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Gastrointestinal parasitic infections of ruminants in extensive management system in Southwest, Nigeria

Bada, A. A.[1]*, Adewole, S. O.[2], Olofintoye, L. K.[2] and Omotoriogun T. C.[1]

[1]Department of Biological Sciences, Elizade University, Ilara-Mokin, Ondo State, Nigeria.
[2]Department of Zoology, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria.

*Corresponding author Email: glorynew.20@gmail.com

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ABSTRACT: Parasitic diseases are major impediments and causes of mortality and morbidity in animals leading to drastic decrease in economic returns in livestock production. This study was carried out to investigate the prevalence of gastrointestinal parasites among free–ranging ruminant species; with the objectives to determine difference in parasitic infection among ruminant species, and difference in parasitic infection between the sexes and age of the ruminant species. Random sampling method was used to collect small quantity of feaces from individual ruminants (n=54). Direct smear method was used to identify the eggs of the helminths in ruminant species. Chi-square test was used to test the hypotheses of the study. Higher prevalence of gastrointestinal parasite was found in *Capra hircus* relative to *Ovis aries and Bos taurus*. Both nematodes (*Trichostrongylu ssp, Haemonchus contortus, Strongloides papillous, Sygamus larygenes* and *Ascaris sp*; and trematodes (*Fasciola gigantica* and *Dicrocoelium dendriticum*) were found in the ruminant in this study. *Trichostrongylu ssp* and *Fasciola gigantica* showed higher prevalence than other gastrointestinal parasites. Young and female had higher infection of helminths than adult and male of the studied ruminant species. Preventing economic loss due to helminthic parasitic infections rely on available data, which in turn is paramount to guide effective coordination of animal health care system.

Keywords: Direct smear, economy, helminth, nematode, trematode.

INTRODUCTION

Parasitic diseases are major impediments and causes of mortality and morbidity in animals; consequently, leading to drastic decrease in efficiency and economic returns in livestock production globally (Badran et al., 2012; Akanda et al., 2014; Hoste et al., 2006; Nwosu et al., 2007; Majeed et al., 2015; Hassan et al., 2019). Though, the economic loses of parasitic infection are difficult to measure; there are reports of these loses in some studies (Nieuwhof and Bishop, 2005; Schweizer et al., 2005; Selzer and Preface, 2009; Charlier et al., 2009; Morgan et al., 2013). The immediate loses associated with animals infected with gastrointestinal parasites includes reduced growth rate and fecundity; poor-quality hides, skin, milk and meat production; and also, weight loss (Morgan et al., 2013).

The systems (intensive and extensive) of livestock production may play key role in parasitic infections. In contrast to intensive system, extensive system (also free-ranging) involves unrestricted movement of animals, feeding on a variety of indiscriminate food substrates (Nakayima et al., 2019). Free-ranging system is mostly adopted for livestock production in developing countries due to its low-cost and affordability. However, animals tend to feed indiscriminately in this system; therefore, easily prone to parasitic infections upon contact with infested substrates during the grazing period and/or foraging activities.

Helminth infection such as *schistosomiasis, ascarisis, tricuriasis, drancunuliasis*, and *strongyloidiasis* are well documented, and among neglected diseases affecting ruminants in tropical Africa (Zeryehun, 2012; Ovutor et al., 2014). All major group of helminths such as roundworm, flatworm, and tapeworm simultaneously occur in ruminants

(Obiora et al., 2009). For example, goats and sheep were found infected with *Oesoghagostomum, Bunostomum and Trichostrongyle* including *Haemonchus, Nematodirus, Strongyloides,* and *Cooperia, Trichostrongylus, Trichris and Strongylus* (Anderson, 2000; van Dijk and Morgan, 2008; Rehbein et al., 2013;). Co-occurrence of parasites contributes to elevate the pathogenic effect in the animals.

The life-cycle of development and adaptations of helminth parasites make it easier to infect ruminants (Roeber et al., 2013). Susceptibility, severity and rate of infection of ruminants depend on the parasite species, and density of worms present in the gastrointestinal tract. Similarly, health and immunological status of the host, climatic conditions and available pasture including level of stress and management strategies can have stronger influence on gastrointestinal parasitic infection in ruminants (Zvinorova et al., 2016).

Moreover, certain risk factors such as age, sex, body condition, genetic diversity and behaviour have been associated with parasitic infection of host animals (Zvinorova et al., 2013). Animals of low-immune or immuno-compromised status, and those exposed to high infection pressure from helminth larval-contaminated environment are more likely to be heavily affected (Roeber et al., 2013; Kaplan, 2004). Despite available studies on ruminant parasites, there are scanty information on host-parasite specificity and differential infection between sexes and/or age groups in ruminant species in Nigeria. Thus, the objectives of this study were to investigate the prevalence of gastrointestinal parasitic infection in free-ranging ruminant species; and to evaluate the ruminant - parasite specificity; examine the effect of age on ruminants-parasite infection, and difference in parasite infection in the sexes in ruminant species in Southwest, Nigeria.

MATERIALS AND METHODS

Study area

Samples were collected from nine Local Government Areas namely; Oye, Ikole, Ido, Ikere, Ise-orun, Emure, Ado-Ekiti, Ijero, and Efon-Alaaye; distributed in three Senatorial Districts (Ekiti North, Ekiti South and Ekiti Central Senatorial districts) in Ekiti State, Nigeria. All sites are located between latitudes 60° 201′ to 80° 101′N and longitudes 40°201′ to 50°401′ E.

Sample collection

Random sampling method was used to collect faecal samples from, goat, *Capra aegagrus hircus*, sheep, *Ovis aries* and cattle, *Bos taurus*. A total of 54 ruminant individuals i.e., 18 individuals from each of the ruminant species, were collected in the morning (between 08:00 to 10:00 hours GMT). Glove-protected hand was passed through the rectum of each ruminant for faeces collection, and preserved in wide-mouthed, sterilized and leak-proof containers before transported on the same day to the veterinary hospital laboratory in Ado-Ekiti, Nigeria. The sampled animals were aged and sexed accordingly during the sampling period.

Microscopic examination of samples

Direct detection and identification of parasitic infection was carried out using microscopic examination of faecal materials. The faeces were first examined for hardness, softness, watery, presence of blood, mucus, coloration and odour. Thereafter, about 0.5 g of faecal sample was collected from the container using a spatula and placed on a slide and emulsified with a drop of normal saline and iodine solutions following the procedure of Beatrice et al. (2013). The slides with cover-slip were examined under the microscope at 400× magnifications resolution for eggs and larvae of helminths.

Data analysis

Data analysis was carried out using R package version 3.1.2 (R Development Core Team (2018). Chi-square was used to test variation in the prevalence of gastrointestinal parasitic infection of ruminant species, and parasitic infection difference between sexes (male and female), and ages (young and adult) were determined for the ruminant species.

RESULTS

Overall, 38.8% (n=21) of the 54 samples collected from ruminants were infected with gastrointestinal parasites. Both infected and non-infected faecal samples were light-green, brownish or dark coloured, exhibiting non-mucoidal and bloody characteristics. Five nematodes (*Trichostrogyle spp, Haemonchus contortus, Strongyloides papillous, Ascaris sp, Syngamus laryngenes*) and two trematodes (*Fasciola gigantica, Dicrocoelium dendriticum*) parasites were identified in the samples collected from the ruminant species (Figure 1).

Polyparasitism was observed across ruminants, for example *Capra hircus* and *Ovis aries* were co-infected by *Trichostrongylus, Haemonchus* and *Strongyloides*. Infection of *Ascaris sp* and *Dicrocoelium* were exclusive to *Capra hircus;* whereas *Faciola* and *Syngamus* was exclusively detected in *Bos taurus*. Generally, the prevalence in gastrointestinal parasites across ruminant species (Table 1) was higher for *Trichostrongylus* than other parasites.

The observed infection in each ruminant species as

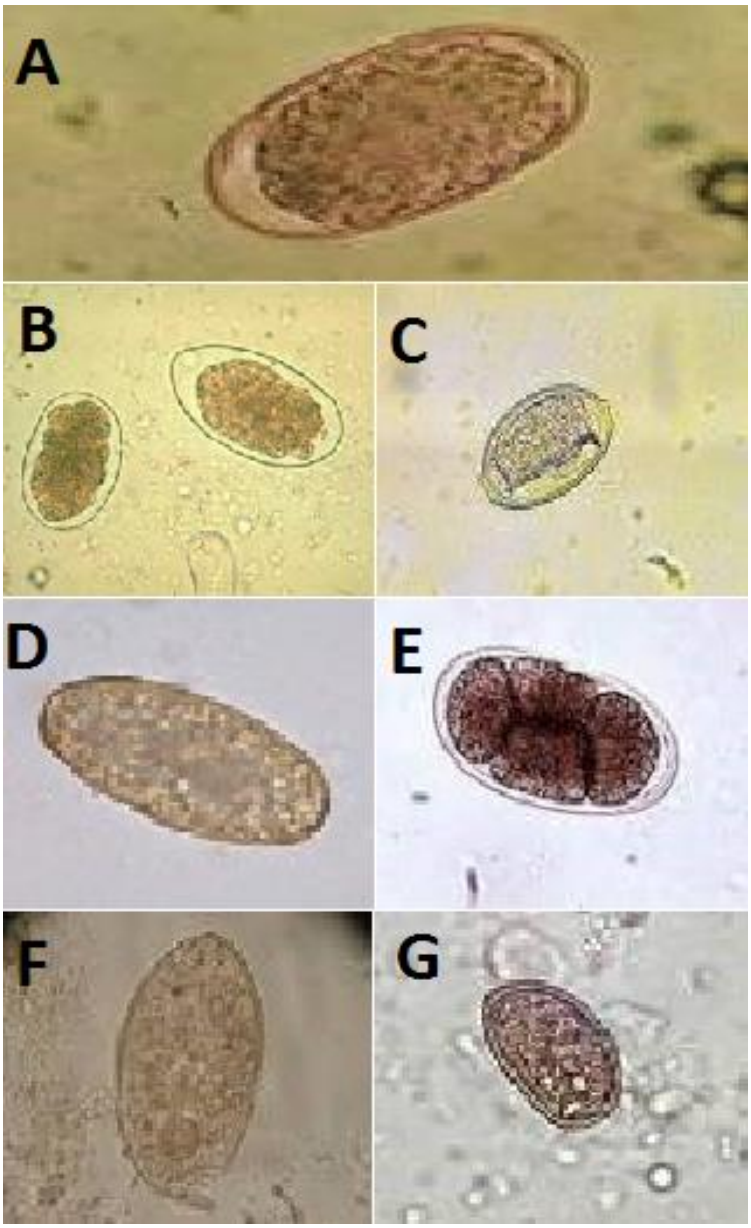

Figure 1. Eggs of helminth parasites detected in feces of ruminants, A- *Haemonchus contortus*, B- *Trichostrogyle spp.,* C- *Strongyloides papillous.,* D- *Ascaris sp.,* E- *Syngamus laryngenes.,* F- *Fasciola gigantica.,* and G- *Dicrocoelium dendriticum*, in samples collected from ruminants in Ekiti State, Nigeria.

Table 1. Gastrointestinal parasites infection (%) based on sex and age of ruminant species examined in Ekiti State, Nigeria. *N,* total number of sexes and/or age examined across species*; n*, number of individual of the sexes and/or age examined for each species. Young ruminant ≥1 to ≤ 5 months old, and adult ≥ 6 months old.

Species	Sex		Age	
	Male	Female	Young	Adult
Capra hircus	30% (*n*=5)	16.7% (*n*=13)	16.7% (*n*=11)	16.7% (*n*=7)
Ovis aries	0% (*n*=3)	15.9% (*n*=15)	16.7% (*n*=12)	5.6% (*n*=6)
Bos taurus	0% (*n*=2)	11.4% (*n*=16)	8.3% (*n*=13)	11.1% (*n*=5)
Summary	30% (*N*=10)	41.0% (*N*=44)	38.9% (*N*=36)	33.3% (*N*=18)

Table 2. Gastrointestinal parasitic infection and prevalence in ruminants within Ekiti State, Nigeria.

Species	Gastrointestinal helminth parasites detection							Infection
	Trichostrongylus	***Haemonchus***	***Strongyloides***	***Ascaris***	***Fasciola***	***Syngamus***	***Dicrocoelium***	
Capra hircus	7.41% (*n*=4)	1.8% (*n*=1)	3.7% (*n*=2)	1.8% (*n*=1)	ND	ND	1.8% (*n*=1)	16.7% (*n*=9)
Ovis aries	7.41% (*n*=4)	3.7% (*n*=2)	1.8% (*n*=1)	ND	ND	ND	ND	12.9% (*n*=7)
Bos taurus	ND	ND	ND	ND	7.41% (*n*=4)	1.8% (*n*=1)	ND	9.3% (*n*=5)
Prevalence	14.82% (*n*=8)	5.6% (*n*=3)	5.6% (*n*=3)	1.8% (*n*=1)	7.41% (*n*=4)	1.8% (*n*=1)	1.8% (*n*=1)	

ND- not detected.

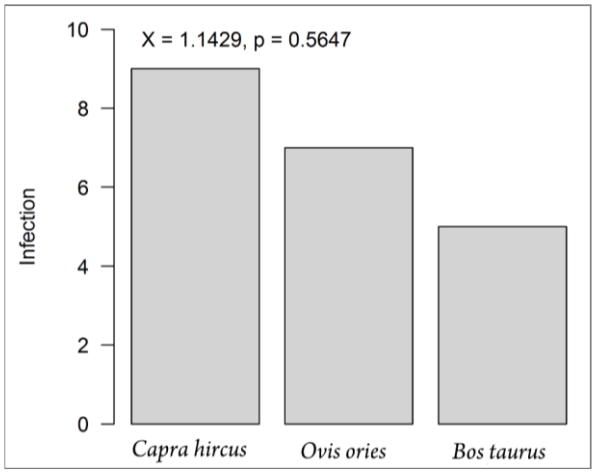

Figure 2. The gastrointestinal parasites infection comparing between infected case among species of ruminant in Ekiti State, Nigeria.

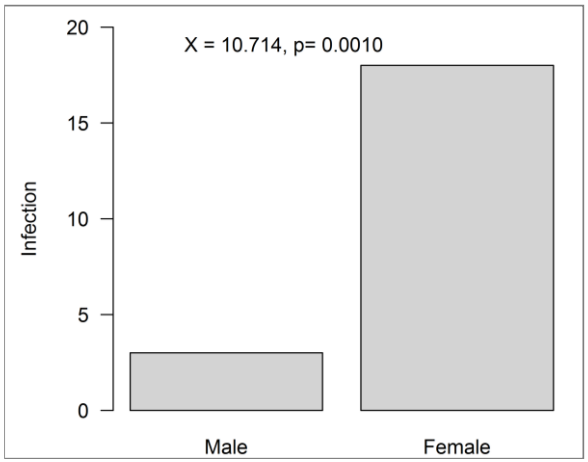

Figure 3. The gastrointestinal parasites infection capering between infected male and female of ruminant in Ekiti State, Nigeria.

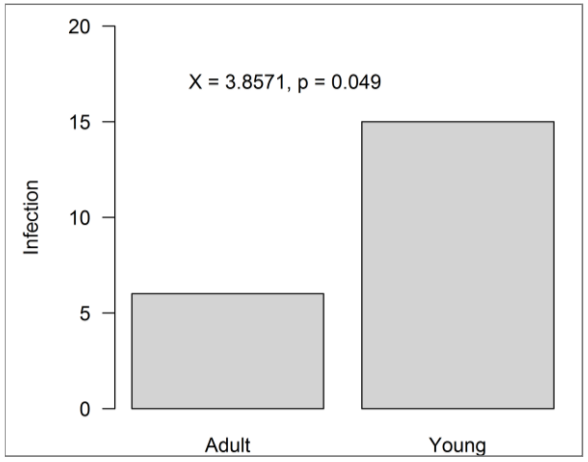

Figure 4. The gastrointestinal parasites infection comparing between infected young and adult of ruminant in Ekiti State, Nigeria.

follows: *Capra hircus* (16.7%, n=9), *Ovis aries* (12.9%, n=7) and *Bos Taurus* (9.3%, n=5) (Table 1). There was no significance difference in gastrointestinal parasitic infection among ruminant species (X^2=1.143, df=2, p=0.564; Figure 2).

Of the sexes, the difference in infection between male and female of the ruminant species was significant (X^2 =10.714, df=1, p=0.001; Figure 3). Thirty percent (30%) of sampled males (n=10) were infected, this infection was exclusive to male of *Capra hircus*; and 41.0% of females (n=44) were infected across the ruminant species (Table 2). Gastrointestinal parasitic infection was higher in females than males.

Similarly, there was a significant difference in parasitic infection between young and adult (X^2 = 3.8571, df=1, p=0.049; Figure 4). 39% of young (n=36) and 33% of adult (n=18) ruminants were infected (Table2). Number of young infected appears slightly higher than adult.

DISCUSSION

In this study, gastrointestinal parasitic infection was examined in three ruminant species. Infected and noninfected faecal samples had the common

nature of faeces from ruminants, and were not different in appearance, character and coloration. Polyparasitism and co-infection of parasites was observed in the ruminants. Mixed infection can be the important cause of morbidity, loss of reproduction and increase susceptibility of ruminants to other diseases (Wang et al., 2006; Abebe and Esayas, 2011). Moreover, exclusive infection of *Ascaris* was found in *Capra hircus;* and *Faciola* and *Syngamus* in *Bos taurus*. Higher infection of parasites was observed in *Capra hircus* relative to the *Ovis aries* and *Bos taurus* (Table 1). Higher gastrointestinal parasitic infection observed in *Capra hircus* than *Ovis aries* and *Bos taurus* in the present study agrees with studies that showed higher prevalence of gastrointestinal parasite in ruminant species (Pawel et al., 2004; Risso et al., 2015; Singh et al., 2015; Jena et al., 2018). This may be attributed to the exposure of *Capra hircus* to contaminated pasture by different types of parasites. Parasites from both nematode and trematode were identified in the samples. Nematodes occurrence was highest in *Capra hircus* (Table 1), which agrees with the report of Kumsa et al. (2010) and Amadi et al. (2012). Specifically, *Trichostrongylus* eggs were highly prevalent in both *Ovis aries* and *Bos taurus* as reported in Abebe and Esayas, (2011) and Kumsa et al. (2010).

The feeding habit of free-ranging ruminants can encourage higher infection of gastrointestinal helminth parasites. Larvae of most parasites such as *Haemonchus contortus, Syngamus larygene, Fasciola gigantica, Dicrocoelium dendriticum* cling to the blades of grasses which can be easily ingested by the ruminants during grazing activities. In addition, nematodes exhibit a broad-range of host infection than trematodes. The humid tropical environment has been considered favourable for the development of various species of nematodes (Yadav, 2000; Hassan et al., 2019) and may have accounted for the highest occurrence in the ruminants in this study. Also, environmental factors favour survival of nematodes than trematodes, and transition between wet and dry seasons enhances the survival of some parasites than others; for example, *Trichostrongylus sp.* thrive rapidly in wet season than *Haemonchus sp.* The occurrence of *Trichostrongylus sp.* in the gut of ruminants causes profuse and persistent diarrhoea, this was observed in ruminants during field sampling in this study.

In this study, higher parasitic infection was observed in females than the males which agrees with a study in Ethiopia where higher prevalence of helminth infection was found in females (Dagnachew et al., 2011). Other studies have also documented that female are more susceptible to parasitic infections than male ruminants (Alexander and Stinson, 1988; Tariq et al., 2008; Jittapalapong et al., 2012; Zvinorova et al., 2016; Verma et al., 2018; Hassan et al., 2019). Male versus female differences in parasitic infection exist; the difference has been attributed to ecological, behavioural, or physiological differences between the sexes (Zuk and McKean 1996; Grear et al., 2009; Poulin, 1996; Fuxjager et al., 2011; Kiffner et al., 2013). The reason for the higher prevalence of gastrointestinal parasites in female than male in this present study is not clear. There is suggestion that female reproductive behaviour and activities such as gestation, parturition, breast feeding and care of young- can suppress their immunity; therefore, making them easily susceptible to infection (Krishnan et al., 1996; Lloyd, 1983). Also, females eat more voraciously after delivery of their young, and may pick up eggs of these parasites in their food. In contrast, there are studies that showed male-biased parasitic infections, which has been attributed to immunosuppressive effect of testosterone leading to increase susceptibility of infection in the males (Folstad and Karter, 1992; Klein, 2004).

Also, this study observed higher parasitic infection in the young than adult ruminants. This corroborates previous study in Ethiopia (Dagnachewa et al., 2011), in which age influenced the prevalence of helminthiasis, and the higher susceptibility of younger animals (Keyyu et al., 2003). There is potential for direct and indirect association between host age and parasitic infection as demonstrated in other studies that showed these interactions (Emiru et al., 2013; El-Shahawy, 2016; Verma et al., 2018). It has been suggested that adult individuals are less heavily infected as a consequence of changes in feeding or behavioural patterns, habitat utilization, or immunity acquisition (Kołodziej-Sobocińska, 2019) but also that adult animals have usually developed a stronger immunity and harbor lower infection levels (Kethineni et al., 2006). Young and subadult animals with immature immune systems are most susceptible to infection (Cornell et al., 2008; Kethineni et al., 2006; Treboganova, 2010; Woolhouse, 1998; Bush et al., 2001; Kaplan, 2004; Roeber et al., 2013). Also, young ruminants can be infected through breast-feeding (milk) and/or placental during pregnancy (Coati et al., 2004; Lee et al., 1976).

Conclusion

This study showed that young and female ruminant animals were more infected than male and adult. Young and female are crucial to animal production and management of these animals can be achieved through strategic deworming using broad-spectrum anthelmintic plants that are effective against gastrointestinal infections. Veterinarians should constantly advice pastorals and ruminants' owners on control and preventive measure of gastrointestinal helminths in Ekiti State in other to improve returns from livestock production.

CONFLICTING INTERESTS

The authors declare that they have not conflict of interest.

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