HAEMONCHOSIS AND HAEMOPARASITES OF SMALL RUMINANTS REARED IN NORTH WESTERN, NIGERIA

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ABSTRACT

Small ruminants (goats and sheep) production systems worldwide are significantly constrained by haemo and gastrointestinal parasites. The study was carried out in North-western Nigeria from November 2011 to October 2012 with the aim to identify the common haemoparasites and haemonchosis in small ruminants. Three hundred abomasum samples with corresponding blood samples were collected from 200 goats and 100 sheep, respectively at necropsy. The abomasa were examined by Hansen and Perry method for the presence of Haemonchus contortus while blood samples were examined using the thin blood smear and Haematocrit Centrifugation Techniques (HCT). The prevalence of Haemonchus contortus in small ruminants was 80.3% with goats and sheep having prevalence of 78% and 85%, respectively. The prevalence for H. contortus in small ruminants during late dry, early dry, late rain and early rain were 64.9%, 84.1%, 89.9% and 81.1%, respectively. The prevalence were statistically significant among the seasons ($p<0.05$) with highest prevalence in the late rainy season. The total number of adult worms collected was 21862. The highest adult worm burdens were obtained during late rainy season (August to October) when a mean worm burden of 180.2 ± 51.45 and PCV of 26.63 ± 0.63 were recorded. The mean worm burdens for early dry, late dry and early rain were 42.60 ± 6.93, 31.67 ± 5.56 and 61.10 ± 11.33, respectively. The PCV values for the season were 27.73 ± 0.79, 26.60 ± 0.87 and 28.40 ± 0.65, respectively. The values of PCV for the four sub-seasons were not significant from one another but the value of PCV obtained during early rain was different from those of other sub-seasons. The PCV had a weak negative correlation with worm burdens with Pearson correlation coefficient of -0.2632 which was highly significant ($p<0.001$). Out of 200 goats and 100 sheep examined for haemoparasites, only one goat had heavy infection with Trypanosoma vivax and a sheep had mixed infection with Theileria ovis and Anaplasma ovis. The prevalence of three protozoans encountered was 0.33% each in small ruminants. The PCV of infected goat and sheep with protozoan parasites was 25% and 20%, respectively. The results suggest that Haemonchus contortus may be the major cause of anaemia in the study area. It is therefore recommended that further research be embarked upon to determine the effect of nutrition in ameliorating the effects of helminth infections and anaemia in small ruminant.

Keywords: Haemonchosis, Haemoparasites, Prevalence, Small ruminants, Sub-seasons

INTRODUCTION

Small ruminants play an important socio-economic role within traditional animal husbandry systems in many developing countries, including Nigeria, where over 80% of the nation's livestock lies in the hand of small holders or other traditional groups (Dalhatu and Ala, 2010). However, in recent times, benefits derived from these animals were notably below expectation owing to low productivity (Jatau *et al.,* 2011). One of the most important factors responsible for the decline in productivity is disease. Gastrointestinal and blood parasitic infections seemed to be the most prominent in this regard.

Among different types of parasitic infections, gastrointestinal nematode infections (GNIs) are the most important as far as their adverse effects and prevalence are concerned (Molento, 2009; Tadesse *et al*., 2009). They cause weight loss, reduced feed intake, impaired fertility, lowered immunity, damaged gastric function and high mortality rate, leading to enormous economic losses (Carvalho *et al*., 2012). One exception to this is the highly pathogenic nematode parasite of small ruminants, *Haemonchus contortus,* which is considered to be the main culprit causing anaemia and hypoproteinaemia in ruminants. It has been estimated that each worm sucks about 0.05 ml of blood per day by ingestion or seepage from lesions (Urquhart *et al.,* 2000). Surveys in countries around the world have shown that amongst domestic animals, sheep and goats suffer more frequently from haemonchosis (Nwosu *et al.,* 2007; Tariq *et al.,* 2008). *Haemonchus contortus* is capable of causing acute disease and high mortality in all classes of livestock. Death rate due to acute haemonchosis is very high and may go up 50% in small ruminants (Itty *et al*., 1997).

Small ruminants in Sub-Saharan Africa may be infected with a wide variety of haemoparasites such as the Rickettsiae: *Anaplasma* and *Ehrlichia* (*Cowdria*), and the protozoan parasites: *Theileria*, *Babesia* and *Trypanosoma* (Bell-Sakyi *et al*., 2004; Okaiyeto *et al*., 2008). Some haemoparasite species are only evident when the host is undergoing a clinical response to infection, while other members of the same genera may be seen in blood smears from apparently healthy animals. Infection with many of these heamoparasites species results in a state of pre-immunity, in which the host becomes a long term asymptomatic carrier serving as a source of infection for the tick or insect vector (Young *et al.,* 1988). The tropical environment is for various reasons eminently suitable for the development of these parasitic diseases (Payne, 1990).

This study was therefore conducted to identify the common haemoparasites and haemonchosis of small ruminants in relation to the anaemia in North-western Nigeria, with the aim to advising the livestock farmers on the control strategies of these parasites in order to minimise small ruminants' production losses. The abattoir was selected because it will represent a wide range of husbandry and environmental practices.

MATERIALS AND METHODS

Study Area: The study was carried out in Dogarawa (Trading) slaughter slab in Zaria, Savannah zone of North-western Nigeria from November 2011 to October 2012. The zone is characterised by a tropical climate with two main seasons; a rainy season (May to October) and a dry season (November to April). The minimum temperature recorded was 13.8^0C in December and maximum of 37.1^0C in April. The relative humidity was highest (83.8%) in the month of August and lowest (18.0%) in the month of March and with total annual rainfall of about 1417.3 mm. The sheep breed available at the Dogarawa slaughter slab located in the study area was mostly the Yankasa, while the goats were mostly of the red Sokoto breed. The small ruminants were bought by butchers from Zaria town, the adjoining peri-urban areas, town markets and surrounding villages. The small ruminant management system in these areas vary from free range grazing with little or no supplementation to tethering during the cropping season (April – November); while roaming freely during the dry season. Although this system of management is cheap and less labour intensive, it is characterized by low productivity and high losses due to accidents, diseases and theft (Baah *et al.,* 2012). For the purpose of conducting the study and the subsequent analysis, the calendar months in the year were divided into four sub-seasons. These were early dry (November, December and January), late dry (February, March and April), early rain (May, June and July) and late rain (August, September and October) sub-seasons.

Sample Collection: Blood and abomasum samples were collected from 200 goats and 100 sheep slaughtered in Dogarawa slaughter slab between November 2011 to October 2012. Immediately following slaughter, 5ml of blood samples were collected from the severed jugular vein into bijou bottle containing EDTA as anticoagulant. Following evisceration, abomasum was legated with string and separated from omasum and duodenum to avoid leakage and mixing of contents. Each sample was collected into a clean labelled polythene bag within 30 minutes of evisceration and transported immediately on ice to the Department of Veterinary Parasitology and Entomology Laboratory for examination. The blood samples and corresponding abomasum samples collected from the same animal were labelled with the same number. Twenty to thirty samples for both goats and sheep were collected each month for the period of sample collection.

Haemoparasites: A thin blood smear was prepared from each blood sample using the method of Hansen and Perry (1994) and Cheesbrough (1999). A drop of blood on one end of a clean glass slide, then use a spreader to spread the blood by allowing the spreader to touch the blood, 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, air-dry and fixed in methanol for 5 minutes. Stained in 1:10 Giemsa and Buffer dilution and stain for 25-30minutes and rinse with distilled water then allow to dry. The smears were examined at x100 magnification (oil immersion) for presence of haemoparasites and identification.

Packed Cell Volume: The remaining blood samples were used to determine the packed cell volume (PCV). After gently mixing the blood, a 75 × 1.5 mm capillary tube was filled with blood up to ¾ of its length by capillary action and one end sealed. Then, all of the blood-filled tubes were centrifuged for 4 minutes at 16000 rpm using a microhaematocrit centrifuge. Finally, each tube was placed in a micro-haematocrit reader, to determine the percentage of packed red cell volume (PCV) for each animal (Hansen and Perry, 1994; Urquhart *et al*. 2000).

Haemonchus contortus: Each abomasum was opened on the tray with the help of a scissor. The contents were then washed several times using tap water, paying particular attention to cleaning between the folds of the mucous membranes. The parasites were recovered by passing the content through a sieve of 100 µm diameter mesh and were later back-washed into another container. The samples were examined for adult *H. contortus*. The parasites were picked with wire loop with the aid of an illuminator (Picker x-ray in Veterinary Helminthology Laboratory ABU-Zaria) (Hansen and Perry, 1994; Taylor *et al*., 2007). The worms were preserved in 10% formalin and were then poured into Petri dishes and examined under a stereomicroscope. Identification was made using keys developed by various researchers (Hansen and Perry, 1994). Some parasites that were not cleared were cleaned with lactophenol for detailed morphological examination.

Data Analysis: The percentage prevalence of parasite species was calculated as number of individuals of a host species infected with a particular parasite species divided by the number of host examined times 100. Data obtained for adult *H. contortus* counts were expressed in tables as mean ± SEM. Data were further subjected to t-test and analysis of variance (ANOVA) followed by Turkey's post hoc test where necessary. Chi-square and odds ratio were also used to test for association between the species of the host and seasons of the year. Value of $p<0.05$ was considered significant.

Pearson correlation was also used to test for relationship between PCV and adult *H. contortus* counts. GraphPad prism version 4.0 Windows from Graphpad Software, San Diego, California USA was used to analyze the data.

RESULTS

The results of necropsy examination in small ruminants are shown in Table 1. From the abomasa of 300 small ruminants examined for adult *H. contortus*, the prevalence was 80.3%. The prevalence in goats and sheep were 78% and 85%, respectively. The difference in the two species of small ruminants was not statistically significant ($p>0.05$) but considering species as a risk factor, sheep were one- and-half times more at risk of infection with adult *H. contortus* than goats. The prevalence for *H. contortus* during late dry, early dry, late rain and early rain were 64.9%, 84.1%, 89.9% and 81.1%, respectively. The prevalence was statistically significant among the sub-seasons ($p<0.05$) with highest prevalence during the late rainy sub-season.

The total number of adult *H. contortus* collected was 21862. The highest adult worm burdens were obtained during late rainy season (August to October) when a mean worm burden of 180.2 ± 51.45 was recorded. The least was obtained during late dry season (February to April) when a mean worm burden of 31.67 ± 5.56 was recorded (Table 2). The mean worm burden during the late rainy sub-season was significantly higher ($p<0.05$) than the means for the other three sub-seasons. The mean burdens for the early dry and early rain were not significantly different from one another but were both significantly higher ($p<0.05$) than the mean for the late dry sub-season. The PCV values for early dry, late dry, early rain and late rain were 27.73 ± 0.79, 26.60 ± 0.87, 28.40 ± 0.65 and 26.63 ± 0.63, respectively. The values of PCV for four sub-seasons were not significantly different from one another but the value of PCV obtained during early rain was different from other sub-seasons. The PCV had a weak negative correlation with worm burdens at Pearson correlation coefficient of -0.2632 which was highly significant ($p<0.001$).

The prevalence of protozoan infections among the small ruminants indicated that out of the 200 goats examined, only one goat had heavy infection with *Trypanosoma vivax* with prevalence of 0.5% in the month of March (Table 3). On the other hand, 100 sheep examined, only one had mixed infection with *Theileria ovis* and *Anaplasma ovis* in the month of September. The prevalence of protozoan infections in small ruminants was 0.6%*.* Three protozoans encountered were *Trypanosoma vivax*, *Theileria ovis* and *Anaplasma ovis* with 0.3% prevalence each (Table 3). Goats and sheep that were infected with protozoa parasites had 25% and 20% PCV respectively.

DISCUSSION

The result of the abomasum examination suggested that haemonchosis is present in the study area. The prevalence of 80.3% recorded in the study area is similar to the range of 77 – 100% reported from other geographical zones of Nigeria (Chiejina, 1986; Nwosu *et al*., 1996a,b; Ajanusi and Chiezey, 2005). Though, the findings are higher than the results of other surveys in sheep and goat carried out in North-eastern Nigeria (Nwosu *et al.,* 2007). The occurrence of haemonchosis in an area is influenced by a multifactorial system, which comprises hosts, parasite and environmental effects (Muhammad *et al*., 2009).

In this study, species and seasons play an important role in prevalence and worm burdens of haemonchosis in small ruminants. Higher prevalence was observed in sheep than in goats and this agreed with other works in Nigeria (Nwosu *et al*., 2007; Jatau *et al.,* 2011) and elsewhere in the world (Waruiru *et al*., 2005; Asif *et al*., 2008). High prevalence in sheep is assumed to be due to the grazing habit where they graze closer to the ground fostering opportunity of exposure to parasites. However, it is in contrary to reports of Keyyu *et al*. (2006) and Raza *et al*. (2007) where they had higher prevalence in goats than in sheep. In this regard, it is assumed that sheep do have a considerably higher immunological response to gastrointestinal parasites when compared to goats (Urquhart *et al*., 2000).

Table 1: Prevalence of *H. contortus* in small ruminants by species of the host and season of the year

Category	Number Examined	Number positive (%)	X^2(P- value)	Odd ratio
Species				
Goat	200	156 (78)	2.068(0.1505)	1
Sheep	100	85 (85)		1.6
Total	300	241 (80.3)		
Season				
Late dry	74	48(64.9)	16.95(0.0007)	1
Early dry	63	53(84.1)		2.9
Late rain	89	80(89.9)		4.8
Early rain	74	60(81.1)		2.3
Total	300			

For species (P>0.05) while season (P<0.05)

Table 2: Seasonal *H. contortus* counts and corresponding packed cell volume examined in small ruminants in North-western Nigeria

Season	Month	Worm count	Season	PCV	Season
Early Dry	November	72.70±14.80		34.10±0.84	
	December	51.38±12.23		23.70±1.10	
	January	15.68±3.95		29.49±1.20	
			42.60±6.93^{b}		27.73±0.79
Late Dry	February	23.53±6.95		26.13±1.23	
	March	27.50±12.26		24.0±1.46	
	April	41.16±9.24		28.89±1.54	
			31.67±5.56^{a}		26.60±0.87
Early Rain	May	100.5±29.78		27.80±1.43	
	June	23.33±6.65		31.17±0.90	
	July	56.18±10.02		26.68±0.73	
			61.10±11.33^{b}		28.40±0.65
Late Rain	August	74.81±8.95		26.54±0.78	
	September	273.2±148.7		26.63±1.43	
	October	188.7±30.01		26.70±0.98	
			180.2±51.45^{b}		26.63±0.63

Means within the same column with different superscripts are statistically significant

Table 3: Prevalence of Protozoan infections in small ruminants in North-western Nigeria

Small ruminants	Number Examined	Prevalence *Trypanosoma vivax*	*Theileria ovis*	*Anaplasma ovis*	PCV
Goats	200	1 (0.5)	0 (0.0)	0 (0.0)	25
Sheep	100	0 (0.0)	1 (1.0)	1 (1.0)	20
Total	300	1 (0.3)	1 (0.3)	1 (0.3)	

Number in parenthesis = percentage, PCV = packed cell volume

Considering the seasons of the year as a predisposing factor, high prevalence and worm burdens were observed during the late rainy season. This result agreed with the findings of Hansen and Perry (1994) and Almalaik *et al.* (2008). The high prevalence and worm burdens obtained in this study could be as a result of the management system operated by most small ruminant owners especially during the rainy season when animals are confined to avoid damage to crops. Consequently, such animals are overstocked with the pens not properly cleaned. These factors with the high humidity during the rainy season predispose them to the parasitic infections. It has been reported that the tropical climatic conditions, especially rainfall and temperature, favour the development and survival of parasitic nematode eggs to infective stages (Josiah et al., 2015). This might explain the high prevalence rate observed in this study.

The mean PCV recorded from the four sub-seasons of the year during the study period in small ruminants were lower, this indicated the onset of anaemia arising from the infections. The mean PCV of infected animals during the late rainy sub-season when the worm burdens were high and availability of good quality pasture was the same with mean PCV of infected animals during the dry season when the worm burdens were low and absent or low quality of pasture. The lower mean value of PCV during the late rainy sub-season is likely due to the blood-sucking effects of the adult worms in which each adult sucks up to 0.05ml of blood per day (Urquhart *et al.* 2000). In addition, the worms secrete anticoagulant so that the site of attachment continues to bleed even after the worm has become replete and detached (Ajanusi and Chiezey, 2005). Infection with *Haemonchus* spp may cause severe anaemia and hypoproteinemia, leading to depression, loss of condition, reduced productivity and eventually death (Al-Shaibani *et al.,* 2009).

The lower mean value of PCV during late dry sub-season might due to poor nutrition. Poor nutrition lowers the resistance of the animal, thus enhancing the establishment of worm burdens and increasing the pathogenicity of the parasites. It is well known that adequately fed animals are more able to tolerate parasitism than animals on a low plane of nutrition (Waruiru *et al*., 2004; Knox *et al*., 2006). Thus, small ruminants affected by blood-sucking parasites, such as *H. contortus*, may be able to maintain their haemoglobin levels as long as their iron and protein intakes are adequate. However, if the animals iron reserves and protein intake is reduced then their haemopoeitic systems become exhausted, and they may die (Vatta *et al*., 2002). The study therefore demonstrated a significantly ($p<0.0001$) negative correlation between worm burdens and PCV. This means that as worm burdens increased, the PCV decreased and vice versa. This result agreed with the result of Ajanusi and Chiezey (2005), Menkir *et al. (*2007) and Okaiyeto *et al*. (2008).

The results of this study also suggested that protozoan infection may not be a threat to small ruminants in the study area, as the prevalence of three protozoans encountered was 0.33% each for *Trypanosoma vivax*, *Theileria ovis* and *Anaplasma ovis.* This is lower than those of Ajanusi and Chiezey (2005) which reported prevalence of 9.2% and 3% for *Anaplasma ovis* and *Theileria ovis,* respectively and that of Okaiyeto *et al*. (2008). Though the PCV of two infected small ruminants with protozoans were lower than the mean PCV recorded in small ruminants with haemonchosis. The observed anaemia characterised by low mean PCV values of two infected animals suggested that the haemo parasitic infection may be the cause of the anaemia. Similar observation was earlier made by Okaiyeto *et al*. (2008).

In conclusion, the findings from this study indicated the infection of small ruminants with haemonchosis and environmental factors such as rain and relative humidity with optimal temperature play major role in the infection. Small ruminant farmers may not have noticed the effects of the haemonchosis on their animals because of the sub-clinical or chronic nature of the infection, however, their effects is usually manifested in productivity. It is therefore recommended that further research be embarked upon to determine the effect of nutrition in ameliorating the effects of helminth infections and anaemia in small ruminants. It is also important to note that since haemoparasitic diseases constitute a major handicap to livestock farmer where they are present, farmers should be constantly advised in the study area on routine control of ectoparasites that may transmit them.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Prof. O. J. Ajanusi in the Department of Parasitology and Entomology, Ahmadu Bello University (ABU), Zaria and the technical staff of Protozoology and Helminthology Laboratory in the Department of

Parasitology and Entomology, Faculty of Veterinary Medicine, ABU, Zaria, Nigeria.

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