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Intestinal parasitic infection in wild animals of a zoological garden in Alborz, Iran

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ABSTRACT

Here we studied the intestinal parasites in animals at a zoological garden in Alborz, Iran. A total of 83 fecal samples from various captive wild animals, consisting of 21 different species were collected randomly and analyzed for the presence of the different stages of parasites by direct smear preparation and zinc sulfate flotation followed by Ziel-Neelsen staining method. The examined animals in this study consist of 7 species of carnivores (26 samples), 10 species of herbivores (46 samples), and 4 species of different groups of birds (11 samples). Examination of fecal samples revealed that 22 (26.50%) of animals, that belonging to 7 animal species, were infected with different intestinal parasites. Among gastrointestinal parasites positive captive wild animals 18 samples (21.68 %) belong to herbivores and 4 samples (4.81 %) to Aves. Among captive wild animals the prevalence of parasites was higher in herbivores (21.68%) followed by Aves (4.81). Results indicated that out of 22 animal samples that parasites were encountered, 14 (16.86%) were infected with helminths (Trichuris spp., *Nematodirus* spp., *Ascaridia galli* and some unknown Nematodes eggs) and 8 (9.63%) were infected with protozoa (Oocysts of *Eimeria* sp.). In the conclusion, it could be resulted that there is a need of control measures against the spread of infectious parasitic diseases among animals within the zoo.

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Introduction

Zoos are places where a great number of valuable animal species are put together taken out of their natural habitats (Panayotova-Pencheva, 2013) and these Zoological collections are represented with exotic animal species which would never or rarely meet certain parasites amongst natural circumstances. Keepers may play the role of mechanical vector of parasites and improper feeding systems can encourage the parasite infection. Parasite control, due to the specific nature of zoological collection, is one of the pillars of preventive health care of zoo animals (Kvapil et al., 2017).

Browsing animals forced to graze or pick up food from the ground are at a greater risk of infection with geohelminths. Serious cases of parasite infection may then arise if a parasite is introduced in a new environment where fully susceptible suitable hosts are available (Borgsteede, 1996).The same situation

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applies to wild animals in captivity, which are normally kept in the same enclosure for prolonged periods of time, with space limitations and under constant stress, leading to immunosuppression and consequent higher susceptibility to parasitic infection (Mir et al., 2016).

In addition, as zoos are institutions which are opened to the public, close contact with humans ,which would not happen in the natural environment of the captive animals, rises the risk of development of anthropozoonosis (Panayotova-Pencheva, 2013). This significantly augments the risk of spreading the parasitic zoonoses posing a threat to the health of the animals themselves, the personal of the zoos and of course to the visitors (Panayotova-Pencheva, 2013). Some studies have revealed that gastrointestinal parasites of wild animals in captivity include zoonotic species to humans and raise public health concerns (Adejinmi & Ayinmode, 2008; Ajibade et al., 2010; Akinboye et al., 2010; Levecke et al., 2007; Opara et al., 2010; Otegbade & Morenikeji, 2014).

Regular coprological examinations seem to be an efficient tool to control the parasite burden in most of the animals, especially in wild animals that were kept in captivity conditions. By using a system of preventive and therapeutic means, parasitic infections in zoos are reduced to a minimum ,but the absence of the natural biological balance due to the artificial amassment of various animals in one and the same location can also result in development of parasites in such animals which normally are not specific host to them (Panayotova-Pencheva, 2013).

Previously, we carried out a survey to establish the gastrointestinal parasites profile in animals at the Eram zoological garden in Tehran, Iran, that according to our study, examination of fecal samples revealed that 24 (16.7 %) of animals were infected with intestinal parasites. Out of 24 parasites encountered, 10 (41.6 %) and 14 (58.4 %) were helminths and protozoa respectively. Cryptosporidium spp. infection was detected in 6 (4.1 %) of samples (Nasiri et al., 2017).

In a recently published study (Kiani et al., 2018), one hundred fresh fecal samples were collected from 35 species of animal lived in Eram park zoo, Tehran, Central Iran during Oct 2015 to Jun 2015. 65.7% (23/35) of zoo animal species were infected with intestinal parasites. The superfamily *Trichostrongyloidea* (6/16) and *Strongylus* sp. (16/4) were the most prevalent helminthic infections, while *Blastocystis* sp. (6/14), *Entamoeba cyst* (3/14) and Eimeria sp. (3/14) were the common protozoan parasites. For the first time, *Bivitellobilharzia nairi* egg was identified an elephant at Iran. They indicated that intestinal parasitic infections were apparently circulating among animals of the Eram park zoo (Kiani et al., 2018).

To have a better understanding about the prevalence of the parasites those affecting zoo animals, the present study was carried out to establish the gastrointestinal parasite profile of the captive wild animals of a central zoological garden in Alborz, Iran.

Materials and Methods

Animals Sample Collection and Study site: The zoological garden of this study is one of the zoological gardens in Iran with different numbers of wild animal species. Between May and August 2018, freshly faecal samples were collected from 83 zoo animals representing 21 different species. Animals were classified into herbivorous, carnivores and aves. Information about the examined animals was obtained from zoo labels on the cages of each species. When it was possible and where animals kept separately in cages, the samples were collected individually, but where animals kept in the groups in a cage, samples were collected randomly from each cage. All samples were labeled with related animal species and were collected in 50 ml clean vials and then transported to the Parasitology Laboratory of Razi Vaccine and Serum Research Institute and were stored at +4◦C immediately upon arrival.

The laboratory procedures and techniques: Samples were examined macroscopically, to verify the presence of nematodes, cestodes, and/or fragments of parasites, and then were processed by qualitative methods of faecal sample examination. All samples were examined by direct wet mount preparation, formalin ethyl acetate concentration, zinc sulfate flotation and Ziehl Neelsen stain technique within 24 hours of collection. Slides were microscopically screened at 100x ,400x and 1000x magnification and detected parasites were identified by their morphometric characteristics as mentioned in references (Bowman, 2014; Soulsby, 1982; Yamaguti, 1961; Zajac & Conboy, 2012). Collected parasites were deposited in the Museum of Parasitology Department, Razi Vaccine and Serum Research Institute, Karaj, Alborz, Iran.

Ethics Statement: This research was carried out accordance with the recommendations in the Guide for the Care and Use of Laboratory Animals of the Razi Vaccine and Serum Research Institute and all animals experiments were approved by Institutional Animal Care and Research Advisory Committee of the Razi. Vaccine and Serum Research Institute based on the Specific National Ethical Guidelines for Biomedical Research issued by the Research and Technology Deputy of Ministry of Health and Medicinal Education of Iran.

Results

A total of 83 fecal samples from various captive wild animals, consisting of 21 different species were collected randomly and analyzed for the presence of the different kinds and stages of parasites. Scientific and common names of zoo animals that were sampled are listed in Tables 1, 2 and 3. Data showed that the examined animals were consist of 7 species of carnivores (26 samples), 10 species of herbivores (46 samples), and 4 species of different groups of birds (11 samples) that were listed in Table 4. Examination of fecal samples revealed that 22 (26.50 %) of animals, that belonging to 7 animal species, were infected with different intestinal parasites. Table 5 presents the list of detected gastrointestinal parasites according to the captive wild animals' species in this research. Among gastrointestinal parasites positive captive wild animals, 18 samples (21.68 %) belong to herbivores (Figure 1-4) and 4 samples (4.81 %) belong to Aves (Figure 5-6). Types, numbers and percentages of different species of parasites indicated in table 6. Among captive wild animals the prevalence of

Table1. The taxonomic characterization of 7 species of examined carnivores.

Scientific Name	Common name	Number of examined carnivores
Panthera leo	African lion	5
Hyaena hyaena	Striped hyena	2
Procyon lotor	Raccoon	3
Ursus arctos	Brown bear	5
Felis chaus	Jungle cat	4
Lynx lynx	Black eared	4
Canis lupus familiaris	Siberian husky	3
Total	7 Species	26

Table 2. The taxonomic characterization of 10 species of examined herbivores

Scientific Name	Common name	Number of examined animals
Lama glama	Llama	8
Equus hemionus onager	Asiatic wild ass (onager)	5
Camelus ferus	Wild Bactrian camel	4
Cervus elaphus maral	Maral or red deer	5
Dama dama	Fallow deer	4
Equus ferus caballus	Horse	5
Equus ferus caballus	Falabella miniature horse	2
Ovis orientalis	Wild sheep	4
Capra aegagrus	Wild goat	5
Gazella subgutturosa	Goitered gazelle or Persian gazelle	4
Total	10 Species	46

Table 3. The taxonomic characterization of 4 species of different groups of examined birds.

Scientific name	***Common name***	***Number of examined bird***
Struthio camelus	*Ostrich*	2
Pavo cristatus	*Tavous*	5
Alectoris chukar (Perdicinae)	*Kabk*	3
Aquila chrysaetos	*Golden Eagle*	1
Total	4 Species	11

Table 4. The type, species and number of examined and positive animals.

Animal types	Number of species	Number of animals	Number of positive animals	Percentage ofpositive animals
Carnivores	7	26	0	0 %
Herbivores	10	46	18	21.68 %
Aves	4	11	4	4.81 %
Total	21	83	22	26.50 %

Table 5. Positive number and percentage of different species of examined animals

Scientific name of animals	Number of examined animals	Number of positive animals	Detected parasite with number of infected animals	Percentage of positive animals (in species/in all)
Ovis orientalis	4	4	Oocysts of *Eimeria* sp.	100 (4.81)
Capra aegagrus	5	4	Oocysts of *Eimeria* sp.	80 (4.81)
Lama glama	8	2	*Trichuris* spp. egg (1) *Nematodirus* spp. egg (1)	25 (2.40)
Camelus ferus	4	3	*Nematode eggs*	75 (3.61)
Equus ferus caballus	5	5	*Nematode eggs and Larvae*	100 (6.02)
Pavo cristatus	5	2	*Nematode eggs*	40 (2.40)
Alectoris chukar	3	2	*Ascaridia galli*	66.66 (2.40)
Total	34	22		64.70 (26.50)

parasites was higher in herbivores (21.68 %) followed by Aves (4.81). Results indicated that out of 22 animal samples that parasites were encountered, 14 (16.86%) were infected with helminths and 8 (9.63 %) were infected with protozoa (Table 6).

Table 6. Types and numbers of different species of parasites.

Kinds of parasites	Type of Detected parasites	Number(percentage) of positive animals
Protozoa	*Eimeria* spp.	8 (9.63)
Helminthes	*Nematodes* spp. eggs	14 (16.87)
All parasites	*Total*	22 (26.50)

Discussion

Although wild animals are usually infected with several species of parasites, but, natural resistance against parasitic diseases and a state of equilibrium between host and parasite generally prevent the development of clinical disease, unless in stress conditions (Mir et al., 2016).

Figure 1. The detected *Nematodirus* spp. eggs from *Lama glama* (Lama) (×400 magnification).

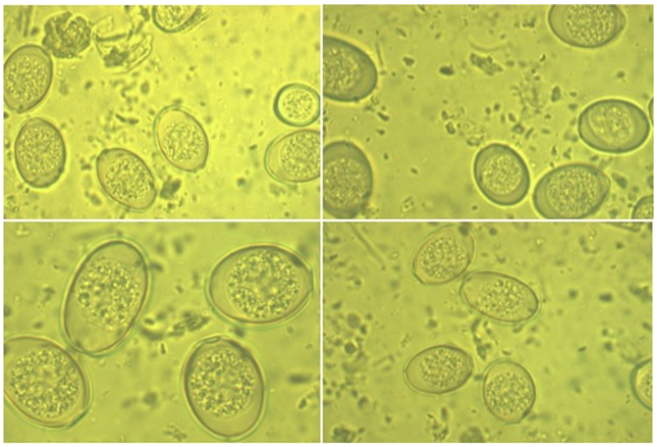

Figure 2. The detected Eimeria sp. from *Capra aegagrus* (Wild goat) (×1000 magnification)

In the present research, wild animal species in a national park of Alborz province were investigated for

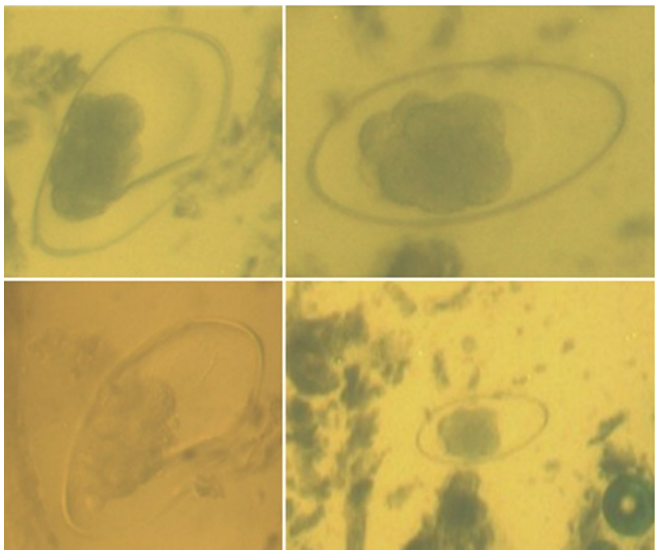

Figure 3. The detected *Nematodirus* spp. eggs from *Camelus ferus* (Wild Bactrian camel) (×1000 magnification).

gastrointestinal parasites by examination of faecal samples. The overall prevalence of these parasites in the animals at zoological garden, showed an infection rate of 26.50 %. The prevalence of gastrointestinal helminths (16.86 %) were almost higher than protozoans (9.63 %) and the gastrointestinal helminths comprised mainly of nematodes that this finding agrees with the reports of other researchers that nematodes were responsible for most of the helminthic diseases of veterinary importance, because they don't need intermediate hosts (Otegbade & Morenikeji, 2014). All the parasites genus identified in this research have previously been identified and described in captive wild animals by other authors (Lim et al., 2008).

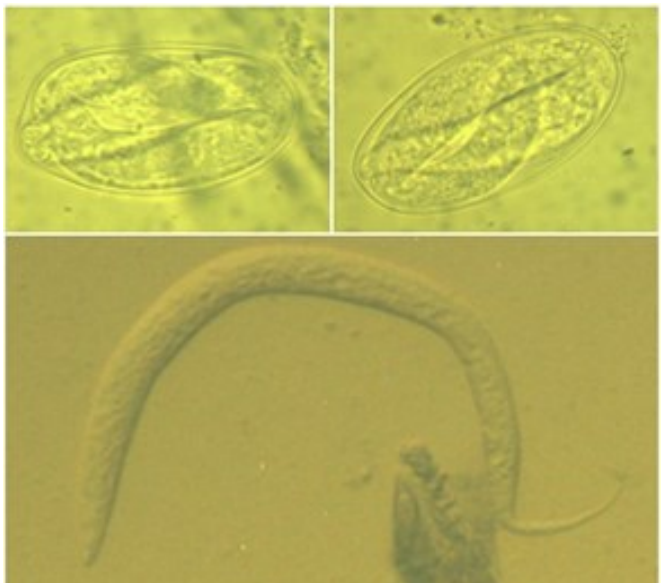

Figure 4. The detected Nematode larvae and eggs from Equus ferus caballus (horse)(×1000 magnification).

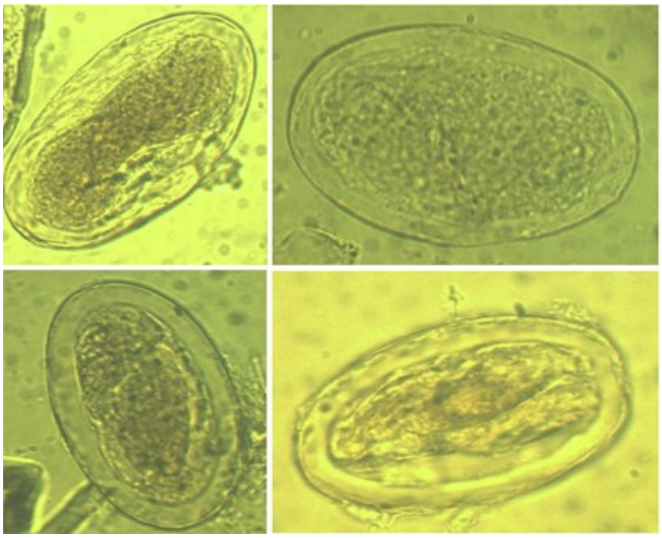

Figure 5. The detected nematode eggs from *Pavo cristatus* (Tavous) (×1000 magnification).

According to previous researches, as animal were apparently healthy during the period of examination and there was no reported mortality and clinical signs, the observed prevalence indicates probable subclinical infection, which may flare up under stress conditions and can cause pathogenicity (Mir et al., 2016). Based on the prevalence of gastrointestinal parasites and by administration of desired anti helminthic drugs to the captive wild animals periodically that coupled with better sanitary measures, we would be able to reduce the parasitic infection in the zoos (Thawait et al., 2014). The Parasitic prevalence survey is a way of monitoring the impact on the health and maintenance of wild animals' population (Allwin, 2015), and the prevalence of gastrointestinal parasites recorded in the wild animals in this study shows the need to design and implement a control program for parasite elimination.

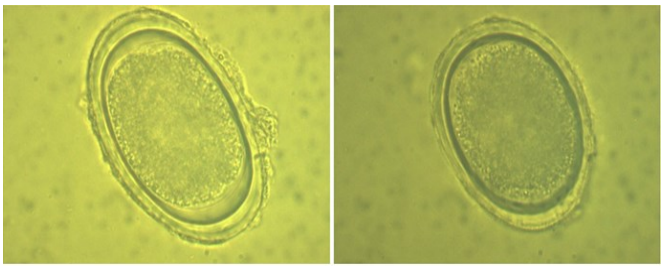

Figure 6. The detected *Ascaridia galli* eggs from *Alectoris chukar* (Perdicinae) (×1000 magnification).

Conclusions

In conclusion, the findings of this study reported that both protozoan and helminth gastrointestinal parasites are prevalent in the wild animals of this zoo that they can serve as potential reservoirs of some zoonotic parasite for transmission to humans. It should pay attention that among husbandry procedures and diseases preventive measures, the routine monitoring of parasitic diseases and the use of selective treatments can represent crucial measures for the control of gastrointestinal parasitic infections in zoological gardens. The high prevalence of gastrointestinal parasites found in zoo animals examined in this study emphasizes the importance of controlling these parasitic diseases in order to keep animals, especially in the case of endangered species, in healthy conditions and prevent probable infection of humans working with these animals to zoonotic parasites.

Conflict of interest statement

We declare that we have no conflict of interest.

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