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Point Prevalence of Gastrointestinal Parasites in Animals at a Zoological Garden in Ibadan, Oyo State, Nigeria

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Abstract

Gastrointestinal parasites are a serious impediment to animal production and sustainability in Nigeria. This study investigates the prevalence of gastrointestinal parasites among captive animals in the Zoological Garden in Ibadan, Nigeria. A total of 57 freshly voided faces were collected from seven species of zoo animals. The overall prevalence of helminth and protozoal parasites was 27 (47.5%) and 28 (49.1%), respectively. Carnivorous species had the highest prevalence of *Toxocara species* (100%). Hyenas had a high prevalence of multiple parasites, including *Capillaria species* (100%), *Toxocara species* (66.7%), *Taenia species* (66.7%) and *Cryptosporidium species* (33.3%). Primates exhibited high protozoan infection rates (44.4%) and lower helminth infection rates (27.8%). However, hoofed mammals showed higher helminth prevalence (63.7%) than protozoan parasites. Equine species had multiple helminth infections with the highest prevalence in *Anoplocephala species* (80%), followed by *Fasciola species* (60%), *Strongyloides species* (60%) and *Dicrocoelium species* (40%). In this study, there was co-infection with multiple helminths in camel. Coccidian oocysts and helminth burdens in avian species were (53.3%) and (13.3%), with *Eimeria species, Cryptosporidium species* and *Heterakis gallinarum* having a prevalence of 46.6%, 40% and 13.3%, respectively. This research demonstrated high prevalence of gastrointestinal and zoonotic parasites, including *Cryptosporidium species, Strongyloides species* and *Toxocara species* across different host groups, highlighting the potential risk to public health.

Keywords: Prevalence; gastrointestinal parasites; captive; wild animals

Introduction

Nigeria is home to several natural beauties and has a rich, diverse wildlife. Several factors threaten the survival of wild animals, including habitat loss, poaching, climate change, and wildlife diseases, especially those caused by gastrointestinal parasites [1]. Zoological gardens display collections of wild animals for research, conservation, education, and recreation. Animals in zoos are captured from their natural habitats and kept in man-made environments [2, 3]. The main challenges of keeping wild animals in captivity are parasitic diseases [4]. In their natural habitats, wild animals may have immunity to ectoparasites and endoparasites, or maintain a balance with them as they roam across large areas. Parasites can infect hosts, but the animal's immune system determines whether disease develops [5]. Capturing animals for captivity can affect their overall welfare and ecological needs, increasing their vulnerability to diseases [6], even when they are provided with adequate food, water, and hygiene in zoological gardens [7]. When pathogens spread between species, they can disrupt ecosystems by reducing biodiversity, changing the structure and behavior of animal populations, and affecting interspecies interactions, including predator–prey relationships [8]. Gastrointestinal parasites, which inhabit the digestive tract, are commonly detected through faucal analysis. Because their presence, absence, or relative abundance reflects the condition of host species, these parasites serve as powerful bio indicators of ecosystem health [9]. Monitoring parasites provides insight into the stability of animal populations, the resilience of ecological communities, and the potential impacts of environmental changes. In this way, parasites are not merely agents of disease but also valuable markers that help assess the balance and integrity of ecosystems. Therefore, this study aimed to determine the prevalence of gastrointestinal parasites in a zoological garden at Ibadan, Nigeria.

Materials and Methods

Study site

The Zoological Garden is situated at a latitude of 7°23′47″N and longitude 3°55′0″E in Ibadan, Oyo State, Nigeria. It was founded in 1948 as a menagerie for teaching and research. The climate in Ibadan is tropical, with clear wet and dry seasons, supporting a diverse range of animal life. To prevent parasitic diseases, zoo animals at this facility are treated routinely and whenever tests are positive for parasitic infections. Veterinarians and attendants carry out regular examinations on the animals in the Zoological Garden. When diarrhoea is observed, faecal examination is performed, and any positive animals are treated accordingly, with supplementary analysis performed after the treatment period. Furthermore, in this zoo, newly acquired animals are quarantined and clinically examined, with faecal and blood samples collected and analysed by veterinarians to determine their health status.

Sample collection and parasitological analysis

Faecal samples were collected in the morning with the assistance of the Zoo animal handlers. Individual freshly voided faecal samples were collected. A total of 57 samples were collected from seven species of wild animals housed in the Zoological Garden. Samples were collected four to six weeks after the animals' routine deworming. Of these samples, Felines accounted for 10, canines (3), equines (5), Camel (1), Primates (18), Ruminants (5) and Aves (15). All samples were stored at 4°C, transported to the laboratory, and examined within 48 hours. Samples were subjected to macroscopic examination to verify the presence of adult nematodes, cestodes and parasite fragments and to microscopic examination using flotation and sedimentation techniques. Fresh wet-mount smears, along with modified Ziehl-Neelsen and Giemsa-stained smears prepared from 10 mL of sediment obtained from faecal samples processed via formol–ether centrifugation, were also prepared. Microscopically, samples were evaluated at magnifications of 100x, 400x, and 1,000x.

Results

The overall parasite burden among animals in the Zoological Garden was high with helminths (47.5%) and protozoa (49.1%) of the total samples examined. Felines and canines exhibited the highest helminth prevalence (100%). Protozoan infections were also common in these groups, affecting 50% of felines and 33.3% of canines (Figure 1). Primates exhibited lower helminth incidence (27.8%) but relatively high protozoan prevalence (44.4%). Hoofed mammals had a mixed burden, with helminths detected in 63.7% and protozoa in 45.5%. Avian species exhibited the lowest helminth prevalence (13.3%) but the highest protozoan burden (53.3%).

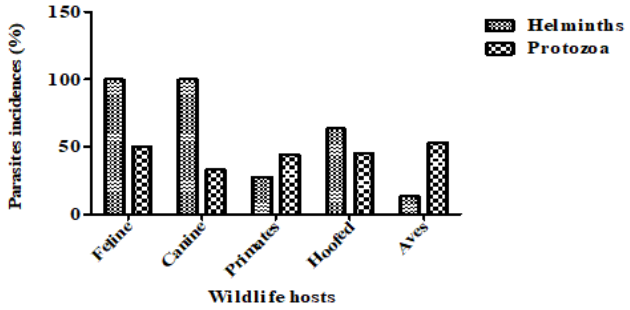

Figure 1: Overall Helminth and Protozoan incidences among animals in the University of Ibadan Zoological Garden

Among the carnivores, all lions (100%) were infected with *Toxocara spp*. and Hyaenas were also heavily parasitised by *Capillaria spp.* (100%), while *Taenia spp.* and *Toxocara spp.* were present in 66.7% and *Cryptosporidium spp.* at 33.3%. Equines exhibited a diverse parasite spectrum, with high prevalence of *Anoplocephala spp.* (80%), followed by *Fasciola spp.* (60%), *Cryptosporidium spp.* (60%), *Strongyloides spp.* (60%) and coccidian oocysts at 20%. Multiple parasites were detected in Camel, including *Dicrocoelium spp., Dictyocaulus spp., Anoplocephala spp., and Trichuris spp.* In primates, protozoan infections were slightly higher with Coccidian oocysts (38.9%), *Cryptosporidium spp.* (27.8%) and *Strongyloides spp.* at 27.8%. Ruminants showed high prevalence of Coccidian oocysts (40%) and *Cryptosporidium spp.* (20%), while *Fasciola spp.* had 20% prevalence. Birds exhibited the highest protozoan burden, with Coccidian oocysts (46.6%) and *Cryptosporidium spp.* (40%). Helminth infection was relatively low, with *Heterakis spp.* detected in 13.3% of the aviary (Table 1).

Table 1: Prevalence of gastrointestinal parasites among captive animals in the University of Ibadan Zoological Garden

Parasites	Lions (N=10) %	Hyaena (N=3) %	Equine (N=5) %	Camel (N=1) %	Primates (N=18) %	Ruminants (N=5) %	Aves (N=15) %
Toxocara spp	10 (100)	2 (66.7)	-	-	-	-	-
Capillaria spp	-	3 (100)	--	-	-	-	-
Taenia	-	2 (66.7)	-	-	-	-	-
Strongyloides spp	-	-	3 (60)	-	5 (27.8)	--	-
Fasciola spp	-	-	3 (60)	-	-	1 (20)	-
Dicrocoelium spp	-	-	2 (40)	1 (100)	-	-	-
Dictyocaulus spp	-	-	-	1 (100)	-	-	-
Anoplocephala spp	-	-	4 (80)	1 (100)	-	-	-
Heterakis spp	-	-	-	-	-	-	2 (13.3)
Trichuris spp	-	-	-	1 (100)		-	-
Cryptosporidium spp	3 (30)	1 (33.3)	3 (60)	-	5 (27.8)	1 (20)	6 (40)
Coccidian oocysts	2 (20)	-	1 (20)	-	7 (38.9)	2 (40)	7 (46.6)

-= Negative

Several zoonotic gastrointestinal parasites were identified across different animal groups in the University of Ibadan Zoological Garden (Table 2). *Cryptosporidium spp.* was the most widely distributed and detected in felines, hoofed mammals, primates, and birds. *Strongyloides spp.* was observed in hoofed mammals and primates and *Toxocara spp.* was restricted to felines and canines. *Fasciola spp.* was detected only in hoofed mammals and *Taenia spp.* was observed in canines.

Table 2: Zoonotic parasites detected in University of Ibadan Zoo animals

Animals	*Cryptosporidium spp*	*Strongyloides spp*	*Toxocara spp*	*Fasciola spp*	*Capillaria spp*	*Taenia spp*
Feline	+	-	+	-	-	-
canine	+	-	+	-	+	+
Hoofed mammals	+	+	-	+	-	-
Primates	+	+	-	-	-	-
Aves	+	-	-	-	-	-

-- = Negative, + = Positive

Among birds, Heterakis spp. was detected in speckled pigeons and White stork goose, while *Cryptosporidium spp.* was present in White stork goose and Senegal parrots. Coccidian oocysts were widespread, occurring in speckled pigeons, African grey parrots, White goose, and White stork goose. Overall, protozoan infections were more common than helminths in avian species. However, no parasite was found in Vultures and Marabou storks (Table 3). In non-human primates, *Cryptosporidium spp.* was the most prevalent in Mona monkeys, Green monkeys, and Chimpanzees. *Strongyloides spp.* was observed in Green monkeys, while Coccidian oocysts were found in Mona monkeys, Green monkeys and Chimpanzees.

Table 3: Parasites detected in various species of birds and Non-Human Primates at the University of Ibadan Zoological Garden

	Animal groups			
Avian species	*Heterakis spp.*	*Cryptosporidium spp.*	*Strongyloides spp.*	Coccidian oocysts
Vulture	-	-	-	-
Speckled Pigeon	+	-	-	+
African grey Parrot	-	-	-	+
Marabou stork		-	-	-
White goose	-	-	-	+
White stork Goose	+	+	-	+
Senegal Parrot	-	+	-	+
Non-Human Primates				
Mona Monkeys	-	+	-	+
Baboons	-	-	-	-
Green Monkeys	-	+	+	+
Chimpanzees	-	+	-	+

- = Negative, + = Positive

In felines, adult lions were positive for *Toxocara spp*. Adult lions also harboured Coccidian oocysts and *Cryptosporidium spp.* Hyaenas exhibited a broader parasite spectrum, with *Toxocara spp., Cryptosporidium spp., Capillaria spp.*, and cestodes detected. Horses were infected with *Cryptosporidium spp., Anoplocephala spp., and Strongyloides spp.*, while donkeys carried Coccidian oocysts, *Cryptosporidium spp., and Anoplocephala spp*. The camel was positive for mixed helminth infections including *Dictyocaulus spp*. (lungworm), *Dicrocoelium spp., Anoplocephala spp and Trichuris spp*. (Table 4).

Table 4: Parasites detected in Feline, Canine, Equine, Ruminants and Camels at the University of Ibadan Zoological Garden

Animals	*Toxocara spp.*	Coccidian oocysts	*Cryptosporidium spp.*	*Capillaria spp.*	*Anoplocephala spp.*	*Strongyloides spp.*	*Dictyocaulus spp.*	*Fasciola spp.*	*Taenia spp.*	*Trichuris spp.*	*Dicrocoelium spp.*
Adult Lions	+	+	+	-	-	-	-	-	-	-	-
Hyenas	+	-	+	+	-	-	-	-	+	-	-
Horses	-	-	+	-	+	+	-	-	-	-	+
Donkeys	-	+	+	-	+	-	-	-	-	-	-
Camel	-	-	-	-	+	-	+	-	-	+	+

- = Negative, + = Positive

Discussion

Gastrointestinal parasites are undoubtedly the bane of livestock and wildlife productivity and sustainability in Nigeria. This study demonstrated a high prevalence of gastrointestinal parasites among captive animals at the University of Ibadan Zoological Garden, with overall burdens of helminths at 47.5% and protozoa at 49.1%. The high prevalence observed in this research highlights captivity as a key risk factor for parasite transmission driven by confinement, environmental contamination, and possible interspecies contact [10]. It also aligns with previous reports that parasitic infections are widespread in zoological settings, particularly in tropical regions where environmental conditions favor parasite survival and transmission [11].

Carnivores exhibited the highest helminth burden (100%), particularly *Toxocara spp.* in felines and canines, reinforcing the well-established host specificity and transmission efficiency of ascarid infections in wild carnivores. Similar patterns have been reported in captive zoo carnivores, where persistent environmental contamination and feeding of raw meat contribute to sustained transmission cycles [10]. The concurrent detection of protozoa in these groups further indicates exposure to contaminated water or fomites, as protozoan cysts are environmentally resistant and are readily transmitted in captive settings. Similar studies in captive lions have reported high Toxocara prevalence linked to feeding practices involving raw meat and inadequate parasite control [12]. The presence of protozoa in these groups further indicates exposure to contaminated water or food, as protozoan cysts such as *Cryptosporidium spp.* are known for their environmental persistence [13].

In contrast, primates showed lower helminth prevalence but relatively high protozoan infection rates, supporting earlier observations that protozoan infections dominate in non-human primates under captive conditions [14] and also consistent with recent molecular studies demonstrating the predominance of protozoan parasites such as *Cryptosporidium spp.* and Giardia duodenal is in captive primate populations [15]. This pattern likely reflects faecal–oral transmission facilitated by social behavior,

enclosure sharing, and hygiene limitations. The detection of *Cryptosporidium spp.* and coccidian oocysts among several primate species is particularly important given their zoonotic potential and documented transmission between primates and humans [16]. However, the absence of detectable parasites in Baboons may reflect effective immune responses, better enclosure hygiene, or recent antiparasitic treatment.

Hoofed mammals showed a mixed parasite burden, with higher helminth prevalence (63.7%) consistent with grazing-related exposure to helminth infective stages in contaminated pastures or feeds and water. Comparable findings have been reported in zoo ungulates, where pasture contamination and the availability of intermediate hosts sustain helminth life cycles [17]. The detection of trematodes and cestodes further supports the role of environmental and ecological factors, including intermediate hosts, parasite transmission within captive systems.

Avian species exhibited lower helminth prevalence but higher protozoan burdens, indicating that protozoan infections, particularly coccidia and Cryptosporidium, dominated in birds under captive conditions. This aligns with a report showing that protozoan parasites are more prevalent in avian species due to high stocking densities, stress-induced immunosuppression, and rapid environmental dissemination of infective oocysts [18]. The widespread occurrence of coccidian oocysts across multiple bird species suggests persistent contamination of enclosures; the absence of parasites in some species may reflect species-specific resistance or lower exposure [10]. The absence of detectable parasites in some bird species may reflect species-specific resistance or differences in exposure and enclosure hygiene.

The widespread occurrence of zoonotic parasites, particularly *Cryptosporidium spp.*, underscores the public health implications of these findings. Recent molecular epidemiological study confirms the broad host range and cross-species transmission potential of Cryptosporidium in zoo settings, highlighting its importance in One Health frameworks [19]. The detection of other zoonotic helminths, including *Strongyloides spp.* and *Toxocara spp.*, further emphasises the risk of environmental contamination and human exposure, particularly for animal handlers and visitors.

Overall, the high prevalence of gastrointestinal parasites observed in this study, within a month and a half after routine deworming, indicates that the animals' enclosure is continually seeded with helminth ova. Improved parasite control strategies are needed in zoological settings. Regular faecal monitoring, strategic deworming, enhanced sanitation, and water quality management are essential to reduce infection pressure. Importantly, the presence of zoonotic parasites reinforces the need for integrated One Health approaches that consider the interconnected health of animals, humans, and the environment.

Conclusion

The study revealed a high prevalence of gastrointestinal parasites among captive animals. Carnivores showed the highest helminth infections, while birds and primates had more protozoan infections, likely due to differences in diet, hygiene, and environmental exposure. Several gastrointestinal parasites identified include *Toxocara spp., Cryptosporidium spp., Strongyloides spp., and Fasciola spp.,* indicating complex transmission dynamics, with zoonotic species posing potential public health risks. Overall, the findings reinforce the need for improved hygiene, routine parasite monitoring, and effective deworming strategies to enhance animal health and reduce public health risk.

Conflicts of interest

Authors declare no conflicts of interest exist.

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