

## Gastrointestinal helminths detected in wild horses in Konya Province, Turkey

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**Abstract:** This study was conducted to identify the gastrointestinal helminths of wild horses in Konya, Turkey. Fresh stool samples collected from 66 horses were evaluated by flotation, sedimentation, Baermann-Wetzel, and stool culture methods. All 66 stool samples examined were found to be positive for helminths and the following parasites were detected: *Trichonema* spp. was detected in all stool samples (100%), followed by *Poteriostomum* spp. (45.5%), *Strongylus vulgaris* (34.9%), and *Strongylus equinus* (27.3%). In addition, *Oesophagodontus* spp. (9.1%), *Strongylus edentatus* (7.6%), *Triodontophorus* spp. (4.6%), *Gyalocephalus* spp. (4.6%), *Oxyuris equi* (3.0%), *Parascaris equorum* (1.5%), and *Strongyloides westeri* (1.5%) were detected at lower levels. Wild horses with multiple helminth species infections included 23 horses (34.9%) with two species, 18 (27.3%) with three species, 15 (22.7%) with one species, 7 (10.6%) with four species, and 3 with five species (4.5%). This study is important in terms of providing information regarding the helminth fauna of free-living wild horses in Turkey.

**Key words:** wild horse, helminth, nematode, *Strongylus*, Turkey

### 1. Introduction

Horses have been used for different purposes in the field of transportation and agriculture throughout history. As a result of mechanization, they have gradually lost their significance in these fields and their numbers have declined [1]. On the other hand, unused horses have been released into the wild life and have started to live freely in certain areas, increasing in number. These horses, which are recently known as wild horses, yıldı, mustang, feral horses, and free-roaming horses, live in Afyon (Akdağ, Emirdede Plateau, Kumalar Mountain), Antalya (Eynif Plain, Beydağlar, İzmir (Gediz Basin), Karaman (Karadağ), Kayseri (Erciyes Mountain), Manisa (Spil and Yunt Mountain), Samsun (Kızılırmak Basin), and Sinop provinces in different regions of Turkey [2,3].

Horses can be infected by many internal parasites, including protozoan species, nematodes, cestodes, and trematodes. Among these parasites, the most common and important parasitic pathogens are nematodes [4]. Helminths cause various pathological disorders based on species, numbers, and tissues in which they are found [5,6]. In general, the presence of parasites does not explicitly cause clinical symptoms; however, life-threatening colitis along with severe clinical manifestations such as colic, severe weight loss, and diarrhea can occur in horses with

clinical symptoms [4]. Research involving the internal and external parasites of horses has generally been restricted to a specific province or territory in Turkey. The presence of many helminth species in horses and donkeys has been determined in different studies. Prior studies determined ascarid and oxyurid infections to be prominent in horses reared on stud farms, while horses living outside of these farms were found to be generally exposed to Strongylid nematode infections [7,8].

While there have been many studies related to horses, donkeys, and mules reared in Turkey [7–15], there is only one report on wild horses [16]. In that account, *Strongylus vulgaris* was found to be common in feces collected around the water sources of wild horses, but no information was reported about the status of other parasites [16].

This study was planned to identify the digestive system helminths of wild horses of different ages and genders owned by the General Directorate of Nature Conservation and National Parks, Ministry of Agriculture and Forestry in Konya.

### 2. Materials and methods

Stool samples were taken from wild horses of different ages and genders, which were brought from Karaman, Karadağ to the town of Çumra, Konya for a Ministry of Forestry and

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Water Affairs project conducted by the General Directorate of Nature Conservation and National Parks. The source of the study material was wild horses freely living in nature in groups of 15–20 heads and using common areas with wild sheep and other animals living in that place specifically for feeding. Stool samples were collected in paddocks after the wild horses were caught and brought together within the scope of the project. Fieldwork was conducted in November of 2017, at which time 66 stool samples were collected from a herd of approximately 250 wild horses. Because of the difficulty in capturing and inspecting the horses, additional stool samples could not be procured. Stool samples were generally taken after horses had newly defecated. In order to prevent stool collection from the same animals, the horses were directed to different paddocks after stool sample collection. Sufficient stool samples for parasitological examinations were taken gently from the ground, especially from the top of the feces. Horses' numbers were written on the sample containers for identification.

Stool samples were brought to the laboratory for evaluation where they were examined by sedimentation, Fülleborn's flotation, and Baermann-Wetzel methods for trematode, cestode, and nematode infections. Fecal cultures were performed with the flotation method on all stool samples in which strongyle-type eggs were identified, and the larvae (L3) obtained in culture were identified at the genus or species level according to their morphological structure based upon relevant literature [17–19].

**3. Results**

Helminth eggs were detected in all 66 stool samples examined in the study. The following nematode genera or species were found: *Trichonema* spp., *Poteriostomum* spp., *S. vulgaris*, *S. equinus*, *S. edentatus*, *Oesophagodontus* spp., *Triodontophorus* spp., *Gyalocephalus* spp., *Strongyloides westeri*, *Oxyuris equi*, and *Parascaris equorum* (Table 1, Figure 1). Trematode and cestode eggs were not encountered. *Trichonema* spp. infection was the most prevalent infection of the wild horses; *Trichonema* spp. in combination with other species was found to form double, triple, quadruple, and quintet mixed infections (Table 2).

**4. Discussion**

Helminths are one of the most common infectious agents of Equidae. Studies on helminth infections of Equidae in different regions of Turkey noted several helminth species based on the results of necropsy or stool examinations [6,8,11–14,20]. In Turkey, identification of 2 trematode, 4 cestode, and 55 nematode species in horses, 2 trematode, 2 cestode, and 47 nematode species in donkeys, and 16 nematode species in mules has been recorded [8]. While necropsy could not be performed in this study, 11 nematode species were detected in fecal samples. No

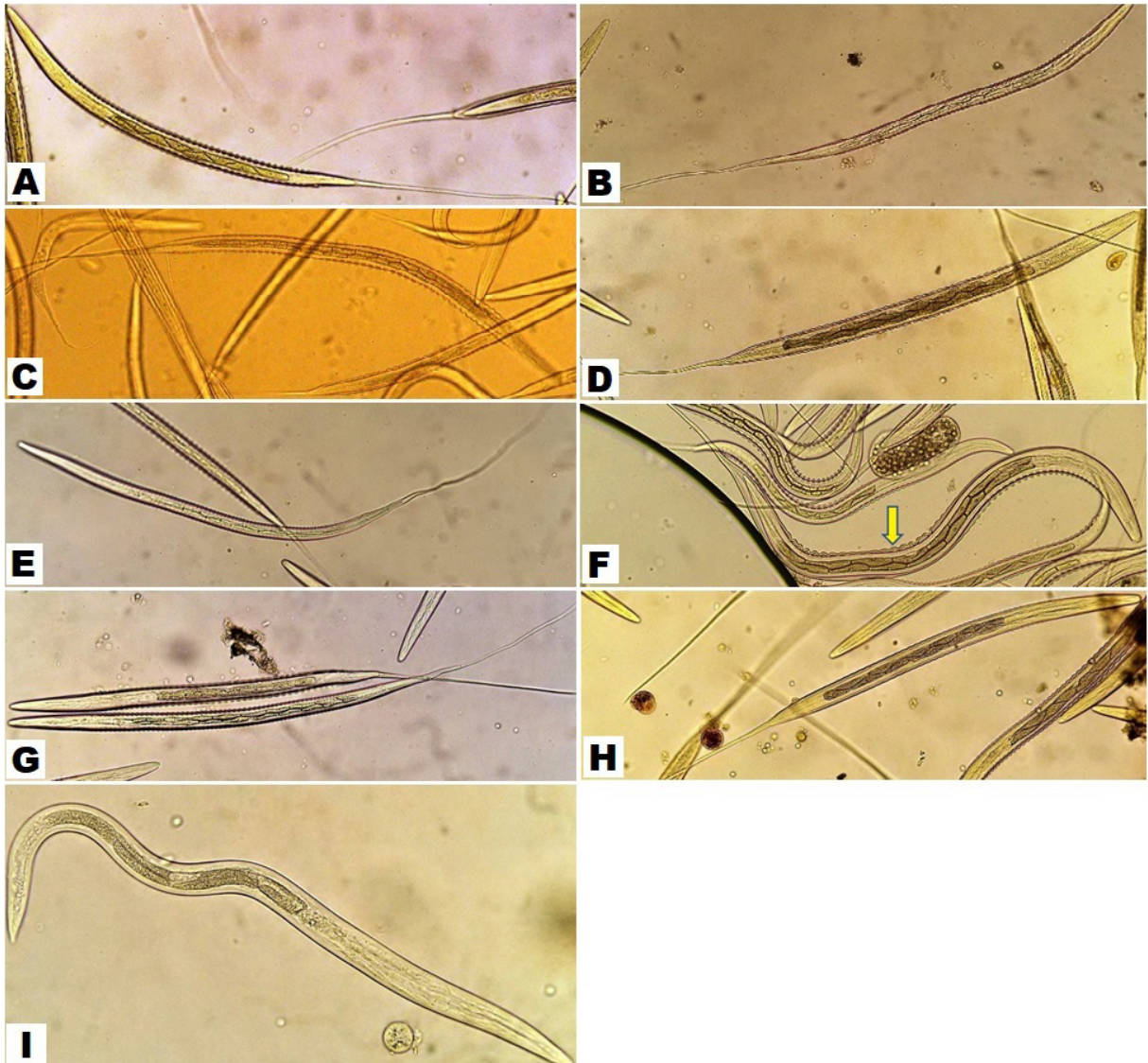
**Table 1.** Helminth species detected in fecal examinations of wild horses.

Helminth species	Number of infected horses (n)	Infection rate (%)
<i>Trichonema</i> spp.	66	100.0
<i>Poteriostomum</i> spp.	30	45.5
<i>Strongylus vulgaris</i>	23	34.9
<i>Strongylus equinus</i>	18	27.3
<i>Strongylus edentatus</i>	5	7.6
<i>Oesophagodontus</i> spp.	6	9.1
<i>Triodontophorus</i> spp.	3	4.6
<i>Gyalocephalus</i> spp.	3	4.6
<i>Strongyloides westeri</i>	1	1.5
<i>Oxyuris equi</i>	2	3.0
<i>Parascaris equorum</i>	1	1.5

cestodes or trematodes were detected. Unlike the other studies, this study was conducted on wild horses free-living in nature, and this is the most comprehensive study on the gastrointestinal helminth fauna of wild horses in Turkey.

Intestinal nematodes are significant parasitic agents commonly found in horses grazing in contaminated pastures and not treated with appropriate anthelmintics [21]. The most common of these nematodes are small strongyles (Cyathostomines) and large strongyles. *Parascaris equorum*, *S. westeri*, *O. equi*, and *D. arnfieldi* are also some of the common pathogenic parasites of horses [22]. Strongyle parasites are usually found in the large intestines of horses and cause disease characterized by anorexia, emaciation, anemia, dullness, diarrhea, colic, and weight loss. These parasites can also cause sudden death. Among the large strongyle species, *S. vulgaris*, which is a blood sucker nematode that resides in right ventral colon and cecum, is the most pathogenic species for horses and is one of the most well-known reasons of colic in horses [22,23]. Fecal samples of wild horses living in Karaman, Karadağ examined for internal parasites revealed the presence of *S. vulgaris* in a prior study in Turkey. In that short report, fecal samples were only collected from around the water sources [16]. The samples collected for the present study were from wild horses living in the town of Konya and were from newly defecated feces. The horses were transported from the Karadağ region of Karaman within the scope of another project. In the present study, 10 different nematode species or genera were detected in addition to *S. vulgaris*.

According to various studies performed in Turkey, the rate of helminth infections of domestic horses varies from



**Figure 1.** A: Larva of *Trichonema* spp.; B: Larva of *Poteriosomum* spp.; C: Larva of *Strongylus vulgaris*; D: Larva of *Strongylus equinus*; E: Larva of *Strongylus edentatus*; F: Larva of *Oesophagodontus* spp.; G: Larva of *Triodontophorus* spp.; H: Larva of *Gyaloecephalus* spp.; I: Larva of *Strongyloides westeri*.

52% to 100% [8,11–14,20,24]. Although the results obtained in the present study were similar to those of previous studies [8,11], the infection rate of wild horses was found to be higher than most of the rates detected in previous studies [12–14,20,24]. Strongylidae eggs were detected in all stool samples in the present study. The high level of infection in wild horses is thought to be related to the lifestyle and environment of these horses. Domestic horses, which were used in the previous studies, are used for sport or different purposes in the public hands. Therefore, wild horses have a higher risk of catching the helminth infections than domestic horses due to grazing in constantly contaminated environments and the absence of antihelminthic treatment.

Additionally, wild horses, which continuously cause environmental contamination due to parasitic scattering, are a constant source of infection for domestic horses [25]. The risk of helminth infections of domestic horses increases due to the capture and redomestication of wild horses and common use of pastures with wild horses. As a result of the findings obtained in this study, it is also thought that wild horses in the region where the study was carried out pose a risk for helminth infections in domestic horses. A similar situation is assumed between wild horses living in different geographical regions [2,3] and domestic horses in Turkey.

All gastrointestinal helminths detected in the present study – *Trichonema* spp. [8,11,14], *Poteriosomum* spp.



**Table 2.** Mono and mixed helminth infections of wild horses.

Type of infection (number of cases)	Helminth species	Number of infected horses (n)
Mono infection (15)	<i>Trichonema</i> spp.	15
Dual infection (23)	<i>Trichonema</i> spp. + <i>Poteriostomum</i> spp.	10
	<i>Trichonema</i> spp. + <i>Strongylus equinus</i>	6
	<i>Trichonema</i> spp. + <i>Strongylus vulgaris</i>	3
	<i>Trichonema</i> spp. + <i>Strongylus edentatus</i>	2
	<i>Trichonema</i> spp. + <i>Strongyloides westeri</i>	1
	<i>Trichonema</i> spp. + <i>Oxyuris equi</i>	1
Triple infection (18)	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>Poteriostomum</i> spp.	9
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>S. equinus</i>	3
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>Poteriostomum</i> spp.	2
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>S. edentatus</i>	1
	<i>Trichonema</i> spp. + <i>Poteriostomum</i> spp.+ <i>Gyalocephalus</i> spp.	1
	<i>Trichonema</i> spp. + <i>Poteriostomum</i> spp.+ <i>Triodontophorus</i> spp.	1
	<i>Trichonema</i> spp. + <i>Poteriostomum</i> spp.+ <i>P. equorum</i>	1
Quadruple infection (7)	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>S. equinus</i> + <i>Oesophagodontus</i> spp.	2
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>S. equinus</i> + <i>Poteriostomum</i> spp.	2
	<i>Trichonema</i> spp. + <i>S. equinus</i> + <i>Poteriostomum</i> spp.+ <i>Oesophagodontus</i> spp.	1
	<i>Trichonema</i> spp. + <i>S. edentatus</i> + <i>Oesophagodontus</i> spp.+ <i>Gyalocephalus</i> spp.	1
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>Poteriostomum</i> spp. + <i>Oxyuris equi</i>	1
Quintet infection (3)	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>Oesophagodontus</i> spp. + <i>Gyalocephalus</i> spp.+ <i>Triodontophorus</i> spp.	1
	<i>Trichonema</i> spp. + <i>S. vulgaris</i> + <i>S. edentatus</i> + <i>Poteriostomum</i> spp. + <i>Triodontophorus</i> spp.	1
	<i>Trichonema</i> spp. + <i>S. equinus</i> + <i>S. edentatus</i> + <i>Poteriostomum</i> spp. + <i>Oesophagodontus</i> spp.	1
Total		66

[11,13], *S. vulgaris* [8,11,13,14], *S. equinus* [8,13,14], *S. edentatus* [8,11,13,14], *Oesophagodontus* spp. [14], *Triodontophorus* spp. [11,14], *Gyalocephalus* spp. [8], *S. westeri* [11, 20], *O. equi* [10–12,20], and *P. equorum* [10–12, 14] were reported in domestic horses in Turkey. However, some significant helminths such as *Trichostrongylus axei* [8], *D. arnfieldi* [10,26], *Trichuris* spp. [11], *Anoplocephalidae* spp. [10–12], *Paranoplocephala mamillana* [20], *Fasciola* spp. [11, 20], and *Dicrocoelium dentriticum* [11] were not detected in these horses. In the present study, 11 nematodes were detected as well as many of the previously reported helminth species, but no trematodes or cestode eggs were found. *Trichonema* spp. (100%), *Poteriostomum* spp. (45.5%), *S. vulgaris* (34.9%), *S. equinus* (27.3%), *Oesophagodontus* spp. (9.1%), *S. edentatus* (7.6%), *Triodontophorus* spp. (4.6%),

*Gyalocephalus* spp. (4.6%), *O. equi* (3.0%), *S. westeri* (1.5%), and *P. equorum* (1.5%) were detected. *P. equorum*, commonly found in the small intestine of young horses and foals worldwide [27], was found in only one (1.5%) wild horse. This result may be due to the ages of the wild horses sampled, which unfortunately could not be calculated due to the difficulties in controlling and capturing the animals. Helminth infections with more than one species are common in horses in Turkey [8,11,12,20]. In the present study, dual (34.9%), triple (27.3%), quadruple (10.6%), and quintet (4.5%) mixed infections were found. The mono-infection rate was 22.7%. *Trichonema* spp. was found in all examined fecal samples (100%). *Poteriostomum* spp. (45.5%), *S. vulgaris* (34.9%), and *S. equinus* (27.3%) were determined as prevalent nematodes following *Trichonema* spp., with

other nematodes being relatively less prevalent. While *Trichonema* spp. were detected in all mono infections, *Trichonema* spp. + *Poteriostomum* spp. (43.5%) coexistence was the most common in dual infections, and half of the triple infections consisted of *Trichonema* spp. + *Poteriostomum* spp. + *S. vulgaris*. Saeed et al. [28] reported helminth infections in horses affected by many environmental and host-related factors. Seasonal variation, rainfall, and temperature can be listed as some of the significant environmental factors. Sex, age, and immunological or physiological status of the horse are host-related factors. Parasites, high infection rates, and mixed infections detected in the present study can be attributed especially to environmental factors.

The number of studies on gastrointestinal parasites of wild horses is insufficient worldwide. Many helminths, especially *S. vulgaris*, have been detected in the studies performed [16,25,29–35]. The presence of strongyle eggs and some other helminth infections in wild horses has been reported in the USA [29,35], Canada [34], Australia [25], Venezuela [32], Ukraine [30], and Poland [31,33]. Apart from the nematodes detected in these studies, *Oesophagodontus* spp. and *S. westeri* were detected in the present study. This situation can be attributed to the

environment in which the horses live. Rubenstien and Hohmann [29] stated that the parasite load and variety of horses may differ according to region. For this reason, it will be useful to study the endoparasitic fauna of wild horses that pose a risk of parasitic infection for domestic horses in different parts of the world in order to take necessary precautions in this regard.

In conclusion, wild horses are intensely exposed to strongyle infections. In addition to helminth infections, determination of arthropod infestations and protozoan infections in these animals is important to determine their role in the transmission of parasites to other equine animals, such as owned horses and donkeys. To ensure necessary precautions, it is recommended that the parasitic fauna of the wild horses in other regions should be identified.

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#### Conflict of Interest

The authors declare that they have no competing interest.

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