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Polyparasitism of gastrointestinal parasites among pastoral cattle herds and trade cattle in Gombe metropolis

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ABSTRACT

Gastrointestinal parasites (GIPs) are the major impediment to livestock production in Nigeria. The damage caused by these parasites often results in huge economic loss and some of the GIPs of cattle are great concern to public health. Hence, this study investigated the prevalence and polyparasitism of GIP among cattle in Gombe metropolis. Between May and November 2021, 350 fecal samples were collected randomly from herder's cattle (202) and trader's cattle (148), and examined for GIP ova and oocysts using direct wet mount and concentration technique. Factors such as breed, sex, and age were obtained. The overall prevalence of GIPs was 74.3% while there was higher prevalence (79.2%) among herder's cattle than trader's cattle (67.6%), and more female (75.2%) were infected than male (73.8%). There were no significant differences ($p \geq 0.05$) between the prevalence obtained in the location, sex, and age of the cattle. However, GIPs prevalence among the Red Bororo (84.4%) was significantly higher ($p < 0.05$) than that of White Fulani (73.0%) and Sokoto Gudali (69.6%) cattle. A variety of GIPs ova and cysts were detected which includes trematodes: *Fasciola* spp. (4.9%), *Schistosoma bovis* (3.8%), and *Paramphistomum* spp. (2.2%); cestodes: *Taenia saginata* (6.3%), *Hymenolopsis* spp. (3.7%), and *Monezia* spp. (2.9%); nematodes: *Ascaris* spp. (4.9%), *Gongylonema* spp. (4.9%), *Strongyloides* spp. (4.9%), *Trichuris* spp. (4.5%), *Nematodirus* spp. (2.2%), *Trichostrongylus* spp. (1.1%), *Ostertagia* spp. (1.1%), and *Toxocara* spp. (0.6%); and coccidians: *Eimeria* spp. (2.2%) and *Sarcosystis* spp. (1.1%). Moreover, the prevalence of mono infection (52.0%) was significantly higher ($p < 0.05$) than polyparasitism (22.3%). This study revealed a high prevalence of GIPs among cattle in Gombe metropolis. Therefore, prevention and control of parasitic infestations, regular deworming, good husbandry management, and practices are advocated and should be encouraged through extension services.

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1. Introduction

Livestock farming is among the major sector representing an asset in both traditional and modern agriculture in sub-Saharan Africa as well as in tropical and subtropical regions of the world, providing animal protein, milk, and beef. Nigeria is the largest livestock producer in sub-Saharan Africa with an estimated population of over 57 million goats, 38 million sheep, and 19 million cattle, and the larger number of this

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population is concentrated in northern region of the country (Adebowale et al., 2020; Ola-Fadunsin et al., 2020). The worth of Nigeria's livestock is estimated to the tone of USD6 billion and they contribute greatly to the agricultural components of the GDP of which cattle production makes up to 40% (Ola-Fadunsin et al., 2020). In addition to the importance of cattle as a source of animal protein, they serve as source of flexible income for family units, employment, hides and skin for leather production, drought power for farming, and manure.

Gastrointestinal parasite (GIP) infections are the major cause of gastroenteritis in livestock and constitute a major impediment to livestock industry where all ages of cattle are affected (Adelakun et al., 2020). GIPs are major setback to profitable cattle production in developing countries like Nigeria. They also have different impact according to production system, management, and geo-climatic conditions, while some of them are threat to human health because they are zoonotic and can be transmitted to humans (Obi et al., 2020).

The direct losses caused by these parasites are attributed to hyper-acuteness and death, premature slaughter, and rejection of some parts at meat inspection, while indirect losses include the reduction in productive potential such as decreased growth rate, weight loss, diarrhea, anorexia, and sometimes anemia (Owhoeli et al., 2014). However, their effects are also characterized by lower outputs of animal products, byproducts, manure, and transaction, thereby affecting the contributions of cattle in ensuring food security, especially in developing countries. The productivity loses through reduced feed utilization due to subclinical or chronic infections are responsible for economic losses in the livestock industry. In addition, these infections enhance susceptibility to bacterial and viral diseases and losses resulting from condemnation of carcasses and organs as well as cost of drugs and veterinary care (Gunathilaka et al., 2018).

GIPs are widely prevalent in many parts of Nigeria and various investigations have been conducted in different geographical areas of Nigeria (Adelakun et al., 2020; Lemy and Egwunyenga, 2017; Obi et al., 2020; Ola-Fadunsin et al., 2020; Yahaya and Tyav, 2014; Yuguda et al., 2018). However, despite the huge population of pastoralists and their cattle in Gombe State, there is scarcity of reports on the prevalence of intestinal parasites among cattle in Gombe metropolis. Good management and knowledge of the prevalence of GIPs are essential for the prevention and control of parasitic infections, especially potential zoonotic parasites in the state. Hence, this study aimed to assess the prevalence of GIPs among pastoral cattle and trade cattle in Gombe metropolis.

2. Materials and Methods

2.1. Study area

This study was conducted between May and November 2021 in Gombe Local Government Area (LGA). The LGA is located within the sub-Sudan climatic zone between latitude 12°8' and 10°24'N, and longitude 11°22' and 11°24'E (Fig. 1), with over total population of 250,000 (National Population Census, 2006). According to the National Bureau of Statistics (2015), the population is projected to be 417,000 and expected to be 618,876 in 2021 (increases by 6.79% yearly) and covered land area of 52.434 km^2. Gombe metropolis has so many ethnic groups which include Fulani, Hausa, Tera, Tangale, etc. but the most widely spoken language is Hausa.

2.2. Study population

The study population was cattle from different cattle herders within Gombe metropolis and cattle (trade) presented for sale in Gombe cattle market (Tashan Dukku).

2.3. Sample size and sampling

The minimum sample size (n) required was determined according to Thrusfield (2007) using 95% level of confidence, the prevalence of 80.72% (Luka et al., 2018), and desired absolute precision of 5%, that is, $n = (Z_{1-\alpha/2})^2 p\,(1-p)/d^2 = 239$ cattle. However, 350 cattle were examined to increase precision.

A total of 350 samples of both sex, different ages, and breeds were collected from the study area. About 202 samples were collected from three different herds (herder cattle) while 148 samples were collected from cattle market (trader cattle). Symptomatic cattle and cattle over 3 years were excluded.

2.4. Data and sample collection

Data on the age, sex, and breed were collected. The age was grouped into 1–12, 13–24, and 25–36 months. Male and female cattle were randomly selected without any preference. The breeds of cattle sampled included Red Bororo, White Fulani, and Sokoto Gudali. Fecal samples were collected directly from the rectum into properly labeled sterile universal bottles. The fecal samples were kept in a cool box with ice packs after collection and during transport to the laboratory.

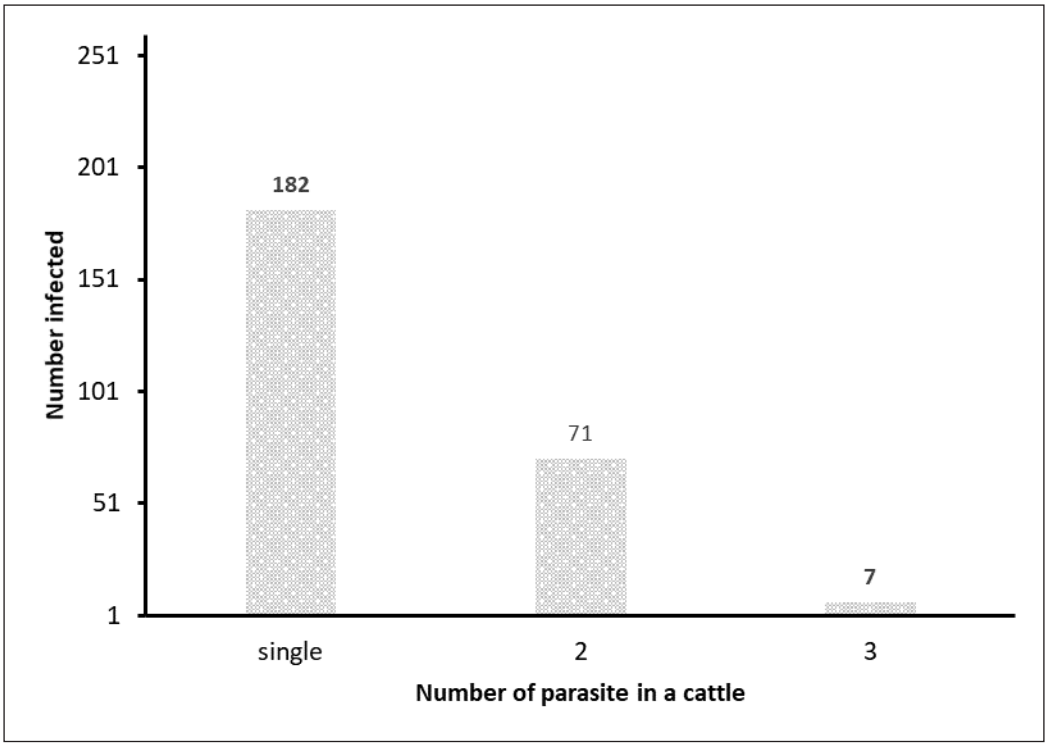

Figure 1. Distribution of single and co-infection among cattle in Gombe metropolis.

2.5. Parasitological examination

The fecal samples were processed at the Department of Biological Sciences Laboratory, Gombe State University, Gombe State. Fecal samples were submitted as fresh material or in 10% formalin or sodium acetate acetic acid formalin preservatives. Fresh or preserved fecal samples were examined for GIP ova or oocycts using wet mounts or concentration method.

2.5.1. Macroscopic examination

The samples were examined macroscopically to detect the presence of any color, consistency (whether formed, semi-formed, soft, or watery), presence of blood, mucus, and adult worms.

2.5.2. Direct wet mount

About 5 g of fecal sample was picked from the mid of the sample container using sterile applicator sticks and emulsified with a drop of physiological saline (0.85%) on a clean grease free slide, covered with cover slide examined under a microscope.

2.5.3. Concentration method

About 1 g (pea size) of feces was emulsified with 3–4 ml of saturated salt solution in a 20 ml conical glass tube. It was stirred vigorously, and more salt solution was added till the tube was nearly full, with the stirring being continued. Any coarse matter which floated was removed and the tube was placed on a flat surface with a glass slide being placed over the top of the tube which was in contact with the fluid. It was allowed to stand for 30 minutes, then aliquoted on a glass slide for observation for the presence of eggs or cysts (Parameshwarappa et al., 2012).

2.6. Ethical consideration

Institutional ethical clearance and approval were obtained from the Department of Biological Sciences, Gombe State University, and Gombe State prior to the commencement of the study. Also, necessary approvals and consents were gotten from the cattle owners and traders prior to the study.

2.7. Data analysis

Data were analyzed using IBM Statistical Package for Social Sciences software package version 23 and GraphPad Prism version 6. Descriptive statistics was used to determine the prevalence, and chi-square analysis was employed to test the presence of association and differences between breed, age, and sex in relation to prevalence.

3. Results

3.1. Prevalence in relation to demographic factors association of GIPs

Out of the 350 fecal samples, 260 (74.3%) were positive for GIPs, while 79.2% and 67.6% of the herder

and trade cattle, respectively, were infected (Table 1). There was no significant difference ($p \geq 0.05$) in the prevalence of GIPs between the locations. In respect to sex, 75.2% of the female examined were positive compared to 73.8% positive of the male, whereas, the prevalence was not significantly different ($p \geq 0.05$). The cattle between the ages 25 and 36 months were highly infected (76.4%) while those between 1 and 12 months were the least infected (66.7%). However, Red Bororo breed was the most infected (84.8%) and significantly ($p < 0.05$) higher than GIPs infection in Sokoto Gudali (69.9%) and White Fulani (73.0%).

3.2. Polyparasitism of GIPs among cattle in Gombe metropolis

The results from this study revealed that 52.0% of the infections were mono infections while prevalence of polyparasitism was 22.3%. However, the mono infections were significantly higher ($\chi^2 = 306.58, p = 0.0001$) than the poly infections across the demographic factors (Table 2). According to location, herder's cattle have highest poly infection (22.8%) than trade cattle (21.6%). In terms of sex, there was more mono infection in male (52.9%) while female had the most poly infection (24.8%). Cattle of age 1–12 months had the highest mono infection (58.3%) whereas, those that were 25–36 months had the highest poly infection (29.8%). In relation to breeds, 60.9% of the Sokoto Gudali were the most mono infected and the least poly infection (8.7%) was also observed among this breed (Table 2). Figure 1 showed that 71 (91.0%) of the poly infections were infections that involved double parasites while 7 of the infections involved 3 parasites.

The distribution of mono infection revealed that *Taenia* sp. was the most prevalent with 6.3%, followed by *Fasciola* sp., *Ascaris* sp., *Strongyloides* sp., and *Gongylonema* sp. with 4.9% each, respectively, while the least prevalent was *Toxocara* sp. with 0.6% (Table 3).

Table 4 showed different combinations of GIPs as poly infection, with *Ascaris* and *Taenia* with the most distribution with almost all the parasites encountered.

4. Discussion

Gastrointestinal parasitism is one of the major health problems affecting the productivity of cattle worldwide (Leon et al., 2019). The findings of this study showed that a number of GIPs affect cattle in the study area and hence, this provides baseline information on the GIPs that are often responsible for both direct and indirect productivity loss in cattle industry such as decreased growth rate, weight loss, diarrhea, anorexia, anemia, and subsequent death (Abraham et al., 2018).

The study revealed that 74.3% of the animals were infected with one or more species of GIPs. This is similar to the findings by Ola-Fadunsin et al. (2020), Yuguda et al. (2018), and Akinmoladun and Olafare (2014) who reported 79.9%, 74.3%, and 80% helminth prevalence, respectively, in some parts of Nigeria. The result also differs with other authors

Table 1. Prevalence and association of GIPs in relation to demographic characteristics of cattle in Gombe metropolis.

	Group	No. examined	No infected (%)	χ^2	*p*
Location	TD	148 (42.3)	100 (67.6)	3.867	0.049
	HD	202 (57.7)	160 (79.2)		
	Total	350 (100.0)	260 (74.3)		
Gender	Male	221 (63.1)	163 (73.8)	0.303	0.582
	Female	129 (36.9)	97 (75.2)		
	Total	350 (100.0)	260 (74.3)		
Age (month)	1–12	48 (13.7)	32 (66.7)	4.321	0.115
	13–24	141 (40.3)	105 (74.5)		
	25–36	161 (46.0)	123 (76.4)		
	Total	350 (100.0)	260 (74.3)		
Breed	White Fulani	281 (80.3)	205 (73.0)	6.189	0.042
	Red Bororo	46 (13.1)	39 (84.8)		
	Sokoto Gudali	23 (6.6)	16 (69.6)		
	Total	350 (100.0)	260 (74.3)		

TD = Trade Cattle; HD = Herder cattle.

Table 2. Prevalence of mono and co-infection in relation to demographic characteristics of cattle in Gombe metropolis.

	Group	No. examined (%)	Mono infection (%) ***	Poly infection (%)
Location	TD	148 (42.3)	68 (45.9)	32 (21.6)
	HD	202 (57.7)	114 (56.4)	46 (22.8)
	Total	350 (100.0)	182 (52.0)	78 (22.3)
Gender	Male	221 (63.1)	117 (52.9)	46 (20.8)
	Female	129 (36.9)	65 (50.4)	32 (24.8)
	Total	350 (100.0)	182 (52.0)	78 (22.3)
Age (month)	1–12	48 (13.7)	28 (58.3)	4 (8.3)
	13–24	141 (40.3)	79 (56.0)	26 (18.4)
	25–36	161 (46.0)	75 (46.6)	48 (29.8)
	Total	350 (100.0)	182 (52.0)	78 (22.3)
Breed	White Fulani	281 (80.3)	142 (50.5)	63 (22.4)
	Red Bororo	46 (13.1)	26 (56.5)	13 (28.3)
	Sokoto Gudali	23 (6.6)	14 (60.9)	2 (8.7)
	Total	350 (100.0)	182 (52.0)	78 (22.3)

*** $p < 0.01$ mono infection versus poly infection.
TD = Trade cattle; HD = Herder cattle.

Table 3. Prevalence of mono infection encountered among cattle in Gombe metropolis.

Parasite	Frequency	%
Trematodes		
Fasciola	17	4.9
Schistosoma bovis	14	3.8
Paramphistomum spp	8	2.2
Cestodes		
Taenia saginata	23	6.3
Hymenolopsis spp	13	3.7
Moneizia spp	10	2.9
Nematode		
Ascaris spp	17	4.9
Gongylonema spp	17	4.9
Strongyloides	17	4.9
Trichuris spp	16	4.5
Nematodirus spp	8	2.2
Trichostrongylus spp	4	1.1
Ostertagia spp	4	1.1
Toxocara sp	2	0.6
Protozoa		
Eimeria sp	8	2.2
Sarcocystis sp	4	1.1
Total	182	52.0

who had reported lower prevalence of 41.89% and 21.9% in Gombe state abattoir (Luka et al., 2018) and Vom ranch, Jos, and Plateau state (Abraham et al., 2018), respectively. The high prevalence reported in this research could be attributed to the period or season in which the study was conducted. This study was conducted in raining season where there were a lot of grasses which might be infected with the eggs, cyst, or larvae of GIP. There were also stagnant water bodies which harbors the snail intermediate host that enhances trematodes transmission. Other factors that could contribute to parasitic infections in cattle include sample size, sources of cattle sampled as well as the level of education of the farmers (Obi et al., 2020).

The prevalence found in the two locations (herder and trader's cattle) differs, 79.2% and 67.6%, respectively, although the temperature and humidity in the zone are similar but the management of the farm, sanitary programs, and management of pastures in the control of infectious agents are different. The high prevalence of GIPs among herder's cattle could be attributed to the fact that the herders engaged their cattle in free-grazing management which increases their exposure to cyst, ova, and larvae or the intermediate host of these GIPs on pasture. Moreover, this feeding imbalance often leads to malnutrition which also contributes to lack of immunity against parasite. However, low prevalence recorded in the trade cattle might be as a result of deworming and other medications the cattle owners often administered to their animals in order to keep them in best state of health before their arrival at the point of sale.

Table 4. Prevalence of co-infection encountered among cattle in Gombe metropolis.

Parasite	Frequency	%
Ascaris + Fasciola	1	0.3
Ascaris + Gongylonema	3	0.9
Ascaris + Moneizia	1	0.3
Ascaris + Moneizia + Strongyloides	1	0.3
Ascaris + Strongyloides	1	0.3
Ascaris + Taenia	2	0.6
Ascaris + Taenia + Moneizia	1	0.3
Ascaris + Trichuris	1	0.3
Eimeria + Ascaris	1	0.3
Eimeria + Fasciola	1	0.3
Eimeria + Ostertagia	1	0.3
Fasciola + Strongyloides	1	0.3
Fasciola + Ostertagia	2	0.6
Fasciola + Taenia	2	0.6
Fasciola + Taenia + Trichuris	1	0.3
Fasciola + Toxocara	1	0.3
Fasciola + Trichostrongylus	1	0.3
Gongylonema + Moneizia	1	0.3
Gongylonema + Taen	2	0.6
H. nana + Gongylonema	1	0.3
Moneizia + Ascaris	1	0.3
Moneizia + Ostertagia + S. bovis	1	0.3
Moneizia + Taenia	2	0.6
Nematodirus + H. nana	2	0.6
Nematodirus + Toxocara	2	0.6
Ostertagia + Strongyloides	1	0.3
Ostertagia + Trichostrongylus	1	0.3
S. bovis + Ascaris	2	0.3
S. bovis + Strongyloides	1	0.3
S. bovis + Taenia	2	0.6
S. bovis + Toxocara	1	0.3
Schistosoma + S. bovis + Toxocara	1	0.3
Strongyloides + Gongylonema	1	0.3
Strongyloides + Toxocara	1	0.3
Taenia + Ascaris	3	0.9
Taenia + Ascaris + Toxocara	1	0.3
Taenia + Fasciola	1	0.3
Taenia + Gongylonema	1	0.3
Taenia + Gongylonema + S. bovis	1	0.3
Taenia + H. nana	1	0.3
Taenia + Moneizia	1	0.3
Taenia + Nematodirus	1	0.3
Taenia + Schistosoma	1	0.3
Taenia + Toxocara	4	1.2
Taenia + Trichostrongylus + Ostertagia	1	0.3
Taenia + Trichuris	1	0.3
Toxocara + Trichostrongylus	1	0.3
Trichostrongylus	1	0.3
Trichostrongylus + Fasciola	1	0.3
Total	78 (22.3)	78 (22.3)

In relation to sex, female cattle had higher prevalence than the male and this corresponds with the findings of Umar et al. (2021) in earlier study conducted in Azare, North-Eastern Nigeria and Akinmoladun and Olafare (2014) in Ondo State. Contrary, reports from Gunathilaka et al. (2018) and Ola-Fadunsi et al. (2020) showed that male cattle were more susceptible to GIPs. Nonetheless, since both male and female animals were exposed to the same poor feeding habit and lack of veterinary cares which are among the factors that predispose cattle to GIPs, high difference in prevalence should not be expected and hence, no statistical difference was observed between sex and prevalence in this study. Some authors had suggested that male domestic ungulates are more susceptible to GIP infections due to hormones debilitating immune functions, which favor the growth and spread of parasites in male guts (Apio et al., 2006; Ola-Fadunsi et al., 2020).

However, there is statistical association between GIPs and breeds, with Red Bororo being more susceptible to GIPs than white Fulani and Sokoto Gudali. This is similar to the result of Umar et al. (2021), who reported higher prevalence in Red Bororo than other breeds. However, the factors that predispose Red Bororo to be more susceptible to GIPs are yet to be explored, as other authors had reported higher GIP prevalence in other breeds (Ola-Fadunsi et al., 2020; Yuguda et al., 2018). Although there has been a belief that exotic and cross breeds are more at risk to helminth infections compared to indigenous breeds (Bisimwa et al., 2018).

Furthermore, the prevalence of mono infection was highly significant than poly infection. Polyparasitism is the occurrence of two or more parasites in a single host. This is similar to the finding by Akinmoladun and Olafare (2014) who reported higher prevalence of 46.7% mono infection than 33.3% polyparatism. Meanwhile, other authors have reported higher polyparasitism prevalence than mono infection (Thanasuwan et al., 2021; Zawu et al., 2016). The damage cause by mono infection and polyparasitism

of GIPs varies and depends on different intrinsic and extrinsic epidemiological and biological factors, while it differs greatly from season to season and between geographical locations depending on the prevailing climatic conditions (Hailu et al., 2011). However, stress, poor nutrition, and concurrent disease had been associated with the release of hypobiotic larvae of GIPs from their dormant state and this often leads to clinical helminthosis (Aktaruzzaman et al., 2013). Poor husbandry practices, inadequate nutrients, and too many small pools could have contributed to the prevalence of polyparasitism in the study area.

In addition, 16 genera of GIPs were identified in this study, and this is similar to those identified by Yuguda et al. (2018) in Bauchi state. The study is at variance with the findings of Singh and Bello (2017), who reported seven genera of GIPs in sokoto abattoir and also, Umar et al. (2021) who reported six genera of GIPs in Azare. Moreover, the most prevalent specie is *Taenia* egg and this could be attributed to overcrowding of large number of animals in one place where good sanitation and hygiene are not practiced. Also, the transmission of *Taenia* egg does not require an intermediate host, hence these factors contribute to the higher prevalence of *Taenia* egg in the study area and this may cause significant economic losses to the farmers and meat sector.

5. Conclusion

GIPs were highly prevalent in cattle from Gombe metropolis. The study showed a wide variety of parasites while some of the animals have multiple parasitic infections. Thus, farmers should be educated about prevention and control of parasitic infestations, which include regular deworming, good husbandry management, and practices. The prevalence of *Fasciola*, *Taenia*, *Monezia*, and *Trichuris* also represent risk factors to public health, hence concerted effort should be geared to the control and monitoring of GIPs in Gombe State.

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Conflict of interest

The authors declare that they have no competing interests.

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