Middle-East Journal of Scientific Research 24 (7): 2342-2351, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.07.23797

Study on Prevalence of Major Tick and Tick Borne Hemoparasites of Dogs Visiting Jimma University Veterinary Open Air Clinic

[1]Assefa Kebede Tsegay, [1]Belay Abebe, [1]Faruka Amano and [2]Abera Gemeda

[1]School of Veterinary Medicine, College of Agriculture and Veterinary Medicine,
Jimma University, P.O.Box:307, Jimma, Ethiopia
[2]Ethiopian Veterinary Drug and Feed Administration and Control Authority, Addis Ababa, Ethiopia

Abstract: A cross-sectional study was conducted in Jimma town, Jimma zone, south west Ethiopia, from November, 2014 to April, 2015 with objective of determining the prevalence of tick and tick borne haemoparasites of dogs visiting Jimma University Veterinary open air clinic. To collect samples, dogs were humanely restrained. Blood samples were purposively collected from 252 dogs of different age groups, breed and sexes. Thorough examination of hair and skin of ears, face, neck, shoulder, chest, belly, inner flank and rump was performed to collect ticks. Blood smears were prepared from each blood sample and subjected to Giemsa staining. Following the standard procedures and keys, haemoparasites were identified under oil immersion. The findings indicate that 72 dogs (28.6%) were infected with two genera of tick borne haemoparasites; namely, *Babesia* (18.25%) and *Ehrlichia* (11.9%). In addition to that 1.6% of mixed infections were recorded. On the other hand, out of 233 local and 19 exotic breeds of dogs examined; 63 (27%) and 9 (47.4%) were positive for one or more haemoparasites, respectively. In this study, 143 male and 109 female dogs were examined and their respective prevalence was found to be 28% and 29.4%. Furthermore, 122 puppies, 89 adults and 41 older dogs were included in this study; and the prevalence of haemoparasites was found to be 24.6%, 33.7% and 29.3%, respectively. Out of the 252 dogs examined; 110 dogs were examined anemic; of them, 37(33.6%) were both anemic and positive for one or more haemoparasites. However, 35 (24.6%) dogs were positive for one or more haemoparasites despite they were having normal PCV value. Out of all the dogs examined, only 29 (11.5%) were recorded to have one genus of tick. Out of the 29 dog's positive for tick, 79.3% them were infected with one or more haemoparasites. There were statistically significant differences ($p<0.05$) in the prevalence of tick borne haemoparasite infection and presence of ticks (11.5%). However; sex, age and breed were not significant ($p>0.05$). In general, the current study revealed that tick borne haemoparasites are economically important disease of dogs in the study area. And hence, application of the conventional preventive and control measures like destruction of stray dogs and designing tick control strategies in dog should be established in Ethiopia. Lastly, the present finding led to a significant conclusion that Jimma and its surrounding Kebeles are highly enzootic for the vector borne haemoparasites of dog (*Babesia* and *Ehrlichia*) and the tick vector, Rhipicephalus sanguineus.

Key words: Prevalence · Tick · Tick borne · Haemoparasite · Babesia · Ehrlichia · Dogs

INTRODUCTION

There are about 500 million dog populations in the world. Out of these, 400 million are stray dogs [1, 2]. It is common to observe one or more dogs in many rural and urban areas of Ethiopia. Dogs play many roles in human societies such as pets, guard, hounds, sheep dogs, tracker dogs, guide dogs and as food source [3].

In Ethiopia, dog populations in urban and suburban regions are composed of dog that roams only with their owners and stray also wander off sporadically [4]. In both cases, the animals came into close contact with human and their dwelling. Therefore, they act as reservoirs and transmitters of zoonotic diseases [5, 6]. One of the candidates for such zoonosis is tick borne haemoparasites of dogs [7]. Dogs are one of the most

Corresponding Author: Assefa Kebede Tsegay, School of Veterinary Medicine,
College of Agriculture and Veterinary Medicine, Jimma University, P.O.Box:307, Jimma, Ethiopia.

important hosts in the maintenance of tick population, mainly because of their proximity to human populations as pets, which can easily favor human infection [8]. The most common tick borne haemoparasitic infections of dogs are babesiosis and ehrlichiosis. Both significantly contribute to illness of dogs across the New World and Old World tropics, due to infestations of brown dog ticks [9] and hence both canine ehrlichiosis and canine babesiosis brings huge economical loss in developing and developed countries. Canine babesiosis is a common and clinically significant tick borne haemoprotozoan disease with a worldwide distribution [10]. Canine babesiosis is transmitted by a variety of well-described Ixodid tick vectors around the world [11].

Ehrlichia canis (*E.canis*) are a group of small, gram-negative, pleomorphic, obligate intracellular cocci that infect different blood cells in various dog species. There has recently been a reclassification of the family Anaplasmataceae to which the *Ehrlichia* belongs and some species of Ehrlichia were reclassified into the genera Anaplasma or Neorickettsia and Ehrlichia. However, the taxonomy of Ehrlichia canis was remained unchanged. Currently, the genus Ehrlichia contains five recognized species: E. canis, E. chaffeensis, E. swingier, E. muris and E. ruminantium. E. canis causes canine monocytic ehrlichiosis (CME). The name of Cowdria ruminantium was changed to Ehrlichia ruminantium [12].

Furthermore, it should be noted that cross-reactivity and co-infection is common among the *Ehrlichia spp*., [13]. From *Ehrlichia* species; *E. canis* is a major health problem for dogs, especially purebred dogs. In most tropical and subtropical regions of the world, *E. canis* is transmitted by the common brown dog tick, *Rhipicephalus sanguineus*. Other Ehrlichial species of dogs are *A. platys* and *E. ewingii* [14].

Another haemoparasites transmitted by the same tick species is *Hepatozoon canis*; the real importance and pathogenicity of this interesting parasite is not quite clear, but it is becoming more and more apparent that it can be quite a serious pathogen [15].

Out of the different strains of *Babesia canis,* some are transmitted by *R. sanguineus* ticks which occur in most tropical and subtropical regions [16]. The climate impact on the activity and distribution of *R. sanguineus*, the brown dog tick, carrying many pathogens of animal and human may be a big challenge in the future [17, 18]. In Ethiopia, there is no well organized data on these diseases. Therefore, the objectives of this study were:

- To determine the prevalence and associated risk factors of tick borne haemoparasites of dogs coming to Jimma University Veterinary open air clinic
- To identify ticks associated with haemoparasites of dogs.

MATERIALS AND METHODS

Study Area: The study was conducted at Jimma University Veterinary open air clinic. This clinic is found in Jimma University College of agriculture and School of Veterinary campus. Animal were come to this clinic from Jimma town and surrounding Kebeles. Jimma town is located in the South western part of the country in Oromia Regional State (Figure 1). The town is located at about 352 km south west of Addis Ababa, the capital city of Ethiopia. Geographically, it is located at 7°13' and 8°56' N latitude and 35°52'and 37°37' E longitude. The area has an altitude ranging between 880 and 3358 meter above sea level. The annual rain fall is ranging between 1200-2000 mm and the annual temperature of the area ranges 7°C to 30°C. Total area coverage of Jimma Town is 4626 hectares with different agro-ecology. The altitude range from the highest peak Jirane, (2010a.s.l.) and the lowest peak, Bosakito

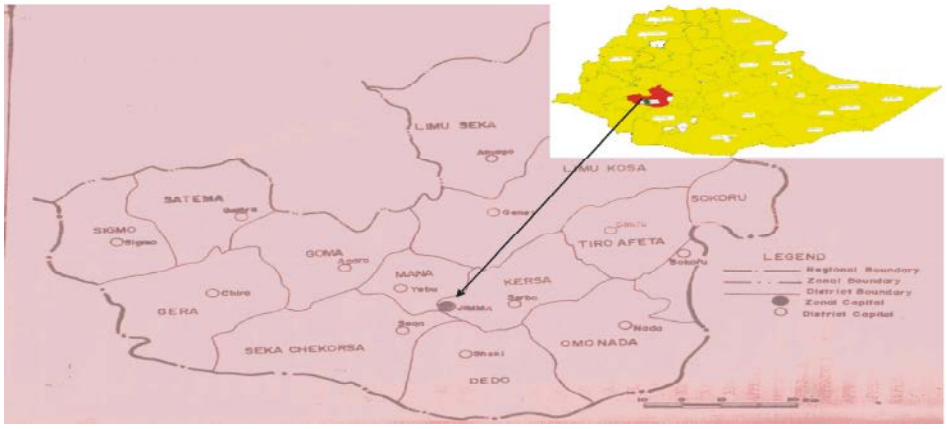

Fig. 1: Map of study area [19].

(1410 a.s.l.). According to the statistical data of 2007, the total human populations of Jimma town is about 17, 4, 446 **(**88, 766 males and 85, 680 females). The livestock population of the area was reported to be about 2, 016, 823 cattle, 942, 908 sheep, 288, 411 goats, 74, 574 horses, 49, 489 donkey, 28, 371 mules, 1, 139, 735 poultry and 418, 831 bee hives [19] but there was no data recorded on dog population.

Study Population: All breeds, sex and age of dogs visiting Jimma University Veterinary open air clinic were considered. The dogs were coming from Jimma town and surrounding Kebeles.

Study Design: A cross-sectional study was conducted from November 2014 to April 2015.

Sample Size Determination: Sample size required to study this parasite was determined according to Thrusfield [20] formula.

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

where, n= required sample size
P_{exp}= expected prevalence and
d= desired absolute precision

There was no any study conducted in this particular topic in Jimma town and hence 50% expected prevalence, 95% level of confidence interval and 0.05 absolute precision was used. Therefore, 384 dogs were expected to be collected, however, only 252 dogs were considered in this study due to lack of cases visiting to the clinic within the time scheduled.

Sampling Method: All dogs visiting the veterinary open air clinic were purposively sampled.

Study Methodology

Sample Collection: Data on breed, sex and age of dogs were collected before blood sampling. Age was described by dividing into three groups as puppy, adult and older according to Macpherson *et al*. [21] (Annex 1). Thorough examination of hair and skin of ears, face, neck, shoulder, chest, belly, inner flank and rump was performed to collect tick samples. Then after, following humane restraining of each dog, they were examined for ticks and tick were collected from positive animals in universal bottles with 70% ethanol and simultaneously, blood samples were collected directly from peripheral blood vessels of the dogs by using the hygienic procedures like shaving and disinfecting the area. Blood sample from each dog was collected in the EDTA coated vacutainer tubes for haematological study and thin blood smear were prepared for staining. Blood samples were immediately transported to Jimma University parasitology laboratory by using cold chain and further processed parasite morphological identification and PCV determination was performed following the procedures stated by Steven *et al*. [22].

Laboratory Investigation: All samples collected were tested immediately on submission to the laboratory. The blood samples were subjected to thin blood smear examination which are fixed with methanol then stained with Giemsa solution to identify the morphology of each parasite under oil immersion (100× magnification). Packed Cell Volume (PCV) values of blood samples were determined using haematocrit centrifuge and PCV reader. According to Adamu *et al*. dog with PCV value <35% were considered as anemic and dogs with PCV value>36% were considered as non-anemic [23].

Lastly, tick species were identified according to the standard morphological identification key described by Walker *et al*. [24] in Jimma University Veterinary parasitology laboratory using stereomicroscope.

Data Analysis: Data were entered to Microsoft Excel spread sheet of Windows 2007. All statistical analysis was carried out using statistical program for Social Sciences version 20 (SPSS INC. Chicago, IL). Descriptive statistics was used to estimate prevalence of the disease across the individual factors. Pearson's chi square was used to assess possible association between the prevalence of haemoparasites and explanatory variables (risk factors). P-value <0.05 and 95% confidence level were used for statistical significance.

RESULTS

Examination of Giemsa stained blood smear of 252 dogs confirmed 72 (28.6%) positive for at least one or more genera of dog heamoparasites. In this study, out of 233 local and 19 exotic breeds of dogs examined; 63 (27%) and 9 (47.4%) were found to be positive for one or both of the dog hemoparasites (*Babesia* and *Ehrlichia*), respectively. However, there was no statistical significant differences in the prevalence rate of parasites between local and exotic breeds (P>0.05). In this study, 143 male and 109 female dogs were examined and their respective prevalence was found to be 28% and 29.4%. Furthermore,

122 puppies, 89 adults and 41 older dogs were included in this study; and the prevalence was found to be 24.6%, 33.7% and 29.3% respectively. The prevalence was statistically insignificant in both sex and age groups of the study animals (P<0.05). Packed Cell Volume (PCV) of the study animals was also assessed and dogs with PCV<36% were considered as anemic and hence out of 252 dogs examined, 110 were anemic. Out of these anemic cases, 37(33.6%) were positive for haemoparasites and the rest 35 dogs (24.6%) with haemoparasites were having normal PCV range, i.e., 35 (24.6%) dogs were positive despite they were having normal PCV value. Moreover, PCV was not significant (P>0.05) in overall result. Out of all the dogs examined, only 29 (11.5%) were recorded to have one or more genera of ticks; of which 23(79.3%) dogs were infected with the parasites and the presence of ticks and the haemoparasites were statistically significant (P<0.05). Lastly, all risk factors; except, presence or absence of tick infestations were not statistically significant (Table-1). In this study, the highest prevalence (40%) was observed in Ifabula and the least in Mantina Kebele (3.7%).

In the other side, 46 dogs (18.25%) were positive for *Babesia*, 30 (11.9%) for *Ehrlichia* and 4 (1.6%) dogs were positive for mixed infections (*Babesia* and *Ehrlichia*) (Table 2).

Table 1: Summary of Overall result (haemoparasites) with variables (risk factors)

Variables	No. sample	No. affected (P+ve)	Prevalence	OR	P-value	X2	95% CI
Breed							
Local	233	63	27%	2.43	0.059	3.56	0.94-1.62
Exotic	19	9	47.40%				
Total	252	72	28.60%				
Age							
Puppy	122	30	24.60%				
Adult	89	30	33.70%				
Old	41	12	29.30%	-	0.35	2.11	-
Total	252	72	28.60%				
Sex							
Male	143	40	28%				
Female	109	32	29.40%	1.07	0.81	0.058	0.62-1.86
Total	252	72	28.60%				
Origin							
Bosakito	50	15	30%				
Hirmat	38	10	26.30%				
Mantina	27	1	3.70%				
Sato	48	17	35.40%				
Furustale	42	12	28.60%	-	0.088	11.08	-
Ifabula	20	8	40%				
Kitofurdisa	27	9	33.30%				
Total	252	72	28.60%				
PCV	110	37	33.60%	1.55	0.12	2.45	0.89-2.69
Anemic	142	35	24.60%				
Normal	252	72	28.60%				
Total							
Tick							
Present	29	23	79.30%				
Absent	223	49	22%	13.6	0	41.34	5.25-35.3
Total	252	72	28.60%				

*Anemic ……PCV<35% Normal…..PCV>36%,< 54%

Table 2: Prevalence of each parasite with their co-infection

Hemoparasites	No. positive	Prevalence (%)
Babesia	46	18.25%
Ehrlichia	30	11.9
Co-infection	4	1.6%
Total	72	28.6%

Table 3: Summary of *Babesia* with variables

Variables	No. sampled	No. affected	prevalence	Odds ratio	P-value	x2	95% CI
Breed							
local (1)	233	40	17.20%	2.23	0.12	2.45	0.80-6.21
exotic(2)	19	6	31.60%				
Total	252	46	18.25				
Age: puppy	122	20	16.40%				
adult	89	18	20.20%	-	0.76	0.56	-
old	41	8	19.50%				
Total	252	46	18.25%				
Sex: male	143	24	16.80%				
female	109	22	20.20%	1.25	0.49	0.48	0.66-2.38
Total	252	46	28.60%				
Origin							
Bosakito(0)	50	10	20%				
Hirmat(1)	38	5	13.20%				
Mantina(2)	27	1	3.70%	-	0.36	6.56	-
Sato (3)	48	9	18.80%				
Furustale(4	42	9	21.40%				
Ifabula(5)	20	5	25%				
Kitofurdisa(6)	27	7	25.90%				
Total	252	46	18.25%				
PCV							
Anemic	110	29	26.40%				
normal	142	17	12%	2.63	0.003	8.6	1.4-5.1
Total	245	46	18.25%				
Ticks							
present	29	17	58.60%	9.48	0	35.8	4.11-21.68
absent	233	29	13%				
Total	252	46	18.25%				

Haemoparasite species identified in this study were *Babesia* and *Ehrlichia* (*Anaplasma*) spp. The prevalence was found to be 18.25% (46\252) for *Babesia* spp., (Table 3) and 11.9% (30\252) for *Ehrlichia* (*Anaplasma*) spp., (Table 4). *Babesia* species were high prevalent as compared to *Ehrlichia species,* however, there was no statistically significant difference between the two haemoparasites. Presence or absence of tick was strongly associated with presence and absence of *Babesia* species ($P<0.05$) but there was less association with *Ehrlichia* ($P>0.05$). In this study, out of 233 local and 19 exotic breeds of dogs examined; 46(18.25%) and 6(31.6%) were positive for *Babesia*, respectively. However, there was no statistical significant difference in the prevalence rate between local and exotic breeds ($P>0.05$). In this study, 143 male and 109 female dogs were examined and their respective prevalence was found to be 16.8% and 20.2% for *Babesia*. Furthermore, 122 puppies, 89 adults and 41 older dogs were included in this study; and the prevalence was found to be 16.4%, 20.2% and 19.5% (Table 3), respectively. The prevalence was statistically insignificant in both sex and age groups of the study dogs ($P>0.05$).

Packed Cell Volume (PCV) of the study animals was also assessed and dogs with PCV≤36% were considered as anemic and hence out of 252 dogs examined; 110 dogs were diagnosed anemic; out of them, 29(26.4%) were both anemic and positive for canine babesiosis. However, 17 (12%) dogs were positive despite they were having normal PCV value. PCV was statistically significant ($P<0.05$) in case of canine babesiosis. Out of all the dogs examined, only 29 (11.5%) were recorded to have one or more genera of ticks; of which 17(58.6%) dogs were infected with the *Babesia* and statistically significant ($P<0.05$) (Table-3). Lastly, out of Jimma town Kebeles included in this study, dogs coming from Kitofurdisa were found to be more positive to canine babesiosis than the other Kebeles and the least was, Mantina.

From haemoparasite species identified in this study *Ehrlichia* (*Anaplasma*) spp was one. The prevalence was found to be 11.9% (30\252) for *Ehrlichia* spp., (Table 4). *Ehrlichia* species were lower in prevalence as compared to *Babesia* species*;* however, there was no statistically significant difference between the two haemoparasites. Presence or absence of tick have less association with presence or absence *Ehrlichia* ($P>0.05$). In this study out

Tables 4: Summary of *Ehrlichia* With variables (risk factor)

Variables	No. sampled	No. affected(P^{+ve})	Prevalence	OR	P-value	X^2	95% CI
Breed							
local	233	26	11.2%*				
exotic	19	4	21.10%	2.12	0.2	1.64	0.66-6.9
Total	252	30	11.90%				
Age:							
puppy	122	12	9.80%				
Adult	89	13	14.60%	-	0.57	1.12	-
Old	41	5	12.20%				
Total	252	30	11.90%				
Sex: male	143	16	11.20%				
female	109	14	12.80%	1.17	0.69	0.16	0.54-2.51
Total	252	30	11.90%				
Origin							
Bosakito	50	6	12%				
Hirmat	38	7	18.40%				
Mantina	27	0	0.00%	-	0.37	6.54	-
Sato	48	8	16.70%				
Furustale	42	4	9.50%				
Ifabula Kitofurdisa	20	2	10.00%				
Total	27	3	11.10%	252	30	11.90%	
PCV							
Anemia	110	11	33.60%				
normal	142	19	24.60%	0.72		0.33-1.60	
Total	252	30	11.90%				
Tick							
present	29	6	20.70%	2.16	0.12	2.41	0.80-2.84
absent	223	24	10.80%				
Total	252	30	11.90%				

Age estimation: puppy <1year, adult ≥1yrs and ≤ 7yrs, old >7yrs

of 233 local and 19 exotic breed dogs examined; 26(11.2%) and 4(21.1%) were positive for *Ehrlichia*, respectively. However, there was no statistical significance difference in the prevalence rate of *Ehrlichia* between local and exotic breeds (P>0.05). In this study, 143 male and 109 female dogs were examined and their respective prevalence was found to be 11.2% and 12.8% for this parasite. Furthermore, 122 puppies, 89 adults and 41 older dogs were included in this study; and the prevalence was found to be 9.8%, 14.6% and 12.2% (Table 4), respectively. The prevalence was statistically insignificant in both sex and age groups of the study dogs (P>0.05).

Packed Cell Volume (PCV) of the study animals was also assessed and hence out of 252 dogs examined; 110 dogs were examined anemic; out of them, 11(33.6%) were both anemic and positive for canine Ehrlichiosis. However, 19 (24.6%) dogs were positive despite they were having normal PCV value. In this case; PCV was insignificant (P>0.05). Furthermore; in this study, dogs infected with one or more canine haemoparasites were having lower PCV (average 31.9%) compared to non-infected dogs (average 41.4%).

Out of all the dogs examined, only 29 (11.5%) were recorded to have one or more genera of ticks; of which 6 (20.7%) dogs were infected with the canine Ehrlichiosis. This was statistically insignificant (P>0.05) (Table-4). In the present study, from all Kebeles of Jimma town studied; dogs coming from Hirmata were having high prevalence than the rest Kebeles (18.4%).

DISCUSSION

In the present study, the overall prevalence of haemoparasites (*Babesia* and *Ehrlichia*) in dogs was found to be 28.6%. This was relatively higher than the findings of Mohamed *et al*. [25] and Godara *et al.,* [26] which was reported to be 16.39% in both Jaipur and Ludhiana (Punjab) districts. It is also further higher than the finding of Senthil Kumar *et al*., [27] who reported a prevalence of haemoparasites in stray dogs to be 12.61%. The difference might be due to different factors like climatic factors required for the biology of the parasites and its vector and veterinary service delivery and public awareness differences regarding to caring their dogs.

Additionally, most of our country dogs were stray dogs; so they have high chance to be infected because stray dogs get less care than owned dogs.

In this study, high prevalence of hemoparasites (*Babesia* and *Ehrlichia*) was recorded in exotic breeds of dogs (47.4%) than in local breeds (27%). This was in line with the findings of Harrus *et al*. [28] who stated that the German Shepherd dogs and Siberian Huskies (exotic) are prone to develop more severe clinical signs to haemoparasites due to the fact that cell-mediated immunity was reduced in German Shepherd dogs compared to Beagle dogs [29]. In contrast to this, it was reported that the prevalence of haemoparasites is usually higher in local breeds compared to exotic breeds of dogs [30].

In this study, the overall prevalence of haemoparasites in female dogs (29.4%) was relatively higher than in males (28%). Unlike the current findings, there were no haemoparasites prevalence differences among the different sexes [30]. This finding also disagreed with the previous findings of Bashir *et al*., [31] and Ekanem *et al*. [32] who reported haemoparasites tend to be more frequently found in males (3.39%) than in females (1.32%) in Pakistan. Similarly, other serological study done by Costa *et al*., [33] reported higher sero-positivity of haemoparasites in males than in females. This also disagreed with the current finding. This might be due to females are highly exposed to vectors than males due to their contact with many male dogs during estrus period which expose them to different haemoparasites.

Moreover, the prevalence of haemoparasites was not statistically significant in both sex age and breed of study animals. This was in agreement with the findings of previous studies [34, 35].

In this study, the major haemoparasites identified were *Babesia* and *Ehrlichia.* Similar result was reported in Nigeria by Bhatia *et al.* [36] and Adamu *et al*. [23]. However, the prevalence was 18.25% for *Babesia,* 11.9% for *Ehrlichia* and 1.6% for mixed infections. This findings were relatively higher in compared to the findings of Bhatia *et al.*, [36] from Nigeria who reported 2.8% for each parasites and 5.5% for mixed infections and the previous reports by Adawa [30] which was reported to be *B.canis* (16.02%) and *E. canis* (7.24%). The slight differences might be due to various factors like climatic factor and disease intervention performed in the two countries.

In the present study, low prevalence was recorded to canine ehrlichiosis (11.9%) than to canine babesiosis (18.25%). This was in line with the findings of Barbara *et al*., [37] who reported similar results in Brazil.

The current study revealed that canine babesiosis to be 18.25%. This was in line with the finding of Ahmed *et al*., [38] and (Matjila *et al*. [39] who reported 18.5% and 20% prevalence of *Babesia gibsoni* from Pakistan, respectively. However, it was relatively lower than the findings of Cabannes *et al*. [40] who reported a prevalence of 14% from the same country as above. These differences might be associated with various factors like climatic factor and health care standard of the two countries.

The prevalence of haemoparasites in different age groups of dogs was found to be relatively high in adults (33.7%) than in puppies (24.6%) and old dogs (29.3%). This result was in agreement with study done by Fukumoto *et al*. [41] which was indicated that dogs <2 years of age were more likely infected with *Babesia* species than the dogs of other ages and according to Sándor *et al*. [42] seropositivity for *Babesia* infection first increased and then declined with age, reaching a maximum in case of 3.1-to 5-year-old dogs (adult).

However, this finding was in contrast to the findings of Bashir *et al*. [31] who reported higher seropositivity rate of haemoparasites in puppy (6.1%) than in other age groups of dogs in Pakistan. In other side, higher probability of exposure to hemoparasites was reported in older dogs than in adults by Rodriguez *et al*. [43] in Mexico. The differences among the different countries might be associated with the differences in agro-climate that favors the survival and infection of dogs with the haemoparasites and their vector, ticks. These differences might be also due to host risk factors (breed difference in immunity with age etc.), environmental factors and vector distribution.

Furthermore; in this study, dogs infected with one or more canine haemoparasites were having lower PCV (average 31.9%) compared to non-infected dogs (average 41.4%) This was in line with previous findings of Puteri *et al.* [44] was relatively similar which reported that, dogs infected with one or more canine haemoparasites had a lower PCV (average 29.7%) compared to non-infected dogs (average 35.8%).

Out of all the dogs examined, only 29 (11.5%) were recorded to have one or more genera of ticks. This result was contrasting with the findings of Agbolade *et al.* [45] and Adamu *et al*. [23] who reported prevalence of 24.3%

for *R. sanguineus.* According to these authors, *R. sanguineus* was recorded to be the most abundant tick species commonly found on dogs from Africa and other countries in the world. This might be due to the different factors like climatic factors required for the biology of the parasites and its vector; presence of appropriate host, veterinary facilities and public awareness to take care of dogs.

Out of the 29 (11.5%) of dogs found to be infested by ticks, 23(79.3%) of them were infected with one or more of haemoparasites. For example, out of the 29 (11.5%) of dogs found to be infested by one or more genera of ticks; 17(58.6%) of dogs were infected with the *Babesia* species. Similar result was reported from North-East India by [34] who reported a prevalence of 57.3% of canine babesiosis.

In current study, the overall prevalence of *Ehrlichia* (*Anaplasma*) was 11.9%. This finding was less than the finding of NDIP *et al*. [46] who reported a prevalence of 21% from South Africa and were relatively higher than the findings of Aguiar *et al.* [47] who reported a prevalence of 6.2% from Brazil. This variation may be due to infection rate of the vector that was found in the different study areas, level of host immunity and differences in sample size.

CONCLUSION

Tick born haemoparasites are one of the most common disease problems in dogs. The results of the present study revealed that prevalence of canine haemoparasites were higher in Jimma town and its surrounding Kebeles than the reports of other authors somewhere in the world. The major tick born haemoparasites identified were: *Babesia* and *Ehrlichia species*. The tick species identified as a vector of these parasites in the study area was *Rhipicephalus sanguineus.* Hence, the presence of these parasites in pet animals may pose significant health problems to canine owners. Therefore, based on the above view, the following recommendations were forwarded:

- Professionals should consider tick and tick borne haemoparasites of dogs during their diagnosis, treatment and prevention strategies..
- Emphasis should be given to the control and prevention of haemoparasites in order to reduce the incidence of the disease.
- Awareness creation on the canine haemoparasites zoonosis and their transmission dynamics should be practiced in the area.
- Further country wise serological and molecular based study should be conducted to know the status of the disease.

AKNOWLEDEGMENTS

The authors would like to acknowledge Jimma University College of Agriculture and Veterinary Medicine for financial support to conduct this research.

Conflicts of Interest: The authors declare that there are no conflicts of interests.

REFERENCES

1. Matter, H.C. and T.J. Daniels, 2000. The human dog relationship: a tale of two species. In: Macpherson, C.N.L., Meslin, F.X., Wandeler, A.I. (end). Dogs zoonoses and public health. CABI walling ford, 17-62.
2. World Society for Protection of Animals, 2009. Animal Welfare in a Global Perspective.
3. Szabova, E., P. Juris, M. Miterakova, D. Antolova, I. Papajova and H. Sefcikova, 2007. Prevalence of important zonootic parasites in dog population from the Slovak republic, *Helminthologia*, 44: 170-176.
4. Beck, A.M., 2000. The human dog relationship: a tale of two species. In: Macpherson CNL, Meslin, F.X., Wandeler, A.I. (end); Dogs, zoonoses and public health.CABIwallingford, pp: 1-16.
5. Trapp, S.M., J.B. Messick, O. Vidotto, F.S. Jojima and H.S. Autran de Morais, 2006. *Babesia gibsoni* genotype Asia in dogs from Brazil. Vet. Parasitol., 141: 177-180.
6. Gracenea, M., M.S. Gomez and J. Torres, 2009. Prevalence of intestinal parasites in shelter dogs and cats in the metropolitan area of Barcelona (Spain), Acta parasitol., 45: 73-77.
7. Furtado A.P.E.S. Docarmo, A.C.R. Geiose, E.G. Vallinoto, R.M. Lanfredi and J.N.Santos, 2009. Detection of dog's filariasis inMarajo Island, Brazil by classical and molecular methods. Parasitol Res., 105: 1509-1515.
8. Sousa, R., S. Nóbrega, F. Bacellar and J. Torgal, 2002. Prevalence of important zonootic parasites in dog population from the Slovak republic, Helminthologia, 44: 170-176.

9. Kjemtrup, A.M. and P.A.A. Conrad, 2006. Review of small canine proplasms from California; *Babesia conradaein* the literature, Vet.parasitol., 138: 112-117.
10. Jacobsen, L.S., 2006. The South African form of severe and complicated canine babesiosis: clinical advances 1994_2004. Vet. Parasitol., 138: 126-139.
11. Birkenheuer, A.J., M.T. Correa, M.G. Levy and E.B. Breitschwerdt, 2005. Geographic distribution of babesiosis among dogs in the United States and association with dog bites: 150 cases (2000-2003), J.Am.Vet Med Assoc., 227: 942-947.
12. Waner, T., S. Harrus, F. Jongejan, H. Bark, A. Keysary and A. Cornelissen, 2001. Significance of serological testing for ehrlichial diseases in dogs with special emphasis on the diagnosis of canine monocytic ehrlichiosis caused by Ehrlichia canis. Vet. Parasitol., 95: 1-15.
13. Ortanto, D., F. Dantas-Torres and E.B. Beitsch werdt, 2009. Managing canine VBD of zonootic concern part one. Rtends parasitol., 25: 157-163.
14. Santos, A.S., M.Santos-Silva, V. Almeida, F. Bacellar and J. Dumler, 2004. Detection of *Anaplasma phagocytophilum* DNA in *Ixodes* ticks (Acari: Ixodidae) from Madeira Island and Setúbal district, mainland in Portugal, Emerging Infectious Diseases, 10(9): 1643-1648.
15. Correa, M.J. and M.G. Levy, 2005. Geographical distribution of Babesia among dogs in the US and association with dog bite: 150 cases (2000-2003) J.A.M. Vet. Med. Associ., 227: 942-947.
16. Beget, F. and J.L. Marie, 2009. Emerging arthropod-sites like *Ehrlichia canis* and *Anaplasma platys* may be borne diseases of companion animals in Europe, Vet. Parasitol., 163: 298-305.
17. Doudier B., J. Olano, P. Parola and P. Brouqui, 2010. Factors contributing to emergence of Ehrlichia and Anaplasma spp. as human pathogens. Vet. Parasitol., 167: 149-154.
18. Jimma Agricultural Office, 2008. Statistical Abstract, Jimma,Oromia, Ethiopia.
19. Thrusfield, M., 2005. Survey, in Veterinary Epidemiology, 2nd edn. Blackwell Science Ltd, Oxford, pp: 178-198.
20. Macpherson, C.N., F.X. Meslin and A.I. Wandeler, 2000. Dogs, Zoonoses and Public Health Anthony Rowe Limited, Eastbourne.
21. Stockham, Steven L. and Michael A. Scott, 2008. Fundamentals of Veterinary Clinical Pathology, 2nd ed., BlackWall publishing.
22. Adamu, N.B., J.Y. Adamu and L. Salisu, 2012. Prevalence of ecto-, endo- and haemoparasites in slaughtered dogs in Maiduguri, Nigeria, Revue Méd. Vét., 163(4): 178-182.
23. Walker A.R., A. Bouattour, J.L. Camicas, A. Estrada-Peña, I.G. Horak, A.A. Latif, R.G. Pegram and P.M. Preston, 2007.Ticks of domestic animals in Africa: a guide to identification of species Edinburgh: Bioscience Reports.
24. Eljadar Mohamed, S.M., L.D. Singla, S.K. Uppal, M.S. Bal and P.D. Juyal, 2010. Studies on morphometric variations of haematozoa in dogs. (Abstr). National Congress of V eterinary Parasitology. Hisar, Haryana.
25. Godara, R., R.L. Sharma, C.S. Sharma and D.K. Sharma, 2010. Parasitic infections in dogs in semi-arid Jaipur (Rajasthan), J. Vet. Parasitol., 24: 83-86.
26. Senthil Kumar, K., S. Vairamuthu and D. Kathiresan, 2009. Prevalence of haemoprotozoans in Canines in Chennai city.TamilNadu, J. Vet. Anim. Sci., 5: 104-108.
27. Harrus, S., T. Waner, A. Keysary, I. Aroch, H. Voet and H. Bark, 1998. Investigation of splenic functions in canine monocytic ehrlichiosis. Vet. I mm S Harrus, T Waner and H Bark, 1998. Canine monocytic ehrlichiosis an update. Comp. Cont. Ed. Prac. Vet., 19: 431-444.
28. Nyindo, M., D.L. Huxsoll, M. Ristic, I. Kakoma, J.L. Brown and C.A. Carson, 1980. Cell-mediated and humoral immune responses of German Shepherd Dogs and Beagles to experimental infection with Ehrlichia canis, Am. J. Vet. Res., 41(2): 250-4.
29. Danakuka, Y.A., 1990. Survey and management of parasitic infections of dogs in Zaria. A thesis submitted to the postgraduate school of Ahmadu Bellou Uiversity, Zaria, Inpartial Fulfilment for the degree of Master of Science (Veterinary Medicine)
30. Bashir, I., S. Chaud Dry., Sahmed and M. Saeed, 2009. Epidemiological and vector identification on canine babesiosis, J. Vet. Parasitol., 29: 51-54.
31. Ekanem, M.S., Et. Al, H.O.C. Mbagwu, K.N. Opara and Q.C. Agbata, 2010. Ticks infestation of domestic dogs (Canis familiaris lupus) in Uyo, Akwa Ibom State, Nigeria, World J. Appl. Sci. Tech., 2: 191-196.
32. Costa, J.r., L.M. Rembeck, K. Ribeiro, M.F. Beelitz, P. Pfister and L.M. Passos, 2007. Sero prevalence and risk indicators for canine ehrlichiosis in three rural areas of Brazil. Vet. J., 174(3): 673-6.

33. Irwin, P., M. Gatne, G. Coleman, L. McInnes and R. Traub, 2010. A survey of canine filarial diseases of veterinary and public health significance in India. Para. Vect., 3: 30.
34. Nonyelu Maureen Ifeoma, 2013. The Prevalence of Haemoparasitic Infection in Dogs Attending ECWA Vertinary Clinic, Bukuru, Jos South Local Government Area, Plateau State, Advances in Microbiology, http:// dx.doi.org/ 10.4236/ aim.2013.33043Published Online July 2013 (http://www.scirp.org/journal/aim), 3: 302-308.
35. Bhatia, B.B., K.M.L. Pathak and D.P. Banerjee, 2007. Textbook of Veterinary Parasitology, 2nd ed., Kalyani Publishers, New Delhi, India, pp: 188-340.
36. Maria Bárbara, Paraná da Silva, Souza1, Danielle and Custódio Leal, Débora, 2010. Medina Barboza1 Rosângela Soares Uzêda2 Adriano Costa De Alcântara Fernando Ferreira Marcelo Bahia Labruna Luís Fernando Pita Gondim Carlos Roberto Frankel.
37. Ahmad, S.S., M.S. Ahmad and M.A. Khan, 2007. Prevalence of canine babesiosis in Lahore, Pakistan. Khan Pet Centre, University of Veterinary and Animal Sciences, Lahore J. Anim. Pl. Sci., 17: 1-2.
38. Matjila, T.P., A.M. Nijhof, A. Taoufik, D. Houwers, E. Teske, B.L. Penzhorn, T. de Langeand and F. Jongejan, 2005. Autochthonous canine babesiosis in the Netherlands. Vet. Parasitol., 131(1-2): 23-29.
39. Cabannes, A., H. Cabannes, F. Pelse, Lucchese and M. Appriou, 2002. Séroprévalence de la babésiose canine dans le sud-ouest de la France, Rev. Méd. Vet., 153: 27-28.
40. Fukumoto, S., Y. Tamaki, H. Shirafuji, S. Harakawa, H. Suzuki and X. Xuan, 2005. Immunization with recombinant surface antigen P50 of *Babesia gibsoni* expressed in insect cells induced parasite growth inhibition in dogs. Clin Diagn Lab Immunol., 12: 557-559.
41. Sandor, H., R. Edelhofer and R. Farkas, 2006. Seroprevalence of canine babesiosis in Hungary.
42. Rodriguez, R.I., R.E. Albornoz and G.M. Bolio, 2005. *Ehrlichia canis* in dogs in Yucatan, Mexico: Seroprevalence prevalence of infection and associated factors. Vet. Parasitol., 127: 75-79.
43. Puteri Azaziah Megat Abd Rani, Peter J Irwin, Glen T Coleman, Mukulesh Gatne and Rebecca J Traub, 2011. A survey of canine tick-borne diseases in India, Parasit Vectors, 4: 141.
44. Agbolade, O.M., E.O. Soetan, A. Awesu, J.A. Ojo, O.J. Somoye and S.T. Raufu, 2008. Ectoparasites of domestic dogs in some Ijebu communities, southwest Nigeria, World Appl. Sci. J., 3: 916-920.
45. Ndip, L.M., R.N. Ndip, S.N. Esemu, V.L. Dickmu and E.B. Fokam, 2005. Ehrlichial infection in Cameroonian canines by Ehrlichia *canis* and Ehrlichia ewingii. Vet. Microbiol., 111: 59-66.
46. Aguiar, D.M., 2007. Prevalence of *Ehrlichia canis* (Rickettsiales: Anaplasmataceae) in dogs and *Rhipicephalus sanguineus* (Acari: Ixodidae), ticks from Brazil. Vector-borne Diseases, Surveillance, Prevention, 44(1): 126-132.