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Tick Prevalence and Associated Udder Damage and Mastitis on Cattle in Jimma Town, Southwestern Ethiopia

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Abstract

A cross-sectional survey was conducted to determine tick prevalence and their association with mastitis on 390 cattle at three communal grazing sites and two dairy farms from October 2008 to April 2009 in Jimma town. Ticks were collected from half body parts and udder and teats were examined on lactating cows and heifers to identify tick lesions and mastitis. Of total 3015 ticks in number collected, 3 genera and 5 species of ticks had been identified: *Amblyomma cohaerens* (44.94%), *Amblyomma variegatum* (31.11%), *Boophilus decoloratus* (18.97%), *Rhipicephalus evertsi evertsi* (3.08%) and *Amblyomma gemma* (1.9%). There was a significant variation with predilection site of tick species. *A. variegatum*, *A. gemma* and *R. evertsi evertsi* had a significance variation with age of the animal. *B. decoloratus* and *R. evertsi evertsi* had significance variation with breed of cattle. Udder, Brisket and Perineum were the predominant predilection sites for the tick species collected. *R. evertsi evertsi* was the only species prefer Ano-vulva region. Result on the immature ticks (larvae and nymphs) shows that, 63.47% *Amblyomma*, 35.75% *Boophilus* and 0.77% *Rhipicephalus* genera. Neck, Dewlap, Udder and Perineum were the main predilection sites of ticks on which the immature ticks were collected. Although (123) 31.6% of the sampled cattle had some degree of udder and teat damage, out of those cows and heifers with udder and teat damage (30) 24.39% was positive for mastitis. The tick species found on cattle with udder and teat damage were *Amblyomma cohaerens* (46.51%), *Amblyomma variegatum* (40.62%), *Boophilus decoloratus* (11.88%) and *Amblyomma gemma* (0.99%). There was a significance variation between study sites and breed of cattle on animals with mastitis. Tick infestations associated udder lesions, and mastitis is major problems in cattle and deserves further attention owning to their potential impact on milk production affecting food security.

Keywords: Cattle; Ticks; Mastitis; Udder damage; Jimma; Ethiopia

Introduction

Tick infestation and tick-borne diseases (TBDs) are important conditions affecting livestock health and productivity in Ethiopia. Ticks are responsible for direct damage to livestock through their feeding habits. The damage is manifested as hide damage, damage to udders, teats and scrotum, myiasis due to infestation of damaged sites by maggots and secondary microbial infections. They transmit a variety of infective organisms mechanically or cyclically to animals and man. Most of the diseases transmitted by ticks are of major economically importance. Moreover, they inflict great havoc by continual loss of blood and creating different grade of lesions on the skin [1,2].

Mastitis usually occurs in response primarily to intramammary bacterial infection, but also to intramammary mycoplasmal, fungal or algal infections. Mechanical trauma, thermal trauma, and chemical insult predispose the gland to intramammary infection. Occurrence of mastitis depends on the interaction of host, agent, and environmental factors. Mammary tissue damage reduces the number and activity of epithelial cells and consequently contributes to decreased milk production [3].

Ticks also affect production in various ways. They can affect growth rate, milk production, fertility and the value of hides, cause udder damage, and mortality. Among this, mastitis is one of the most complex diseases of cows that mostly predisposed by different tick species under different management system and breed [4].

In Ethiopia, the studies so far conducted in the country indicated that the most important ticks belong to genera *Amblyomma, Boophilus, Hyalomma* and *Rhipicephalus*. These ticks are important transmitter of diseases and can damage hides and skins and interfere with meat and milk production.

Ticks are one of the dominant ectoparasite of cattle that cause cow's and heifer's udder to swollen and harden which leads the culling and decrease in milk production. Relevant data on the population dynamics of ticks on cattle (exotic and local) and mastitis (hardening and swelling of udder) due to tick's species is essential for the development of effective tick, and tick borne disease control strategies.

Therefore, the objectives of this study are to identify the tick species with its predilection site, determine the prevalence of tick species and to see the effect of tick on udder and teat and its association with mastitis on cattle in Jimma town, southwestern Ethiopia.

Significance of the study

The study result is useful for strengthen the tick control program like using acaricides, tick resistant breed, chemotherapy and chemoprophylaxis (for TBDs), traditional tick control and management. It also opens the future further study on the effect of ticks on mammary gland on other parts of the country. The result also used for local program in improving production quality and access to control service.

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Materials and Methods

Study area

The survey was conducted in Jimma town by selecting three grazing sites where cattle's of Jimma town grazing together and dairy farms. The sites were, Seto, Kito, Jiren and two dairy farms in the town. Jimma town is found in Oromia Regional State 357 km from Addis Ababa. The altitude of the area varies between 1600-2110 above sea level. The total area of the town cover is 4626 hectare. The mean annual rainfall is ranging from 1420-1800 mms. The area has 12°C-28°C an average range of temperature. The human population of the town was estimated approximately 150, 000. Jimma town has 18354 cattle, 1846 goat, 3310 sheep, 1400 horses, 250 donkeys, and 65 mule populations [5].

Study population

Study animal: A total of 390 cattle (local and cross) was selected by systematic random sampling technique for ticks collection and identification from eight half- body regions of cattle: Udder, brisket, perineum, thigh, anovulva, ear, abdomen and neck, for the tick survey in Jimma town, during study period (from November 2008 to April 2009).

The animals was identified by their own breed and categorized into age, and site. The animal's management system in all study sites of Seto, Kito and Jiren was more traditional in which they graze a natural pasture during day time (extensive management) and of a two dairy farms, i.e., a cross breed is feed and watered in house and graze outside together some times (semi-intensive).

Study design: The study type is a cross-sectional study which is describing and quantifying the distribution of tick species tick borne disease and mastitis.

Sample size and sampling method: Ticks was collected from 390 cattle selected based on the availability of ticks on their body purposeful sampling technique from three selected sites and two dairy farms of Jimma town. The sample size was determined using the formula given by Thrusfield, by assuming the expected prevalence of 50% tick infestation, confidence interval 95% and at 5% absolute precision and minimum sample size value [6].

Therefore, 390 cattle sample size employed. Then adult ticks were collected from eight different half- body parts of cattle. Cattle grazing in group from three sites and two dairy farms were selected randomly in every study days per week. After that adult Ixodid ticks were collected from eight half-body regions of the animal body into separate sample bottle. All the collected adult ticks were identified to species level using stereomicroscope at JUCAVM Veterinary parasitology and pathology laboratory within one week of the collection.

Study methodology

Tick collection and identification: Tick samples were collected early in the morning. The samples were preserved in 70% alcohol and identified according to their species, sex, and developmental stage. Collection is done by hand picking method after examine the presence of the tick on different body parts of the animal. Udder, brisket, perineum, thigh, anovulva, ear, abdomen and neck were the body part where ticks were collected. Ticks were identified, counted and recorded by species, sex. All ticks was counted and kept in pre-labeled by time, date of collection, predilection site of ticks, ages of the animals, and breed of animals in universal Bottles containing 70% alcohol until identification was done under stereomicroscope according to Walker et al. and Morel [7,8].

A total of 100 thin blood smears was made during study period. The smears were dried, fixed with methanol alcohol for 5 minutes, stained with Giemsa solution in phosphate buffered saline (pH 7.2) for 30 minutes and examined under oil immersion compound microscope for tick borne diseases [9,10].

The presence of tick and lesions on the udder was first observed visually and then palpation of the hardening and swelling of udder later checked for mastitis with California mastitis test (CMT). Finally, the number of cows and heifers having this problem were registered from all study sites and ticks collected and identified from those affected animals.

Data analysis: Data was entered to Microsoft Excel data base system and using SPSS 16.00 version software computer program. Chi-Square test was employed to determine the association between tick species with age, breed and predilection site of the animals. Descriptive statistic was used to summarize the data generated from the study and the prevalence of mastitis was calculated using percentage values and chi-square test used to calculate the association of the disease with breed, age and site of study.

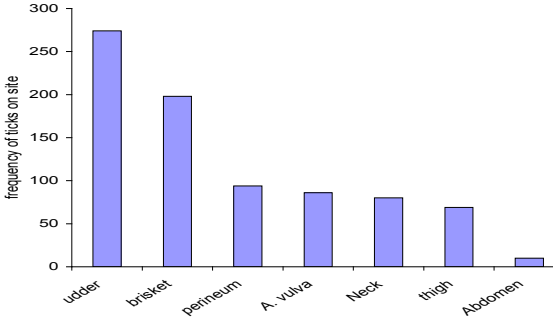
Results

A total of 3015 tick species collected, 3 genera and 5 species of ticks had been identified. 78.73% (*Amblyomma*), 19.16% (*Boophilus*) and 3.11% (*Rhipicephalus*) genera were encountered (Table 1). Among the five species identified *Amblyomma cohaerens* (44.94%), *Amblyomma variegatum* (31.11%), *Boophilus decoloratus* (18.97%), *Rhipicephalus evertsi evertsi* (3.08%) and *Amblyomma gemma* (1.90%) contained. *A cohaerens* was the most abundant and followed by *A. variegatum* and *B. decoloratus*. The least one was *A. gemma* (Table 2). There was a highly significance variation of all tick species with predilection sites ($p<0.000$). *A. variegatum* ($p<0.005$), *A. gemma* ($p<0.001$) *Rh. e evertsi* ($p<0.010$) had a significance variation with age of the animal. *B. decoloratus* ($p<0.001$) and *Rh. e evertsi* ($p<0.027$) had significance variation with breed of cattle. Udder, Brisket and Perineum were the most sites where the tick species collected. *Rh. e evertsi* was the only species prefer Anovulva region (Graph 1).

Data on the immature ticks (larvae and nymphs) shows that, 63.47% (*Amblyomma*), 35.75% (*Boophilus*) and 0.77% (*Rhipicephalus*) genera. Neck, Dewlap, Udder and Perineum were the sites on which the immature ticks were collected.

No	Genus	Total tick	Prevalence %
1	*Amblyomma*	2350	78.73%
2	*Boophilus*	572	19.16%
3	*Rhipicephalus*	93	3.11%

Table 1: Prevalence of tick genera collected on cattle in Jimma town.



Graph 1: Frequency of site attachment of tick species on cattle in Jimma town.

No	Tick species	Total ticks	Prevalence	Predilection sites
1	*Amblyomma cohaerens*	1355	44.94%	Udder, Brisket, Perineum, thigh Anovulva and Abdomen
2	*Amblyomma variegatum*	938	31.11%	Udder, Brisket, Perineum, thigh, Anovulva and Abdomen
3	*Boophilus decoloratus*	572	18.97%	Udder, Brisket, Perineum, thigh, Anovulva and Abdomen
4	*Rhipicephalus e. evertsi*	93	3.08%	Anovulva
5	*Amblyomma gemma*	57	1.90%	Udder, Brisket, Perineum, thigh, Anovulva and ear

Table 2: Percentage distribution of tick species infesting cattle at Jimma town with predilection site encountered.

From 100 thin blood smear slide observed, 1 (1%) *Babesia Bigemina* parasite was identified. From a total of 123 udder of cows and heifers observed and examined during the study period, 30 (24.39%) of cows and heifers was positive to mastitis due to tick species. Tick species found were *Amblyomma cohaerens* (46.51%), *Amblyomma variegatum* (40.62%), *Boophilus decoloratus* (11.88%) and *Amblyomma gemma* (0.99%). There was a significance variation between study sites (X^2=9.576, p>0.023) and breed (X^2=15.682, p>0.000) of cattle udder examined.

Amblyomma cohaerens was the most abundant tick species found in the western Ethiopia and recorded on the first in this study. Although, generally observed in low numbers as compared to the previous findings. The species was collected from Udder, Brisket, Perineum, Anovulva and Abdomen. There was a significance difference between the predilection sites (p<0.000) and found in high count on udder of cattle than other body parts.

Amblyomma variegatum was the second most abundant tick species found. This tick was found through all the study time and sites next to *Amblyomma cohaerens*. It was also collected from the animal body where of the *Amblyomma cohaerens* collected but in less count than it. The p-value of predilection site (p<0.000) was also the same as *A. cohaerens,* but there was a significance difference on age group (p<0.005). It increases on older animals. *Boophilus decoloratus* was the third abundant tick species next to *Amblyomma variegatum* encountered in Jimma town. The species was observed on all body parts collected. But, it is mainly collected from neck of the cattle.

Rhipicephalus evertsi evertsi was the only species found from the genera *Rhipicephalus* in Jimma town. The tick was counted in small number and only collected from Anovulva (under the tail and around the vulva), which was the favorable site and specific to it. Predilection site (p<0.000), age (p<0.010) and breed (p<0.027) had significance variation when compared with the species. *Amblyomma gemma* was the least species found in the study area. Only 0.99% from the total tick species collected and identified. It was collected from Brisket, Udder, Thigh, Anovulva, Ear and Perineum in least count. There was a significance variation between the species and age of the cattle (p<0.001).

During the period of observation, 772 immature ticks were collected. The immature ticks were identified into genera and *Amblyomma* 490 (63.47%), *Boophilus* 276 (35.75%) and *Rhipicephalus* 6 (0.77%) were found. Dewlap, Neck and udder were the major sites on the body of cattle where mainly the larvae and nymphs collected. In the prevalence of tick borne disease, 100 thin smear blood samples were made and examined under compound microscope. From examined slides only 1(1%) of *Babesia* parasite was observed. The parasite was *Babesia bigemina.*

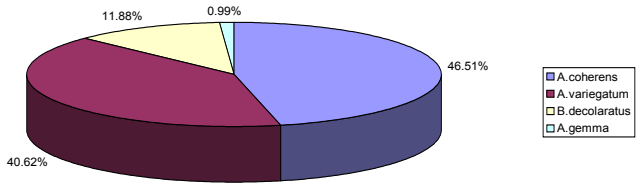
The study done on the mastitis due to tick species infestation on the udder showed 30 positive cases (swelling, hardening, pyogenic swelling and teat closure and deformity). Ticks develop resistance to back dip. Out of 123 udders of cows and heifers examined during the study period, 21 cows and 9 heifers of both breeds were with the disease (Table 4). This case was highly observed on cross breeds, which is highly significant (p<0.000) and also on dairy farms cows and heifers (p<0.023). The new own result on this Harding and swelling of udder and teat (mastitis) due to ticks was, the observation of the case on heifers**.** From this, the only cross breed heifers were positive to the case and most of them were JUCAVM heifers. This swelling and hardening of udder and teat will make the heifer's teats partially or fully will be closed during they give birth. The ticks also make the heifers to leave for longer time without giving birth. The tick loads on all positive cases from half body part of the cattle's were 10-20/udder. The tick species frequently encountered were 46.51% (*Amblyomma cohaerens*), 40.62% (*Amblyomma variegatum*), 11.88% (*Boophilus decoloratus)* and 0.99% (*Amblyomma gemma*) in decreasing order (Graph 2 and Table 3).

Discussion

In the present study five species of the three genera were found. These are *Amblyomma cohaerens, Amblyomma variegatum, Boophilus decoloratus, Rhipicephalus evertsi evertsi and Amblyomma gemma*. The climatic factor, vegetation, and the grazing of cattle together in group increase the prevalence and the presence of similar tick species distribution in the area [10]. This result was consistent with previous tick species survey in western part of the country and Jimma zone [8,11-14].

Amblyomma cohaerens was the most abundant tick from all tick species surveyed (44.94%). The present observation (survey) supports the previous findings [11-14]. *A. cohaerens* was the most abundant in western, Ethiopia, where the climate is humid for much of the year it is the most abundant tick on cattle [15]. It also predominates in areas of broad leaved forest [12]. This species was collected mainly from udder; this is due to its long mouth and behavior of the tick.

Amblyomma variegatum was the second most abundant tick species (31.11%). The *A. variegatum* distribution is similar to that of *Boophilus decoloratus* and it is more wide spread throughout the western zone



Graph 2: Prevalence of tick species causing mastitis in Jimma town.

Swelling/Harding of udder and teat	No of examined	Prevalence (%)
Present	30	24.39
Absent	93	75.61

Table 3: Prevalence of mastitis (udder and teat injuries) that influenced by tick on cow and heifer at Jimma town.

Risk factors	No examined	Positive	Prevalence (%)	X^2	p-value
Site					
JUCAVM	22	11	8.943	9.576	0.023
Seto	46	9	7.317		
Kito	45	8	6.504		
Jiren	10	2	1.623		
Age					
Cow	75	21	17.07	1.358	0.171
Heifer	48	9	7.317		
Breed					
Cross	52	22	17.886	15.682	0.000
Local	71	8	6.504		

Table 4: Prevalence of mastitis (udder and teat swelling/harding) by site, age and breed in Jimma town.

but less abundant than *Amblyomma cohaerens* [11,12]. It is also the most widely distributed cattle tick in Ethiopia, but its abundance varies greatly [15]. In the present survey *Amblyomma variegatum* was increase or collected more than *Boophilus decoloratus*. This is due to the change in behavior of the tick and climatic condition. Its presence for long time on the animal body also increases the distribution on cattle. This species was collected more on larger animals or cows; this was due to the large size of the animals and physiological condition of cows.

This species has a great economic importance on cattle, because it has an association with heart water (cowdriosis) and dermatophilosis. Its long mouth also causes the deep penetration to skin tissue which predispose to secondary bacterial complication. It is one of the main tick species that lead the cow and heifers to mastitis case. This effect is due to its long mouth, strong attachment and longevity on the udder.

Boophilus decoloratus was the third tick species encountered (18.97%). Climatic factors and cattle raising practices associated with different breeds have a direct influence on the biology and ecology of *B. decoloratus*. No significant increase in tick population was observed during the short rains, *Boophilus decoloratus* peak population occur in May, June and July(maximum) and September and October is moderate [16]. This species has also a great economic importance on cattle, because it transmits *Babesia bigemina* and *Anaplasma marginale* on cattle. On this study it was the third abundant species next to *Amblyomma variegatum*. This result supports the seasonal finding of Abebaw and Pegram et al. [11,16]. This species collection was high on cross breed than local this was due to the blood level of the animals i.e., cross breed are more susceptible than local.

Rhipicephalus evertsi evertsi was the fourth common and abundant tick species (3.08%). *Rh. e. evertsi*, never numerous, appears to occupy a wide range of climatic and ecological condition, in coincide with the previous reports [11]. The present finding supports the previous finding of Abebaw [13]. This species prefer the site Anovulva, because of its short mouth can feed on soft or thin area, the high body temperature of the animal on the site, and also the needs to protect from external manual and climatic effect make it specific to the site.

Amblyomma gemma was the fifth species encountered during the study period (1.90%). It was the least species encountered during the study period, which supports the previous findings [12,14].

On immature ticks collection *Amblyomma genera* (63.42%) had been more than *Boophilus* (35.75%) and *Rhipicephalus* (0.77%). This result supports the previous finding of Yitbarek [14]. But, the dominant predilection site of these immature ticks collected was Neck, Udder, Dewlap and Perineum. This is due to the immature stage preferred to attach the soft areas, because of the mouth parts of the ticks and the penetration by hypostome is not as such possible.

The preference of *Amblyomma* species (*Amblyomma cohaerens* and *Amblyomma variegatum)* to the udder (46.51% and 40.62%) respectively signifies their importance in causing udder and/or teat deformation in Jimma town. The prevalence of mastitis 30 cases (24.39%) of cows and heifers in Jimma town is due to the species *Amblyomma cohaerens* and *Amblyomma variegatum* effect on the udder. The 46.51% of the ticks collected from the udder was *Amblyomma cohaerens* this is due to high abundance in the area, the finding of 40.62% *Amblyomma variegatum* presence on udder is due to its long mouth, site preference, longevity on the site and its resistance to acaricide makes it the dominant causative agent of udder disease. The present result greatly support the Alekaw, which is 35.8% culling of cows due to useless udder and teat closure [17].

There is a great significance variation between cross and local breeds ($p<0.000$) of the town cattle. This finding also supports the previous findings of Demelash et al. [18]. The other significance variation present was the sites of study. JUCAVM dairy farm cattle are highly affected than other site, this is due to the breed and management system (which increase on semi-intensive cross than extensive local cattle) of ticks population. In JUCAVM farm the ticks *Amblyomma variegatum* was highly becoming resistant to acaricide sprayed weekly, for this the cattle in the farm were highly infected with the ticks and they resist the tick infestation, even the heifers waited for long time without giving the calf. Therefore, since the ticks were endemic to this area and the control of these ticks is become difficult, the strategic tick control and application acaricides of the *Amblyomma* sites is essential.

In general, the distribution limits of ticks are not fixed and constant, but are determined by a complex interaction of factors such as climate, host density, host susceptibility and grazing habits [19]. It follows that update studies of the present kind are necessary for the continuous understanding of the dynamic of tick population and the effect of the species on cattle (mastitis and TBDs). Such understanding ultimately leads to application of improved control strategies.

Conclusion and Recommendation

Available information on tick species, tick population dynamics and its effect on udder and disease transmission are essential to asses the losses encountered due to ticks. The survey of tick species is the main factor that exerts a major quantities influence on mastitis and the transmission of TBD. Therefore, this study of cattle tick species survey and its association with mastitis on cattle was done in Jimma town to provide this basic information. The tick species identified in the study area were *Amblyomma cohaerens*, *Amblyomma variegatum*, *Boophilus decoloratus*, *Rhipicephalus evertsi evertsi* and *Amblyomma gemma*. Among the species identified *A. cohaerens*, *A. variegatum* and *B. decoloratus* were the most abundant in the area. These species has a great economic importance on the cattle especially due to their mechanical effect on animal body and as a vector of disease transmission in Jimma town. JUCAVM dairy farm is highly at risk to udder infection; in this farm *Amblyomma variegatum* causes a great damage on udder and teats. This species also increase in number on wet condition and rainfall. Generally, the presence of these species on the study area needs a strong strategic, threshold, tick resistant cattle and management control programs. *Boophilus decoloratus* is also observed next to *Amblyomma variegatum*, this species transmitting the disease called *Babesiosis*. To control this species the seasonal observation and application of acaricides on immature stages and adults are essential. Depend on the above conclusion the following recommendations are forwarded:

- Controlling tick species should be by observing the life cycle with these influencing factors on the area is essential.
- Spraying of acaricides especially to udder area is essential to control *Amblyomma* species, strategic control and proper follow up of mammary gland infection should be given attention to heifers of JUCAVM dairy farm.
- Cross and exotic breed cattle in the town also need the threshold and strategic control program.
- Strategic tick control application of acaricides based on tick population,
- integrated tick control (biological, chemical and ecological control methods combined with short interval pasture rotation and burning), and
- Extension work (educating animal owners on the problems of tick especially on mastitis, and the different control methods, which can be available in the area) is more essential.
- TBDs in the town, needs a further investigation to control the *Babesia* parasite and other parasites with the tick *Boophilus decolaratus*.

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