 55.1%) farm types than that of free-range (4.4 to 14.8%) farm types. All the currently encountered tick genera infested 48.5%, 46.8% and 4.8% of beef, dairy and free range grazing cattle farms, respectively. The result showed all animals are found in endemic environment for tick infestation and thus the burden might cause economic losses mainly by reducing milk and meat yields, body weight gain, skin and hides quality, and risk of tick-borne diseases. Therefore, tick infestation in the study farms warrants strategic tick control approaches.

Keywords: Beef farm; Dairy farm; Free-range grazing; Infestation; Tick genera

Introduction

Tick infestation and tick-borne diseases (TBDs) are the major problems in livestock production in Sub-Saharan Africa (Mattioli *et al.*, 2000; Jongejan and Uilenberg, 2004). Tick-borne diseases, namely, East Coast Fever, anaplasmosis, babesiosis and cowdriosis have been reported to affect the optimal livestock productivity in East African region (McCosker *et al.*, 1993). Apart from acting as vectors for TBDs, ticks have been recognized as important ectoparasites of livestock by sucking blood, causing local necrosis which results in low quality hides (Jongejan and Uilenberg, 2004), secondary bacterial infections (Ambrose *et al.*, 1999), lowering productivity in terms of weight gain (Pegram and Oosterwijk, 1990) and milk yield (Sajid *et al.*, 2007), increasing susceptibility to the other diseases (De Castro, 1997), dermatosis, toxicosis and paralysis (Solomon Gebre and Kaaya, 1998). Based on the number of hosts required to complete their development during their life cycle, ticks can be classified as one-host, two-host and three-host ticks (Walker *et al.*, 2003). Due to medical and veterinary importance of ticks, their control and the transmission of tick-borne diseases remain a challenge for the cattle industry in tropical and subtropical areas of the world (Lodos *et al.*, 2000). Tackling ticks is a priority for many countries in tropical and subtropical regions (Lodos *et al.*, 2000) including Ethiopia (Solomon Gebre and Kaaya, 1998; Sileshi Mekonnen *et al.*, 2001; Feyissa Regassa, 2001). In Ethiopia, ticks incur the economic loss when they infest cattle. Several previous studies were made on tick prevalence, body distribution, number, male to female ratio (Solomon Gebre and Kaaya, 1998; Mekonnen Sileshi *et al.*, 2001; Feyissa Regassa, 2001; Belew Tiki and Mekonnen Addis, 2011, Tadesse Birhanu and Sultan Abdella, 2014) on cattle in different parts of Ethiopia. Although ticks cause huge economic loss of significance in the livestock industry in Ethiopia, not much research work has been done to elucidate the extent of the problem in the present study area. Therefore, this study was conducted to determine tick prevalence and degrees of infestation as well as associated risk factors in three cattle farming systems of Haramaya University in Ethiopia.

Materials and Methods

Study area

The study was undertaken from November 2014 to April 2015 on the main campus of Haramaya University, which is located in the East Hararighe Zone of Oromia Regional State, Ethiopia, at the distance of about 500 km east of Addis Ababa, the capital city of Ethiopia. The altitude of study area is about 2047m above sea level and located at 41° 59' 58" latitude and 09° 10' 24" longitudes. The area has native grasses and legumes interspersed vegetation with open Acacia shrub land and 18°C mean annual temperature and 65% relative humidity and receives 900 mm annual rainfall with a bimodal distribution pattern, peaking in mid-April and mid-August. There are four seasons, as a short rainy season (mid-March to mid-May), a short dry season (end of May to end of June), a long wet season (early July to mid-October) and long dry season (end of October to end of February). Main pasture production is expected after the short rain season, continuing until the end of the long wet season (NMSA, 2013).

Study animals and farm description

The animals selected for the study were drawn from different production systems: dairy, beef and free grazing production systems. The dairy farm consisted of Holstein Friesian and Jersey exotic breeds with few pasture grazing period. Preventive veterinary practices like use of anthelmintics, vaccination, manual removal and other biosecurity were periodically applied (Adem Hiko and Anteneh Wondimu, 2011). Beef farm animals are mainly the Hararighe highland local breed purchased from different districts of East Hararighe Zone, of Oromia Regional State. The animals are kept for three or more months under semi-extensive farming system with frequent grazing. On the other hand, the free-range grazing production system is of the Borana local breed cattle used mainly for research purpose. They are totally kept under free range pasture grazing condition.

Study design and sample size determination

A cross-sectional study was carried out on the selected cattle farm type. The required sample size for the study was determined according to formula given by Thrusfield (2007) at 50% expected prevalence, 5% desired precision and 95% confidence interval. The computed sample size was 384, but the number

was increased to 519 animals. These animals were sampled using systematic random sampling techniques by taking into account the variation of age, sex, breeds and body condition of animals of the 3 breeds of cattle. Age of the animals were determined as young (<1 year), adult (1-3 years) and old (> 3 years) (Nicholson and Butterworth, 1996). The body condition scores were classified as good, medium and poor were based on criteria set by Nicholson and Butterworth (1996).

Tick collection and laboratory examination

The whole body part of each study animal was examined for the presences of ticks. From positive animals, ticks were collected into universal bottles by considering the body regions of the animal. The collected ticks were preserved in 70% ethyl alcohol and transported to Parasitology Diagnostic Laboratory, College of Veterinary Medicine, Haramaya University. Identification and classification into respective genera was made according to Walker *et al.* (2003) guidelines using gross and stereomicroscopic examination.

Data analysis

The collected data from the field were entered into excel sheet and analyzed by using SPSS version 20. Microsoft excel spread sheet. The data were analyzed by using Statistical Package for Social Students (SPSS) version 21 and Win-Pepi 11.35 soft wares. Descriptive statistics was used to determine the tick infestation and assess any association between the tick infestations with host risk factors (sex, age, breed and body condition score). In all the analyses, confidence level was held at 95% and $P < 0.05$ was set for significance.

Results

Overall 73.9% of examined cattle were positive for tick infestations (Table 1). Tick prevalence in free-range grazing farm (32.4%) was significantly lower than in both beef farm (79.2%; OR = 7.9; 95% OR CI 4.2-16.9) and dairy farming (82.3%; OR = 9.6; 95% OR CI 5.0-18.8). Significantly lower ($p < 0.05$) on Borana breed (20%; 95% OR CI 0.5-1.99) than others. But differences in infestation between sex gropes ($p > 0.05$) and among age groups of animals were not observed ($p > 0.05$).

Table 1. Overall tick prevalence in study cattle farming systems based on the considered risk factors.

Risk factors		No. Examined	No. (%) Positive	OR*	95% OR CI	P-value
Farm type	Free grazing farming	71	23 (32.4)	1	0.6-1.6	0.00
	Beef farming	245	194 (79.2)	7.9	4.2-16.9	
	Dairy farming	203	167 (82.3)	9.6	5.0-18.8	
Breed	Borana	65	13 (20.0)	1	0.5-1.99	0.00
	Holstein Friesian	178	145 (81.5)	17.6	8.2-38.6	
	Hararighe H*	247	202 (81.8)	17.9	8.6-38.6	
	Jersey	29	24 (82.8)	19.2	5.5-74.1	
Sex	Female	244	167 (68.4)	1	0.9-1.13	0.174
	Male	275	217 (78.9)	1.7	1.14-2.6	
Age	Adult	216	145 (67.1)	1	0.6-1.52	0.06
	Young	79	54 (68.4)	1.1	0.59-1.9	
	Old	224	185 (82.6)	2.3	1.45-3.7	
Body condition	Good	231	134 (58.0)	1	0.68-1.47	0.00
	Medium	224	187 (83.5)	3.6	2.3-5.8	
	Poor	64	63 (98.4)	45	7.5- 184	
Total		519	384 (73.9)			

Note: Hararighe H* = Hararighe Highland Breeds; *OR=Odds ratio; CI = Confidence interval

Four tick genera, consisting *Subgenus Boophilus*, *Amblyomma*, *Hyalomma* and *Rhipicephalus* were observed respectively on 51.0%, 58.3%, 48.2% and 53.1% infested animals (Table 2). Infestation percentage by these tick genera was variable in degrees but observed in all farm types, breed, sex, age and body condition of animals.

As shown in Fig.1, single to multiple of three tick genera and one subgenus infestation were frequent in cattle managed under both beef (34.7-62.9%) and dairy (22.2-55.1%) farming stems than that of free-range farm (4.4-14.8%).

Table 2. Prevalence of tick genera in study cattle farming systems based on the considered risk factors

Risk factors of		No. of positive animal	No. (%) of positive animal for tick genus			
			<i>Subgenus Boophilus</i>	<i>Amblyomma</i>	<i>Hyalomma</i>	<i>Rhipicephalus</i>
Farming system	Beef farm	194	91 (46.9)	116 (54.8)	91 (46.9)	103 (53.9)
	Dairy farm	167	93 (55.7)	91 (54.5)	83 (49.7)	89 (53.3)
	Free grazing farm	23	12 (52.2)	17 (73.9)	11 (47.8)	12 (52.2)
Breed	Borana	13	7 (53.9)	7 (53.9)	5 (38.5)	9 (69.2)
	Holstein Friesian	145	86 (59.5)	80 (55.2)	71 (48.9)	74 (51.0)
	Hararighe Highland	202	94 (46.5)	126 (62.4)	95 (47.0)	106 (52.5)
	Jersey	24	9 (37.5)	11 (45.8)	14 (58.3)	15 (62.5)
Sex	Female	167	95 (56.9)	95 (56.9)	88 (52.7)	88 (52.7)
	Male	217	101 (46.5)	129 (59.5)	97 (44.7)	116 (53.5)
Age	Adult	145	71 (48.9)	89 (61.4)	74 (51.0)	83 (57.2)
	Young	54	28 (51.9)	25 (46.3)	22 (40.7)	19 (35.2)
	Old	185	97 (52.9)	110 (59.5)	89 (48.1)	102 (55.1)
Body condition	Good	134	72 (53.7)	76 (56.7)	62 (46.3)	75 (55.9)
	Medium	187	99 (52.9)	111 (59.4)	96 (51.3)	92 (49.2)
	Poor	63	25 (39.7)	37 (58.7)	27 (42.9)	37 (58.9)
Total		384	196 (51.0)	224 (58.3)	185 (48.2)	204 (53.1)

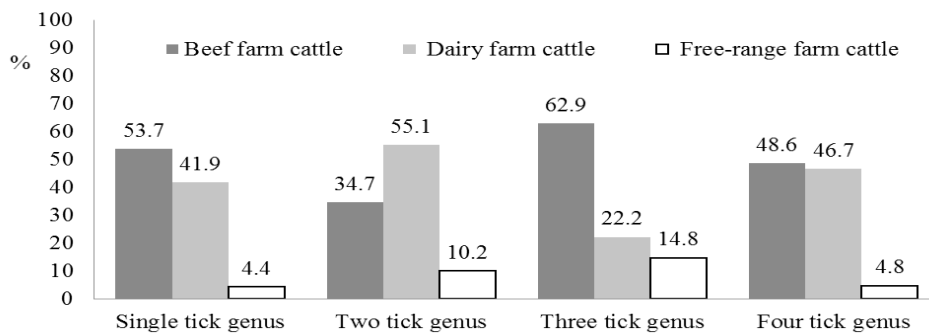


Figure 1. Single to multiple tick genera on cattle in the study farming systems

For all genera combination, highest infestation was observed in beef farm followed by dairy than the free-range type (Table 3). Beef farm (48.5%), dairy farm (46.78%) and free range razing farm (4.8%) tick positive cattle were infested by four tick genera (*Subgenus Boophilus*, *Amblyomma*, *Hyalomma*, and *Rhipicephalus*).

Table 3. Multiple tick genera from infested cattle by the cattle farm type

Tick Status	Tick genera	No. (%) of positive tick animal by farm type			Total No. (%)
		Beef	Dairy	Free-range	
Single tick genera	<i>Subgenus Boophilus</i>	16 (50.0)	15 (46.8)	1 (3.1)	32 (8.3)
	<i>Amblyomma</i>	41 (60.3)	22 (32.4)	5 (7.4)	68 (17.7)
	<i>Hyalomma</i>	19 (48.7)	19 (48.7)	1 (2.6)	39 (10.2)
	<i>Rhipicephalus</i>	33 (51.6)	29 (45.3)	2 (3.1)	64 (16.7)
	<i>Sub total</i>				203 (52.9)
Two tick genera	<i>Subgenus Boophilus, Amblyomma</i>	11 (37.9)	15 (51.7)	3 (10.3)	29 (7.6)
	<i>Boophilus, Hyalomma</i>	4 (28.5)	9 (64.3)	1 (7.1)	14 (3.6)
	<i>Subgenus Boophilus, Rhipicephalus</i>	2 (33.3)	3 (50.0)	1 (16.6)	6 (1.5)
	<i>Sub total</i>				49 (12.8)
Three tick genera	<i>Subgenus Boophilus, Amblyomma, Hyalomma</i>	3 (60.0)	1 (20.0)	1 (20.0)	5 (1.3)
	<i>Subgenus Boophilus, Amblyomma, Rhipicephalus</i>	4 (80.0)	1 (20.0)	0 (0)	5 (1.3)
	<i>Amblyomma, Hyalomma, Rhipicephalus</i>	10 (58.8)	4 (23.5)	3 (17.6)	17 (4.4)
	<i>Sub total</i>				27 (7.0)
Four tick genera	<i>Subgenus Boophilus, Amblyomma, Hyalomma, Rhipicephalus</i>	51 (48.5)	49 (46.78)	5 (4.8)	105 (27.3)
	<i>Sub total</i>				105 (27.3)
<i>Grand total</i>		194 (50.5)	167 (43.5)	23 (5.9)	384 (100)

Discussion

Three hundred eighty-four (73.9%) of examined cattle were found to be infested with one or more tick genera, showing high chance of tick occurrence in the studied farms. It was higher than the 25.64% previous reports of Belew Tiki and Mekonnen Addis, (2011) in Holeta, Ethiopia. Tick prevalence in the studied dairy farm (82.3%) and beef farms (79.2%) were significantly higher than in free-range grazing farms (32.4%). This finding is consistent with the results reported of Pawlos Wasihun and Derese Doda (2013) in Humbo district, which was 61%. However, the result of this study contrast the previous report of Belew Tiki and Mekonnen Addis (2011) who reported tick infestation of 45.4% in cattle kept under extensive production and 10.06% in those under semi-intensive farms. It was hypothesized that regular livestock management can be reduced tick infestation in semi intensive animal while movement in extensive farming exposes cattle to tick infestation (Pawlos Wasihun and Derese Doda, 2013; Belew Tiki and Mekonnen Addis, 2011). However, the present study dairy animals were kept under few grazing period after rainy seasons (Adem Hiko and Anteneh Wondimu, 2011) which might exposed endemic tick population within the farm and the surrounding area.

With regard to beef animals, relatively higher tick prevalence situation could be associated with the collection of already infested animal from different part of east Hararighie like Kersa, Chalenko, Kobo, Haramaya and others districts and kept without treatment until slaughter. This could due to distribution of tick population in various agroecology and infesting the livestock in the location. Mekonnen Sileshi (1996) has also reported the risk and distribution of various tick genera in cattle under various agroecology of Ethiopia.

The differences among breeds with low (20.0%) in Borana breed cattle than the 81.5% in Holstein Friesian, the 82.8% in Jersey and the 81.8% in Hararighe highland were contradictory with reports of Belew Tiki and Mekonnen Addis (2011) who reported the highest prevalence in local breed (44.96%) than in both cross (15.83%) and Jersey (8.50%) breeds. The differences could be associated with the risk and differences in the farm management systems, prevalence of tick population in confined farm (Furlong *et al.*, 2007). The majority of Borana breeds are free grazing which averted the risk of drug resistant tick (Kagaruki, 1991) in cases of the present study farm. The higher tick prevalence in those of Hararighe Highland breed might be associated with purchase of already

infested beef cattle and kept still untreated, in the campus. These animals may also act as sources of various tick genera and species for the dairy and free grazing cattle farms as well as for sheep and goat in the respective farms.

The low tick prevalence (58.0%) in those with good body conditions than in medium (83.5%) and poor (98.4%) body condition animals were similar to the reports of Getachew Alemu *et al.* (2014) on cattle in Northwest Ethiopia. The higher prevalence of ticks in the poor body condition scores than other counter parts could be due to the less resistance behavior of weak animals to ticks infestation and the condition was aggravated by significant effects of tick on animal performance.

This study revealed similar tick infestation in females (68.4%) and males (78.9%) animals which might be due to equal exposure of both sex groups of animal. Present finding is similar with the 63.4% in males and 60.9% in females reports of Musa *et al.* (2014) in Northern Nigeria. Again similar tick infestation among adult (67.1%), young (68.4%) and older (82.6%) cattle were observed in this study which could be due to equal exposure of all studied animals regardless of age and sex under respective farming systems. But, tick infestation in younger animals had a significantly higher (85.4%) than adult (55.8%) and older animals (35.0%) (Musa *et al.*, 2014). The difference might be due to variation in their immunity level against tick in cattle of Ethiopia and Nigeria.

Subgenus *Boophilus*, *Amblyomma*, *Hyalomma* and *Rhipicephalus* were important genera of ticks encountered with a total prevalence of 51.0, 58.3, 48.2 and 53.1% respectively. Similar genera of ticks were reports in and around Asella town by Tessema and Gashaw (2010) and in Fitcha Selale, North Shewa by Tadesse Birhanu and Sultan Abdella (2014) indicating the widely distributions of these tick genera in different agroecology and geographic areas Ethiopia. The current finding showed genera of subgenus *Boophilus* (51.0%) in infested cattle in the study area and found higher than the 18.1% in and around Holeta Town (Belew Tiki and Mekonnen Addis, 2011), 15.4% in and around Asella town (Tessema and Gashaw, 2010), in Rift Valley region of Ethiopia (Solomon Gebre and Kaaya, 1998), 23.5% in Fitcha (Tadesse Birhanu and Sultan Abdella, 2014). Morel (1980) stated that subgenus *B. decoloratus* is often collected in Ethiopia and abundant anywhere. But, the higher report from the current

finding could be associated with the wetter highlands and sub-highlands environment of Haramaya district (NMSA, 2013).

The prevalence of *Amblyomma* (58.3%) was comparable with 60.1% in and around Asella town (Tamiru Tessema and Abebaw Gashaw, 2010), but higher than the 39.1% from Fiche by Tadesse Birhanu and Sultan Abdella (2014), 45% in and around Assosa town (Bossena Fantahun and Abdu Mohamed, 2012) all from Ethiopia. *Hyalomma* (48.2%) infested cattle was higher than the 12.4% (Tadesse Birhanu and Sultan Abdella, 2014) in Fiche and 2.5% (Tessema and Gashaw, 2010) in and around Asella town. This could be due to differences in agroecology, animal management and *Hyalomma* tick burden in various area of the country. *Rhipicephalus* (53.1%) was higher than the 22% (Tessema and Gashaw, 2010), 25.0% (Tadesse Birhanu and Sultan Abdella, 2014). Moreover, the present finding of *Rhipicephalus* was higher than 31.4% reports of Kassa and Yalew in 2012 from Haramaya district showing increased prevalence of this genus in the area either due to absence of animal treatment or change in whether condition.

The observation of 52.9%, 12.8%, 7.0% and 27.3% single, two, three and four tick genera combinations infested animals with diversified tick genera in Haramaya University main campus cattle farms, and possible co-existence of different tick genera both on infested animals and in geographic area with various distribution. Similarly Hezron *et al.* (2012), Lynen *et al.* (2008) and Ogden *et al.* (2005) indicated co-existence of different tick genera between the geographic distributions of one another. This could be due to presence of suitable shrub land, temperature, relative humidity, and bimodal rainfall distribution in the studied area (NMSA, 2013) which might be favor the survival and multiplication different tick genera in the presence cattle in the area (Pegram *et al.*, 1981; NMSA, 2013).

Conclusion

The results of this study demonstrated that all cattle in the study sites and farms were infested by ticks of Subgenus *Boophilus*, *Amblyomma*, *Hyalomma* and *Rhipicephalus* tick genera. In addition, the number of ticks found on the animals from all breeds of cattle was found to be relatively small. Therefore the result clearly showed that all animals are found in endemic environment in which the burden do not cause economic loses mainly by reducing milk and

meat yields, body weight gain, and risk of tick borne diseases. In addition, direct effect of ticks through skin and hide damage which downgrades quality and responsible for rejection of the product from national and international markets is also minimal. Therefore, tick infestation in the farms in the present epidemiological situation warrant strategic tick control in all study farms. In order to ascertain the current findings further studies such as prevalence of ticks to the species level and seasonal dynamics and biology of major economically important tick species should be conducted in the study areas. Only when we have these data it is possible to formulate the type of tick control methods in the present study areas and elsewhere.

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