A new species of Eimeria with notes on previously known species collected in horses from Iran

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Short Report

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Abstract

Background

We conducted a cross-sectional study of indigenous breeds of horses from the north and northeast of Iran to establish the prevalence and distribution of *Eimeria* species.

Material and Methods

340 fecal samples from randomly selected horses (141 from the north of Iran and 199 from the northeast of Iran) were examined for *Eimeria* oocyst using standard coprological techniques.

Results

Out of 340 samples, only 3 from north Iran were positive for coccidiosis. Two infections occurred by *E. leuckarti* species, and one infection happened by *E. uninugulata*. The mean intensity of oocyst output (3–38 o.p.g.) was very low. No clinical signs of gastrointestinal disorder were noticed in any horses during this study.

Conclusion

This study reports for the first time on the prevalence of *E. uninugulata* in horses from farms in North Iran. A more comprehensive study in different rural areas of Iran would be advantageous to develop a better understanding of the molecular identification and characterization of *Eimeria* species and strengthen the knowledge we currently have.

1. Introduction

Coccidiosis in equids is caused by protozoa of the genera *Eimeria* that infect the intestinal tract (Sazmand et al., 2020). Three species of *Eimeria* are capable of infecting horses; *E. uninugulata*, *E. solipedum*, and *Eimeria leuckarti* (Dubey & Bauer, 2018). Although three species of *Eimeria* were characterized by horses, only *E. leuckarti* is a valid species infecting equids, including horses, donkeys, and zebra (De Souza et al., 2009). There is a prepatent period of 16–35 days for protozoal infection. As a result of consuming contaminated water or food containing sporulated oocysts, infection occurs (Fletcher et al., 2012). Sporozoites emerge from the oocysts after undergoing excysts due to bile exposure in the small intestine (Dubey et al., 2019). The oocysts shed as the final product of the sexual reproduction cycle infects new hosts through their faeces (Tympnopoulou et al., 2021). There is a greater prevalence of infections in foals aged 30–125 days in comparison to adults (Bianchi et al., 2019; Ola-Fadunsin et al., 2019).
There are some cases of *Eimeria* that are located throughout the villus, but they are typically located in enterocytes that are displaced in the lamina propria (Yun et al., 2000). In immunohistochemistry studies, it has been proven that the parasitized host cell is an enterocyte, not a vascular or mesenchymal cell (Bundina & Khrustalev, 2016). There may be erosions or ulcers on the villi, which may be atrophic (Hirayama et al., 2002). An eosinophilic infiltration is often observed with this infection; however, it is unclear whether it is specific to *E. leuckarti* or whether it is part of a helminth infection that is concomitant with this infection (Gülegen et al., 2016). In addition, there are also cases of hemorrhagic lesions accompanied by mild or severe mononuclear cell infiltrations.

In addition to being a universal disease, coccidiosis is most commonly seen in horses that are kept in small, oocyst-contaminated areas. There are few reports on eimeriosis in equids in Iran, with infection rates of 0.5–57.14% in horses and 7.7% in donkeys (Sazmand et al., 2020; Tavassoli et al., 2010). However, due to the lack of adequate research in the north and northeast of Iran, no comprehensive study explores these parasites. Hence, the current study aimed to determine the prevalence of *Eimeria* in equines in the study area, identifying the most common species and the intensity of faecal oocyst output.

2. Methods And Materials

2.1. Study area

The study was conducted from October 2021 to July 2022 in two different climatic areas in Iran. The first region was Mashhad, the capital city of Khorasan Razavi in northeast Iran. Mashhad is located in the northeast of Iran, geographically located at 36°20' north latitude and 59°35' east longitude. Mashhad lies in the altitudinal range of 995 meters above sea level, and its weather condition is cold, covering an area of 328 km². Mashhad features a cold semi-arid climate with hot summers and cold winters. The city only sees about 250 millimeters (9.8 inches) of precipitation per year, some of which occasionally falls in the form of snow.

The second region was Babol, one of the most important cities in the north of Iran, between the northern slopes of the Alborz coast of the Mountains and the southern Caspian Sea. The city is approximately 20 kilometers south of the Caspian Sea on the west bank of the Babolrud River and receives abundant annual rainfall. Babol has a humid subtropical climate that borders on a Mediterranean climate.

2.2. Study Animals and Design

To determine Eimeria prevalence and potential risk factors, coprological examinations were conducted on 340 randomly selected indigenous breeds of horses. Out of 340 stool samples, 199 were taken from Mashhad, and 141 were taken from Babol.

After the samples were collected from the selected site, they have transported to the Ferdowsi University of Mashhad parasitology laboratory for further examination and analysis. Flotation techniques were used
to examine fecal samples, and oocysts per gram (OPG) were quantified at 10x and 40x magnifications using a modified McMaster standard.

3. Results

Out of 340 samples, only 3 from north Iran were positive for coccidiosis. 2 infections occurred by *E. leuckarti* species, and one infection happened by *E. uninugulata*, which is the first report of this species in Iran. The mean intensity of oocyst output (3–38 o.p.g.) was very low. No clinical signs of gastrointestinal disorder were noticed in any horses during this study.

In the majority of the cases, no clinical signs are documented in the animals excreting *E. leuckarti* oocysts. These findings are supported by our observation revealing only a few foals with temporary diarrhea.

The size of *Eimeria leuckarti* was estimated 55 x 38µm and *Eimeria uninugulata* was 17 x 13µm

4. Discussion

In this study, the protozoan *E. leuckarti* was observed in two cases of the studied horses from north Iran. Ahmadi et al. have reported four *E. leuckarti*-infected samples in Shahrekord district horses (Karimi ghahfarrokhi et al., 2014). According to the results of this study and the study conducted in the Shahrekord region, it can be concluded that *E. leuckarti* exists in Iranian horses with a low prevalence. There have been reports of *E. Leuckarti* parasites on horses in North America and other parts of the world, but they are ubiquitous protozoal parasites (Attia et al., 2018; Jenkins et al., 2020; Jota Baptista et al., 2021). As a result of a survey conducted on Kentucky horse farms, 41% of foals examined were found to have an oocyst, and 85% of farms had foals with an oocyst, according to the survey (Lyons & Tolliver, 2004; Lyons et al., 2006). Studzinska et al. reported 9.18% *E. leuckarti* in Poland (Studzińska et al., 2008), and Gülegen et al. reported 2.9% *E. leuckarti* in Turkey (Gülegen et al., 2016). Also, a species of *E. uninugulata* was observed in one sample (0.29%) of horses from the north region, which was reported for the first time from horses in Iran. This species has already been reported in the Soviet Union, Tajikistan, Uzbekistan, and Turkey (Dubey & Bauer, 2018).

The protozoan parasites of the genus *Eimeria* multiply in the intestinal tract and cause tissue damage, with resulting interruption of feeding and digestive processes or nutrient absorption; dehydration; blood loss; and increased susceptibility to other disease agents (Blake et al., 2020; Gajadhar et al., 2015; Gutiérrez-Expósito et al., 2017). The disease may be mild, resulting from the ingestion of a few oocysts, and may escape notice, or it may be severe as a result of the ingestion of millions of oocysts (Kompi et al., 2021). Like many parasitic diseases, coccidiosis is largely a disease of young animals because immunity quickly develops after exposure and gives protection against later disease outbreaks (Abbas et al., 2019).
Despite the lower prevalence of coccidian disease in horses, sporadic clinical cases and deaths are still possible, especially in young foals starting to wean (Mulwa et al., 2020). Compared to other animals, it is much less common for horses to be affected by clinical \textit{leuckarti} than in other species. However, clinical cases and deaths occur from time to time, especially in foals just recently weaned from their mothers (Kalef, 2015). Regardless of which type of facility the horses are kept in, coccidiosis can strike any type of horses (dos Santos et al., 2014). Despite the fact that there is some doubt about the pathogenicity of \textit{E. leuckarti} in horses, it has been described in foals and young horses to exhibit diarrhea lasting several days and to develop an acute massive intestinal hemorrhage leading to rapid death from the disease (Kornaś et al., 2011; Marinković et al., 2013).

Based on the results of the present study, it can be concluded that some examined horses in northern Iran are suffering from subclinical coccidiosis and are infected with different \textit{Eimeria} species. While none of the horses had clinical signs of coccidiosis, there was evidence of subclinical contamination with coccidiosis in the herd. Thus, more research needs to be carried out on this subject in local rural areas in Iran, and pay greater attention to the molecular identification and characterization of the species of \textit{Eimeria} found there. Based on these results, Iran can develop a strategy to control the disease based on relevant data that will provide a solid foundation.

\textbf{Declarations}

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\textbf{Conflict of interests:}

The authors declare no conflict of interest.

\textbf{Data availability:}

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

\textbf{Ethical approval:} All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

\textbf{Author contribution}
Conceptualization: [Hassan Borji], …; Methodology: [All Authors], …; Formal analysis and investigation: [All Authors], …; Writing - original draft preparation: [Soheil Sadr]; Writing - review and editing: [All Authors], …; Funding acquisition: [Self-funding], …; Supervision: [Hassan Borji]. All authors checked and approved the final version of the manuscript for publication in the present journal.

Consent to participate:  
Not applicable

Consent for publication:  
Not applicable

References


Figures
E. leuckarti

Figure 2

E. uninugulata