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Original Article

Prevalence study of zoonotic gastrointestinal parasitic infections in goats in Makurdi Metropolis, Nigeria

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Summary
Zoonotic infections pose a significant public health threat. Because of the close contact between diseases of domestic animals and humans, the current study aimed to determine the prevalence of zoonotic gastrointestinal parasitic infections in goats in three selected abattoirs in the Makurdi metropolis. For this purpose, a total of 150 fecal samples were collected from July through October 2013, using a random sampling method. Wet mount and Formol-ether sedimentation techniques were used to prepare the specimens, which were subsequently examined using a compound microscope (40 X) to identify characteristic eggs of the parasites in goats. The Chi-Square test at a significant level of 0.05 was used for data analyses. Of the 150 fecal specimens examined, 143 (95.33%) were infected with at least one gastrointestinal parasite. Altogether, eight parasites were identified among the 143 positive specimens- *Strongyloides papillosus* 43 (28.7%), *Fasciola gigantica* 37 (24.7%), *Trichuruis spp* 25 (16.7%), *Giardia spp* 13 (8.7%), *Marshallagia marshalli* 9 (6.0%), *Cryptosporidium spp* 8 (5.3%), *Eimeria spp* 5 (3.3%), and *Trichostrongyle spp* 3 (2.0%). Three zoonotic parasitic infections were detected (i.e., *Giardia spp, Cryptosporidium spp, and Eimeria spp*) with an overall prevalence of 17.3%. This study shows that zoonotic gastrointestinal parasites are prevalent among goats slaughtered at abattoirs in the Makurdi metropolis. Given the public health implications of gastrointestinal parasites in goats, health education, personal hygiene, and the control of these parasites among goats are recommended.
Keywords: Gastrointestinal parasites, Goats, Zoonosis, Public health

Introduction

There is a complex web of interactions between man, animals, and the environment. These interactions could be an important interface for zoonosis, the transmission of animal diseases to man. Thus, there is a relationship between animals, human health, and the environment as recognized by the One Health Commission and WHO (One Health Commission, 2010).

One Health, as defined by the WHO, "is an integrated and unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems". It recognizes the close link and inter-dependence of human health, domestic and wild animals, plants, and the wider environment (WHO, 2021).

The transmission of animal diseases to man is a long-standing phenomenon. Approximately 75% of emerging infectious diseases are zoonotic

infections (Wondwossen et al., 2014). An essential feature of zoonotic diseases is that animals can be important reservoirs, complicating the control efforts of the disease in man.

Throughout history, there has been a relationship between animal disease and man. The One Health concept seeks to understand these interactions between humans, animals, and environmental factors and their impact on health (One Health Commission, 2010).

Cryptosporidium and *Giardia* species are some of the most common intestinal parasites (protozoans) of goats with zoonotic potential (Utaaker et al., 2017; Thompson et al., 2008). Direct evidence of transmission of these parasites to man via food and water sources is limited (Robertson, 2009). However, molecular studies have demonstrated that some genotypes of these parasites are zoonotic (Geurden et al., 2008). Generally, *Cryptosporidium* is more likely to infect humans than *Giadiasis* and *Eimeria* species (Utaaker et al., 2017).

These parasites invade the intestinal lumen with a pathogenic progression, causing abdominal pain symptoms and mild diarrhea in healthy adults. They could however be devastating in infants or as opportunistic infections, causing severe diarrhea and dehydration (Karshima et al., 2018). In immunocompromised individuals, the infection may spread to extra-intestinal sites, causing persistent diarrhea and life-threatening dehydration (Souvik et al., 2014). In children, it causes poor growth and cognitive development in children (Nordeen et al., 2012).

Goats are affected by a wide range of gastrointestinal parasites, some of which are zoonotic. Transmission is via the fecal-oral route and is more likely to be higher in areas with open rearing of goats (a common practice in Nigeria), living near livestock (as seen among displaced persons), poor environmental sanitation, lack of portable water source, the use of goat dung for vegetable manure and other purposes (for instance, the use of goat faces on vegetable leaves to prevent goats from eating is a common practice in Nigeria) are potential drivers of transmission of zoonotic gastrointestinal parasites of goats to man (Paul et al., 2020).

Zoonotic infections pose a significant public health threat. Although, *Cryptosporidium, Giardia, and Emeiria* species have been reported in goats, their zoonotic potential and public health threat are often not highlighted. This study aimed to evaluate the prevalence of gastrointestinal parasite infections of zoonotic potential among goats in three selected abattoirs in the Makurdi Metropolis.

Materials and methods

Study area

The study was carried out in three abattoirs located in the Makurdi metropolis. Makurdi, the capital of Benue State, is located between latitude 7° 40'N-7° 50' N and longitude 8°25'E-8°40'E. Makurdi lies within the Benue valley in the middle belt zone of Nigeria and is divided by the River Benue into the North and South banks. The state has a tropical climate with wet and dry seasons. The rainy season takes seven months (April - October) with an annual rainfall ranging from 1200 - 2000 mm. On the other hand, the dry season takes five months (November – March). The abattoirs visited were Wadata, Wurukum and North bank abattoirs.

Sampling

One hundred fifty fecal samples were collected randomly from goats slaughtered at the three abattoirs at the time of sample collection between July and October 2013. Samples were collected from 5 males and 145 female goats. Of the total of 150 goats sampled, 129 were adults, while 21 were young goats. Stool samples were collected from the rectum of goats slaughtered every morning at the abattoirs and put into labeled sample bottles. The samples were immediately preserved with 10% formalin and taken to the laboratory for examination.

Laboratory examination

The Formol-ether Sedimentation technique was used to detect ova in feces. One gram (match stick head size) of the fecal sample was placed in a beaker using a broomstick and 3 mL of formic water was pipetted twice into the beaker. The sample was stirred by a stick before sieving. The

sieved sample was transferred into a centrifuge tube. Three mL of diethyl ether was dropped into the sieved sample, shaken, and allowed for five minutes. The sample was then centrifuged at 3000 rev/min for five minutes. The supernatant fluid was decanted and sediment was dropped on the slide and covered with a coverslip for viewing under the microscope. Lugol iodine was used to stain for better viewing. Fecal examination was done under the microscope with two objectives of 10× and 40×. The characteristic ova of the gastrointestinal parasites encountered were identified using a chart prepared from various literatures.

Data analysis

Data obtained from laboratory analysis were analyzed using SPSS 20 and presented in tables and bar charts. Chi-square test was used to compare the prevalence by gender and age of goats, and a *P-value* of < 0.05 was considered significant.

Results

Of the 150 fecal samples examined, 143 (95.33%) were infected with at least one gastrointestinal parasite. In total, eights parasites were found among the 143 positive samples (Table 1). Of the 145 infected samples, 26 (17.30%) were infected with zoonotic parasites (*Giardia spp, Cryptosporidium spp,* and *Eimeria spp*) (Table 1, Figures 1 and 2). Out of the five males examined, all (100%) were infected. While, 138 (95.17%) of the 145 females examined were infected. Out of the 29 young goats examined, 25 animals (86.21%) were infected with intestinal parasites. While, out of 121 adult goats examined, 118 cases (97.52%) were infected. There was no notable difference in infection with respect to the age and gender of goats sampled (Table 2).

Table 1- Gastrointestinal parasites that were identified in goats examined in the present study.

Parasites	No. Infected (%)
Strongyloides papillosus	43 (28.7%)
Fasciola gigantica	37 (24.7%)
Trichuruis spp	25 (16.7%)
Giardia spp	13 (8.7%)
Marshallagia marshalli	9 (6.0%),
Cryptosporidium spp	8 (5.3%),
Eimeria spp	5 (3.3%)
Trichostrongyle spp	3 (2.0%).
Total	143

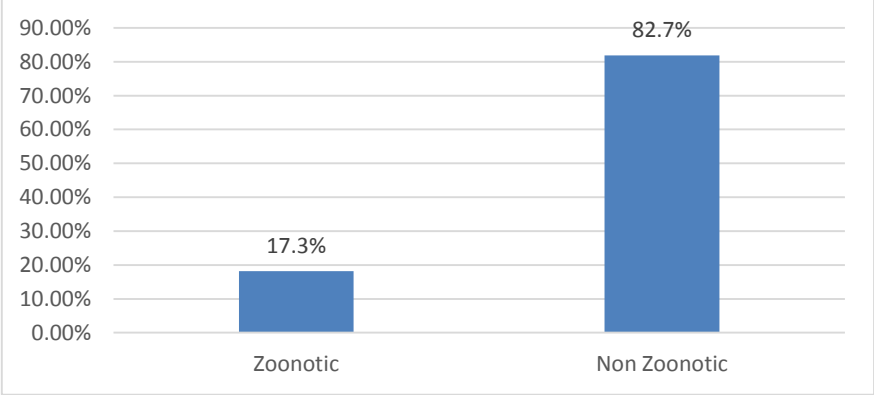

Fig. 1. Prevalence of zoonotic and non-zoonotic gastrointestinal parasites in goats.

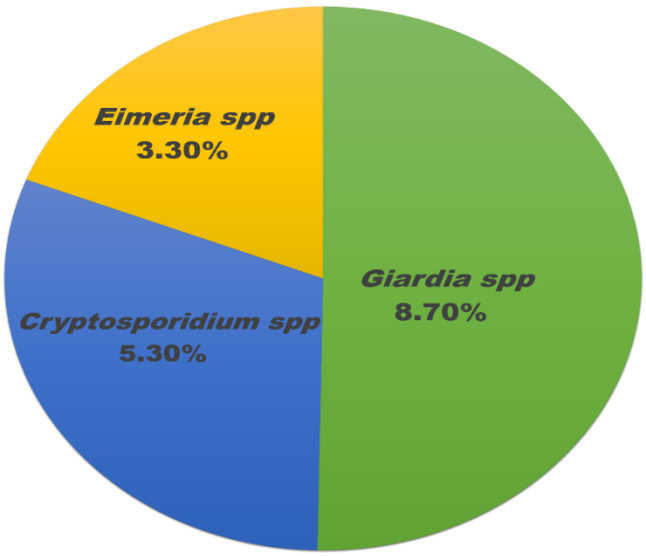

Fig. 2. Prevalence of zoonotic gastrointestinal parasites infection in goats.

Table 2- Prevalence of gastrointestinal parasites infection by gender and age in goats.

Gender/Age	No. Examined	No. Infected (%)	χ^2	*P-Value*
Gender				
Male	5	5 (100)		
Female	145	138 (95.17)	0.058	0.83
Total	**150**	**143 (95.33)**		
Age				
Young	29	25 (86.21)		
Adult	121	118 (97.52)	0.165	0.97
Total	**150**	**143 (95.33)**		

Discussion

The prevalence of gastrointestinal parasites of goats with zoonotic potential is reported in this study. Though, the prevalence was lower (17.30%) than non-zoonotic parasites (82.70%), the public health threat posed by these zoonotic parasites cannot be overlooked.

In Nigeria and most other areas that goats are kept in the free-range (non-intensive) management system, a little or no veterinary care and hygiene practices are adopted. This could be a major factor responsible for the overwhelmingly high prevalence of infections (95.33%) reported in this study.

Cryptosporidium spp, *Giardia spp*, and *Eimeria spp* have been reported as the most prevalent zoonotic gastrointestinal parasite infections of goats (Robertson, 2009). Similarly, *Cryptosporidium spp*, *Giardia spp*, and *Eimeria spp* were found as the prevalent zoonotic infections in this study.

The overall prevalence of zoonotic parasites in this study (17.30%) was lower as compared to the previous studies. *Eimeria spp* alone has been reported to have a prevalence of 85.03%, 31.81%,

and 33.04% in Ethiopia, Nepal, and Thailand, respectively (Rahda and Mahendra, 2017; Etsay et al., 2020; Jittapalong et al., 2011). However, the 3.31% prevalence of *Eimeria spp* in this study is similar to the 4.3% reported in Malaysia (Paul et al., 2020).

According to a previous study (Utaaker et al., 2017), *G. doudenalis* was reported to have a prevalence of 33.8%. While, *Cryptosporidium* had a prevalence of 0.5%, which varies with the report of this study.

The high prevalence and diversity of gastrointestinal parasites in goats have been widely reported globally. A prevalence of 94.48% has been reported in India (Singh et al., 2015). Similarly, 89% and 88.10% prevalences have been reported in Papua New Guinea and China, respectively (Koinari et al., 2013 and Guiying et al., 2018).

However, a lower prevalence, such as 78.60% in Malaysia (Paul et al., 2020), 75.75% in Western Nigeria (Adejinmi et al., 2015), 64.00% in northwest Nigeria (Maimadu et al., 2020), 46.00% in South-South Nigeria (Abah & Ebong, 2017) and 37.5% in Abuja, Nigeria (Jegede et al., 2015) have also been documented. Such variations in the prevalence could be a result of climatic, seasonal, and methodological differences in various studies.

There was no significant difference in infection by the gender of goats sampled. This is not consistent with other studies in Nigeria and Zimbabwe, where gender was reported to be an important risk factor for infection (Odogu and Okaka, 2016; Zvinorova et al., 2016). Also, contrary to other findings, in which younger goats were more infected (Paul et al., 2020), there was no significant difference in infection by age in this study. These variations could be due to the disproportionate sampling of goats by gender and goats in this study.

Conclusion

On the whole, it seems that the zoonotic gastrointestinal parasites are prevalent in the slaughtered goats in the Makurdi metropolis. In view of the public health implications of gastrointestinal parasites in goats, health education, personal hygiene, and the management of these parasites in goats are recommended.

Acknowledgments

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Conflict of interests

The authors declare that there is no conflict of interest.

Ethical approval

Not applicable.

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