Species Identification and Prevalence of Ixodid Ticks in Sheep and Goats Reared in Plateau State, Nigeria

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Abstract. Tick infestation constitutes a major health challenge and setback to the economically viable livestock industry in Nigeria and the world at large. This informed the continuous research on the economic importance of ticks on domestic animals over the years and research has shown low animal production due to the harm caused by ticks. A total of 300 animals (sheep=121 and goats=179) were selected from three senatorial district of Plateau State. One hundred (100) of the 300 animals were randomly sampled from each Local Government Area (L.G.A.) representing the three senatorial districts. A total of three hundred and twenty three (323) ticks were collected from 139 animals (sheep 81 and goats 58) from September-November, 2018 and identified to species level. Seven species of ticks from three genera were identified of which *Rhipicephalus sanguineus* had the highest prevalence (54.5%). Higher infestation of tick was recorded in female animals (sheep 71 %; goats 49%) compared to male (sheep 10 %; goats 09%). However, the variation in prevalence between animal type and sex was not statistically significant ($P<0.05$). The level of infestation was highest in Kanke L.G.A. (68.0%), followed by Jos-South (47.0%) and lowest in Shendam L.G.A. (24.0%). This study revealed that tick infestation on small ruminants cut across the three senatorial zones of Plateau State, posing a high risk of transmission of tick borne pathogens to both humans and animals. Regular treatment of small ruminants and appropriate tick control strategies are advocated and recommended.

Keywords: Ixodid Ticks, Infestation, Small ruminants, *R. sanguineus*, Plateau State, Nigeria

Introduction

In Nigeria, ruminants (cattle, goats, and sheep) are among livestock farm animals, principally reared by farmers as part of the country's agricultural system (Lawal-Adebowale, 2012). A report published in 2012 by Lawal-Adebowale revealed that Nigeria has population of about 34.5 million goats, 22.1 million sheep and 13.9 million cattle largely concentrated in the Northern part of Nigeria than Southern part. Sheep and goats play significant roles in the social and economic well-being of Nigerians. They serve as major source of meat, skin, farmyard manure, used for sacrifices and cultural festivals, generate employment for youths, and a major source of income for sellers of live animals and butchers amongst other benefits (Ayoade, 2000; Lawal-Adebowale, 2012).

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The values and productivity of these small ruminants can neither be over emphasized nor overlooked- hence their health challenges as they are being endangered by several factors amongst which are ticks infestations. Tick and tick-borne diseases are the major health problems limiting or restricting livestock productivity in Nigeria. Ticks are obligate blood feeding ectoparasites of vertebrates particularly mammals, birds and reptiles throughout the world. Tick species are widely distributed around the world but they tend to thrive more in countries with warm, humid climates which are conducive for their reproduction (Kilpatrick *et al.,* 2007). They are known to be vectors of bacterial, parasitic and viral pathogens whose effects are felt directly (skin lesions, impairment of animal growth) or indirectly, thus making them a serious public health threat as most are zoonotic (Stachurski, 2000; Socolovschi *et al.*; 2008; de la Fuente *et al.,* 2008; Olson & Patz, 2010).

Ticks are ranked as the most economically important ectoparasites of livestock in the tropics including Sub-Sahara Africa (SSA). In Africa, Tick fauna is remarkably diverse, with about 50 endemic Tick species that are known to infest domestic animals (Walker *et al.,* 2003). However, the highest impact on livestock health is caused by species belonging to only three genera, this includes *Amblyomma*, *Hyalomma* and *Rhipicephalus* (Rajput *et al.,* 2006).

Due to economic and veterinary importance of ticks, their control is a priority for many countries in tropical and sub-tropical regions (Lodos *et al.,* 2000). Investigations to carry out the level of infestation and the type of species involved can play a significant part in formulating strategic control methods towards these parasites (De Castro, 1997). Besides, identification of tick species help in the diagnosis of different tick-borne diseases and their various control programs (Kassa & Yalew, 2012; Gedilu *et al.,* 2014).

Over the years considerable amount of research has been done regarding ixodid ticks infestation on livestock around the world and in Nigeria (Adil *et al.,* 2019; Soundararajan *et al.,* 2018; Ali *et al.,* 2015; Iwuala & Okpala, 1978; James-Rugu & Iwuala, 2002; Ogo *et al.,* 2012; Reye *et al.,* 2012; Kamani *et al.,* 2013; Lurenzo *et al*., 2013; and Kaze *et al.,* 2017) where different species of ticks were found and identified.

Previous studies on ticks and tick-borne diseases in Plateau State, Nigeria were centered on cattle, and as such leaving a lacuna on such data in the small ruminants (sheep and goats). Presently, there is no information on prevailing tick species infesting small ruminants in the areas (Kanke, Jos-South and Shendam) under study in Plateau State, Nigeria. This study therefore, focused on the identification and determination of the distribution of different tick species infesting sheep and goats in the three Senatorial Districts of Plateau State, Nigeria.

Materials and Methods

Study Area

The study was carried out in three LGAs (Jos-South, Kanke and Shendam) representing the three Senatorial Districts of Plateau State.

Jos-South headquarters is in Bukuru. It lies on Longitude 9°48’00’’N Latitude 8°52’00’’E. It has an area of 510km^2 and a population of 306,716 at the 2006 Census. The major language spoken in Jos-South is Berom.

The headquarters of *Kanke* LGA is Kwal, with the coordinates on Longitude 9°23’35.27’’N and Latitude 9°37’58.26’’E. It has an area of 926 km^2 and population of 121,424. The major languages spoken in Kanke are Ngas, Myet, Boghom, Taroh and Badawa.

*Shendam***,** also is a LGA in Plateau State, Nigeria with the headquarters in Shendam. It lies on Longitude 8°53’00’’N Latitude 9°32’00’’E. It has an area of 2,477 km^2 and a population of 208,017. The major language spoken in Shendam is Geomai. Shendam is also bordered by Ibi Taraba State to the South, Quan-Pan LGA to the East, Pankshin to the North and Mikang LGA to the West (NIPOST Archive, 2009) (Figure 1).

Figure 1. Map of Plateau State, indicating the three study areas (black star) (www.plateaustate.gov.ng)

Study Design

A total of 300 animals (sheep and goats) 100 from each LGA were randomly selected from different farms and examined for tick infestations after informed consent from the farm owners had been obtained. The ticks sampling were carried out from September to November 2018.Questionnaire was administered to farmers to evaluate their Knowledge, Attitudes and Practices (KAP) on ticks and tick-borne Infections on their farm animals.

Tick Sampling

Sample Collection

The entire body surface of the animals (sheep and goats) was inspected for ticks after fully restraining the animals. All visible ticks were removed by handpicking or using a pair of special forceps by carefully holding the basis capitulum of the tick in order not to cause damage to the mouthparts and pulling off. Ticks from each animal were collected and placed in separate universal bottles containing 70% ethyl alcohol that had been pre-labeled. Required information like sample number, collection date, location of sampling, animal age and sex of animal were recorded. Age of the animals was based on the information provided by their owners and also by the animal dentition according to compilation of Turton, 1999.

Tick Identification

Ticks collected were taken to Entomology Laboratory of Parasitology Division at National Veterinary Research Institute (N.V.R.I), Vom, Plateau State, Nigeria for identification. Counting and identification the of ticks to genus and species level was done using a Stereomicroscope while a standard identification key given by Walker *et al.* (2003) was used to identify the ticks.

Data Analysis

Data generated from the field study in the three Senatorial Districts were subjected to Chi-Square statistical analysis using Statistical Package for Social Science (SPSS) Version 23 to determine the level of association of ticks and the ruminant animals.

Results

The examination of ticks on sheep and goats in the study areas gave the following results in Table 1.

Table 1. Distribution of tick species collected from the Study Areas

Study Area	**TICK SAMPLES OF DIFFERENT SPECIES**							
	A. variegatum	*R. evertsi*	*R. decoloratus*	*R. muhsamae*	*R. sanguineus*	*R. (Boophilus) spp*	*H. truncatum*	**Total**
Jos-South	6	14	-	3	69	-	5	97
Kanke	20	28	11	13	102	11	2	187
Shendam	5	14	7	3	5	3	2	39
TOTAL	**31**	**56**	**18**	**19**	**176**	**14**	**9**	**323**

A total of 323 Ixodid ticks were collected from the three study areas of which seven species belonging to three genera (i.e. *Amblyomma, Hyalomma* and *Rhipicephalus* including *Boophilus* sub-species) were identified. Larval stages of *R. sanguineus* were also found and identified. Five species belonged to the genus *Rhipicephalus*, one species each belonged to the genera *Amblyomma* and *Hyalomma.* The tick species identified for *Rhipicephalus* include *R. evertsi, R. decoloratus, R. muhsamae, R. sanguineus* and *Rhipicephalus (Boophilus) sub-species* while *A. variegatum* and *H. truncatum* were identified for the other genera.

Distribution of ticks in relation to study areas is as presented in Table 1. It was observed that Kanke recorded the highest number of ticks (187) belonging to different species, followed by Jos-South and Shendam with 97 and 39 respectively.

Table 2. Prevalence of ticks according to the Study Areas

Study Area	**No of Animals Sampled**	**No of Animals Infested**	**% infestation**	**X^2**	***P*-value**	**95% CI**
Jos-South	100	47	47.0	35.006	0.000*	40.6 – 52.2
Kanke	100	68	68.0			
Shendam	100	24	24.0			
Total	300	139	46.3			

Note: * = Significant difference at P≤0.05

Table 2 above shows the prevalence of ticks in the study areas with an overall prevalence of 46.3%. Distribution of the prevalence according to the study sites shows a statistically significant difference (P<0.05) with the highest rate in Kanke (68.0%), followed by Jos-South (47.0%) while Shendam (24.0%) had the least.

Table 3. Distribution of ticks collected on Animals in the Study Areas

Study Area	No of sheep examined	No of sheep infested	No of goats examined	No of goats infested	X^2	P-value
Jos-South	26	13 (50.0%)	74	34 (45.9%)	0.127	0.722
Kanke	65	56 (86.2%)	35	12 (34.3%)	28.127	0.000*
Shendam	30	12 (40.0%)	70	12 (17.1%)	6.015	0.014*
Total	121	81 (66.9%)	179	58 (32.4%)	34.639	0.000*

Note: * = Significant difference at P≤0.05

Out of the 300 animals examined for ticks 121 were sheep while 179 were goats. From Table 3, it was observed that though there was a higher prevalence of tick infestation among sheep in Jos South, it is not statistically significant (P>0.05). However, in Kanke and Shendam LGAs, there is significantly more tick infestation in Sheep than in Goats (P<0.05).

On the overall, it was observed that tick infestation is consistently and statistically more prevalent in sheep than in goats within the entire study areas (P<0.05).

Table 4. Prevalence of Tick infestation amongst sex

Animal Species	Animal sex	No of animal examined	No of animal infested (prevalence %)	X^2	P-value
Sheep	Male Female	17 104	10 71	**0.589**	**0.443**
Goats	Male Female	37 142	09 49	**1.389**	**0.238**

Table 4 above shows the result of animals examined with ticks in relation to sex. The study shows that in both sheep and goats, female generally had higher infestation rate when compared with the male. However, the difference in infestation of ticks between the sexes was not statistically significant (P<0.05).

Table 5. Percentage prevalence of recovered and identified tick species

Tick species	No of ticks identified (Prevalence)	95% Cl of the prevalence
A. variegatum	31 **(9.6%)**	**6.6 – 13.3**
R. evertsi	56 **(17.3%)**	**13.6 – 19.8**
R. decoloratus	18 **(5.6%)**	**2.8 – 6.9**
R. muhsamae	19 **(5.9%)**	**3.6 – 9.0**
R. sanguineus	176 **(54.5%)**	**46.7 – 56.9**
R. (Boophilus) spp	14 **(4.3%)**	**2.2 – 5.1**
H. truncatum	9 **(2.8%)**	**1.3 – 5.2**

Note: CI=Confidence Interval

The result in Table 5 shows the prevalence of all the tick species identified in the study areas, of which *Rhipicephalus sanguineus* was the most prevalence (54.5%), while *Hyalomma trancatum* was the least abundant with (2.8%).

This prevalence of tick species is also presented in a chart form as shown in Figure 2 below.

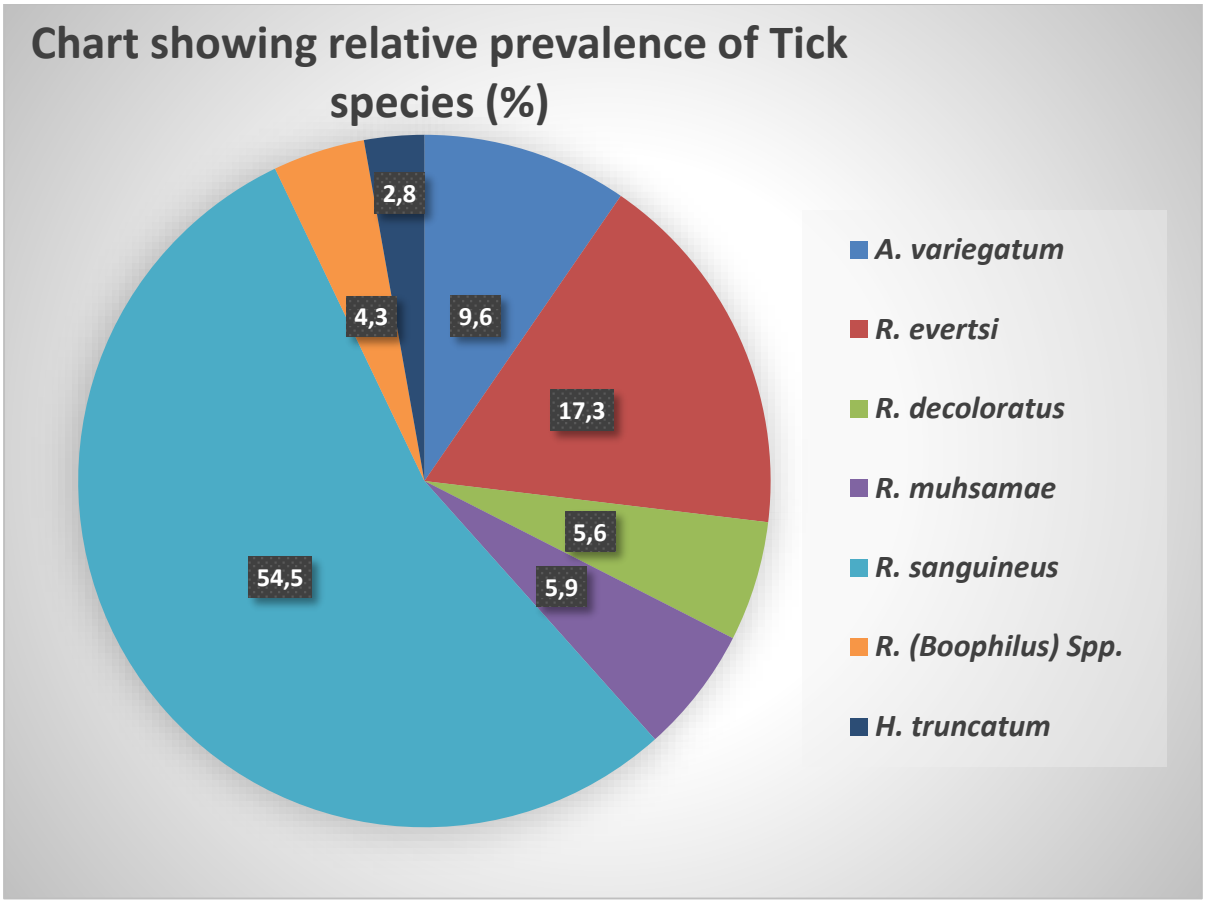

Figure 2. Chart showing relative prevalence of Tick species (%)

Table 6. Presents the different species of ticks and their developmental stages from the three study sites

Tick species	Jos South/ Sex (stages)				Kanke/ Sex (stages)				Shendam/ Sex (stages)				TOTAL
	M	F	N	L	M	F	N	L	M	F	N	L	
A. variegatum	4	2	-	-	1	19	-	-	1	4	-	-	31
R. evertsi	5	9	-	-	12	16	-	-	6	8	-	-	56
R. decoloratus	-	-	-	-	-	11	-	-	1	6	-	-	18
R. muhsamae	3	-	-	-	3	10	-	-	1	2	-	-	19
R. sanguineus	38	30	-	1	65	36	-	1	1	2	-	2	176
R. (Boophilus) spp	-	-	-	-	-	11	-	-	-	3	-	-	14
H. truncatum	3	2	-	-	-	2	-	-	-	2	-	-	9
TOTAL	53	43	-	1	81	105	-	1	10	27	-	2	323

Note: **M**=Male adult, **F**=Female adult, **N**= Nymph and **L**=Lavae

Table 6 shows the developmental stages (Adults, Nymph and Larval) of different species of ticks found across the study areas. In the distribution, female adult ticks were found more in Kanke and Shendam with 105 females compared with 81 males and 27 females compared with

10 males respectively. While, on the contrary, in Jos-South male adult ticks (53) were recorded more than females (43). Meanwhile, no nymph was found in any of the three study areas, but four (4) larval stages of *R. sanguineus* were found across the three study sites, Shendam two (2) while Kanke and Jos-South one (1) each as shown in the table above.

Discussion

Over the years, ticks have been implicated in the transmission of different pathogens such as viruses, bacteria, protozoa and filarial nematodes in animals and humans (Dantas-Torres, 2008), therefore, it is important to document information about their distribution and abundance wherever they are found. The results on the distribution and abundance of tick species infesting the small ruminants in our study areas revealed (Table 1) that ticks are common ectoparasites of small ruminants in Plateau State, Nigeria. It also suggested that sheep and goats are equally susceptible to the identified ticks in the study. *R. sanguineus* outnumbered all the other tick species found in all the three sampling sites and represented 54.5% of the total tick collections with Kanke (58%) recording highest tick infestation.

The present study revealed the overall prevalence of tick infestation rate in the study areas as 46.3% (Table 2), recording Kanke LGA with the highest rate of 68.0% followed by Jos-South 47.0% while Shendam the least with 24.0%. This overall small ruminants infestation rate (46.3%) was a little lower than that observed in Ivory Coast by Yao-Acapovi et al. (2018) who recorded 54.45%, but higher than 36.79% reports of Tassou (2009) in the Alibori Division in Benin.

In this study, the overall prevalence of ticks was recorded as 66.9% and 32.4% in sheep and goats respectively (Table 3). The study also recorded more infestation rate in sheep than goats across all the three locations with sheep 86.2% and goats 34.3% in Kanke, Jos-South recorded 50.0% and 45.9% in sheep and goats respectively while Shendam 40.0% and 17.1% were recorded for sheep and goats respectively. These results were close to those of Tongjura *et al.* (2012) in Nasarawa State, Nigeria, who reported tick infestation rate higher in sheep (49.5%) than goats (39.3%). In Adamawa State, Nigeria, Wahedi *et al.* (2020) reported 78.0% in sheep and 50.0% in goats while Alayande *et al.* (2016) recorded sheep (21.2%) and goats (3.8%) in Sokoto State, Nigeria. Obi *et al*. (2014) reported 17% in sheep and goats 12.7% in Anambra State while Ofukwu *et al.* (2008) gave similar account of 8.9% in sheep and goats 7.5% in Benue State, both in Nigeria. Also, this is in agreement with the work of Iwuala and Okpala (2000) supporting the account that goats graze less and just within the home compared to sheep and cattle that graze far into the bush hence come in contact with more vegetation and subsequently more ectoparasites such as ticks. Apart from Nigeria, the corresponding percentage of infestation in sheep and goats in this study agrees with the following researchers Fufa *et al*. (2012) who reported sheep (80.3%) and goats (66.12%) in Ethiopia, Salifou *et al.* (2004) which were 25.12% and 10.31% for sheep and goats respectively in South Benin. But, on the contrary, disagrees with the findings of Yao-Acapovi *et al.* (2018) of Ivory Coast, who recorded tick infection rates of 55.45% and 51.49% in goats and sheep respectively.

In the sex related rate of infestation as shown in Table 4, the females of both sheep and goats had the highest infestation of 71% and 49% respectively as against 10% and 9% in males. This agrees with the report of Obi *et al.* (2014) in Anambra State, Nigeria where females of both sheep and goats had the highest infestation of 63.6% and 70.8% respectively as against 36.4% and 29.2% in males. The high infestation of females of both ruminants can be ascribed to their restraint either during lactation or gestation that makes them less active, low immunity or for this reason they are exposed to heavy loads of ectoparasite infestation (Veen *et al.*, 2005). The males' activities could be of assistance in shading off some of these ectoparasites passively, and could be source of transmission to healthy females during mating.

Different tick species are widely distributed and a number of researchers reported the distribution and abundance of tick species in different parts of the world including Nigeria. In this study, as shown in Table 5 and Figure 2, *R. sanguineus* was found to be the most prevalent tick species (54.5%), supporting Dantas-Torres (2011) report for *R. sanguinues* as the most widespread tick in the whole world. Adil *et al*. (2019) in Pakistan reported *R. saguinues* (57.2%) more in abundance in sheep and goats than other tick species. The findings in this study is also in tandem with that of Yao-Acapovi *et al.* (2018) of Ivory Coast, who recorded the dominance of *R. sanguinues* (71.09%) on sheep and goats. Also, Amuta *et al.* (2010) reported that *R. sanguinues* was the most prevalent (80.5%) infesting dogs in Wurukum, Makurdi, Nigeria. In Bauchi State, Nigeria, Aminu (2015) reported *R. sanguinues* (70%) as the most prevalent in goats examined for ticks infestation. The abundance of this species can be explained by the promiscuous behavior of its small ruminants vertebrate hosts with stray or guard dogs (Fahmy *et al.*, 1981) as identified in the study areas. Almost all the households visited keep dogs and *R. sanguinues* is the dog's main tick.

The identification of several tick species in this study indicates the economic importance of the ticks and potential existence of tick borne diseases in the areas as most are known to have the ability of transmitting protozoan and rickettsial diseases from animals to humans.

The high infestation of small ruminants observed especially in Kanke LGA which was seen generally more in sheep across the three study sites could be attributed to the fact that sheep graze far from home than goats, thereby getting more exposed to vegetation and ectoparasites (Iwuala & Okpala, 2000). Furthermore, despite the dry season period in which the sampling was carried out, that is known for decrease in infestation rate and tick burden, the relatively low infestation rates obtained in Shendam could also be attributed to the fact that farmers there seek attention of veterinarians from time to time which was visible on the questionnaire administered to them.

Conclusions

It can be concluded therefore that sheep and goats are potential hosts of ticks that can cause harm to humans too through transmission of pathogens.

The importance of periodic application of acaricides in the control of tick infestation of the animals in the study areas should continuously be re-emphasized to the animal owners. Furthermore, the need for veterinarians' attention to be sought from time to time is advocated to reduce the tick population in the study areas.

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