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# Epidemiological study on abomasal nematodes in slaughtered small ruminants raised in the guinea savannah zone of Nigeria

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**Abstract**

Gastrointestinal nematodes are one of the major causes of productivity losses in small ruminants in sub-Saharan Africa. A study was carried out to evaluate the prevalence, worm burden of abomasal nematodes and associated faecal egg counts (FEC) of small ruminants slaughtered from November, 2011 to October, 2012. Two genera of adult abomasal nematodes recovered were *Haemonchus* spp. *and Trichostrongylus* spp. Goats had the prevalence of 78.5% and 17.5% for *Haemonchus* spp and *Trichostrongylus* spp., respectively while sheep had prevalence of 85% and 31% for *Haemonchus* spp. and *Trichostrongylus* spp. A significant difference (p<.005) was observed between host species (goats and sheep), age and sex of animal. There was a seasonal arrest of *Haemonchus* spp. which was greater during the late dry season than other seasons. Faecal examination revealed Strongyle egg (71% in sheep and 62% in goats) being the most prevalent followed by *Strongyloides* (8% in sheep and 8.2% in goats) and *Trichuris* (4% in sheep and 6% in goats) eggs. The mean FEC in sheep for *Strongyloides,* Strongyle and *Trichuris* were 4208±343.1, 2966±435.7 and 90±23.80, respectively. The mean FEC in goats for *Strongyloides,* Strongyle and *Trichuris* were 2630±138.8, 1301±189.9 and 138.8± 30.39, respectively. The prevalence of worm and FEC showed a definite seasonal sequence that corresponded with the regional relative humidity and rainfall pattern. This knowledge is important for the control of nematode infection in small ruminants in Nigeria.

*Keywords*: Abomasum, Nematodes, Season, Small Ruminants, Worm burden

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## Introduction

*Haemonchus contortus* is recognized globally as a major constraint to both small and large-scale small ruminant production systems in developing countries, leading to significant economic losses (Tariq *et al.,* 2010). In Nigeria it is estimated that about 40-60% of the lambs die due to gastrointestinal nematode infections (Owhoeli *et al.,* 2014). Apart from mortality, other losses include lowering of reproductive rate, weight loss and increased cost of production due to additional veterinary bills (Bambou *et al.,* 2013).

Small ruminants play an important socio - economic role within traditional farming systems in many developing countries, including Nigeria, where 80-90% of the nation's livestock lies in the hand of small holders or other traditional groups (Dalhatu & Ala, 2010). There is a pressing need to increase the production of domestic animals, to overcome the acute shortage of animal protein in the diet of the average Nigerian (Shaib *et al.,* 1997). Any effort to raise the level of meat production in the country must take into consideration the detrimental role played by parasitic diseases in livestock production.

Reports from various countries have shown that climate change especially elevated temperature, has already changed the overall abundance, seasonality and spatial spread of endemic helminths (Singla, 1995; Van Dijk *et al.,* 2010). This has obvious implications for sheep and goat producers, policy-makers and raises the need for improved diagnosis and early detection of livestock parasitic disease. Also there is great need to increase awareness and preparedness to deal with disease patterns that are changing. Host factors such as age, breed, nutrition, physiological state and presence or absence of inter-current infections also influence the incidence rate and severity of infection with GI nematodes (Wadhawa *et al.,* 2011; Roeber *et al.,* 2013). Epidemiological knowledge is crucial to the development of a comprehensive and sustainable strategy for controlling gastrointestinal nematode infections in sheep and goats in the different agro-ecological zones and management systems.

The present study was therefore aimed at determining the current status of abomasal nematodes of slaughtered goats and sheep raised under savannah climate zone of environment in North West Nigeria.

## Materials and methods

*Study area*

The study was carried out in Savannah zone of North western Nigeria from November 2011 to October 2012. The zone is characterised by a tropical climate having two main seasons i.e. a rainy season (May to October) and a dry season (November to April). The monthly mean temperature records show a range from 13.8 to 37.1$^0$C and an average annual rainfall of 1417.3 mm (Ati *et al.,* 2009). The sheep breed available at the Dogarawa slaughter slab located in the study area were mostly the Yankasa while the goats were mostly of the Red Sokoto breed. These were bought by butchers from Zaria town, the adjoining peri-urban areas 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 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) seasons

*Study design and sample size*

A cross-sectional type of study was undertaken. The sample size required for the study was calculated according to the formula given by Thrusfield (2005) using 95% level of confidence and expected prevalence rate of 89.1% (Chiezey, 2005). Finally, 100 sheep and 200 goats were included as sample size and simple random sampling strategy was used to select individual animals. In the study area because of the high premium on sheep they are rarely slaughter outside festive season. The abomasums and corresponding faecal samples of the same animals were collected from each of 100 sheep and 200 goats. The age of the animals were estimated by their dentition (Abegaz and Awgichew 2009) and sexes determined by their genitalia. For this study, animals less than two years were considered to be young while those above two were considered to be adult. Twenty to thirty samples for both sheep and goats were randomly collected per month over a period of 12 months.

*Sample collection and examination*

Worm Recovery: Following slaughter and evisceration, the abomasums were ligated with a string and separated from omasum and duodenum to avoid leakage and mixing of contents. Each abomasum was collected into a labelled polythene bag within 10 minutes of evisceration and transported to the Helminthology laboratory in the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University (ABU), Zaria immediately for examination. Worm collection, identification and counting were made in accordance with procedures and techniques described by Rober *et al.* (2013). The recovery of immature stages of *H. contortus* from the mucosa of the abomasum of sheep and goats was performed, using the digestion technique (Bambou *et al.,* 2013).

Faecal samples collection and analysis: Faecal samples were collected directly from the rectum of the animals using clean disposable polythene gloves. The nematode eggs present were identified in general terms as strongylid eggs, except for the eggs of *Strongyloides* and *Trichuris* species; using the keys given by Roeber *et al. (*2013). The faecal egg counts per gram were determined by the modified McMaster techniques using saturated solution of sodium chloride as the floating medium (Bambou *et al.,* 2013).

*Meteorological data*

Daily data on minimum and maximum temperature, rainfall and relative humidity were obtained from the Meteorological station located in the College of Aviation, Zaria. The monthly averages for each weather factor were then calculated.

*Data analysis*

The data obtained were organized into tables. Data obtained for egg and adult counts were expressed as mean ± SEM. They were further subjected to t-test and analysis of variance (ANOVA) followed by Tukey's post hoc test where necessary. Chi- square analysis was also used to test for association between the presence of helminth eggs and adult worms and variables like sex, age, species and seasons of the year. Value of P< 0.05 was considered significant. GraphPad (2015) prism version 4.0 was used to analyze the data.

**Results**

The abomasums of 200 goats and 100 of sheep were examined. This revealed the presence of two different genera of nematodes (Table 1). Goats and sheep had the prevalence of 78.5 and 85% for *Haemonchus* spp., respectively while for *Trichostrongylus* spp. were 17.5 and 31 % respectively. *Haemonchus* spp. worm burden was significantly (p<0.05) higher in sheep than goats. Considering sex and age of small ruminants, female animals had higher prevalence and worm burden than males; while adult small ruminants had higher prevalence and worm burdens than young.

The results of weather data and *Haemonchus* worm burden are shown Figures 1, 2 & 3. The highest *Haemonchus* worm burdens were recorded in the month of September when the mean temperature, mean relative humidity and total rainfall were $24.9^0$C, 81.1% and 224.1mm, respectively. The least were recorded in the month of January when the mean temperature, mean relative humidity and total rainfall were $22.1^0$C, 27.6% and 0.0 mm, respectively.

The seasonal variations of the mean worm counts revealed that the mean worm counts of *Haemonchus* spp. was high during early rain and attained the peak during late rainy season in both sheep and goats (Figure 4). The mean worm count was statistically significant between the late rain and other seasons (P<0.05) (Figure 5). The mean worm counts of *Trichostrongylus* spp. were in very low numbers but higher in goats during late rain season.

The monthly recovery of total number of adult *Haemonchus* spp. count and its inhibited larvae ($L_4$) are shown in Table 2. The overall contribution of the mucosal larvae to total worm burden of *H. contortus* in small ruminants was 1.1% with a statistical difference (P<0.05) between mean adult *Haemonchus* counts and inhibited larvae. The contribution of arrested development in the population of the *Haemonchus* began to appear in November, December, January, February, March, April, September and October.

A total of 200 faecal samples of goats and 100 sheep examination revealed the presence of three different nematode egg types (Table 3). Goats had the prevalence of 62, 8.5 and 6% for strongyle egg, *Strongyloides* and *Trichuris* eggs, respectively while sheep had 71, 8 and 4% for strongyle egg, *Strongyloides* and *Trichuris* eggs, respectively. Faecal egg counts per gram of faeces showed the same trend irrespective of the species, sex and age of the small ruminants.

**Table 1**: Specie, sex and age prevalence and mean counts of adult abomasal helminths recovered from small ruminants

| Helminths spp. | Prevalence (%) | Mean worm counts | Prevalence (%) | Mean worm Counts |
|---|---|---|---|---|
| By Species | Goats (n=200) | | Sheep (n=100) | |
| | | Mean ±SEM | | Mean ±SEM |
| *Haemonchus spp Trichostrongylus* spp. | 157(78.5) | 60.83±5.88$^{a}$ | 85(85) | 145.6±68.99$^{b}$ |
| By sex | 35(17.5) | 29.56±8.96 | 31(31) | 16.61±3.68 |
| | Male (n=225) | | Female(n=75) | |
| *Haemonchus* spp. | 173(76.9) | 63.14±6.47$^{a}$ | 65(86.7) | 166.4±63.19$^{b}$ |
| *Trichostrongylus* spp. | 60(26.7) | 19.46±5.50 | 21(28) | 20.62±6.13 |
| By age | Young(n=140) (>2years) | | Adults(n=160) (<2years) | |
| *Haemonchus* spp. | 108(77.1) | 79.13±9.16 | 130(81.3) | 102.6±32.16 |
| *Trichostrongylus* spp. | 31(22.1) | 26.45±7.41 | 41(25.6) | 26.83±7.90 |

Means with different superscripts within the same row are statistically significant

**Table 2**: Monthly recovery of total number of adult *Haemonchus* spp counts and its inhibited larvae ($L_4$) in Dogarawa slaughter slab in Zaria, north western Nigeria

| Months | Total number of adult *Haemonchus* spp (%) | Total number of inhibited larvae (%) | Specific (%) contribution of $L_4$ to adult |
|---|---|---|---|
| November | 727 (3.3) | 1 (0.4) | 0.1 |
| December | 1233 (5.6) | 17 (7.3) | 1.4 |
| January | 298 (1.4) | 21 (9.0) | 6.6 |
| February | 353 (1.6) | 46 (19.7) | 11.5 |
| March | 385 (1.8) | 23 (9.8) | 4.6 |
| April | 782 (3.6) | 4 (1.7) | 0.5 |
| May | 2010 (9.2) | 0 (0.0) | 0.0 |
| June | 420 (1.9) | 0 (0.0) | 0.0 |
| July | 1236 (5.7) | 0 (0.0) | 0.0 |
| August | 1945 (8.9) | 0 (0.0) | 0.0 |
| September | 7377 (33.7) | 14 (6.0) | 1.9 |
| October | 5096 (23.3) | 108 (46.2) | 2.1 |
| Total | 21862 (100) | 234 (100) | 1.1 |

**Table 3**: Prevalence and mean egg counts per gram of faeces of small ruminants by species, sex and age in Dogarawa slaughter slab in Zaria, north west Nigeria

| Helminth eggs | Prevalence (%) | EPG Mean±SEM | Prevalence (%) | EPG Mean±SEM |
|---|---|---|---|---|
| Species | Goats(200) | | Sheep(100) | |
| Strongyle | 124(62) | 1301±189.9[a] | 71(71) | 2966±435.7[b] |
| *Strongyloides* | 17(8.5) | 2630±138.8 | 8(8) | 4208±343.1 |
| *Trichuris* | 12(6) | 138.8±30.39 | 4(4) | 90.00±23.80 |
| Sex | Male(225) | | Female(75) | |
| Strongyle | 136(60.4) | 1537±224.6[a] | 59(78.7) | 2771±428.3[b] |
| *Strongyloides* | 22(9.8) | 2468±1329 | 5(6.7) | 444.0±121.1 |
| *Trichuris* | 14(6.2) | 131.1±24.99 | 1(1.3) | 60.00±00 |
| Age | Young(140) | | Adult(160) | |
| Strongyle | 94(67.1) | 1797±300.9 | 108(67.5) | 1898±270.3 |
| *Strongyloides* | 11(7.9) | 958.2±475.8 | 13(8.1) | 3012±2121 |
| *Trichuris* | 10(7.1) | 190.0±46.98 | 5(3.1) | 53.20±12.42 |

Means with different superscripts within the same row is statistically significant

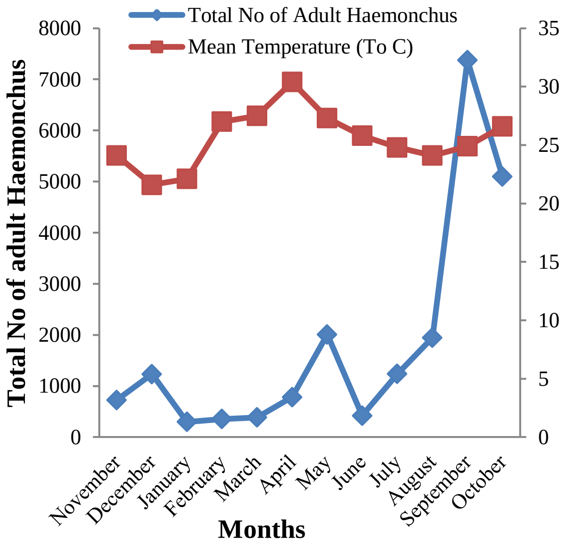


**Figure 1**: Monthly mean temperatures recorded in Meteorological Station in Zaria and total number of adult *Haemonchus* counts in Zaria, West

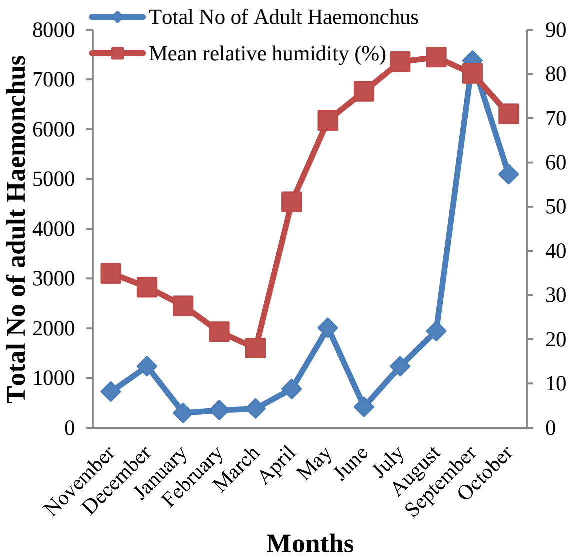


**Figure 2:** Mean Relative Humidity recorded in Meteorological station in Zaria and total number of adult *Haemonchus* counts in Zaria, West Northern

Northern Nigeria

Nigeria

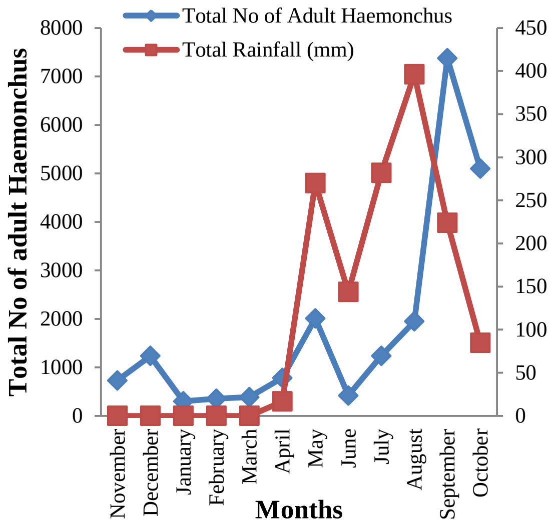


**Figure 3**: Monthly total rainfall recorded in Meteorological station in Zaria and total number of adult *Haemonchus* counts in Zaria, north west Nigeria

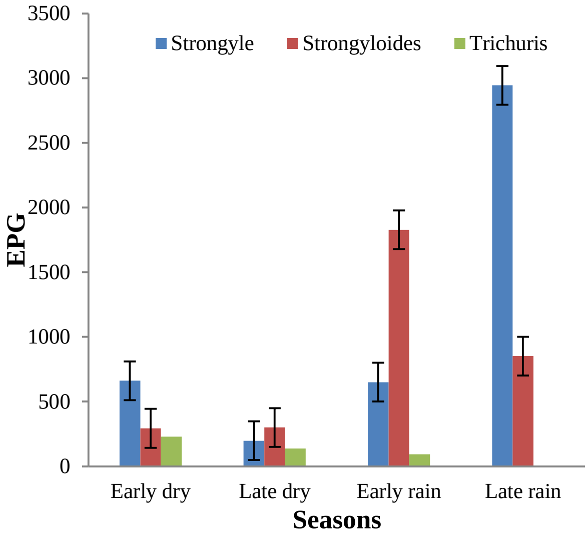


**Figure 4:** Seasonal variation of egg per gram counts of faeces in goats in Dogarawa slaughter slab in Zaria, north west Nigeria

Among the three nematode egg types recovered, only strongyle eggs in goats and sheep was statistically significant (P< 0.05). The mean egg counts per gram of faeces of Strongyle eggs was higher in sheep than in goats (P<0.05) and higher in females than in males (P< 0.05). There was no statistical difference for strongyle eggs among different ages of small ruminants. In goats, the mean egg counts were highest for *Strongyloides* (2630±138.8) and lowest for *Trichuris* (138.8±30.39). For sheep, the mean egg counts were highest for *Strongyloides* (4208±343.1) and lowest for *Trichuris* (90.00±23.80). Figures 4 & 5 show seasonal variation of mean egg counts per gram recovered from goats and sheep. The mean strongyle egg counts of goats and sheep were significantly (p<0.05) higher during the late rainy season than other seasons. *Strongyloides* ova were higher in goats during early rainy season. The *Trichuris* egg types encountered during the study did not show any definite seasonal variations (P< 0.05).

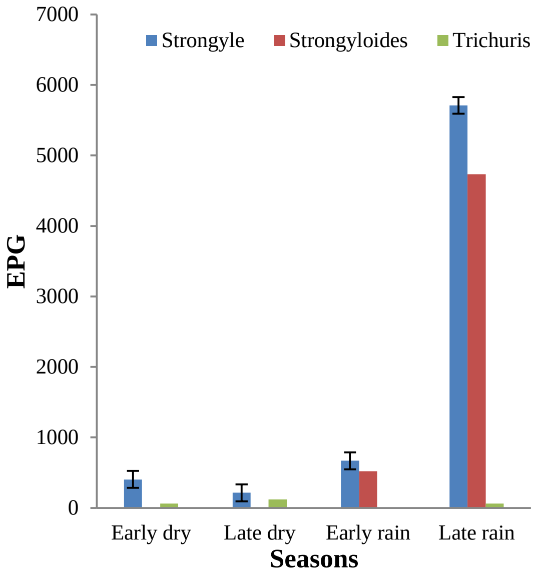


**Figure 5:** Seasonal variation of egg per gram counts of faeces in sheep in Dogarawa slaughter slab in Zaria, north west Nigeria

**Discussion**

In the present study, *Haemonchus* spp. and *Trichostrongylus* spp. were the abomasal nematodes recovered. *Haemonchus* spp. was recorded in higher prevalence and worm burden in both species of the small ruminants. The high biotic potential and shorter generation interval of *Haemonchus* (Torres-Acosta *et al.,* 2003) allows its greater contamination of pastures and re-infection of animals. This probably accounts for its high prevalence than *Trichostrongylus* spp. encountered in this study. This high prevalence rate and worm burden was in accordance with the findings of Chiezey (2005) in Zaria Nigeria. The prevalence was however higher than the findings of Nwosu *et al.* (2007) conducted in North eastern Nigeria.

The average *Haemonchus* worm count of sheep is significantly higher than goat. The higher prevalence and worm burden of haemonchosis in sheep than goats may be attributed to a variety of factors like ground grazing habit of sheep and extensive pasture grazing when compared with goats (Javed *et al.,* 1992). This study revealed that majority of small ruminants harbouring adult abomasal nematodes had light to moderate degree of infection but very small proportions had heavy degree of infection. This was also true for the mean faecal egg counts (FEC).

It was observed that the female animals had higher infection of *Haemonchus* than males. This finding supports the general understanding of helminth infections that female animals are more susceptible to helminthiasis. Sex difference in helminth infection has been attributed to differences in sex hormones especially during the peri-parturient period due to a decreased immune status (Urquhart *et al.,* 1996; Valcarcel & Romero, 1999).

Age was considered an important risk factor in gastrointestinal tract (GIT) helminthiasis (Raza *et al.,* 2007). In this report the adult worm load of *H. contortus* is higher in adults as compared to young ones. This is probably due to the fact that the adult animals can withstand higher infection without much adverse effect leading to chronicity of infection. Also there was the likelihood that the young animals had been given anthelmintic which made them eliminate helminths infection.

In the present study, adult *Haemonchus* burdens were high from May to October while *Trichostrongylus* was prevalent during the late rain. When this finding was correlated with weather data, it seemed that *Haemonchus* thrives in higher temperature conditions while *Trichostrongylus* spp. thrives in seasons with a cooler temperature. This finding is consistent with that of Ogunsusi & Eysker (1979).

The proportion of inhibited larvae recorded in this study agrees with report of Fayza *et al.* (2003) in desert sheep. The higher number of inhibited larvae recorded in this study during the late dry season without recording any inhibited larvae during the early rain season contradicts the report of Ogunsusi & Eysker (1979) who reported inhibited larvae throughout the rainy season in the Zaria. In *Haemonchus* spp*,* inhibited development represents a seasonal phenomenon, enabling the parasite to survive unfavourable conditions such as winter or a dry season. Our findings are also similar to other epidemiological studies on nematode parasites of small ruminants in semi-arid regions of the African continent, where inhibition of *H. contortus* is a feature during the adverse climatic periods of the year (Getachew *et al.,* 2007). However, the increased number of inhibited larvae in this study during the late rainy season (September and October) agrees with the results of Ogunsusi & Eysker (1979) who reported greatest numbers of inhibited larvae of *H. contortus* during the long rainy seasons in the Zaria. The inhibited development may also be associated with host resistance (Chiejina, 1986; Getachew *et al.,* 2007) whereby the presence of adult worms causes the "feedback" inhibition of incoming infective larvae which go into arrest until the adult worm population decreases in number or is eliminated (Armour, 1982; Gibbs, 1986).

The nematode egg types recovered from both goats and sheep were those of strongyles, *Strongyloides* and *Trichuris* spp. The result showed that strongyle egg was the most prevalent and higher in sheep than in goats, respectively. This result agrees with the report of Jatau *et al. (*2011) in the same region as well as other regions in Nigeria (Nwosu *et al.,* 1996). Strongyle egg counts reflect not only the presence of *Haemonchus* and *Trichostrongylus* but also of other Trichostrongylid parasites that may have been present in the other parts of the gastrointestinal tract.

Optimal development of eggs and pre infective stages into $L_3$ occurs between 15°C and 30°C, but development will take place at varying rates within the temperature range of 4°C to 35°C if moisture is present (Vlassoff *et al.,* 2001). The temperature conditions were adequate all year round in the study area and never fell below 20°C throughout the study months. However, the rainfall seemed to be the limiting factor in the months with least helminth prevalence. In the humid and savannah zones of the tropics, rainfall is the major factor determining the availability and transmission of strongylid nematodes in sheep and goats on natural pastures (Ogunsusi, 1979; Fakae, 1990).

The high prevalence of *Strongyloides* recorded during early rain may be due to the fact that *Strongyloides* life cycle consists of a parasitic generation and a free-living generation. Under unfavourable conditions *Strongyloides* exists as free living. The life cycle of strongyloides includes a free living generation in which the egg develops in the soil to free living male and female when environmental conditions are unfavourable. Successive generations of free living adults can be produced in this way, but as soon as conditions become favourable, the eggs produced by free living female go on to produce larvae that are the same as the infective $L_3$ stage larvae that penetrate the skin to infect animals. From the findings of nematode counts at necropsy and egg per gram (EPG), there is a gradual build up of adult worm populations in grazing animals leading to the peak EPG recorded at about the peak of the rainy season. Thereafter, EPG declined with the lowest numbers being encountered about the peak of the dry season.

In conclusion, the result of this study clearly shows that haemonchosis is one of the major helminth diseases of small ruminants in Savannah climate of north west Nigeria. Subclinical infections are the most important forms of infection since they are associated with economic losses such as poor growth rates and reduced weight gain. This may be one of the contributory factors to low productivity in the study areas. Therefore there is need to educate livestock farmers in the study area on the need for good management and strategic deworming in order to increase livestock productivity.

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