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Prevalence of Camel Ticks in Berbere District, Bale Zone, South East Ethiopia

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Abstract: The study was conducted from September 2015- Feb. 2016 to determine the prevalence of tick infestation on camel and identify the major tick genera that parasitize camel in Berbere District of Bale Zone, South eastern Oromia. All visible individual adult tick specimens were collected from different predilection sits of the body of camel. Out of 384 examined camels, 366 (95.3%) were found to be infested by ticks. A total of 384 adult ticks were collected from eight different body regions of camel, which belongs to four different genera and identified using direct stereo-microscopy. The three genera of ticks identified during the study periods were *Amblyomma*, *Hyalomma* and *Rhipicephalus* (*Boophilus*). The most abundant tick found in the study area was *Amblyomma* (49.7%), *Hayalomma* (21%), *R.* (*Boophilus*) (29.4%). Higher infestation level of tick was recorded on the escutcheon (42.2%) and lower on the ear (0.3%) of body regions. The survey findings showed that the infestation rate were 248 (95.4%) and 118 (95%) in male and female animals, respectively. The prevalence of tick infestation between different age group was 38 (95%) and 328 (95.3%) in less than 2 years (young) and greater than 2 years (adult), respectively. In this study there was not a significant difference ($p>0.05$) in tick infestation between sex, age groups and also body conditions of the animal. Therefore, because of the severe damage to hides thereby reduces the foreign exchange of the country, special attention should be given to the control and prevention of ticks; they also transmit some diseases which can cause severe loss to the productivity of camel.

Key words: Bale · Berbere · Camel · District · Oromiya · Prevalence · Ticks

INTRODUCTION

Livestock are the main stay of the vast majority of African people. They contribute a large proportion of the continent's gross domestic product (GDP) and constitute a major source of foreign currency earning for a number of countries. Livestock production, indeed, contributes to improve food security and poverty alleviation in developing world. However, animal diseases, lack of improved stock, poor food resources and other improved stock, poor food resources and other multifaceted problems limit the potential of livestock [1].

Livestock production in many part of the world is constrained by several factors like diseases. Ectoparasite particularly tick have considerable impact on animal (affect 90% of the world's livestock population) either inflecting by direct damage or by transmission of tick born diseases. Tick infestation is of great important in the production of animal disease and can cause direct losses in which they widely distributed throughout the world particularly in tropical and sub tropical countries. Vector and vector born diseases are major constraints to the development of viable livestock industries where ever they occur. So, different species of animals can be infected by different ectoparasites, particularly, ticks [2].

The camel is a multipurpose animals uniquely adapted to arid and semi arid environment which enables pastoralist people to live in difficult environment of the world [3]. The camels were and still are valued as riding, baggage, draught animals, hair hides as well as the best

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food providers in the arid areas [4]. *Camels dromedaries* (one humped camel) are mostly concentrated in the arid of low land of Eastern Africa which include Somalia, Sudan, Kenya, Ethiopia and Djibouti. According to FAO [5], Ethiopia possess 1.06 Million camels which are mainly found in Southern, Eastern and Northern Eastern arid region of the country including Borena, Ogaden and Afar region. The camel' particular physiology give them success in climate of hotter and dried than those which other domestic animals cannot tolerate [6].

Mainly, camels are kept for milk meat production, beast of burden and a draft animal for agriculture. Recently, they are one national export commodity especially in eastern part of Ethiopia. Apart from rampant disease that affects camels, in accessible environment remain one of the major constraints to address and investigate camel diseases as well as to generate the valuable information regarding these animals [4]. Due to the fact that camels are kept in remote, migratory and poor infrastructure condition, available studies were based on small animal number, one times survey, interviewing, questionnaire, estimation and simulation [7].

The country's environmental condition and vegetation are highly conductive for ticks and TBDs perpetuation [8]. Many are active blood feeders and may cause death from anaemia. Some species cause tick paralysis and it is possible that other ticks may elaborate toxins other than those causing paralysis. Heavy tick burdens cause sufficient irritation and stress such that affected animals becomes anorexic which may lead reduction in production [9]. Ticks can also affect growth rate milk production, Udder damage, fertility and the value of feeds and mortality [10]. The economic losses caused by tick and TBDs in cattle alone are estimated at US $ 13.9-18.7 billion annually worldwide [11]. However in tropical and sub-tropical countries they cause a tremendous economic importance in livestock production. The problem is severing in developing countries where the resource for control and eradication is very limited [12].

In Ethiopia, the studies so far conducted in the country indicated that the most important ticks belong to the genera, *Amblyomma, Hyalomma* and *Rhipicephalus* (*Boophilus*). These ticks are important transmitter of different diseases. The most commonly known TBDs are anaplasmosis, babesiosis, thelerosis, cowdriosis and tick associated dermatophilosis. The extensive surveys have been also carried out on the distribution of tick's species in livestock in different regions of the country [8, 13-16]. Of all ticks recorded *A. varigatum* and *R.* (*B.*) *decoloratus* are considered to be the most widely distributed and economically important except, [15] which is *A. cohaerens* instead of *A. varigatum* in Jimma Area. Other common tick species are also reported in many surveys carried out in different parts of the country.

Despite these facts, there was no research conducted on ectoparasites of camels in the study area, therefore, it is quite important to know the prevalence, distribution and genera of ticks in camel so as to design necessary strategic prevention and control measures. Therefore, the objectives of this study were to determine the prevalence tick infestation and to identify the genera of ticks that parasitize camel in the study area.

MATERIALS AND METHODS

Study Area: The study was conducted from September 2015 to December 2015 in Bale zone, at Berbere district. Bale zone is found in the Oromia Region, it is found 534km far from Addis Ababa and 99km far from Zonal town which is Robe. Berbere district is bounded by Goro district in the North, Dalo Mena district in South, Goba district in the West and Gura Damole district in the East. The district has a several Peasant Associations (PAs) with total area of 153, 86 hectors. According to the agro- ecological condition the study area has highland (Dega), midland (Woyna-dega) and lowland (Kola) with 5%, 25% and 70%, respectively.

The study area has a summer rain fall, where the highest rain fall is between March and May and winter dry season from December to February with a mean temperature of 34°C and altitude range of1500 m.a.s.l and the annual rain fall 500-800 mm. The topography of the area is characterized pleatu which covers about 65% of the total land of the area from which Agriculture Land 21% (32, 367hek), Forest land 43% (66, 127 hector), Bush land 19.5% (30, 000 hector) , Grazing land 4.5% (6, 900 hek) and Others 12% (18, 392 hek). The area has different types of soil (red, brown and sandy) covered by various bush formation low woods, ever green plants , of various types with some semi-arid and arid vegetation. The main agricultural products in the area are Maize, Teff and Sorghum. Cash crop Coffee, Sugar cane, Mango and Avocado [17].

Study Animal: The study conducted on camel at different sites. The animals were selected and sampled by simple random sampling technique from the study area for tick collection and identification with different sex. Based on the owner's information and [18] the sampled animals

classified into two age groups, young (<2years) and adult (>2years). Following the recommendation of [19] nine predilection sites (ear, head, neck/brisket, foreleg, belly, rear legs, escutcheon, tail and shoulder) back side of tick tics were carefully examined by restraining the animals. The livestock population of Berbere district was cattle (132, 500), sheep (18, 940), goat (131, 000), horse (500), mule (5, 480), donkey (11, 850*),* camel (5, 645) and poultry (32, 926).

Study Design: A cross-sectional study was conducted to assess the prevalence of tick infestation and to identify the common tick species in the area. Besides, favorable predilection site of the tick species, the relative tick burden and a possible risk factor such as age, sex, origin and body condition of the animal were considered.

Sample Size Determination: The total number of camel required for study were calculated based on the formula given by [20] using simple random sampling method by taking 95% confidence interval and 5% desired absolute precision. The expected prevalence of camel tick in the study area was taken as 50%.

$$n = \frac{1.96^2 XP_{\exp}}{d^2}\frac{(1 - P_{\exp})}{}$$

where: n = required sample size, P_{exp} = expected prevalence and d= desired absolute precision. Accordingly, the estimated sample size was 384 animals.

Study Methodology

Tick Collection Techniques: Ticks were collected manually with the help of thumb forceps without causing damage to the mouth part and other body regions. All visible attached adult ticks of all species were collected from different body regions of each animal. The collected adult ticks from different study sites were kept separately in to a universal sample bottle containing 70% alcohol (ethanol) for identification [19, 21]. Then the ticks were taken to Berbere Veterinary Clinic and identified by observing different anatomical identification following the standard identification procedure described by [21-22].

Tick Identification: Identification of the collected tick samples was made using direct microscope. During processing the tick samples in each universal bottle were poured in Petri dish. Unwanted foreign materials such as hair, dry skin and other dirt were removed. The ticks were then spread on filter paper to absorb excess preservative fluid. Ticks with dirty scutum were rubbed on filter paper to make them clean and easy for identification [21]. Forceps was used to manipulate ticks and tilt them towards the light source or put them on one side to clearly see the key diagnostic features. Identification to the genus level was made using information and drawing of the different genera of ticks presented in [21-22]. The main identification features were the color, size and shape of mouth parts, scutum, anal grooves, festoons, punctuations and legs. Examination of these structures was used to group ticks in to one of the following genera *Amblyomma*, *Rhipicephalus*, *Hyalomma.*

Data Management and Analysis: Data obtained in this survey was entered in MS Excel work sheet and analyzed using SPSS version 20.0 for windows software. Simple descriptive statistical analysis was used to analyze distributions of tick species and its attachment site. Chi-square test was applied to compare the infection rate with regard to sex groups and age groups. Whereas Odd ratio (OR) was also used to analyze and compare an associations of tick infestation in relation with place of origins and body condition of the animals and a 95% confidence interval and 5% absolute precision was used to determine whether there was significance difference between measured parameters.

RESULTS

From a total of 384 examined camels, overall of 366 (95.3%) were found to be infested by ticks. The study comprised peasant associations (PAs), sex, age and body conditions of animals as a major factors those play a role for the infestation of ticks in the study area.

Prevalence of Ticks Infestation Based on Peasant Associations, Sex, Age and Body Conditions of Animals: Comparison was made on tick infestations of camels with a little variation among peasant associations of Berbere district selected for the study. Different rate of tick infestations were recorded in three of them 94.5%, 92.6% and 96.3% in Sirima, Hambela and G/edo, respectively. A relatively high tick infestations record was observed in G/edo peasant association. However, statistically insignificant ($p > 0.05$) was observed in tick infestation among peasant associations (Table 1).

On the other hand, the survey was conducted on the tick's infestation of female and male animals. Out of 260 male and 124 females camel examined, 248 (95.4%) and

Table 1: Prevalence of ticks infestation Based on Peasant Associations, Sex, Age and Body conditions of Animal

Variables		No of examined	No of infested	Prevalence (%)	P-value	OR	95%CI
PAs	Sirima	146	138	94.5	0.51	1.51	0.44-5.14
	Hambela	135	125	92.6	0.95	1.04	0.27-3.97
	G/edo	108	104	96.3			
Sex	Male	260	248	95.4	0.790	1.13	0.42-3.18
	Female	124	118	95			
Age	Young	40	38	95.3	-	-	-
	Adult	344	328	95.3	0.857	0.87	0.19-3.95
Body conditions	Good	22	20	91	0.630	1.73	0.19-15.9
	Medium	176	165	94.2	0.295	1.78	0.61-5.01
	Poor	187	181	96.8	-	-	-
	Total	384	366	95.3			

Table 2: Distribution and Proportion of Ticks on Different Body Regions

	Predilection Sites								
Tick Genera	Ear (%)	Dewlap (%)	Foreleg (%)	Belly (%)	Rear leg (%)	Escutcheon (%)	Shoulder (%)	Tail (%)	Total (%)
Amblylomma	-	44 (41.9)	9 (27.2)	37(8.6)	-	100(62)	1(50)	-	191(49.7)
Haylomma	-	22 (20.9)	14(42.4)	1(2.3)	11(100)	32(20)	-	-	80 (21)
Rhpicephelus (Boophilus)	1(100)	39 (37.1)	10(30.3)	5 (11.6)	-	30(18.5)	1(50)	27(100)	113 (29.4)
Total	1(0.3)	105(27.3)	33(8.6)	43(11.2)	11(2.9)	162(42.2)	2(0.52)	27(7)	384(100%)

118 (95.2%) were harbored different ticks species, respectively. However, the difference in tick infestation rate between sex groups was not statistically significant (P>0.05) (Table 1). Analysis of age wise prevalence of tick infestation between two age groups indicated that almost there was no difference in prevalence rate between these age groups that was 328 (95.3%) and 38 (95%) in adult and young, respectively. However, there was no significant variation on the prevalence of tick infestations (P>0.05) among age groups (Table 1).

Based on body condition of the animal, camels were grouped into three 22 good, 175 medium and 187 poor, with prevalence of 20 (91%), 165 (94.2%) and 181 (96.8%), respectively. However higher infestation of animals with poor body condition was seen, tick infestations among body conditions of the animals was not statistically significant (P>0.05) (Table 1).

Prevalence of Ticks Infestation Based on Their Genera and Favorable Attachment Site: In this study, different tick genera were collected from 384 camels with different prevalence of tick's infestation in *Amblyomma* (49.7%), *Hayalomma* (21%), *Rhipicephalus(Boophilus)* (29.4%). However, there was no significant variation on the prevalence of tick infestations (P>0.05) among age groups (Table 1). Most tick species that infest camel prefer a favorable attachment site for their survival. The most favorable predilection sites for different species ticks are the ventral body parts (Udder, scrotum, axillae, belly and groins), hoof (dewlap), tail, head and back. Of the total 384 ticks specimens collected, Escutcheon (42.2%), tail (7.3%), belly (11.2%) and foreleg (8.6%) were the most favorable sites. On the contrary, the ear and head regions of animals were the list preferred site for tick infestations (Table 2).

DISCUSSION

In the present study, prevalence of tick's infestation was investigated in Berbere district of Bale Zone by applying field and laboratory studies. The study was conducted on camel which represents a vital contribution of food security and human welfare in vulnerable house hold of dry area. They are important for milk and meat production, transportation draft power and house Holt income generation. Despite such fact this survey demonstrated some of the constraint to utilize livestock. Out of 384 examined camels 366 (95.3%) where found to be infested by different genera ticks. The prevalence of tick species in female camel 118 (95.2 %) was slightly lower than that of 248 (95.4%) male. Because of the result has also showed the occurrence of male camel dominantly in the study area which might be because of the higher population of male animals in the study area due to their importance for trading for most of the local people.

Based on body condition of the animal, camels were classified into three groups as good, medium and poor, with prevalence rate of 91%, 94.2% and 96.8%, respectively. Higher infestation of animals with poor body

condition was seen, tick infestations among body conditions of the animals. This is due to high infestation of tick result in poor body condition due to consumption of high amount of blood and fluid by those ticks. The infestation of ticks was not statistically significant ($p>0.05$) among body condition of animal. In this study, different tick genera were collected from 384 camels with different prevalence of tick's infestation in *Amblyomma* (49.7%), *Hayalomma* (21%), *Rhipicephalus* (*Boophilus*) (29.4%) and similarly the study reported by [10] in which many species of ticks were known to exist in Ethiopia.

In this study area, *Amblyomma* (49.7%), was the predominant genus of tick which is followed by *Rhipicephalus* (*Boophilus*) genus. This finding was in agreement with the genera of ticks identified by different researchers in Ethiopia [14, 23, 24]. It is also the most widely distributed camel tick in Ethiopia as indicated by [8], [25]. It is frequently encountered from 1700-2700 m elevation [26]. This tick specie is of great economic importance, because it is an efficient vector of *Cowdria ruminantium.* Generally, it causes a great damage on hide, ulcer and lameness [27]. *Rhipicephalus* was the second abundant tick specious (22%) identified. It is more common in most arid parts of tropical Africa, receiving 250-650mm annual rainfall, in which cattle are the primary domestic hosts [28]. This difference might arise due to agr-ecological and geographical difference. This tick specious is an important vector *of* Bacterium *Anaplasma marginale* which causes bovine *Anaplasmosi*s, protozoan *Babesia occultans* to cattle. It also brings sever abscesses on the attachment site [23].

Several researchers reported the distribution of this tick in drier areas throughout the country [28]. Certain genera of *Hyalomma* have a toxin in their saliva that causes the skin disease known as *sweating sickness*. The attachment of adult ticks to the interdigital clefts always results lameness [23]. *Rhipicephalus* is the least tick genera identified with a prevalence of (7.6%) which is in agreement with the current finding. The feeding of these tick genera can cause toxicoses, which resulting in paralysis [23]. This tick was reported to be distributed in different parts of the country [14, 27, 29]. It was known transmit the bacterium *Anaplasma marginale* [23]. This study indicated that the difference in tick infestation rate between sex groups was not statistically significant. However, there exposure to ticks infestation was the same as they are allowed to dwell together in the grazing area.

This study had clearly figured out that the prevalence of tick infestation in adult (> 2 year) was similar to that of the young (<2 year) animal and their prevalence variation was not statistically significant ($p>0.05$). This finding was almost comparable with that of [30] report. This might be due to young animals mostly dwelling around the home and have access to contact with other species of animals, therefore, the chance of getting tick infestation almost similar to that of adult. The burden of tick infestation is higher at the escutcheon (42.1%) predilection site, with a lower at the ear region (0.26%). These finding was in agreement with previous works of [16] around Gibe. In this study *Amblyomma* and *Hyalomma* were predominantly found on the escutcheon, belly and neck/brisket. Genus *Rhipicephalus* (*Boophilus*) was more commonly found under the tail. On the other hand Genus *Rhipicephalus (Boophilus) was* found everywhere on the body. On camel, ticks with short hypos tome like genus *Rhipicephalus (Boophilus)* attach on the thin skin (ear, head tail and margin of the anus) where long mouth ticks (*Amblyommaa, Hyalomma*) can attach at thicker skin (brisket, belly, escutcheon and neck region) [31].

CONCLUSION AND RECOMMENDATIONS

The study was conducted to identify the major genera of ticks and their prevalence on camel. The most important tick genera identified were *Amblyomma, Hyalomma* and *Rhipicephalus* (*Boophilus*). Referring the tick genera *Amblyomma* was the most abundant tick in the area followed by *Rhipicephalus* (*Boophilus*) and *Hyalomma.* Among the nine predilection sites examined escutcheon was the most important tick attachment site. The presence of these tick species causes severe constraint on livestock production resulting in important economic losses due to emaciation, morbidity and death and disease transmission. Based on the above conclusion the following recommendations are forwarded: Strategic and appropriate application of effective acaricides for effective tick control is required, Creating awareness should be practiced among animal breeders on the issue of tick control measures and better animal management activities and Further detail study must be done to assess the season dynamicity and major tick borne disease in the study area.

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REFERENCES

1. Programme Against African Trypanosomosis (PAAT), 1999. Comments on the SIT draft position paper by discussion group members of PAAT. Lessons from the past solutions for the future. Vet Parasitology, 132(3-4): 205-215.
2. Scwartz, 2001. Borrelia burgdorferi infectivity and maintenance in the cattle tick infectious cycle. England, pp: 115-121.
3. Scwartz, 2001.
4. Tigani, 2005. A, Khalid Io, Watts., Tick Borne Disease, 87: 28-36.
5. FAO, 2003. Livestock sector brief Livestock information sector analysis and policy branch. April 2003, pp: 1-15.
6. Wilson, 1990. Ecological Applications controlling Lyme disease by modifying the density and species composition of Tick Hosts, 5(4): 1133-1140..
7. Scwartz and Dioli, 1992. Species of ticks on Camel and their seasonal population dynamics in eastern Ethiopia. Kluwer Academic publishers, printed in the Netherland, 36: 225-231.
8. Pegram, R.G., H.H.M. Hoogstral and H.V. Wassef, 1981. Ticks of Ethiopia distribution, ecology and host relation hips of tick species infesting livestock, Bull. Entomology Res., 71. 339-359.
9. Radostits, O.M., C.C. Gay, Hinch, K.W. Cliff and P.D. Constable, 2007. Veterinary Medicine: A text book of the disease of cattle, horse, sheep, pigs and goats. 10th ed. Edinbugh: Saunders Elsevier, pp: 1599-1602.
10. Mekonnen, S., 1995. Tick and tick born disease control strategies in Ethiopia proceeding of the second international conference on tick borne pathogens at the host vector interface: A global perspective, August 20-September1, 1995. Kruger National park: South Africa, pp: 441-446.
11. De Castro, J.J., 1997. Sustainable tick and tick borne disease control in livestock improvement in developing countries. Veterinary Parasitology, pp: 69-79.
12. FAO, 1984. Ticks and tick borne disease control. V.L, Rome.
13. Morel, P.C., 1980. Study of Ethiopian ticks: (Acarina; Ixodidae), Ministry of foreign Affairs, France: IEMVT.
14. Seyoum, Z., 2001. Distribution and host parasite relationship of Ixodids ticks in eastern Amhara, Ethiopia. Ethiopian Veterinary Jounal, 9(1): 57.
15. Abebaw, G., 2004. Seasonal dynamics of ticks (Amblyomma cohaerans and Boophilus decoloratus) and development of management plan for tick and tick borne diseases control on cattle in Jimma zone, Southwestern Ethiopia. Institute of agronomy and Animal Production in the Tropics. George- August University, Gottingen.
16. Solomon, G., M. Silashi, M. Nigist, C. Thomas, T. Getachew, M.M. Abebe, B. Genet, S. Demeke and Z. Ejigu, 2007. Comparison of resistance in four breeds of cattle against Ethiopian Ixodid ticks. Ethiopian Veterinary Journal, 11: 107-119.
17. BDAO, 2011. Berbere District Agriculture Office.
18. De Lauta, A. and R.E. Habel, 1986. Teeth. Applied veterinary Anatomy. USA: W.B. Sounders Company, pp: 4-16.
19. Okello-Onen, J., S.M. Hassan and S. Essuman, 1999. Taxonomy of Africa ticks: An Identification, Manual. International Centre for insect physiology and ecology press, Nairobi Kenya, pp: 1-124.
20. Thrusfield, M., 2007. Veterinary Epidemiology. 3rd ed. Singapore: Blackwell Science, pp: 233.
21. Walker, A.R., A. Bouattour, J.L. Camica, A. Estrada-Pena, I.G. Hora, A.A. Latif, R.G. Peg Ram and P.M. Preston, 2003. Ticks of Domestic Animals in Africa: a Guide to identification of species. Netherlands: Bioscience Reports, pp: 1-1221.
22. Matthysse, J.G. and M.H. Colobo, 1987. The Ixodid Ticks of Uganda: Together with species pettnent to Uganda because of their present known distribution. Entomological socity of America, Maryaland: illustrated identification and biology of most of the important species found in eastern and Central Africa.
23. Lakachew, M., 1999. Survey on hard tick (Ixodidae) in Chilga, Dembia and Alefo Takusa Woredas of North Gondar Administrative Zone.
24. Solomon, G.K., G. Feseha, G. Teferi and T. Getachew, 1998. Ticks and tick borne parasite associated with indigenous cattle in Didtuyuta ranch, Southeren Ethiopia. Insect Science Applie, 18: 59-66.
25. Adane, T., 2008. A Study on Major Tick Species Identification on Bovine in and Around Bahir Dar. Haromaya University, Ethiopia.
26. Eshetu, M., 1988. Study of geographical distribution of ticks in Gondar Awraja. DVM thesis. Faculty of Veterinary Medicine, Addis Ababa University, Bishoftu, Ethiopia.

27. De Castro, J.J., 1994. Tick survey: A survey of tick species in western Ethiopia: AG: DP/ETH/83/023. Technical report. FAO, Rome.
28. Hoogstral, H., 1956. African Ixodid Ticks of Sudan. Bureau of medicine and Survey: Department of the navy, Washigton D.C.
29. Morel, P.C., 1989. Manual of tropical veterinary parasitology: Tick born diseases of livestock in Africa. CAB International, UK, pp: 229-460.
30. Eyeruselam, B., 2008. Study on major Ecto-parasites of Camels in and around Dire Dawa, Ethiopia. DVM Thesis, FVM, AAU, Bishoftu, Ethiopia.
31. Shah-Fscher, M. and R. Say, 1989. Manual of tropical veterinary parasitology. 3rd ed. London: Blackwell Publishing, pp: 301-329.

Annex 1: Age determination based on dental formula

Age	Characteristic change
1.5-2	I_1 erupt
2-2.5	I_2 erupt
3	I_3 erupt
3.5-4	*I_4 erupt
5	All incisor and canine are in wear
6	I_1 is level and the neck has emerged from the body
7	I_2 is level and the neck is visible
8	I_3 is level and the neck is visible, I_4 may be level
9	I_4 is level and the neck is visible
10	The dental star is squire in I_1 and in all teeth by 1_2 years
15	The teeth that are not fallen out are reduce (small round pegs)

Note: Canine of ruminant is usually considered as fourth incisorI-Incisor
Source: [18].

Annex 2: Identification certain for different types of tick

Characteristics	Amblyomma	Hyalomma	Boophilus	Rhipicephalus
Gnatosoma	Long	Long	Short	Short
Basis captulali	Rectangular dorsally	Rectangular dorsally	Hexagon	Hexagon
Coxa I	Twospurs	Bfield	Bifield	Twospurs
festoon	Present	Present/Absent	Absent	Present
Ornamentation	Yes	Yes / No	No	No

Source: [21-22]