Nigerian Veterinary Journal
VOL:33 (1) 407-415
ARTICLE

Hemoparasites and Hematological Evaluations in Sokoto Red Goats Slaughtered During the Dry Season in Sabon Gari Local Government Area, Kaduna State, Nigeria.

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SUMMARY

A total of 150 blood samples collected from Sokoto Red goats (SRG) slaughtered at the Zaria Abattoir (ZA) and Dogarawa Small Ruminants Slaughter Slab (DSRSS), Sabon Gari Local Government Area, Kaduna State, Nigeria during the dry season months of January and February, 2009 were examined for hemoparasites using the microhematcrit, thin, and thick blood smear techniques. Packed cell volume (PCV), hemoglobin concentration (Hb), total plasma protein (TP) concentration, total WBC counts, and differential WBC counts were determined. Overall, 24.7% of the goats sampled were positive for hemoparasites. The blood parasites identified were *Anaplasma ovis* (Lestoquard, 1924) 20.0%, *Theileria ovis* (Rodhain, 1916) 3.0%, and *Babesia ovis* (Starcovici, 1893) 1.0%. Mixed infections (1.7%) due to *A.ovis* and *T.ovis* were also detected. *A.ovis* was the most predominant blood parasite detected using the thin blood smear method in the goats. The mean PCV, Hb concentration, TP, and WBC counts in the goats infected with any of the hemoparasites were not significantly different (P>0.05) from those of goats negative for any hemoparasites. However, significant differences (P<0.05) occurred between the non-hemoparasite infected goats and those infected with *T.ovis*. The results have indicated that, based on the diagnostic methods employed, goats slaughtered at the two locations were infected with hemoparasites even during the drier seasons of the year when the tick vector challenge is known to be minimal. Nevertheless, *T.ovis* was identified to have potentially detrimental effects on the health of the goats. None of the goats had trypanosome infection based on the diagnostic methods used.

KEY WORDS: Hemoparasites, *Anaplasma ovis*, *Theileria ovis*, *Babesia* sp, slaughtered goats.

INTRODUCTION

SRG constitute the predominant breed inhabiting the northern parts of Nigeria (Ngere *et al.*, 1984; Blench, 1999). Poor management conditions and diseases lead to poor performance of goats (Delgado, 1979). Goats can utilize a variety of forages and crops to meet nutritional requirements and can survive in a variety of ecological conditions (Oyeyemi, 2002). Goats are said to have the potential to contribute to an increasing demand for meat (Delgado *et al.*, 1999). Estimated population of goats in Kaduna State was 1.6 million (National Bureau for Statistics, 2005).

Hemoparasitic diseases are known to occur in goats (Radostits *et al.*, 2007). *Anaplasma ovis*, a tick-borne disease capable of being transmitted mechanically in goats (Brown *et al.*, 1992) has been reported in Nigeria (Akinboade *et al.*, 1986). *Babesia ovis* and *B.motasi* are transmitted by *Rhipicephalus*, *Hemaphysalis*, *Hyalomma*,

Dermacentor, and *Ixodes* spp (Dipeolu, 1983) in goats. *B.ovis* is mainly transmitted by *Rhipicephalus* spp in Nigeria (Leeflang and Ilemobade, 1977). *Theileriaovis*, *T.lestoquardi*, *T.separata*, and *Theileria* sp. *china* affect goats (Jianxung and Yin, 1997) with *T.lestoquardi* and *T. sp. china* being the only pathogenic species (Uilenberg, 1981, Yin *et al.*, 2003). They are transmitted by *Rhipicephalus evertsi* in Africa.

Trypanosomosis due to *Trypanosoma congolense*, *T.vivax*, *T.brucei*, and *T.evansi* can affect goats; *T.evansi* being the most invasive (Ngeranwa *et al.*, 1993). The role of goats in the epidemiology of trypanosomosis is largely not well understood (Gutierrez *et al.*, 2006). Oladele and Adenegan (1998) reported that goats are relatively resistant to trypanosomosis. However, Omotainse *et al.* (2000) reported infections involving *T.brucei* in goats in Benue State, Nigeria. Trypanosomosis in goats could result in economic losses (Mahmoud and El-Malik, 1977; Katunguka-Rwakishaya, 1996; Omotainse *et al.*, 2000; Tambuwal *et al.*, 2002).

Diagnosis of hemoparasitosis in goats relies on standard parasitologic and serologic techniques. Parasitological methods (wet blood mounts, Giemsa stained thin/thick blood smears, and microhematocrit centrifugation technique) can be used to confirm diagnosis in infected goats. Inoculation of laboratory rodents with suspected blood may be indicated in the diagnosis of some trypanosome infections. Immuno-fluorescent antibody, agglutination, compliment fixation, card agglutination, and enzyme-linked immuno-sorbent assay (Ndungu'u *et al.*, 1995) are the main serological tests used in field surveys, while immunoblotting, isoenzymes, and polymerase chain reaction (Radostis *et al.*, 2007) are more specialized diagnostic techniques.

The objective of this study was to determine the prevalence of hemoparasite infections and associated hematological changes that may occur due to such infections in Sokoto Red goats slaughtered at the the ZA and the DSRSS, Sabon Gari Local Government Area of Kaduna State during the dry season period.

MATERIALS AND METHODS

Study Area

The two slaughter sites were located in Sabon Gari Local Government Area of Kaduna State, Nigeria, which is located in the Northern Guinea Savanna vegetation zone (Kershaw, 1968) and between latitudes 11° 15'N and 11°3'N of the equator and between longitudes 7° 30'E and 7°45'E of the Greenwich Meridian. The average daytime temperature for the month of January was 30°C (86°F) while the night average minimum temperature was 12°C (53°F). The average daily relative humidity for the month was 26% while the average precipitation was 0 mm (Zaria Climate History, 2012).

Sampling

Seventy five SRG slaughtered at the ZA and another 75 at the DSRSS, consisting of 138 (92%) males and 12 (8%) females, were sampled during the months of January and February, 2009. The goats were sampled randomly on the basis of selecting every other goat slaughtered per visit until ten were sampled. A total of eight visits were made to each location during the period to sample a total of 75 goats. The ages of the goats were between 9 and 12 months based on dentition. Immediately following slaughter using the Islamic halal method, 5 ml of jugular vein blood was collected from each goat into an appropriately labeled *bijou* bottle containing approximately 7.5

mg of disodium ethylenediamine tetraacetate, inverted 8 to 10 times to ensure thorough mixing, and immediately processed at the Clinical Pathology and Protozoology Laboratories, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria.

Parasitological Evaluations

Thin and thick blood smears were prepared according to the procedure of Adams *et al.* (1977) and Giemsa staining methods of National Committee for Clinical Laboratory Standards (NCCLS; 2000). The slides were then examined under light microscopy using oil immersion (x100 magnification) to determine the presence of hemoparasites. Blood samples were also concentrated by centrifugation in microhematocrit tubes according to the method of Murray *et al.* (1977) and the buffy-coat area was evaluated under oil immersion for trypanosomes.

Hematologic Parameters

The PCV, Hb concentration, total WBC and differential WBC counts, and plasma TP concentration were determined in each goat blood sample according to the procedures described by Kerr (1989).

All the data obtained were subjected to descriptive statistical analysis and single factor ANOVA using Microsoft Excel® Analysis ToolPak (Microsoft Office, 2007) to determine any significant differences ($p<0.05$) on the factors evaluated between the different categories of goats.

RESULTS

Hemoparasites

The results showed that of the 150 goat blood samples evaluated, 29 (19.3%) were positive for *A.ovis*, 4 (2.7%) for *T.ovis*, 1 (0.7%) for *B.ovis*, 3 (2.0%) had mixed infections (MI) of *A.ovis* and *T.ovis*, while 113 (75.3%) were negative (i.e non-infected; NI) for any blood parasite (Table I).

Hematological Parameters

The mean (±SD) PCV in the *A.ovis,T.ovis,* MI, and NI goats were 36.7% ±9.0, 29.0% ±11.4, 32.7% ±14.5, and 37.0% ±6.7, respectively (Table II). The only goat with *B.ovis* infection had a PCV of 33.0%. Significant difference ($P<0.05$) occurred between the *T.ovis* infected and the NI goats only and not between the other infected groups.

The mean Hb concentrations in the *A.ovis*, *T.ovis*, MI, and NI goats were 12.2 g/dL ±3.0, 9.6 g/dL ±3.0, 10.9 g/dL ±4.8, and 12.3 g/dL ±2.2, respectively (Table II). The *B.ovis* infected goat had Hb concentration of 11.0 g/dL. A significant difference ($P<0.05$) occurred between the *T.ovis* infected and the NI goats only and not between the other infected groups.

The mean plasma TP concentrations in the *A.ovis*, *T.ovis*, MI, and NI goats were 8.1 g/dL ±1.0, 8.8 g/dL ±0.6, 7.2 g/dL ±1.0, and 7.9 g/dL ±0.9, respectively (Table II). The *B.ovis* infected goat had TP concentration of 10.8 g/dL. A significant difference ($P<0.05$) occurred between the NI and *T.ovis*-infected, and between the MI and *A.ovis*-infected goats.

The mean WBC count in the *A.ovis*, *T.ovis*, MI, and NI were 8.7 x 10^3/L ±2.7, 9.0 x 10^3/L ±3.2, 7.2 x 10^3/L ±1.7, and 8.3 x 10^3/L ±2.7, respectively (Table II). The *B.ovis* infected goat had a WBC count of 9.0 x 10^3/L. No significant difference ($P>0.05$) occurred between the mean counts in all the different groups.

The mean differential WBC counts in the *A.ovis*, *T.ovis*, MI, *B.ovis*, and NI goats are presented in Table II. No significant difference ($P>0.05$) occurred between the mean counts in all the different groups.

DISCUSSION

The results of this study showed that 24.7% of the goats sampled during the period were positive for various hemoparasites.

This is in conformity with an earlier report of infection rate of 27.0% on a retrospective study in goats (Useh *et al.*, 2007). The rate of infection obtained in this study can be considered to be high and despite the endemic nature of the parasites, this may still be of concern to the health of goats in the area due to prevailing conditions of poor management and other stressing factors that may expose goats to such infections. Most of the goats in the area were kept under the nomadic, transhumance, or peri-domestic free roaming systems and the tick vectors occurred commonly in the area. Seasonal variations in tick populations are known to occur according to changes in climatic conditions (Dipeolu, 1983; Bayer and Maina, 1984; Dipeolu, 1984; Arong *et al.*, 2011) in which abundance in tick populations occurs during the early parts of the rainy season. This may suggest that a commensurate rise in the number of cases of tick-borne diseases be anticipated during the wet season with increased risk of challenge compared to periods when tick populations are less abundant. The current study was carried out during the dry season, and as such, the outcomes may likely be different had it been conducted during the wet season. Higher prevalence of hemoparasite infections have been reported in the South Western parts of Nigeria in sheep and cattle (Takeet *et al.*, 2009; Akande *et al.*, 2010) and were suggested to be associated with suitable environmental conditions suitable for the survival of vectors of the diseases (Akande *et al.*, 2010). In an investigation conducted on gastrointestinal and hemoparasites in sheep and goats slaughtered at the Kano Abattoir, 17.5% of the Kano Brown goats carried hemoparasite infection but in association with gastrointestinal parasites. However, the Kano study was carried out between the months of July and September which corresponded with the rainy season (Jatau *et al.*, 2011).

The results revealed that 2.0% of the sampled goats had mixed infection due to *A.ovis* and *T.ovis* and majority were singly infected with *A.ovis* while the least occurring was *B.ovis*. The low rates of occurrence of *T.ovis* and *Babesia* spp appears to be in agreement with the report of Useh *et al.* (2007) and (Jatau *et al.*, 2011). The relatively low levels of vector challenge during the dry season could also be a contributing factor. Significant differences occurred in the mean PCV and hemoglobin concentrations of the goats with *T.ovis* infection, indicating the potential significance of theileriosis in affecting the health of infected goats even though *T.ovis* is known to cause mild pathology in sheep and goats compared to other species like *T.lestoquardi* which is the most pathogenic of the small ruminant *Theileria* species in Northern Africa and Asia (Bishop *et al.*, 2004).

In a study on hemoparasites of West African Dwarf sheep in Ibadan, Adejinmi *et al.* (2004) reported severe anemia associated with mixed infections involving *Anaplasma,Eperythrozoon,* and *Babesia* spp in which more 50% of the animals evaluated had hemoparasites either as single or mixed infections. They did not observe any infection with trypanosomes as is the case with the present study. Nonetheless, experimentally infected Savannah goats with *T.brucei* and *T.vivax* developed clinical disease with fall in hematological parameters (Adieza *et al.*, 2008). PCV, Hb concentrations, RBC, and WBC counts were observed to be significantly decreased in animals with mixed hemoparasite infections compared to those with single infections (Adejinmi *et al.*, 2004). Useh *et al.* (2008) reported 3.4% cases of mixed involving *A.ovis* and *T.ovis*, a situation which appears similar to

the findings in this study. Changes in the hematological values in this study were insignificant except in the goats infected with *T.ovis*. Adejinmi *et al.* (2004) attributed the high rate of infection to favorable conditions that promoted the transmission of the infections by suitable vectors. However, in this study, the relatively low rates of infection could be attributed to minimum vector activity during the drier months of the year.

The thin smear technique used provided some limitations to the specificity and sensitivity of the diagnostic methods. However, for practical field purposes, the thin smear method of demonstrating the presence of the parasite has been known to be beneficial despite its limitations especially under conditions of low parasitemia as seen during early stages of infection or after the establishment of a carrier state (Todorovic and Carson, 1991).

CONCLUSION

The findings of this study show that SRG slaughtered at the two locations during the dry season were infected with hemoparasites in which *T.ovis* was the most important. The need to show more concern towards the quality of meat made available to the human population in Nigeria is becoming increasingly relevant. As such, diseases that have the potential of impeding the optimum production performance of goats need to be tackled particularly in the face of poor management. Tick vectors of such diseases have been reported and are known to occur (Idris and Umar, 2007) in goats presented for slaughter in the area. It is also believed that an effective tick control programme will go a long way in improving the situation, particularly during the wet season when conditions become more suitable for their proliferation.

ACKNOWLEDGEMENT

The authors wish to sincerely thank the management of the Zaria Abattoir and the Dogarawa Small Ruminant Slaughter Slab, and the staff of the Veterinary Parasitology and Clinical Pathology Laboratories, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for their assistance.

TABLE I: Hemoparasites in the blood of SRG* slaughtered at the ZA and DSRSS during the months of January and February, 2010

Hemoparasite †	Frequency	Relative frequency	% Relative frequency
Anaplasma ovis	29	0.193	19.3
Babesia ovis	1	0.007	0.7
Theileria ovis	4	0.027	2.7
Mixed *A.ovis* and *T.ovis*	3	0.020	2.0
No parasite found	113	0.753	75.3

Key:SRG = Sokoto Red GoatsZA = Zaria Abattoir;DSRSS = Dogarawa Small Ruminants Slaughter Slab

* Sample size of 150

† Based on blood smear and mHCT evaluations

TABLE II: Mean hematologic parameters of SRG* slaughtered at the ZA and DSRSS during the months of January and February, 2010

	Anaplasma ovis	Mixed infections †	*Theileria ovis*	NPF‡
Parameter	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
PCV (%)	36.7 (9.0)	32.7 (14.5)	29.0 (11.4)	37.0 (6.7)
Hb (g/dL)	12.2 (3.0)	10.9 (4.8)	9.6 (3.8)	12.3 (2.2)
TP (g/dL)	8.1 (1.0)	7.2 (1.0)	8.8 (0.6)	7.9 (0.9)
WBC x 10^3/L	8.7 (2.7)	7.2 (1.7)	9.0 (3.2)	8.3 (2.7)
Neutophils-Band x 10^3/L	5.8 (2.7)	5.0 (2.3)	5.7 (3.1)	5.1 (2.1)
Neutophils-Segmented x 10^3/L	2.8 (1.2)	2.0 (0.8)	3.1 (1.3)	3.1 (1.8)
Lymphocytes x 10^3/L	0.04 (0.1)	0.09 (0.1)	0.03 (0.1)	0.07 (0.1)
Eosinophils x 10^3/L	0.06 (0.1)	0.02 (0.04)	0 (0)	0.06 (0.1)
Monocytes x 10^3/L	0.03 (0.1)	0.04 (0.04)	0.12 (0.2)	0.04 (0.1)

Key:SRG = Sokoto Red GoatsZA = Zaria Abattoir;DSRSS = Dogarawa Small Ruminants Slaughter Slab

* Sample = 150; SD = Standard deviation

† Mixed *Anaplasma ovis* and *Theileria ovis* infections

‡ No parasites found based on the diagnostic tests used

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