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HAEMOPARASITE FAUNA OF DOMESTIC ANIMALS IN PLATEAU STATE, NORTH CENTRAL NIGERIA

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ABSTRACT
Haemoparasitism remains persisting as the major challenge to animal health and production causing the destruction of red blood cells resulting in anaemia, jaundice, anorexia, emaciation, reduced productivity, infertility and even death. This study was conducted to investigate and provide information on the diversity of haemoparasites species affecting animals in Plateau State, North-central Nigeria. Blood samples collected from 1,298 apparently healthy animals (501 cattle; 252 sheep; 393 goats; 129 dogs and 23 horses) were parasitologically screened for the presence of haemoparasites. Babesia bigemina, Babesia bovis, Trypanosoma vivax, Anaplasma marginale, Theileria mutans and Theileria velifera were detected in cattle, with Babesia bigemina (75/501 (14.97%); 95% CI: 12.05 – 18.30) and Anaplasma marginale (27/501 (5.39%); 95% CI: 3.66 – 7.64) been the most prevalent. Anaplasma ovis was detected in both sheep and goats, although Babesia ovis and Babesia motasi were the most prevalent blood parasites affecting sheep and goats respectively. Two species were detected each in dogs and horses with Babesia canis and Theileria equi been more prevent in dogs and horses respectively. The result of this study shows that a variety of haemoparasites species are found to infect domestic animals in Plateau State, North Central Nigeria. Considering the importance of domestic animals to national economy and the devastating effect of these haemoparasites, there is need for a radical approach in terms of appropriate and routine prophylactic treatments of animals, and regular vector (ticks and biting flies) control using efficacious acaricides and fly traps to arrest the menace.
Keywords: Blood parasites, Diversity, Plateau State, Prevalence.

INTRODUCTION

Animals that has been tamed and kept by man as a work animal, food source, means of income or pet are referred to as domestic animals. This includes a wide range of animals including cattle, sheep, goats, pigs, dogs, horses, chickens etc. Domesticated ruminants such as cattle, sheep and goats represent an important source of good quality animal protein in many developing countries of Africa including Nigeria (Unigwe *et al*., 2016). In Nigeria, ruminants comprising sheep, goats and cattle constitute the livestock farm animals and about 36.4 million sheep, 58.0 million goats and 16.8 million cattle are currently been reared by farm families in the country (NBS, 2016). Of the ruminant livestock, cattle are regarded as the main source of animal protein in most household, and their products such as milk, hoof, bones, blood, hides and skin are also of great economic benefits (Sam-Wobo *et al*., 2016).

Dogs are believed to be the first domestic animal in most parts of the world (Kamani *et al*., 2011). Dogs are important household pets mostly kept for various other reasons which include security purposes (personal and military), sheep herding and protection against predators, hunting and leading of the blind. In Nigeria, there has been increased interest in keeping of dogs for security and or hunting or pets and for food in some parts of the country (Okubanjo *et al*., 2013).

About 72% of the world's horse's population is found in the developing countries and they are kept for draft purpose in some areas (Getachew *et al*., 2014). Horses are been used by institutional and private owners in Nigeria for pleasure riding, polo games, ceremonies, crowd control, entertainment and research. They are associated with royalty and some special traditional festivals in the northern parts of Nigeria (Ehizibolo *et al*., 2012).

Haemoparasites are a heterogeneous group of organisms characterized by the presence of at least one or more developmental stages in the bloodstream of man and animals (Benedikt *et al*., 2009). The common blood parasites of birds and other animals are *Haemoproteus* species, *Leucocytozoon* species, *Hepatozoon* species, *Aegyptianella* species, *Trypanosoma* species, *Plasmodium* species, *Babesia* species, *Anaplasma* species, *Ehrlichia (Cowdria)* specie, *Theileria* species, *Schistosoma* species *Leishmania* species and *Mycoplasma* (*Haemobartonella*) species (Quillfeldt *et al*., 2011; Bhattacharjee and Sarmah, 2013; Fakhar *et al*., 2013; Pam *et al*., 2013; Opara *et al*., 2016). The difference in the tropical environment is the reasons suitable for

the development of these parasitic diseases in the animals host (Ademola and Onyiche, 2013).

Haemoparasites have commonly been shown to cause destruction of red blood cells resulting in anaemia, jaundice, anorexia, emaciation, reduced productivity, infertility and even death (Ademola and Onyiche, 2013). The direct losses caused by haemoparasitism are attributed to acute illness and death, premature slaughter and rejection of some body parts at meat inspection. Indirect losses include the reduction of productive potential such as reduced birthrate, decreased milk yield, decreased growth rate, weight loss in young growing animal, late maturity of slaughter stock and decreased work efficiency of draft animals (Ademola and Onyiche, 2013; Ukwueze and Kalu, 2015). The effect of haemoparasitism in animals is determined by the interactions between the type of parasites present in the geographical area, parasite life cycles, the environment including weather patterns and type of farm management, and the host factors (Ukwueze and Kalu, 2015).

Despite several reported prevalence rates of haemoparasitic infections of domestic animals in Nigeria, infection with haemoparasites remains persisting as the major challenge to animal production due to findings from previous researchers such as Ehizibolo *et al*. (2012) that worked on horses in northern Nigeria, Ademola and Onyiche (2013) who worked on ruminants and pigs in Ibadan southwest Nigeria and Ukwueze and Kalu (2015) who worked on small ruminants in Umuahia southeast Nigeria.

For this reason, this present data was analysed to investigate and provide additional information on the diversity of haemoparasites species affecting animals in Plateau State, North-central Nigeria.

MATERIALS AND METHODS

Study area

This study was carried out in Jos South local government area of Plateau State, North-central Nigeria. Jos South covers an area of 5,104 square kilometers and is located between latitude 9º 46 to 9º 77′ N, and longitude 8º 48 to 8º 80′ E. The major ethnic group is Berom beside other major settlers like Hausa, Igbo, Yoruba, Miango and Tarok etc. (Dogo *et al.*, 2017). Plateau State covers an area of 27,147 square kilometers and is almost centrally located between latitude 80° 24′N and longitude 80° 32′ and 100° 38′ east of the Greenwich meridian. The state has a high altitude ranging from approximately 1,200 to a peak of 1,829 metres above sea level. Plateau state has a near temperate climate with a mean annual rainfall of between 131.75 cm to 146 cm and an average annual temperature ranging from 16.3°C and 28.1°C. It records a mean relative humidity of between 46.9% and 51.3% (NBS, 2016; Bolajoko *et al.*, 2016).

Blood samples and processing

About 2mls of anticoagulated blood samples collected from 1,298 apparently healthy animals (501 cattle; 252 sheep; 393 goats; 129 dogs and 23 horses) in Jos south local government were submitted to the Parasitology laboratory of the National Veterinary Research Institute Vom, for haemoparasite diagnosis. The blood samples were submitted between January and December 2012. The samples submitted were from animals raised under extensive and semi-intensive management systems.

Thin blood smear was prepared using standard method as described by Cheesbrough (2000). A drop of blood was placed on one end of a clean, grease free glass slide and made into thin film with aid of a spreader (a clean glass slide). This was done by allowing the spreader to touch the blood at an angle of 45º, and then spread gently but firmly along the surface of the horizontal slide so that the blood is dragged behind the spreader to form the film with a feathered edge. The prepared thin film was then air-dried, fixed in methanol for 5 minutes and stained in freshly prepared 10% Giemsa stain at pH 7.2 (10ml Giemsa solution and 90ml buffer solution) for 25-30 minutes. Afterwards, the stained film was rinsed in buffered water and allowed to dry. The smears were examined at X100 magnification (oil immersion) on an Olympus Microscope for the presence and identification of haemoparasites, according to Soulsby (1986) and Shah-Fischer and Say (1989).

Statistical analysis

Data was analyzed using descriptive statistics that was conducted using percentages and tabulations. The 95% confidence interval was used to determine the range in the level of prevalence of each blood parasite. All statistical tests were conducted using statistical package for social sciences (SPSS) version 22 (SPSS Inc., Chicago).

RESULTS

Of the 1,298 animal blood that were screened, cattle blood were the most numerous been 501 (38.60%; 95% CI: 35.98 – 41.27), followed by goat blood been 393 (30.28%; 95% CI: 27.82 – 32.82). Horse and dog blood were the least numerous been 23 (1.77%; 95% CI: 1.15 -2.61) and 129 (9.90%; 95% CI: 8.40 – 11.66) respectively Table 1.

The diversity and prevalence of blood parasite species of animals in Plateau State, North Central Nigeria is presented in Table 2. Six haemoparasite species (*Babesia bigemina*, *Babesia bovis*, *Trypanosoma vivax*, *Anaplasma marginale*, *Theileria mutans* and *Theileria velifera*) were detected to infect cattle with *Babesia bigemina* (75/501 (14.97%); 95% CI: 12.05 – 18.30) and *Anaplasma marginale* (27/501 (5.39%); 95% CI: 3.66 – 7.64) been the most prevalent. *Babesia ovis* and *Anaplasma ovis* were the species affecting sheep with *Babesia ovis* been the more prevalent haemoparasite infecting 24 of the 252 sheep screened (9.52%; 95% CI: 6.34 – 13.63). Of the haemoparasites (*Babesia motasi* and *Anaplasma ovis*) affecting goats, *Babesia motasi* was the more prevalent specie affecting 24 of the 393 goats (6.11%; 95% CI: 4.04 – 8.82) compared to 12 (3.05%; 95% CI: 1.67 – 5.13) of *Anaplasma ovis* affecting the same animal.

Two species each were detected in dogs (*Babesia canis* and *Hepatozoon canis*) and horses (*Theileria equi* and *Babesia caballi*) with *Babesia canis* (30/129 (23.26%); 95% CI: 16.57 – 31.13) and *Theileria equi* (22/23 (95.65%); 95% CI: 80.37 – 99.78) been the more prevalent blood parasites in dogs and horses respectively.

Table 1: Demographic Information of Animals Studied for Haemoparasite Fauna in Plateau State, North Central Nigeria.

Species	Number of animals	Percentage (%)	95% CI
Cattle	501	38.60	35.98 – 41.27
Sheep	252	19.41	17.33 – 21.63
Goats	393	30.28	27.82 – 32.82
Dog	129	9.94	8.40 – 11.66
Horse	23	1.77	1.15 -2.61
Total	1298		

Table 2: Diversity and Prevalence of Haemoparasite species of Animals in Plateau State, North Central Nigeria.

Animal (Number)	Haemoparasite specie	Number infected	Prevalence (%)	95% CI
Cattle (501)				
	Babesia bigemina	75	14.97	12.05 – 18.30
	Babesia bovis	6	1.20	0.49 – 2.47
	Trypanosoma vivax	18	3.59	2.21 – 5.51
	Anaplasma marginale	27	5.39	3.66 – 7.64
	Theileria mutans	6	1.20	0.49 – 2.47
	Theileria velifera	3	0.60	0.15 – 1.62
Sheep (252)				
	Babesia ovis	24	9.52	6.34 – 13.63
	Anaplasma ovis	15	5.95	3.50 – 9.42
Goats (393)				
	Babesia motasi	24	6.11	4.04 – 8.82
	Anaplasma ovis	12	3.05	1.67 – 5.13
Dogs (129)				
	Babesia canis	30	23.26	16.57 – 31.13
	Hepatozoon canis	17	13.18	8.13 – 19.86
Horses (23)				
	Theileria equi	22	95.65	80.37 – 99.78
	Babesia caballi	12	52.17	32.13 – 71.70

DISCUSSION

Haemoparasite infections have been one of the most economically impactful conditions affecting human and animal health worldwide particularly in developing countries such as Nigeria at the moment (Ademola and Onyiche, 2013); hence the knowledge of its fauna, diversity and prevalence in animals is very important. Dogo *et al*. (2017) reported that cattle, sheep and goats are the major animal species that are been reared by people of Jos South local government area of Plateau State, North-central Nigeria. This may be the reason we had more cattle, sheep and goats samples for this study.

Six haemoparasite species (*Babesia bigemina*, *Babesia bovis*, *Trypanosoma vivax*, *Anaplasma marginale*, *Theileria mutans* and *Theileria velifera*) were detected from cattle in this study. These species with exception of *Theileria velifera* has been previously reported in Nigeria (Kamani *et al*., 2010; Ademola and Onyiche, 2013; Pam *et al*., 2013; Abdullahi *et al*., 2014) not until very recently when it was reported by Lorusso *et al*. (2016) who detected the parasite using molecular diagnostic technique. This shows that the parasite (*Theileria velifera*) may have been wrongly identified in earlier studies where basic parasitological technique was used. Although, the fact that *Theileria velifera* was not detected by previous researchers proves that the parasite is not endemic in Nigeria as it was the least prevalent parasite recorded in this study. *Babesia bigemina* and *Anaplasma marginale* were the most prevalent haemoparasite affecting cattle in this study. Similar to our findings, Abdullahi *et al*. (2014) and Zawua *et al*. (2015) reported *Anaplasma marginale* and *Babesia bigemina* to be the most prevalent blood parasites affecting cattle in their respective works conducted in Nasarawa and Benue states of Nigeria. *Babesia bigemina* and *Anaplasma marginale* has been reported to be the most prevalent haemoparasites affecting cattle in Gambia (Mattioli *et al*., 1997) and Bangladesh (Mohanta *et al*., 2011). The high prevalence of *Babesia bigemina* and *Anaplasma marginale* in this study maybe associated with the peculiarity of their transmission mode. *Babesia bigemina* transmission occurs during the nymphal and adult stages, and the tick remains infected for many generations (Dalgliesh and Stewart, 1983; Ola-Fadunsin, 2017). Transmission of *Anaplasma marginale* can occur biologically and trans-ovarially by ticks, and mechanically by biting flies, through blood-contaminated fomites, contaminated needles, dehorning saws, nose tongs, tattooing instruments, ear tags devices and castration instruments.

In addition, *A. marginale* may be transmitted from cow to calf trans-placentally (Ola-Fadunsin, 2017). The infection rate of between 0.60% and 14.97% of cattle haemoparasites reported in this study suggests continuous challenge by these parasites and the existence of the carrier state in the animal as well as the continuous presence of their arthropod vectors.

Babesia ovis and *Babesia motasi* were the more prevalent haemoparasites infecting sheep and goats respectively in this study. Although *Anaplasma ovis* was detected to also infect these animal species. *Babesia* species and *Anaplasma* species has been reported to be the most prevalent haemoparasites of small ruminants (sheep and goat) in northern Nigeria (Opara *et al*., 2016; Bello *et al*., 2017), southeastern Nigeria (Nwoha *et al*., 2013b; Ukwueze and Kalu 2015) and southwestern Nigeria (Akande *et al*., 2010; Sam-Wobo *et al*., 2016). *Trypanosoma* species were not detected from our study and this has been reported to be endemic among sheep and goats in southwestern Nigeria (Akande *et al*., 2010; Ademola and Onyiche, 2013). The non-detection of *Trypanosoma* species in our studies may be attributed to the fact that the sample area does not fall within the Tsetse flies infested zones of Nigeria as well as small ruminants are not natural hosts for the mechanically transmitted *Trypanosoma evansi* endemic to the area (Jatau *et al*., 2011).

Babesia canis and *Hepatozoon canis* were the haemoparasites detected in our study. These parasites have been reported to be the major haemoparasites of dogs in Nigeria, with the latter been more prevalent (Nwoha *et al*., 2013a; Opara *et al*., 2017) as observed in our study. Other haemoparasite species (*Trypanosoma*, *Anaplasma*, *Theileria* and *Ehrlichia* species) that were not detected in our study has been reported to affect dogs in Nigeria (Nwoha *et al*., 2013a; Adamu *et al*., 2014). The absence of these haemoparasites in our study may be attributed to the fact that the blood samples presented were for local breeds of dogs. However, *Ehrlichia canis* was seen in exotic breed of dog which may be attributed to breed susceptibility (Nyindo *et al*., 1980). *Babesia canis* and *Hepatozoon canis* has been documented to affect dogs in India (Bhattacharjee and Sarmah, 2013) and in Cape Verde (Gotsch *et al*., 2009). The presence of *Babesia canis* and *Hepatozoon canis* in our study may be attributed to the fact that the tick vector (*Rhipicephalus sanguneus*) occur in large numbers in Jos south almost all year round (Kamani *et al*., 2011).

Our findings show that *Theileria equi* (formerly *Babesia equi*) and *Babesia caballi* were the haemoparasites affecting horses in the study area. *Theileria equi* was almost as twice more prevalent compared to *Babesia caballi*. These two haemoparasites were the most prevalent reported among horses in a work carried out by Ehizibolo *et al*. (2012). This group of researchers reported that four species of haemoparasites infect horses in their study carried out in three states (Bauchi, Kaduna and Plateau) in northern Nigeria. The two species reported in our study may suggest that other haemoparasite species are not present among horses in the study area. The occurrence of *Theileria equi* and *Babesia caballi* has been tied closely with the geographic distribution and seasonal activity of its biological vectors (Turaki *et al*., 2014; Davitkov *et al*., 2016). Similar to our findings, higher prevalence of *Theileria equi* compared to *Babesia caballi* has been reported in horses sampled in northern Nigeria (Ehizibolo *et al*., 2012), northeast Nigeria (Turaki *et al*., 2014), in horses sampled in four widely separated states of Nigeria (Mshelia *et al*., 2016), outside Nigeria: in Sudan (Salim *et al*., 2013), Mongolia (Munkhjargal *et al*., 2013), central Balkan (Serbia, Montenegro and Bosnia and Herzegovina) (Davitkov *et al*., 2016) and Spain (Cortés *et al*., 2017). The higher prevalence of *Theileria equi* compared to *Babesia caballi* can be attributed to the fact that horses infected with *T. equi* may remain lifelong carriers, whereas *B. caballi* is eliminated from the bloodstream, this making the transmission and infection of the former easier and higher compared to that of the later.

CONCLUSION

Our study shows that a variety of haemoparasite species are found to infect domestic animals in Plateau State, North Central Nigeria. Haemoparasites such as *Theileria equi*, *Babesia caballi*, *Babesia canis* and *Babesia bigemina* are endemic in the area. Considering the importance of domestic animals to the nation's economy and the devastating effect of these haemoparasites, there is need for a radical approach in terms of appropriate and routine prophylactic treatments of animals, and regular vector (ticks and biting flies) control by using efficacious acaricides and fly traps to arrest the menace.

Authors' contributions

All authors participated in the overall success of this study. All authors provide substantial input, read and approved the final draft.

Conflict of interest

The authors state that there is no conflict of interest among them.

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