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PREVALENCE OF GASTROINTESTINAL PARASITES IN STRAW-COLORED FRUIT BATS IN MAKURDI, BENUE STATE NIGERIA

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ABSTRACT

Fruit bats often referred to as flying foxes belonging to the family Pteropodidae, are ecologically significant mammals that play vital roles in pollination, seed dispersal, and maintaining ecosystem balance. Gastrointestinal parasites are organisms that live inside the digestive system of their host and feed on nutrients meant for the host. The presence of gastrointestinal parasite of fruit bat is profound and infected bats may exhibit reduced foraging activity and altered movement patterns. This research investigates the presence of gastrointestinal parasites in fruit bats within Makurdi metropolis; it aims to elucidate potential public health risks and implications in relation to fruit bat species. To achieve this, 449 fecal samples were obtained from bat roost sites in Makurdi. Fecal flotation and sedimentation techniques were carried out to check for the presence of gastrointestinal parasite ova and oocytes. The results showed a prevalence of 3.79% of gastrointestinal parasites circulating in fruit bat species in Makurdi. Three parasite types were identified: *Eimeria spp*, *Strongyle*-type nematodes, and *Cryptosporidium spp*. From this study, the prevalence obtained indicates that fruit bats in Makurdi metropolis are infected with gastrointestinal parasites, though with a low parasitic burden. However, the detection of *Cryptosporidium spp*, a known zoonotic organism, underscores the potential risk of disease transmission especially in areas where close human contact occurs. The findings from this study provide useful baseline data on the gastrointestinal parasites of fruit bat species in Makurdi and emphasize the importance of continued surveillance and public health awareness to mitigate potential public health threats.

Keywords: Fruit Bats, Gastrointestinal, Parasites, Prevalence, Makurdi

INTRODUCTION

Bats (*order Chiroptera*) are indeed the only mammals capable of true, powered and sustained flight; other "flying" mammals such as flying squirrels only glide rather than generate continuous flapping flight (Anderson and Ruxton 2020). Their forelimbs have evolved into wings, enabling active flig ht, which distinguishes them from other gliding or flying ma mmals (American Society of Mammalogists 2019). The order *Chiroptera* is the second largest order of mammals (after the rodents) with cosmopolitan distribution (American Society of Mammalogists 2019, Mickleburgh *et al*., 2009). Bats are traditionally classified into the megabats and microbats (Jones and Patel 2020, Prothero 2016). Megabats include flying foxes and the old-world fruit bats, which are usually herbivores and consume fruits, flowers, leaves, nectar, and pollens (Jones and Patel 2020, Prothero 2016 and Schwab and Pettigrew 2005). In contrast, microbats are mostly insectivorous in feeding habits; although, few of these species may feed on blood, fruits, nectars, pollens, and vertebrates (Prothero 2016, Fenton; Fleming 1976 and Whitaker 2004).

It has been estimated that more than 1300 species of bats are reported in the world (American Society of Mammalogists 2019; Fenton and Fleming 1976). The food and feeding habits of fruit bats often bring them into contact with contaminated food and water sources, facilitating the ingestion of parasitic eggs or larvae (Jones *et al.,* 2021). The gastrointestinal tracts of fruit bats provide an ideal habitat for various parasitic organisms, which can exploit the bats' dietary habits and roosting behaviors (Jones and Patel 2020)]. However, these bats are also known to harbor a wide range of gastrointestinal parasites, including nematodes, cestodes, trematodes, and protozoans, which can impact their health and behavior (Jones *et al*., 2021). Gastrointestinal parasites in fruit bats have become a focal point of research due to their potential effects on bat populations, their ecological roles, and their implications for zoonotic disease transmission (Jones *et al*., 2021)

Infected bats may exhibit reduced foraging activity and altered movement patterns, which can disrupt their roles as pollinators and seed dispersers (Diniz *et al*., 2019; Morenoet *et al*., 2021). Fruit bats infected with gastrointestinal parasites are less likely to travel long distances in search of food, potentially affecting plant reproduction and ecosystem stability (Nguyen et al., 2020). Furthermore, the presence of these parasites in fruit bats can influence their interactions with other species, including predators and competitors, thereby altering community dynamics (Jones and Patel 2020). From a public health perspective, the zoonotic potential of gastrointestinal parasites in fruit bats is a growing concern (Jones and Patel 2020). Fruit bats often roost near human settlements, particularly in regions with limited access to clean water and sanitation, increasing the risk of parasite transmission to humans (Jones *et al* 2021). Human expansion into bat-inhabited areas, especially via urbanization, agriculture, and habitat loss, creates more frequent and intense human–bat contact and can elevate infection levels in bats, together increasing spillover risk (Rulli *et al*., 2021). Fruit bats are hunted and consumed in Makurdi, other parts of Nigeria and Africa (Ameh *et al.,* 2022), these constant interactions between bats and human population can pose a significant public health risk. Moreover, infected bats can act as a definitive, intermediate or a paratenic host for many protozoan, cestodes and trematodes (Santos and Gibson 2015). However, information on these parasitic faunae in bat species in Makurdi is lacking. Thus, in this study, we have investigated the prevalence of GI parasite species in frugivorous bats found in Makurdi metropolis of Benue.

MATERIALS AND METHODS

Study Location

This study was conducted in Makurdi, Benue state, Nigeria. It covers an area of approximately 471 square kilometers. It is located between Latitude 07° 30′ N to 08° 00′ N of the Equator and Longitude 08° 00′ E to 09° 00′ E of the Greenwich Meridian. The people in the city are of various ethnicities with the dominant groups being Tiv and Idoma. The common languages spoken are Tiv, Idoma and English (JATO Dynamics, 2006).

The state is acclaimed 'The Food Basket of the Nation, (Nigeria)' because of its diverse agricultural products. Makurdi has a tropical climate of wet (April to October) and dry (November to March) seasons (JATO Dynamics, 2006)

Makurdi has a large bat population, with bat roosts found in and around the Benue State Government House located in Makurdi and on trees in private residences around the Old Government Reserved Area (Ameh *et al*., 2022).

Sample Collection and Transportation

A total of 449 fecal samples from fruit bat were collected from bat roost sites. Clean sterile plastic films were overlaid on the ground under the trees were the bats roost. This was done in the evening when bats go out to feed. Fresh fecal samples were scooped using sterile forceps the following morning. Samples were placed in a clean, sterile, well-labelled sample bottles and transported to the Veterinary Parasitology Laboratory of the Veterinary Teaching Hospital, Joseph Sarwuan Tarka University, Makurdi for processing.

Laboratory Processing and Examination

The samples were macroscopically examined for the presence of blood, mucus, segment of cestodes and microscopically examined by the techniques stated below:

Saturated Salt Floatation Technique

Two grams of each fecal sample was thoroughly mixed in 12 mls of saturated salt solution and filtered with the help of a tea strainer. The solution was poured into a 15 ml conical centrifuge tube and a coverslip was placed on the mouth of the tube. After 10 minutes, the coverslip was carefully removed and placed on the glass slide, stained with Lugol's iodine then observed under the microscope at 100x and 400x total magnifications for presence of GI parasite ova and oocytes (Burton and Lalande 2021).

Sedimentation Technique

Two grams of each fecal sample was thoroughly mixed in 12 ml of normal saline and filtered with the help of a tea strainer into a 15 ml centrifuge tube, the filtrate was centrifuged at 1200 rounds per minute for 5 minutes. The supernatant was discarded, and one drop of the sediment was put on a glass slide. Gram's iodine was used to stain the deposits and this was examined microscopically at 100x and 400x magnifications for the presence of ova and oocytes (Adhikari *et al*., 2020).

Data Analysis

Data was summarized and presented using descriptive statistics. Prevalence was determined by dividing the number of positive samples by the total number of samples collected and multiplying by 100.

RESULTS AND DISCUSSION

From the 449 fecal samples examined for gastrointestinal parasites, seventeen (3.79%) were positive for at least one parasite specie. All the positive results in this study were gotten from the floatation technique with none from the sedimentation technique.

Strongyle-type nematodes (fig. 1A) were the most prevalent parasite detected, occurring in 9 samples (2.00%) followed by *Eimeria spp.* (fig. 1B) from 7 samples (1.56%). and then *Cryptosporidium spp* (fig 1C) from 1 sample (0.22%.) One of the positive samples showed a mixed infection with both *Eimeria* spp and Strongyle-type nematode as shown in Table 1.

Table 1: Distribution of Gastrointestinal Parasites in Fruit Bats in Makurdi

S/N	Gastrointestinal parasite	Total number sampled	Total number positive	Percentage (%) positive samples
1	*Eimeria* spp	449	7	1.56%
2	*Strongyle*-type Nematode	449	9	2.00%
3	*Cryptosporidium* Spp	449	1	0.22%
4	Mixed infection (*Strongyle+Eimeria spp)*	449	1	0.22%

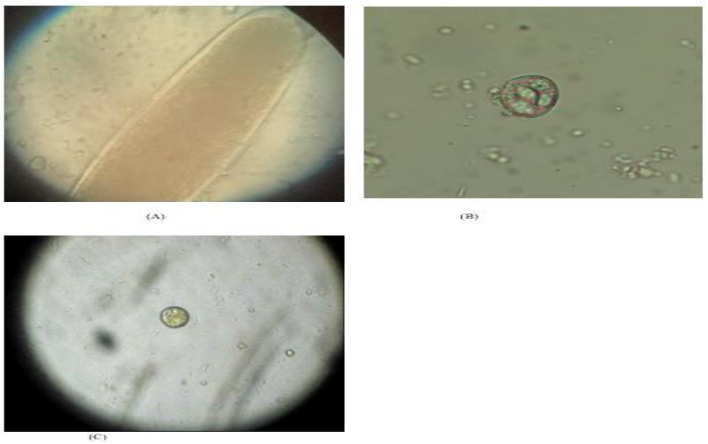

Figure 1: Photomicrographs of Various Parasitic Species. (A) Egg of *Strongyle sp*. 400x, after Flotation Technique (B) Oocyst of *Eimeria sp*. 400x, after Flotation Technique and Giemsa's Stain. (C) Ova of *Cryptosporidium sp*. 400x, after Flotation Technique

Discussion

To the best of our knowledge, this is the first attempt to investigate the prevalence of gastrointestinal parasites of fruit bats in the Benue region.

Gastrointestinal parasites of fruit bats *Eidolon helvum* sampled in Makurdi Metropolis showed an overall low prevalence (3.79%) of infection. However, the study has revealed that the fruit bats in this region harbor gastrointestinal parasites such as *Eimeria spp, Cryptosporidium spp, Strongyle*-type nematode with an occurrence of a mixed infection involving *Stongyle* and *Eimeria spp*. These findings indicate that Fruit bats serve as host to various species of gastrointestinal parasite with the possibility of spillover to human population.

The low prevalence recorded in this study may be attributed to the ecological and behavioral characteristics of *E. helvum*. As a predominantly fruit-eating bat, *Eidolon helvum* is likely less exposed to many soil-transmitted and food-borne helminths than insectivorous or ground-foraging mammals, mainly because it avoids key intermediate hosts and contaminated habitats (Adhikarie *et al*., 2020). Additionally, the roosting habits of urban bat colonies, often located in trees or elevated structures, may further limit contact with contaminated substrates that facilitate parasite transmission. Environmental conditions in urban settings, including habitat modification and reduced availability of intermediate hosts, could also contribute to the observed low parasite burden (Nunes *et al.*, 2016; Hiller *et al*., 2020)**.** This prevalence aligns with the work done in Uganda where 46% of all bat fecal samples tested were positive for one or more gastrointestinal parasite (Ochieng *et al*., 2025b), though this study was carried out in several bat species involving micro and megabats. The results in this study slightly disagree with the work done in Lafia which reported no GI parasite in *Eidolon helvum* specifically, *(*Aliyu *et al* 2025) but gastrointestinal parasite were reported in other species of bats like the *Tadarida brasilensis (*Aliyu *et al* 2025).

In contrast to these findings, reports from other researchers in more advanced countries show a very high prevalence such as from France (100%) (Afonso *et al.,* 2014), Brazil (96.29%) (Afonso *et al*., 2014), Serbia (88.2%) (Horvat *et al*., 2016), and South Africa (85.5%) (Junker *et al*., 2008); Argentina (78.6%) (Falconaro *et al.,* 2018), England (76%) (Lord *et al*., 2012), and Mexico (72-76%) (Caspeta-Mandujano 2015). These differences might be attributed to the application of different sampling techniques in the field, more advanced laboratory methods in these studies, and climatic scenarios in the various study sites.

We grouped one morphotypes of nematode eggs into "*Strongyle*-type," because, without larval cultures, it is not easy to differentiate them only via the egg morphometry. Many previous histologic studies of GI tracts of the insectivorous bats from various geographies have reported the presence of the adults of different *Strongyles* like *Histostrongylus coronatus*, *Macuahuitloides inexpectans*, *Molinostrongylus ornatus*, *Parahistiostrongylus octacanthus*, *Strongylacantha glycyrrhiza*, *Torrestrongylus tetradorsalis*, and *Bidigiticauda serrafreire* (Santos and Gibson 2015; Horvat *et al.,* 2016; Junker *et al.,* 2008; Okafor, 2004; Caspeta-Mandujani, 2015; Genov *et al.,* 1992; Simoes *et al*., 2019). This evidence indicates the predominance of a wide variety of these nematodes in bats. The presence of *Strongyle*-type nematodes in the bat colonies studied, although at a low frequency, suggests occasional exposure to infective larvae, possibly through contaminated fruits or water sources within the urban environment.

The detection of *Eimeria spp* indicates fecal–oral transmission within roosting colonies, where close physical proximity may facilitate parasite spread. The occurrence of a mixed infection in one sample highlights the possibility of overlapping transmission pathways and emphasizes the importance of considering co-infections when assessing parasite ecology in wildlife populations. However, given the low number of positive cases, the epidemiological significance of mixed infections in *E. helvum* within Makurdi town appears minimal. The mixed infection involving *Strongyle-type egg and Eimeria spp* recorded aligns with the work in Uganda which also detected *Cryptosporidium spp* and mixed infections involving *Strongyle* and *Eimeria spp* (Ochieng *et al*., 2025a).

Cryptosporidium spp was the only parasite of zoonotic importance detected although the prevalence was low suggesting limited circulation within the bat population at the time of sampling. *Cryptosporidium* causes diarrhea in humans and is transmitted via faeco-oral route through contaminated food, water, or dust containing oocysts (Lim *et al.,* 2025). The category of individuals prone to this infestation include immunocompromised individuals, children (<5years), elderly (>65years), pregnant women, occupationally exposed individuals and rural communities near bat roosts (Barbosa *et al*., 2023). However, the close association of fruit bats with humans, bat handlers, persons residing near bat roost in Makurdi and the knowledge they have on bat and their pathogen-carrying potential which necessitates ongoing surveillance to monitor for emerging zoonotic parasites and the need for public health enlightenment (Ameh *et al*., 2022). Factors such as habitat encroachment, climate change, or changes in bat behavior could increase the risk of zoonotic transmission in the future (Carlson *et al*, 2022; Eby *et al*., 2022).

CONCLUSION

The findings of this study indicate that *Eidolon helvum* within the Makurdi metropolis harbor gastrointestinal parasites at a prevalence rate of 3.79%. It is therefore recommended that continuous surveillance be carried out in bat colonies to monitor potential changes in parasite dynamics, especially in urban settings where bats live in close proximity to human populations. Such monitoring is important to further understand the ecological role of bats in parasite maintenance, for assessing the potential public health implications of these parasites and to detect spillover infections.

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