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Survey on Bovine Babesiosis and its Tick Vector in and Around Bishoftu Town, Central Oromia, Ethiopia

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Abstract: A cross-sectional study was carried out in and around Bishoftu town from November, 2015 to April, 2016 to determine the prevalence of bovine Babesiosis and identify its tick vector and to identify associated risk factors in local zebu. Thus, a total of 384 blood samples were collected from cattle and examined by thin smears using Giemsa stain for detection of *Babesia.* The Packed Cell Volume of the animals was also conducted to determine anemia. The overall prevalence of bovine Babesiosis in the study area was found to be 2.6% and *B. bigemina* was the only species of the parasite identified. There was no significant difference (P>0.05) in the prevalence of Babesiosis between the age, sex and body conditions of the animals examined. However, the prevalence of the Babesiosis was significantly (P<0.05) higher in tick infested (7.6%) than non infested (1.6%) animals. Furthermore, the present study revealed that the overall tick infestation in study area was 17.2% and the major genera of tick identified were *Amblyomma* (46%), *Rhipicephalus* (30%) and Hyalomma (24%). The mean PCV value of parasitemic cattle was higher (22.45%) than the mean PCV value of parasitemic (19.6%) cattle. In conclusion, the prevalence of bovine babesiosis in the study area was low, but highly associated with tick genera of *Rhipicephalus*. However, it has a paramount importance to conduct further study on the prevalence and epidemiological aspect of the disease via immunological based study. In order to alleviate the existing trends, it is far better to adopt appropriate tick control and strategic prophylactic treatment in the area.

Key words: Babesiosis · Bishoftu · Bovine · Ethiopia · Tick Vector · Prevalence

INTRODUCTION

Ethiopia is one of the countries with the largest number of livestock in Africa and a livestock product plays a major role in the development of Ethiopians' agriculture. Nevertheless, cattle productivity is low. This may be due to disease, improper management, nutritional deficiencies, harsh environment and genetic factors [1].

Tick-borne diseases are present throughout the world, but are most numerous and exert their greatest impact in the tropical and subtropical regions [2, 3]. Many of the tick-borne diseases are haemoparasitic [3, 4]. Their effects often depend on the species and immunity of the host and can vary from development of severe disease to a completely sub clinical infection without any signs of disease [6].

Babesiosis is one of the tick-borne diseases of domestic and wild caused by the genus *Babesia*. Almost any mammals, that serves as a host for a *Babesia* infected tick is a potential reservoir [7]. Bovine babesiosis is caused by intra-erythrocytic protozoan parasites, which is belongs to protozoan parasites of the phylum *Apicomplexa*, class *Sporozoasida*, subclass *Piroplamsia*, order *Piroplasmida*, suborder *Piroplasmorina* and family

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Babesiidae [8]. They are commonly referred as 'piroplasmas' due to the pear-like shaped merozoites which live as small parasites inside RBC of mammals. *Babesia* is the second most common parasite found in the blood of mammals after *Trypanosomes* [7]. More than 100 known *Babesia* species have been identified, that infect many types of mammalian host. Out of these, 18 species cause disease in domestic animals notably in cattle, sheep, goats, horses, pigs, dogs and cats. Bovine babesiosis is caused by multiple species: such as *B. bigemina*, *B. divergens*, *B. bovis*, *B. major*, *B. ovata*, *B. occultans* and *B. jakimovi*. Two species namely *B. bigemina* and *B. bovis* have a considerable impact health and productivity of cattle in tropical and subtropical countries [10]. In addition to its tick vectors, *Babesia* can also spread by biting flies transplacentally and via blood transfusion [11].

Tick borne disease manifest different types of clinical signs that vary in severity from silent infection to acute circulatory shock with anemia, depending on susceptibility, immunity, age of the host, *Babesia* species and parasite load [10]. Infected animals develop a life-long immunity against re-infection with the same species of *Babesia*. There is also evidence of a degree of cross-protection in *B. bigemina* immune animals against subsequent *B. bovis* infection. Calves rarely show clinical signs of disease after infection regardless of the *Babesia* species involved or the immune status of the dams [11].

As ectoparasites ticks are responsible for various types of pathological conditions such as: tick-borne diseases, anemia, irritation, skin abrasion, tick toxicity, tick worry, bite wound and loss of udder which provides portal entry for secondary bacterial infection [12].

A number of studies have been conducted on ticks of cattle in various parts of Ethiopia and several species of ticks belonging to genus *Amblyomma*, *Rhipicephalus*, *Hyalomma* and *Haemaphysalis* have been reported by Nibret *et al*. [13]. However, only few and fragmented studies were carried out with regard to tick borne diseases in Ethiopia. Moreover, due to absence of efficient and sustainable tick control approaches and owing to the marked pathogencity of *Babesia* species, bovine Babesiosis have a devastating effect and continue to remain a threat to the productivity of cattle [9]. In Ethiopia, bovine Babesiosis is one of the least studied hemparasitic protozoan disease.

Therefore, the objectives of this study were:

- To determine the prevalence of bovine Babesiosis and its tick vectors in and around Bishoftu town.
- To identify potential risk factors that contribute to the occurrence of bovine Babesiosis and its tick vectors in the study area.
- To recommend possible control and preventive measures for bovine Babesiosis and its tick vectors.

MATERIALS AND METHODS

Description of Study Area: The study was conducted from November 2015 to April 2016 in and around Bishoftu. Bishoftu town is located in Eastern Shewa Zone of Oromia Regional state about 45 km east of Addis Ababa. The area is located at 9°N latitude and 40°E longitudes at an altitude of 1850 meters above sea level in central part of Ethiopia. It has an annual rainfall of 866 mm of which 84% is in the long rainy season (June to September). The dry season extends from November to February. The mean annual maximum and minimum temperatures are 26°C and 14°C, respectively with mean relative humidity of 61.3% [14].

Study Population: The target animals used in this study were local zebu cattle (*Bos indicus*), which were kept under different production systems with different age, body condition and both sex. Body condition score of animals were classified as emaciated (Poor), moderate and good based on the flesh and fat cover at different body parts of cattle [15]. Animals age were also classified as young (less than three years), adult (three to seven years) and old (above seven years) categories as described by De-Lahunta and Habel [16].

Study Design: A cross-sectional study was carried out from November 2015 to April 2016 to determine the prevalence of bovine babesiosis and identify its tick vectors in and around Bishoftu town central Oromia, Ethiopia.

Sampling Method and Sample Size Determination: The study animals were sampled randomly involving sex, all age and body condition groups. The desired sample was calculated according to the formula given by Thrustfield [17]. It was determined by assuming 50% expected prevalence of bovine babesiosis at 95% confidence interval and 5% absolute precision. As result, a total of 384 cattle were selected using systematic random sampling technique by considering every fifth animal.

Collection of Ticks, Blood Sampling and Transportation: Blood sampling and tick collection were done after proper restraining of the animals according to Urquhart *et al*.

[18]. For thin smear, blood sample was collected with heparinized microhaematocrit tube (Capillary tube) after proper disinfection and preparation of marginal ear vein with alcohol. And, again cattle blood was collected from Jugular vein using EDTA coated vacationer tubes and labeled with all necessary information's, for PCV determination. Finally, blood samples collected were transferred to ice box and thin smears prepared were placed in slide box for proper transportation to the laboratory.

From cattle that were infested with ticks; all observed ticks were collected by gentle rotation of ticks using fingers from their attachment sites and transferred to labeled universal bottle containing 70% ethyl alcohol. Then, all samples collected were dispatched to Addis Ababa University, College of Veterinary Medicine and Agriculture, parasitology laboratory for further parasitological and hematological processes. Tick burden on each animal was assessed and categorized as: none (0), few (1 to 20 ticks), moderate (21 to 50 ticks) and abundant (above 51 ticks) according to the description given by Feben [19].

Packed Cell Volume (PCV) Determination: Blood samples obtained from jugular veins were used for PCV determinations. Capillary microhaematocrit tubes were filled approximately ¾ of its length, then the tubes were sealed at one end with crystal seal and placed in microhaematocrit centrifuge with sealed end lying at the outer most. After screwing the rotary cover and closing the centrifuge lid, the specimens were allowed to centrifuge at 12,000 rpm for 5 minutes. After centrifugation, the capillary tubes were placed in a haematocrit reader. The length of the red cells column was expressed as a percentage of the total volume of blood (PCV) [20].

Blood Film Preparation and Examination: Giemsa staining procedures and microscopic examination of slides were conducted according to OIE [21]. Thin blood smears were made on clean and dry glass slides with a drop of blood taken from marginal ear vein on field. Then the thin smear was allowed to dry in air, subjected to fixation with absolute methyl alcohol for 5 minutes and eventually stained by Giemsa stain for 30 minutes after it has been transported to laboratory. The smears were washed one by one with tap water to remove extra stain and were air dried. Then examined under the oil immersion lens (x100) of a light microscopic according to Zafar *et al.* [22]. The parasites were identified according to the morphological characteristic illustrated by Soulsby [23] and Moretti *et al*. [24].

Identification of Ticks: During identification of ticks petri-dish, forceps, filter paper, stereo microscope and marker were used. The ticks were transferred from universal bottle containers to petri-dish and then spread onto filter paper to absorb excess preservatives. They were examined under stereomicroscope for morphological identification of ticks to their genus level according to standard identification keys given by Walker *et al*. [25].

Data Analysis: The raw data generated from the study were coded and entered in Microsoft Excel sheet database system. Using Statistical Package for Social Science (SPSS) version 20 computer program, the data were analyzed. The Pearson's chi-square test was used to measure the association between prevalence of the parasite with the potential risk factors and ANOVA was used to assess the difference in mean PCV% of the animals in among *Babesia* infected and non-infected. For all analysis, $P<0.05$ was considered as statistically significant.

RESULTS

Prevalence and Distribution of Bovine Babesiosis Based on Risk Factors: From a total of 384 cattle examined, the overall prevalence of bovine Babesiosis in this study area was 2.6 % (n=10) and *B. bigemina* was identified. The study revealed that there was no significant variation ($P>0.05$) among age groups, sex, body condition scores and seasons of study period. However, tick status (Present or absence) and tick burden revealed a statistical significant variation ($P<0.05$) in the occurrence of Babesiosis. Among tick infested animals, those infested by moderate tick burden (21.4%) were followed by few tick burden (4%). On the other hand, autumn was the season of higher infection with prevalence of (3.1%) followed by winter (2.1%), but there was no significance difference ($P>0.05$) (Table 1).

Occurrence of Babesiosis Based on Genera of Tick Vector: The highest infection was observed in cattle infested by genera of *Rhipicephalus* (51.5%) and *Amblyomma* (5%). However, the animals infested by

Table 1: Prevalence of bovine Babesiosis on the basis of risk factors

Risk factors	No of examined animals	Positive	Prevalence (%)	x^2	P-value
Age					
Young	61	1	1.6	0.668	0.716
Adult	176	4	2.3		
Old	147	5	3.4		
Sex					
Male	277	8	2.9	0.316	0.574
Female	107	2	1.9		
Body condition					
Poor	214	6	2.8	0.515	0.773
Moderate	152	4	2.6		
Good	18	0	0		
Season					
Winter	190	4	2.1	0.369	0.544
Autumn	194	6	3.1		
Tick status					
Present	66	5	7.6	7.767	0.005
Absent	318	5	1.6		
Tick burden					
None	318	5	1.6	21.332	<0.001
Few	50	2`	4		
Moderate	14	3	21.4		
Abundant	2	0	0		

Table 2: Occurrence of Babesiosis based on tick genera

Identified tick genera	No of cattle infested by tick	No of animals positive for *Babesia*	Proportion (%)	χ^2	P-value
Amblyomma	40	2	5		
Rhipicephalus	29	8	51.5	10.835	0.001

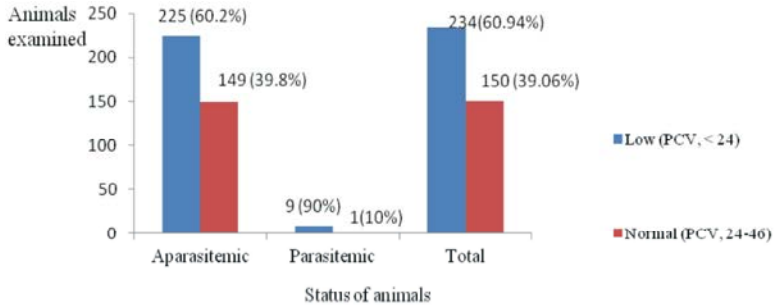

Fig. 1: Percentages of PCV value of parasitemic and aparasitemic cattle

genus of *Hyalomma* were negative for babesiosis. Tick infested cattle by genera of Rhipicephalus showed a statistical significant difference (P<0.05) with the occurrence of babesiosis as compared to *Amblyomma* infested cattle (Table 2).

Packed Cell Volume (PCV) Results: The overall studied animals, 60.94% (n=234) were registered as animals with low PCV (< 24) and 39.06% (n=150) were registered as animals with normal PCV (24 - 46) value. From the examined animals, 60.2% (n=225) of aparasitemic and 90% (n=9) of parasitemic animals were with low PCV value, whereas 39.8% (n=149) of aparasitemic and 10% (n=1) of parasitemic animals were found within normal range of bovine packed cell volume measurement (Fig. 1).

The mean PCV value of aparasitemic (22.45%) cattle was higher than the mean PCV value of parasitemic (19.6%) cattle (Table 3)

Prevalence and Distribution of Ticks

Tick Infestation of Cattle: The study revealed 19.8% (n =76) of examined cattle were found to be infested by one or more ticks. The major identified tick genera were *Amblyomma* 10.42 % (n=40), *Rhipicephalus* 5.2 % (n=20) and *Hyalomma* 4.2 % (n=16) (Fig. 2).

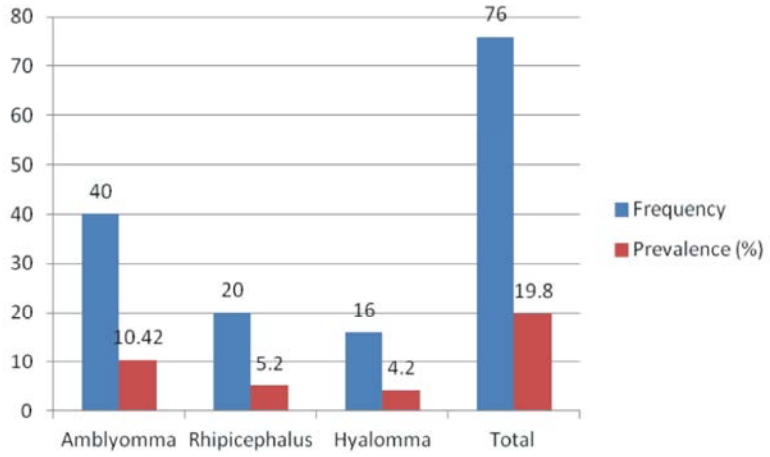

Fig. 2: Prevalence of tick infestation of cattle

Key, * = Total number of animals infested is lesser than the summation of individual infested, because some animals were infested by more than one type of tick genera.

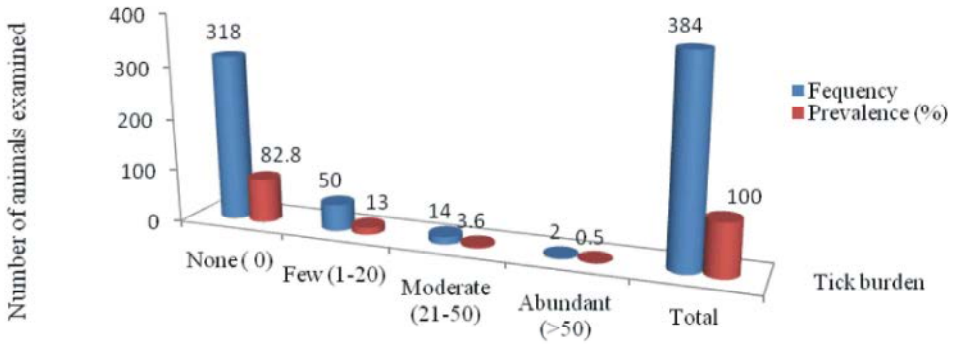

Fig. 3: Status of tick burden of cattle

Table 3: Tick infestation of cattle on the basis of risk factors

Variables	No of animals tested	No of animals positive	Prevalence (%)	χ^2	P-value
Age					
Young	61	12	19.7	0.344	0.842
Adult	176	30	17		
Old	147	24	16.3		
Sex					
Male	277	51	18.4	1.046	0.306
Female	107	15	14		
Body condition					
Poor	214	40	18.7	1.016	0.602
Medium	152	24	15.8		
Good	18	2	11.1		
Season					
Winter	190	23	12.1	6.825	0.009
Autumn	194	43	22.2		

Tick Infestation of Cattle on the Basis of Risk Factors: There was no significance difference ($p>0.05$) with regard to infestation by ticks between age, sex and body conditions of the animals. Nevertheless, there was significant difference in the infestation of ticks between the seasons of the study period (Table 3).

Tick Burden of Cattle: Beyond three quarter of cattle 82.8% (n = 318) were free of tick infestation while 13% (n = 50) were with few, 3.6% (n = 14) were infested by moderate tick burden and 0.5% (n = 2) of the cattle were harboring abundant ticks during the study period (Fig. 3).

Table 4: Tick burden on the basis of risk

	Degree of tick burden (%)					
Risk factors	None (%)	Few (%)	Moderate (%)	Abundant (%)	χ^2	P-value
Age						
Young	49 (80.3)	10(16.4)	2(3.3)	0(0)	1.355	0.969
Adult	146 (83)	23(13.1)	6(3.4)	1(0.6)		
Old	123 (83.7)	17 (11.6)	6(4.1)	1(0.7)		
Sex						
Male	226(81.6)	39(14.1)	10(8.6)	2(0.7)	1.811	0.612
Female	92(86)	11(10.3)	4(3.7)	0(0)		
Body condition						
Poor	174(81.3)	31(14.5)	8(3.7)	1(0.5)	1.831	0.935
Moderate	128(84.2)	17(11.2)	6(3.9)	1(0.7)		
Good	16(88.9)	2(11.1)	0(0)	0(0)		
Season						
Winter	167(87.9)	18(9.5)	5(2.6)	0(0)	7.827	0.05
Autumn	151(77.8)	32(16.5)	9(4.6)	2(1.0)		
Total	318	50	14	2		

Table 5: Numbers of tick genera collected and identified in different body parts of cattle

	Identified tick genera			
Tick attachment sites	*Amblyomma*	*Rhipicephalus*	*Hyalomma*	Proportion (%)
Head	-	2	-	0.2
Ear	4	6	6	1.9
Scrotum/udder	176	16	86	32.8
Belly	6	2	-	0.9
Dewlap/neck	94	187	72	41.6
Vulva/perianal	44	14	20	9.2
Under tail	46	-	22	8
Brisket	8	23	-	3.7
Legs	10	2	2	1.7
Total	388	252	208	100

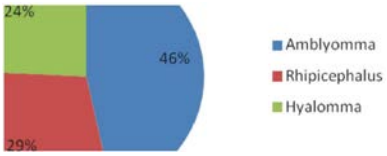

Fig. 4: Pie chart revealing percentage share of the relative number of tick identified

The present study indicated the tick burden was higher in adult and old, male, poor and moderate body condition group as compared to young, female and good body condition animals, respectively. Tick load was higher during autumn than winter seasons of study period. The degree of tick burden has statistically significant ($P<0.05$) between seasons (Table 4).

Proportion of Tick Genera: During this study period, about 848 ticks were collected and subjected to further laboratory identification to genus level. Accordingly, the most abundant tick was *Amblyomma* 46 % (n=388) followed by *Rhipicephalus* 30 % (n=252) and *Hyalomma* 24 % (n = 208) (Fig. 4).

Predilection Site of Ticks: All four genera indentified during the study period in study area were mostly collected from udder/scrotum, dewlap/neck, vulva/ perineum. Again some of them were collected from other body parts of the animals such as head, ear, belly, under tail and leg. In this study, the highest preferred site of ticks were dewlap and neck (42%) followed by udder/

scrotum (33%), vulva/perianal (9%), under tail/axial (8%) and the least tick load was observed on head (0.2%). The observed proportion of tick genera attachment site during study period was summarized and indicated in Table 5.

DISCUSSION

The results of the present study showed that the overall prevalence of bovine Babesiosis at the study area was 2.60% (n=10) and *B. bigemina* was responsible for the occurrence of Babesiosis. This finding was higher than the report of Sitotaw *et al.* [28] and Bihonegn *et al.* [29] who reported that it was 0.6% and 1.5% in and around Bishoftu and in and around Assosa district, respectively. However, the finding was lower as compared to previous studies conducted by Ahmad and Hashim [30] Hamsho *et al*. [31], Fethu *et al.* [32] and Patcharathorn *et al*. [33] who reported that the prevalence was 6.6% in Malakand Agency, 16.9% in Teltele District, Borena Zone, 23% Jimma Zone and 26.6% forest in Salakpra Wildlife Sanctuary in Kanchanaburi province, respectively. The discrepancy might be due to different factors like management systems, proper use of antiparasitic drugs or acaricides, sensitivity of the test used, distribution of infected vector accessibility of animals to wildlife sanctuary and forest area harboring the *Babesia* vectors [7] geographical locations, breeds of cattle and sample size [34].

The highest prevalence of Babesiosis was noted among old age (3.4%) followed by adult (2.3%) and young age cattle (1.6%). This result was in agreement with the result of Hamsho *et al*. [31] and Fethu *et al.* [32] from Teltele District and in and around Jimma, respectively. However, the result was not similar with the finding of Amorim *et al*. [6] who reported that calves were more susceptible to *Babesia* species when compared to adult cattle. The reason for the present result could be due to the fact that young animals, particularly calves under six months of age have maternal immunity acquired from colostrums feeding.

In the present study, the higher prevalence was recorded in male (2.9%) than female animals (1.9%). This finding was in line with the report of Bihonegn *et al.* [27] who reported that the prevalence was higher in male animals. However, Hamsho *et al*. [31] from Teltele District reported that it was higher in female animals. This difference might be due to the fact that male animals are subjected to trek long journey for drought purposes and stressful work that suppress the immune system of the animals.

Furthermore, the present result stated that Babesiosis was higher in poor body condition (2.8%) followed by moderate (2.6%) body condition. This result was similar with the report of Bihonegn *et al.* [29] in and around Assosa district. This could be due to the fact that animals with poor body condition have lower immunity which makes them prone to different infections.

The result also indicated that the occurrence of Babesiosis was higher during autumn season (3.1%) than in winter season (2.1%). This finding was supported by the report of Bihonegn *et al*. [29] who reported that the infection rate of Babesiosis was higher in autumn (2.99%). This could be due to the prevalence of tick borne hemoparasitic disease were low during dry and higher in rainy season [35].

Similarly, the occurrence of Babesiosis was higher in tick infested cattle (7.6%) than non-tick infested cattle (1.6%) and this was statistically significant ($P<0.05$). Furthermore, animals harboring moderate tick burden were more susceptible to Babesiosis than non-infested and animals infested by few and abundant tick burden. It was also showed significant variation ($P<0.05$). The animals carrying abundant tick burden did not show any confirmed case. This might be due to the type of genera or species of tick infested the animals were not vector for *Babesia*. The occurrence was also high in animals infested by *Amblyomma* and *Rhipicephalus* with 46% and 30%, respectively and thus, there was significant difference in animals infested by the *Hyalomma* ($P<0.05$). This result was supported by the report of Alekaw [11] who stated that the occurrence of Babesiosis caused by hemoparasites is related to the presence and distribution of the vector.

Besides this, the mean PCV value of infected cattle (19.6%) and non infected cattle (22.45%) were below normal range and about 60.2% of aparasitemic and 90% of parasitemic animals were registered in to have a PCV of less than the normal range. The difference in PCV value could be deducted into the cause of low PCV (Anemia) in parasitemic cattle occur as a result of *Babesia* together with other factors whereas anemia in aparasitemic cattle might be due to other factors such as others tick born disease and inadequate nutrition.

In the present study, the overall prevalence of tick infestation was 17.19%. This finding was lower than results reported by Pawlos and Derese [36] at SNNP region, Belew and Mekonnen [37] from Holetta and Tesfaheywet and simeon [36] from Bench Maji Zone. This could be due to long dry season of present study period. A tick infestation was tending to decrease during the dry season as compared to the wet seasons [39].

The prevalence of tick infestation was highest in young (19.7%) followed by adult (17.0%) and old (16.3%) age animals. This finding was supported by the result of Kabir *et al*. [40] who reported that young cattle were more susceptible to tick infestation in Chittagong district, Bangladesh. The reason could be attributed to the fact that age, nutrition and hormonal level of the host can influence natural or acquired immunity of cattle to ticks; as the animals increasing in age there was a decreasing in tick infestation [41]. However, this finding was in contrast with the study of Ammanuel and Abdu [40] who reported at Soddozuria Districts, Wolaita Zonethat old animals were more vulnerable.

The sex wise prevalence also indicted that male animals were more infested (18.4%) than female animals (14%).This result was comparable with Chungu *et al*. [43]. who stated that males are more susceptible than female animals. Although the exact cause of higher prevalence of tick in males cannot be explained, but it could be attributed to the fact that males were higher in number in the study sites during the study period.

The finding also indicated that animals with poor body condition were more vulnerable (18.7%) than those with moderate (15.8%) and good body condition (11.1%). This result was harmony with finding of Bianchi *et al*. [41] who reported highest tick infestation in the British cattle breeds having the lowest body condition. It could be due to the fact that animals in poor body condition are less resistant to tick infestation and lack enough body potential to build resistance.

The occurrence of tick infestation was higher during autumn season (22.2%) than winter (12.1%) season and there was significance difference ($P<0.05$). This variation might be due to changes in climatic condition.

The most abundant identified tick genus in the present finding was *Amblyomma* with the proportion of 46%. This result was in line with the report in Asella by Behailu [44] Awassa by Mehari [45] MizanTeferi by Seid [46] and Jimma by Yitbarek [49] who found *Amblyomma* as the most abundant tick genus. *Hyalomma* was also accounted to be the most abundant (24.53%) in the present study area. This high abundance of *Amblyomma* and *Hyalomma* might be due to changes in environmental conditions, with the result of global warming that highly affects the ecology of ticks. *Rhipicephalus* was the second most abundant (30%) tick genera in this study. This result was in contrast with Tadesse and Sultan [49] who reported *Rhipicephalus* as the second most abundant in Fitche Selale. The least tick genera observed throughout this study period was *Hyalomma* (4.2%), this was in disagreement with the finding of Behailu [44] who reported *Rhipicephalus* as the first most abundant tick at Asella. These might be due to the geographical location, altitude factors and or seasons of study which made them not to be abundant equally.

It was also showed that the preferred attachment sites of ticks were udder/scrotum, dewlap/neck, vulva/perineum and other body parts. This finding was similar to the reports of Behailu [44] and Seyoum [49, 50] who reported that the predilection sites of ticks were udder/scrotum, dewlap/neck and vulva/perineum in North Wollo Zone and Asella, respectively.

Higher tick infestation in certain sites could be ascribed to the fact that ticks prefer warm, moist and hidden sites with good vascular supply and thin skin [51, 52].

CONCLUSION AND RECOMMENDATIONS

In conclusion, the present findings indicated that bovine Babesiosis had less prevalence in the study area. This might be due to low tick infestation rate, increase number of private veterinary pharmacy. *Babesia bigemina* was identified as the species responsible for bovine Babesiosis. Prevalence of bovine Babesiosis was significantly higher in animals infested by tick genus of *Rhipicephalus*. It has shown that parasitized animals have lower PCV than non-parasitized animals. Overall prevalence of tick infestation (17.19%) was less than most findings reported from different parts of Ethiopia. The prevalence of tick infestation was higher in autumn season than winter season. The most abundant tick genera investigated was *Amblyomma* and the least one was *Hyalomma*.

Based on the above points, the following recommendations are forwarded:

- Further research should be conducted to elucidate the impacts and epidemiology of bovine Babesiosis using immunological methods and its tick vectors to implement better control measure against ticks and tick borne diseases of cattle and to validate the present study.
- In order to keep it up and alleviate the existing problem and to promote the status of livestock production more feasible in these areas, regular strategic prophylactic treatment and use of acaricides should be enhanced in order to control *Babesia* parasite
- Regular survey of cattle for tick is recommended for inclusion into routine management of cattle in the region.

- Awareness creation should be adopted for those farmers that their livelihood relies on rearing animals.

REFERENCES

1. CSA:Central Statistics Authority, 2009. Central Statistics Authority, Agricultural sample survey. Statistical bulletin 302, Addis Ababa, Ethiopia.
2. Zemene, Z. and M. Addis, 2012. Assessment of major factors that cause skin defects at Bahir Dar 2015. Pre-slaughter, slaughter and post-slaughter tannery, Ethiopia. Advances in Biological Research, 6(5): 177-181.
3. Sathaporn, J., J. Weeraphol, O. Omar, B. Barriga and W. Roger, 2004. Reduced Incidence of Babesia bigemina Infection in cattle immunized against the cattle tick, Babesia microplus. Department of Parasitology. Faculty of Veterinary Medicine, Kasetsart University, Bangkok, Thailand.
4. Desalegn Jarso, Teshale Sori and Misgana Duguma. 2014. Prevalence of Ectoparasites on Small Ruminants Around Kombolcha, North East Ethiopia. European Journal of Biological Sciences, 6(3): 81-87.
5. Scott Moses, M., 2011. Infectious Disease book. Vector borne disease, tick borne-diseases: Protozoan Infection Unified Medical Language System, pp: 13-15.
6. Radostits, O., C. Gay, K. Hinchcliff and P. Constable, 2008. Diseases associated with protozoa. In: Veterinary Medicine:00 A textbook of diseases of cattle, horses, sheep, pigs and goats. 10th edition. Saunders Elsevier, pp: 1483-1540.
7. Homer, J., E. Aquiler, R. Telford, J. Krause and H. Pressing, 2000.Babesiosis. Review of Clinical Microbiology, 13: 451-469.
8. Amorim, L., A. Wenceslau, F. Carvalho, P. Carneiro and G. Albuquerque, 2014. Bovine babesiosis and anaplasmosis complex: Diagnosis and evaluation of the risk factors from Bahia, Brazil. Journal of Veterinary Parasitology Jaboticabal, 23: 328-336.
9. Yabsley, M. and B. Shock, 2013. Natural history of Zoonotic Babesia: role of wildlife reservoirs. International Journal of Parasitology, 2:18-31.
10. Iseki, H., Z. Zhou, C. Kim, T. Inpankaew, C. Sununta, N. Yokoyama, X. Xuan, S. Jittapalapong and I. Igarashi, 2010. Seroprevalence of Babesia infections of dairy cows in Northern Thailand. Veterinary Parasitology, 170: 193-196.
11. Alekaw, S., 2000. Distribution of ticks and tick borne diseases at Metekel ranch, Ethiopia. Journal of Ethiopian Veterinary Association, 4: 40-60.
12. Zintl, A., G. Mulcahy, H. Skerrett, S. Taylor and J. Gray, 2003. Babes iadivergens a bovine blood parasite of Veterinary and zoonotic importance. Review of Clinical Microbiolology, 16: 622.
13. Bock, R., L. Jackson, A. De Vos and W. Jorgensen, 2004. Babesiosis of cattle. Parasitology, 129: 247-269.
14. Daniel, E., S. Robert and L. William, 2012. Medical and Veterinary Entomology. Elsevier Science, USA, pp: 517-558.
15. Nibret, M., B. Basaznew and F. Tewodros, 2012. Hard ticks (Ixodidae): Species composition, seasonal dynamics and body site distribution on cattle in Chilga district, Northwest Ethiopia. Asian Journal of Agriculture and Science, 4: 341-345.
16. ADARDO, 2007. Ada'a District Agricultural and Rural Development Office.
17. Nicholson, M. and M. Butterworth, 1986. A guide to condition scoring of zebu cattle. International Livestock Centre for Africa. Addis Ababa, Ethiopia, pp: 29.
18. De-Lahunta, A. and R. Habel, 1986. Teeth applied Veterinary Anatomy. W.B. Saunders Company, 4-6.
19. Thrusfield, M., 2005. Veterinary Epidemiology. 3rded. Blackwell Publishing, Incorporated, Ames, Iowa.
20. Urquhart, G., J. Armour, J. Duncan, A. Dunn and F. Jennings, 1996. Veterinary Parasitology 2nd edition, Blackwell science, United Kingdom, pp: 307.
21. Feben, A., 2012. Study on ticks infesting cattle and their effect on packed cell volume in and around Bishoftu. DVM Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Bishoftu, Ethiopia.
22. Turkson, P. and E. Ganyo, 2015. Relationship between haemoglobin concentration and packed cell volume in cattle blood samples. Journal of Veterinary Research, 82: 863-865.
23. OIE: Office of des International Epizootics, 2010. Bovine babesiosis, Terresterial manual. Terrestrial Animals, Paris.
24. Zafar, I., M. Sajid, A. Jabbar, Z. Rao and M. Khan, 2006. Techniques in parasitology. 1st edition: Higher Education Commission, Islamabad, Pakistan, pp: 69.
25. Soulsby, E., 1982. Helminths, arthropods and protozoa of domesticated animals 7th ed. Bailliere Tindall, London, pp: 809.
26. Moretti, A., V. Mangili, R. Salvatori, C. Maresca, E. Scoccia, A. Torina, I. Moretta, S. Gabrielli, M. Tampieri and M. Pietrobelli, 2010. Prevalence and diagnosis of Babesia and Theileria infections in horses in Italy. Veterinary Journal, 184: 346-350.

27. Walker, A., A. Boattour, J. Camicas, L. Estradar, A. Pena, I. Horak, A. Latif, R. Pegram and P. Preston, 2003. Tick of domestic animal in Africa, a Guide to identification of species: International consortium on tick and tick born disease (ICTTD-2). Bioscience Reports, University of Edinburgh, United Kingdom, pp: 221.
28. Sitotaw, T., R. Fikru, Z. Fikre and G. Abraha, 2014. Epidemiological significant of major haemoparasites of ruminants in around Debre Zeit, Central Ethiopia. Journal of Parasitology and Vector Biology, 6: 16-22.
29. Bihonegn, W., D. Haimanot, K. Tadele, Z. Tilahun and K. Girma, 2015. Study on the prevalence of Bovine babesiosis and its associated risk factors in and around Assosa Woreda, Benishangul Gumuz Regional State, Western Ethiopia. Researcher, 7: 33-39.
30. Ahmad, N. and H. Hashim, 2007. A comparative study on the incidence of tick and tick born disease on local and crossbreed cattle in Malakand Agency. Journal of Animal and Plant Sciences, 17: 56-58.
31. Hamsho, A., G. Tesfamarym, G. Megersa and M. Megersa, 2015. A Cross-sectional study of bovine babesiosis in Teltele District, Borena Zone, Southern Ethiopia. Journal of Veterinary Science and Technology, 6: 26-30.
32. Fethu, L., G. Adugna and D. Dirsha, 2016. Prevalence of bovine babesiosis in and around Jimma town South Western Ethiopia. Advances in Biological Research, 10: 37-42.
33. Patcharathorn, S., Y. Nantawan, S. Nantiya, S. Sinsamut and P. Nongnuch, 2013. Prevalence and factor associated with Babesia species: Infection of cattle raised nearby forest in Salakpra Wildlife Sanctuary, Kanchanaburi Province.
34. Nasir, A., H. Hashmi and M. Afzal, 2000. Prevalence of haemoparasites in exotic cattle. International Journal of Agriculture and Biology, 2: 402-403.
35. Solomon, G., M. Nigist and B. Kassa, 2003. Seasonal variation of ticks on calves at Sebeta in Western Shoa zone Ethiopia. Ethiopian Veterinary Journal, 7: 17-27.
36. Pawlos, W. and D. Derese, 2013. Study on prevalence and identification of ticks in Humbo district, Southern Nations, Nationalities and People's (SNNPs) Region, Ethiopia. Journal of Veterinary Medicine and Animal Health, 5: 73-80.
37. Belew, T. and A. Mekonnen, 2011. Distribution of Ixodid ticks on cattle in and around Holeta town, Ethiopia. Global Veterinarian, 7: 527-531.
38. Tesfaheywet, Z. and H. Simeon, 2013. Prevalenceofectoparasite infestations of cattle in Bench Maji Zone, southwest Ethiopia. Veterinary World, 6: 291-294.
39. Shiferaw, D. and G. Abebe, 2006. Cattle tick dynamics in different agro-ecological zones of Wolaita, Southern Ethiopia. Ethiopian Veterinary Journal, 10: 85-99.
40. Kabir, M., M. Mondal, M. Eliyas, M. Mamnan, N. Hashem, O. Delinath, C. Miazi, M. Mohiuddin, M. Kashem, R. Islam and M. Elahi, 2011. An epidemiological survey on investigation of tick infestation in cattle at Chittagong District Bangladesh. African Journal of Microbiology Research, 54: 346-52.
41. Bianchi, M., N. Barre and S. Messad, 2003. Factors related to cattle infestation level and resistance to acaricides in Boophilusmicroplus tick populations in New Caledonia. Veterinary Parasitology, 28: 75-89.
42. Ammanuel, W. and M. Abdu, 2014. Prevalence of Ixodid ticks on Bovine in Soddo Zuria Districts, Wolaita Zone, Ethiopia. Acta Parasitologica Globalis, 5: 188-197.
43. Chungu, H., N. Speybroeck, R. Pegramand D. Berkvens, 2001. Rhipicephalusappendiculatus burdens on cattle in relation to age and sex of the host. Southern province of Zambia. Tropicultura, 19: 34-36.
44. Behailu, A., 2004. A study of ticks and tick-borne protozoans in cattle at Asella, Arsi Zone. DVM thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Ziet, Ethiopia.
45. Mehari, B., 2004. Distribution of livestock tick species in Awassa area. DVM Thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre, Ziet, Ethiopia.
46. Seid, B., 2004. Survey of cattle tick species in and around MizenTaferi, Bench Maji Zone of SNNPs, DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
47. Kedir Mohammed and Petros Admasu. 2015. Prevalence of Ixodid Ticks in Small Ruminants in selected Districts of Fafen Zone, Eastern Ethiopia. European Journal of Applied Sciences, 7(2): 50-55.
48. Yitbarek, G., 2004. Tick species infesting livestock in Jimma, Southern Western Ethiopia. DVM thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

49. Tadesse, B. and A. Sultan, 2014. Prevalence and distribution of tick infestation on cattle at Fitche Selale, North Shewa, Ethiopia. Livestock Research for Rural Development, 26(8).
50. Seyoum, Z., 2001. Study of tick and Tick born diseases on cattle at Girran valley in the North Wollo Zone. Ethiopia. Proceeding of the Ethiopian Veterinary Association, pp: 15.
51. Muchenje, V., M. Dzama, J. Chimonyo, G. Raats and P. Strydom, 2008. Tick susceptibility and its effects on growth performance and carcass, chrematistics of Nguni, Bonsmara and Angus steers raised on natural pasture. Animal, 2: 298-304.
52. Daniel Azene, Tewodros Fentahun and Bemrew Admassu. 2015. Study on the Major Defects That Causes Sheep and Goat Skins Rejection in Bahir Dar Tanning Industry, Ethiopia. Academic Journal of Animal Diseases, 4(3): 170-176.