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# Coprological survey of gastrointestinal parasitism in captive wildlife of Kanpur Zoological Park, India

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**Abstract**
Parasites cause several problems for wild animals in captivity and therefore parasitic diseases are an important concern in these animals. This study aimed to find out the prevalence of gastrointestinal parasites in captive wild animals of the Kanpur Zoological Park. The research work was conducted from September, 2016 to April, 2017. A total of 234 faecal samples were randomly collected from Zoo animals (124 samples of herbivores, 61 samples of carnivores, 45 samples of non-human primates and 4 samples of omnivores). The overall prevalence of intestinal parasitic infection in the present study was found to be 32.05% with 20.94% samples positive with helminths, 8.11% samples positive with protozoans and 2.99% samples positive with mixed Infection. A total of eight species of gastrointestinal parasites in herbivores were observed namely, amphistome (2.41%), *Fasciola* sp. (1.61%), *Trichuris* sp. (3.22%), Strongyle, *Strongyloides* sp., *Oesophagostomum* sp., *Trichostrongylus* sp. (2.41%) and *Eimeria* sp. (4.83%). Gastrointestinal parasites in carnivores were observed namely, *Ancylostoma* sp. (8.19%), *Toxocara cati* (8.19%), *Strongyloides* sp. (6.55%), *Trichuris* sp. (4.91%), *Toxocara canis* (3.27%), *Toxascaris leonina* (1.63%), *Spirometra* sp. (1.63%) and *Isospora* sp. (6.55%). *Strongyloides* sp. (13.33%) and *Eimeria* sp. (20%) were observed in non-human primates. Screening of captive wild animals at regular intervals is needed to assess the gastrointestinal parasites to alert the zoo authorities to take up proper preventive measures.

**Keywords:** captive wildlife, gastrointestinal parasitism, Kanpur zoological park

## Introduction
India has a big diversity of wildlife as well as a long history and tradition of conservation. The wildlife has significant importance in ecological balance, cleaning of the environment and scientific importance. A zoo is an ex-situ form of conservation, where wild animals are placed in cages or enclosures for the exhibition. The main purpose of Zoological Gardens is as aesthetic, educational and conservation of the wild animals [46]. Through exploitation of Park and formation of Zoological Gardens wildlife can be protected and therefore it is adapted in many parts of the world [33]. In wild conditions, animals have some natural immunity against the parasites and there is a balance between the parasite and the host and it rarely leads to harmful conditions unless stressed [11].

Parasites cause several problems for wild animals in closed enclosures and therefore parasitic diseases are an importance concern in these animals. When these wild animals are placed in enclosures in Zoological Parks, they feel stress in captivity and their immunity is reduced. Under such circumstances the problem of many diseases with parasitic infestations can occur and cause serious problems to endangered species. Due to these reasons day by day unexpected fall in a number of wild animals is going on [30]. Parasites can directly affect the host existence and reproduction through pathological effects such as tissue damage, blood loss, congenital deformities, spontaneous abortion, rarely death and indirectly affecting the physical condition by declining the host's resistance.

Control and prevention programmes for wildlife mainly depend on financial resources and public health structures, reduction of parasitic load, action on the animal reservoirs and vectors, improved diagnostic tools, environmental and ecological changes, human behaviors and education of the people that are involved in the wildlife and domestic animals chain [8]. However, strategic prevention and control programme for wild animals can be done by continuous periodic regular screening of faecal samples, periodic deworming of the animals,

decreasing the intermediate host, quarantine period for newly acquired animals and improved hygiene practices should be followed in the Zoological Parks for better health of the animals. There should also be enforced policy that visitors should not be allowed to feed animals, thus improving the health of the zoo animals from parasites [1]. Parasitic diseases can also be checked by preventing the contact between wild and domestic animals because wild animals act as a reservoir hosts for most of the parasites [15]. Keeping in view the above facts, the present study was undertaken to identify the prevelance and intensity of gastro-intestinal parasites in zoo animals of Kanpur Zoological Park.

## Materials and Methods

### Study duration and area

The present study was conducted from September, 2016 to April, 2017. The study was carried out at Kanpur Zoological Park located in Uttar Pradesh. It is located about two kilometers from the city's center and outspread in an area of 77 hectare (190 acre) of Kanpur land (coordinates: 26.502886°N 80.303643°E).

### Selection of animals

The study covered all age groups and both sexes of zoo animals found in Zoological Park, Kanpur. Herbivores, carnivores, non human primates and omnivores were selected for the study.

### Collection of samples

A total of two hundred thirty four (n=234) faecal samples were collected from Kanpur Zoological Park. Samples were collected randomly from the top of the heap of faecal mass preferably freshly voided by the animals with the help of spatula into clean sterile poly bags/collection vials with the help of caretaker of the Zoo animals, which were marked with the time, date of collection, species of animal, sex and animals cage number. The labeled samples were transported on ice to the laboratory and stored at 4-8 °C till further processing.

### Coprological examination

Samples were examined in the laboratory of the Department of Veterinary Parasitology, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar as well as in the diagnostic laboratory of Zoo and processed for qualitative and quantitative examination. The qualitative examination was done by the direct smear examination method and concentration methods using sedimentation method and floatation method [48] and quantitative examination was done with the help of Modified McMaster egg counting technique to determine egg per gram (EPG)/ cyst per gram (CPG)/oocyst per gram (OPG) of faeces as described [41]. Sporulation of coccidian species was done in a 2.5% potassium dichromate solution.

### Qualitative examination

#### a) Direct smear examination method

A small quantity of faeces was taken on a clean and grease free slide with the help of a stick. Then few drops of distilled water or normal saline solution (NSS) were added and spread in a small area to make a transluscent thin film. Then a coverslip was placed over it for uniformity of the smear. For carnivores and non-human primates, a wet smear was stained with Lugol's iodine solution then examined under compound microscope. At least three slides from different parts of the faecal samples were examined before conclusion.

#### b) Sedimentation method

A small quantity of faeces was taken in a mortar then some distilled water was added and triturated properly with the help of a pestle then strained with a tea strainer into a beaker to remove coarse faecal material. The filtrate was filled into a centrifuge tube upto two-third of the tube and centrifuged at 2000 -3000 rpm for 5-10 minutes. The supernatant was discarded and the tube was again refilled with distilled water and centrifuged 2-3 times until the supernatant was cleared. Then a drop of the sediment was taken on a clean, dry glass slide and examined under a compound microscope [48]. This method was mostly useful for the examination of eggs of trematodes and cotylodes.

#### c) Floatation method

A small number quantity of faeces was taken into a mortar then some distilled water was added and triturated properly with the help of pestle; was strained with a tea strainer into a beaker to remove coarse faecal material. The filtrate was poured into a centrifuge tube upto two-third of the tube and centrifuged at 2000-3000 rpm for 5-10 minutes. Supernatant was discarded and the tube was again refilled with distilled water and centrifuged 2-3 times until the supernatant was cleared. Then sediment was mixed with floatation fluid (saturated salt solution, specific gravity 1.18-1.20) in a centrifuge tube and again centrifuged at 1500 rpm for 1-2 minutes, then the tube was kept in erect stand and floatation fluid was added with dropper up to the brim of the tube and a coverslip was placed over it so that it touches on its surface with the fluid and was allowed to stand for 5-10 minutes. Then coverslip was gently left vertically and placed on a slide and was examined under compound microscope [48]. This method is mostly useful for the examination of eggs of nematodes and eucestodes.

### Quantitative examination

#### Modified Mc Master method

It is a quantitative method to assess the intensity of different gastrointestinal parasites and most acceptable method for epidemiological study. It is used for counting the number of eggs/cysts/oocysts per gram of faeces and helps in determining the extent of infection and effects of experimental therapy for treatment/ removal of parasites. For this study, one gram of faecal sample was weighed and triturated in a mortar with the help of pestle after adding 14 ml of floatation fluid (saturated salt solution with specific gravity 1.18-1.20) and was sieved through a tea strainer and transferred into plastic /glass test tube of 20 or 30 ml capacity and faecal suspension was uniformly mixed with the help of dropper. Then McMaster egg counting chamber of volume 0.3 ml was charged with prepared faecal suspension and allowed to settle for 30 seconds. Eggs of gastrointestinal nematodes were counted under compound microscope. The intensity of egg per gram of faeces (EPG) of each faecal sample was determined by modified Mc Master Technique [26].

### Identification of coccidian oocysts

Coccidian oocysts when passed in faeces were unsporulated and were not differentiated. Therefore, the culture of faecal sample for sporulation of coccidian oocysts is very much important for diagnosis as well as for epidemiological study.

From the collected faecal sample, a small quantity of faeces were taken in a petridish and 2.5% potassium dichromate solution was added in it and was incubated at 27 °C temperature for a day to a week to allow the development of sporocysts and sporozoites. Aeration with the help of a pasture pipette was done regularly to supply oxygen to the oocyst. A drop of the suspension was examined microscopically to check complete sporulation. After complete sporulation, the oocysts were identified based on sporocysts and sporozoites of different coccidian genera.

## Results and Discussion

A total of 234 faecal samples were randomly collected from zoo animals (124 samples of herbivores, 61 samples of carnivores, 45 samples of non-human primates and 4 samples of omnivores). The overall prevalence of intestinal parasitic infection in the present study was found to be 32.05% with 21.36% samples positive with helminths, 8.11% samples positive with protozoans and 2.56% samples positive with mixed Infection (Table 1). The overall prevalence in this study was found to be 32.05% which is in agreement with the results of Gurler *et al.* [16] and Thawait and Maiti [44] who observed overall prevalence as 32% and 32.5% respectively. Findings of the present research are higher than the reports of Gau *et al.* [10], Kathe *et al.* [21], Shibashi *et al.* [38], Singh *et al.* [40], Khan *et al.* [22] and Li *et al.* [24] who observed the prevalence as 25%, 24.5%, 24.62%, 25.70%, 15.84% and 26.51% respectively. However finding of present work is lower than the reports of Stuart *et al.* [42], Patel *et al.* [34] Kafil *et al.* [18], Wahed [47], Kanungo *et al.* [19], Barmon *et al.* [6], Mir *et al.* [27] and Aviruppola *et al.* [4] who found prevalence as 48%, 48.11%, 90.2%, 44.4%,76.2%, 69.29%, 68% and 62.9% respectively.

**Table 1:** The overall prevalence of intestinal parasitic infections among various animals in Kanpur Zoological Park

| Animals | Sample size | Helminth positive (%) | Protozoa positive (%) | Mixed infection (%) | Total Positive (%) |
|---|---|---|---|---|---|
| Carnivores | 61 | 21 (34.42) | 04 (6.55) | 02 (3.27) | 27 (44.26) |
| Herbivores | 124 | 21 (16.93) | 06 (4.83) | 04 (3.22) | 31 (25.00) |
| Non-human primates | 45 | 06 (13.33) | 09 (20.00) | 00 | 15 (33.33) |
| Omnivores | 04 | 02 (50.00) | 00 | 00 | 02 (50.00) |
| Total positive sample | 234 | 50 | 19 | 06 | 75 |
| Overall prevalence (%) | - | 21.36 | 8.11 | 2.56 | 32.05 |

For herbivore animals, 16.93% of samples collected were positive with helminths, 4.83% with protozoans and 3.22% with mixed infection (Table 1). Parasani *et al.* [33], Opara *et al.* [31] and Khan *et al.* [22] also observed similar trends but different prevalence as 45% and 21%, 58% and 16%, 34% and 15.50% infection with helminths and protozoans respectively. These differences in prevalence may be due to poor hygiene conditions, screening of faecal samples not done at a regular intervals, lack of proper anthelmintic, geographic condition in that particular area.

The prevalence of helminths, protozoans and mixed infection in carnivores was 34.42%, 6.55% and 3.27% respectively (Table 1). The prevalence of helminths infection was more than protozoans infection. Lim *et al.* [25] also observed a similar trend but different prevalence as 34.5% for helminths and 21.8% for protozoans infection. Opara *et al.* [31] noted the higher prevalence of helminths infection (82.2%) than protozoans (17.8%). In contrast to this findings, Ghoke *et al.* [12] observed a higher prevalence of protozoans (59%) in comparison to helminths (34%). These differences in prevalence may be due to geographic conditions, husbandry practices, source of feeds, method of sample collection and the use of anthelmintic in the particular Zoo animals.

In the present study 13.33% of samples in non-human primates were positive with helminths and 20% samples positive with protozoans infection (Table 1) i.e. protozoans infection were more than helminths. Similar trend but different prevalence were noted by Lim *et al.* [25] who observed higher occurrence of protozoans (35.4%) compared to helminths (19.1%). In contrast to these findings, in Belgian Zoological Park, high occurrence of helminths (36.5%) was reported than protozoans (20%) among captive non-human primates by Goossens *et al.* [14]. There is also a report conflict to present study, in a Zoological Park at Kenya where higher occurrence of helminths (64.4%) and lower occurrence of protozoans (17.1%) was found by Munene *et al.* [29].

For omnivores 50% samples were positive for helminth infection only. Out of four wild pigs, two samples were found positive for *Ascaris suum* (50%) (Table1). Similarly *Ascaris suum* (100%) was also reported in the wild boar in the study of Singh *et al.* [39]. Banerjee *et al.* [5] observed *Ascaris suum* (73.6%) in wild boar in Uttarakhand.

A total of eight species of gastrointestinal parasites in herbivores (eggs/cysts/oocysts) were observed namely, amphistome (2.41%), *Fasciola* sp. (1.61%), *Trichuris* sp. (3.22%), Strongyle, *Strongyloides* sp., *Oesophagostomum* sp., *Trichostrongylus* sp. (2.41%) and *Eimeria* sp. (4.83%) (Table 2). *Fasciola* sp. and amphistome in deers were also reported by Kanungo *et al.* [19] at Dhaka Zoological Park, Bengladesh. *Fasciola* sp.was also observed in sambar deer at Periyar Wildlife Sanctuary, Kerala by Ravindran *et al.* [37]. Rao and Acharjyo [36] also reported *Fasciola* sp. along with amphistomes at necropsy in deers at Nandankanan Zoological Park, Odisha. Incidence of amphistomes (3.65%) reported in this study is lower than reports of Islam *et al.* [17] and Banerjee *et al.* [5] who observed prevalence of amphistomes as 5% and 6.50% respectively. Varadharajan and Kandasamy [45] reported Strongyle, *Strongyloides* sp., *Trichuris* sp. and Coccidian species in the herbivores at V.O.C. Park and Mini Zoo, Coimbatore. Mixed infections were also found in case of Rhinoceros with amphistome and Strongyle and in case of Goral mixed infection with *Trichuris* sp. and *Eimeria* sp. EPG/CPG/OPG was also calculated and ranged from 50-350. The EPG/CPG/OPG was highest in *Strongyloides* (350) followed by Strongyle (300), *Eimeria sp.*(150), amphistome and *Fasciola* sp. (100) both equal and *Trichuris* sp. (50) (Table 5). The intensity of different parasites in herbivore animals was calculated and found lower than the findings of Thawait *et al.* [43] who observed intensity in the range of 100-800. It may be due to regular time to time screening of animals, good hygiene practices followed in Zoological Park, periodic deworming of the animals with suitable anthelmintics and less stress to animals because of large areas of animal house.

A total of eight species of gastrointestinal parasites in carnivores (eggs/cysts /oocysts) were observed namely, *Ancylostoma* sp. (8.19%), *Toxocara cati* (8.19%), *Strongyloides* sp. (6.55%), *Trichuris* sp. (4.91%), *Toxocara canis* (3.27%), *Toxascaris leonina* (1.63%), *Spirometra* sp. (1.63%) and *Isospora* sp. (6.55%) (Table 3). Similar gastrointestinal parasitic eggs were also observed in the study of Raja *et al.* [35] who observed *Toxocara cati*, *Spirometra* sp., *Toxascaris leonina*, *Trichuris* sp. and *Ancylostoma* sp. in the carnivore animals at Dhaka Zoo, Bangladesh. *Ancylostoma* sp., *Toxocara cati*, *Toxocara canis*, *Toxascaris leonina*, *Strongyloides* sp. were also reported in the carnivores at University Zoological Park, South West Nigeria by Adeniyi *et al.* [2]. *Toxascaris leonina* was also found in Royal Bengal Tiger from Lucknow and Delhi Zoological Park by Chauhan *et al.* [7] Lucknow and in Kanpur Zoological Park by Gaur *et al.* [11]. In the present studies EPG/CPG/OPG were also determined and ranged from 100-600. The EPG/CPG/OPG was highest in case of *Toxocara cati* and *Strongyloides* sp. (600) followed by *Ancylostoma* sp. (400), *Isospora* sp.(300), *Spirometra* sp. (250), *Toxocara canis* and *Toxascaris leonina* (200) and *Trichuris* sp. (100) (Table 5). The intensity of different parasites in carnivore animals were calculated and found lower than the findings of Thawait *et al.* [43] who observed EPG/CPG/OPG in range of 100-800. It may be due to good managemental conditions, diagnostic tools, proper deworming of the animals and survivability of parasites in this region.

**Table 2:** Prevalence of parasitic infection in herbivore animals

| Animals | Total animals | Sample collected | Positive Sample (%) | Parasite observed | | | | | | | | Mixed infection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Fasciola* sp. | Amphistome | Strongyle | *Strongyloides* sp. | *Trichostrongylus* sp. | *Oesophagostomum* sp. | *Trichuris* sp. | *Eimeria* sp. | |
| Rhinoceros | 04 | 03 | 03 (100) | - | 01 | - | - | - | - | - | - | 01 |
| | | | | - | - | 01 | - | - | - | - | - | |
| | | | | - | 01 | 01 | - | - | - | - | - | |
| Hippopotamus | 06 | 05 | 00 | - | - | - | - | - | - | - | - | - |
| Thamin deer | 15 | 13 | 00(00) | - | - | - | - | - | - | - | - | - |
| Swamp deer | 22 | 19 | 00(00) | - | - | - | - | - | - | - | - | - |
| Black buck | 32 | 27 | 06(22.22) | - | - | - | 03 | - | - | 03 | - | - |
| Sambar deer | 15 | 13 | 05(38.46) | 02 | - | - | - | - | 03 | - | - | - |
| Chou singha | 02 | 02 | 00(00) | - | - | - | - | - | - | - | - | - |
| Sikka deer | 02 | 02 | 00(00) | - | - | - | - | - | - | - | - | - |
| Barking deer | 07 | 05 | 03(60) | - | - | - | - | 03 | - | - | - | - |
| Spotted deer | 15 | 13 | 01(7.69) | - | - | - | - | - | - | - | 01 | - |
| Hog deer | 15 | 13 | 00(00) | - | - | - | - | - | - | - | - | - |
| Himalayan goral | 04 | 03 | 03(100) | - | - | - | - | - | - | 01 | 01 | 01 |
| | | | | - | - | - | - | - | - | - | 02 | |
| Nilgai | 07 | 05 | 02(40) | - | - | - | - | - | - | - | 02 | - |
| Zebra | 01 | 01 | 01(100) | - | 01 | 01 | - | - | - | - | - | 01 |
| Total | 147 | 124 | 24 | 02 | 03 | 03 | 03 | 03 | 03 | 04 | 06 | 03 |
| Prevalence (%) | - | - | 19.35 | 1.61 | 2.41 | 2.41 | 2.41 | 2.41 | 2.41 | 3.22 | 4.83 | 2.41 |

**Table 3:** Prevalence of parasitic infection in carnivore animals

| Animals | Total animals | Sample collected | Positive Sample (%) | Parasites observed | | | | | | | | Mixed infection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Toxocara cati* | *Toxocara canis* | *Toxascaris leonine* | *Spirometra* sp. | *Strongyloides* sp. | *Trichuris* sp. | *Ancylostoma sp.* | Coccidia | |
| Tiger | 07 | 06 | 02 (33.33) | - | - | 01 | - | - | - | 01 | - | 01 |
| | | | | - | - | - | - | 01 | - | - | - | |
| Leopard | 10 | 08 | 06 (75) | 03 | - | - | - | 03 | - | - | - | - |
| Striped Hyena | 13 | 11 | 02 (18.18) | - | 02 | - | - | - | - | - | - | - |
| Jackal | 06 | 05 | 02(40) | - | - | - | - | - | - | - | 02 | - |
| Fox | 04 | 03 | 00 | - | - | - | - | - | - | - | - | - |
| Palm Civet | 04 | 03 | 01 (33.33) | - | - | - | 01 | - | - | 01 | - | 01 |
| Jungle Cat | 04 | 03 | 02 (66.66) | 02 | - | - | - | - | - | - | - | - |
| Leopard Cat | 04 | 03 | 02 (66.66) | - | - | - | - | - | - | - | 02 | - |
| Porcupine | 14 | 12 | 04 (33.33) | - | - | - | - | - | 03 | 01 | - | - |
| Himalayan Black Bear | 05 | 05 | 02 (40) | - | - | - | - | - | - | 02 | - | - |
| Sloth bear | 02 | 02 | 00 | - | - | - | - | - | - | - | - | - |
| Total | 73 | 61 | 23 | 05 | 02 | 01 | 01 | 04 | 03 | 05 | 04 | 02 |
| Prevalence (%) | - | - | 37.70 | 8.19 | 3.27 | 1.63 | 1.63 | 6.55 | 4.91 | 8.19 | 6.55 | 3.27 |

A total of two species of gastrointestinal parasites in non-human primates (eggs/cysts/oocysts) were recovered namely, *Strongyloides* sp. (13.33%) and *Eimeria* sp. (20%) (Table 4). Varadharajan and Kandasamy [45] also observed the *Strongyloides* sp. in non-human primates at V.O.C. Park and Mini Zoo, Coimbatore. Singh *et al.* [39] also reported the *Strongyloides* sp. in langur at Mechendra Choudhury Zoological Park, Chhat Bir, Punjab. EPG/CPG/OPG were also calculated and ranged from 200-350. The highest EPG/CPG/OPG was counted in the case of *Eimeria* sp. (350) followed by *Strongyloides* sp. (200) (Table 5). The intensity of different parasites in non-human primates was calculated and found lower than the findings of Singh *et al.* [39] who observed intensity in the range of 100-7500. It may be due to good hygiene conditions in Zoological Park, regular screening of faecal samples, proper and periodic deworming of animals, and deworming with different salts of anthelmintic to prevent resistance problems.

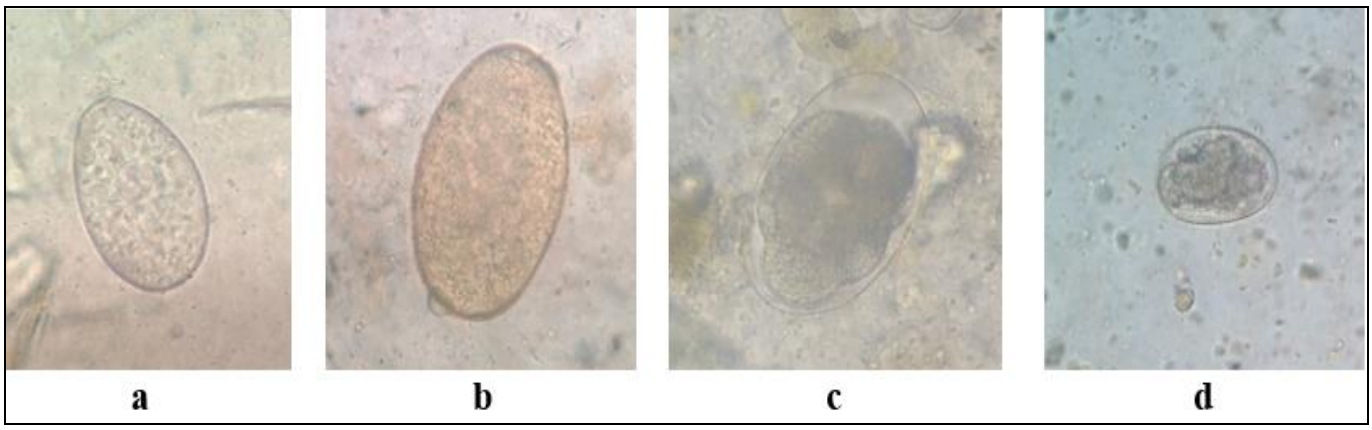
**Table 4:** Prevalence of parasitic infection in non-human primates

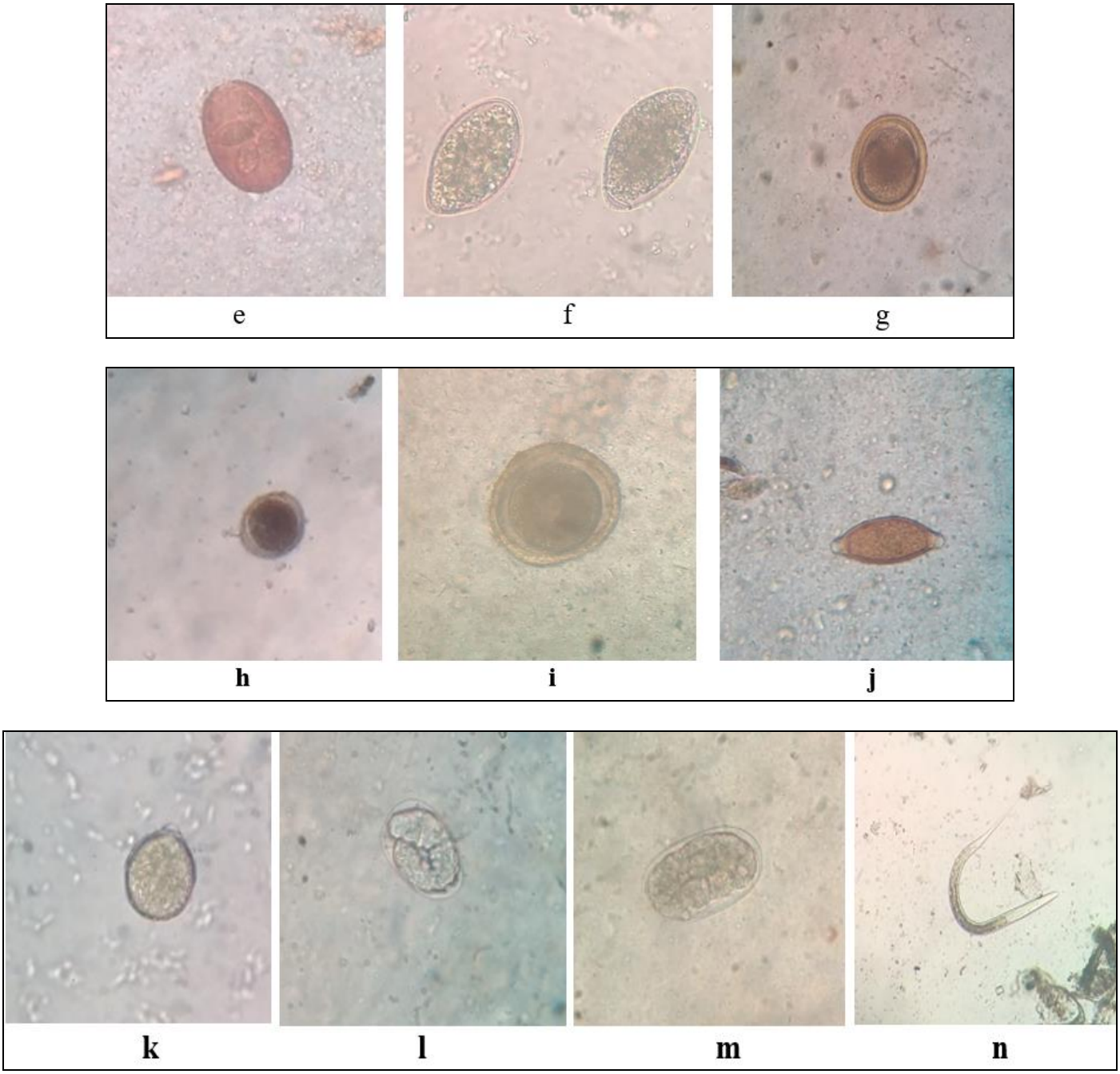
| Animals | Total animals | Sample examined | Positive sample (%) | Parasites observed *Strongyloides* sp. *Eimeria*sp. | | Mixed infection |
|---|---|---|---|---|---|---|
| Langur | 15 | 13 | 07(53.84) | 04 | 03 | - |
| Rhesus monkey | 25 | 23 | 04(17.39) | 02 | 02 | - |
| Bonnet monkey | 07 | 05 | 00 | - | - | - |
| Capuchin monkey | 02 | 02 | 02(100) | - | 02 | - |
| White throated Capuchin monkey | 02 | 02 | 02(100) | - | 02 | - |
| Total | 51 | 45 | 15 | 06 | 09 | 00 |
| Prevalence (%) | - | - | 33.33 | 13.33 | 20.00 | - |

The intensive husbandry of animals in Zoological Park may be one of the reasons for the parasitic infestation in Zoological Park. High density of animals in enclosures and their close contact with other species of animals provides opportunity for transmission of parasites [28]. Enclosures of Zoo animals make the animals more susceptible to different parasites due to stress conditions [20]. Some of the nematodes and protozoan parasites have direct life cycle i.e. without the involvement of intermediate hosts. They are transmitted by feco-oral route through contaminated feed, soil and water and are able to accumulate in that environment [43]. Since parasites observed in this study have direct life cycle and can ability to survive in the environment, there is high possibility of environmental contamination as the reason for higher parasitic prevalence [9, 13, 23,]. As wild animals in Zoological Parks are kept in closed enclosures, there are low chance of access to the intermediate hosts of trematodes and cestodes, and therefore there is low occurrence of infestation with trematodes and cestodes in Zoo animals. Zoo workers may play a role in transmission of many parasites by acting as vehicles for transmitting the different stages of parasites through their hands, clothes, shoes or with working tools contaminated with infected parasites [3, 32]. Wild animals under natural conditions usually tolerate wide range of various infectious agents like bacteria, viruses and gastrointestinal parasites from time to time yet death or epizootics are rarely seen in these animals [5]. However wild animals kept in captivity may die sometimes due to these infectious parasites as their immunity is reduced due to stress conditions.

**Table 5:** Intensity of different gastrointestinal parasites among various animals

| Order | Name of Parasite | Intensity (EPG/CPG/OPG) |
|---|---|---|
| Herbivores | *Trichuris* sp. | 50 |
| | Amphistome | 100 |
| | *Fasciola* sp. | 100 |
| | *Eimeria* sp. | 150 |
| | Strongyle | 300 |
| | *Strongyloides* sp. | 350 |
| Carnivores | *Trichuris* sp. | 100 |
| | *Toxascaris leonine* | 200 |
| | *Toxocara canis* | 200 |
| | *Spirometra* sp. | 250 |
| | Coccidian oocyst | 300 |
| | Hookworm | 400 |
| | *Strongyloides* sp. | 600 |
| | *Toxocara cati* | 600 |
| Non human primates | *Strongyloides* sp. | 200 |
| | *Eimeria* sp. | 350 |
| Omnivores | *Ascaris suum* | 100 |






**a)** Egg of Amphistome of Rhinoceros (10x), **b)** Egg of *Fasciola* sp. of Sambar deer (10x), **c)** Egg of Strongyle of Zebra (40x), **d)** Egg of Strongyle of Rhinoceros (40x), **e)** Sporulated oocyst of *Eimeria* sp. of Goral (40x) **f)** Egg of *Spirometra* sp. of Civet (40x), **g)** Egg of *Toxocara cati* of Leopard (40x), **h)** Egg of *Toxocara cati* of Wild cat (10x), **i)** Egg of *Toxocara canis* of Hyena (40x), **j)** Egg of *Trichuris* sp. of Porcupine (40x), **k)** Unsporulated Coccidian oocyst of Rhesus monkey (40x), **l)** Egg of *Strongyloides* sp. of Langur (40x), **m)** Egg of *Ancylostoma* sp. of Porcupine (40x), **n)** *Oesophagostomum* sp. larvae of Sambar deer (40x)

**Fig 1:** Images of eggs/oocysts/larvae of gastrointestinal parasites found during microscopic examination

## Conclusion

From the results of present investigation, it can be concluded that gastrointestinal helminth parasites are more prevalent than protozoa in animals of Zoological Park, Kanpur. The result of present study suggest that regular screening of faecal samples of zoo animals is required for qualitative and quantitative estimation of parasitic load of these animals. In this way proper diagnosis of parasitic infestation will help in saving ill effects of these parasites in zoo animals. Along with its, it is important to take better prevention and control measures to reduce the environmental contamination with these gastrointestinal parasites. Proper management, routine monitoring of parasitic infestations, treatment of the affected animals and the use of specific anthelmintics can greatly help for the control of gastrointestinal parasitic infections in zoological parks. It is further suggested that a long term epidemiological study of parasitic infection is needed so as to understand the parasitism and prevent possible recurrence of existing infection in zoo animals. There is also need to investigate the prevalence of vectors and intermediate hosts. Such studies will provide a clear concept of parasitic infection in zoo animals there by help in proper prevention and treatment of parasitic infections in zoo animals.

Therefore, a detailed study related to parasites of zoo animals should be carried out to get a clear picture of parasitism in India. There is need for identification of parasites and diagnosis of parasitic diseases using molecular techniques and pathophysiology of different helminth species.

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