

Strongyloid nematodes in the caeca of donkeys in Henan Province, China

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Abstract

Thirty-four donkeys from Henan Province, China, were examined at necropsy for strongyloid nematodes in the caecum (February 2006 to January 2007). Twenty-two species, including 18 Cyathostominae (small strongyles) and 4 Strongylinae (large strongyles), were identified. The five most prevalent Cyathostominae were *Cylicocycylus nassatus* (73.5%), *Coronocycylus labratus* (70.6%), *Coronocycylus labiatus* (67.6%), *Cyathostomum tetracanthum* (61.8%) and *Coronocycylus coronatus* (52.9%), accounting for 70.2% of all species identified; *C. labratus* (124.2 ± 256.4), *Cyathostomum tetracanthum* (96.4 ± 210.5) and *Cylicocycylus nassatus* (80.9 ± 117.1) had the greatest mean abundance, whereas *Strongylus vulgaris* was the most prevalent (88.2%) of the Strongylinae and had the highest mean abundance (34.9 ± 37.8). The numbers of species per donkey ranged from 1 to 15 (with a median of 7.1). Only a small percentage (5.9%) of donkeys were infected by a single species, whereas the other donkeys had infections with multiple species.

Keywords

Donkeys, strongyloid nematodes, caecum, prevalence, abundance, intensity, China

Introduction

It is estimated that more than 90% of 44 million donkeys (*Equus asinus*) in the world are in developing countries (Matthee *et al.* 2000). In these countries, the raising of donkeys is critical because they are used daily for work, particularly transporting people, goods and crops. A severe internal parasite burden can directly affect the health of donkeys and their working performance (Krecek and Guthrie 1999, Matthee *et al.* 2000).

Equids (including horse, donkey, mule and zebra) can harbour a range of parasites in the large intestines, most importantly the strongyloid nematodes (family Strongylidae, subfamilies Strongylinae and Cyathostominae) which have substantial community richness (Hoste *et al.* 1999, Chapman *et al.* 2003, Gasser *et al.* 2004, Anjos and Rodrigues 2006). Various epidemiological studies of internal parasites of the horse have been carried out in different parts of the world (e.g., Reine-meyer *et al.* 1984, Bucknell *et al.* 1995, Gawor 1995, Silva *et al.* 1999, Collobert-Laugier *et al.* 2002, Pereira and Vianna 2006). However, there is a limited number of studies of the nematodes of the donkey. Most studies have been conducted in Africa, in countries including Burkina Faso (Vercruysse *et al.*

1986), Zimbabwe (Eysker and Pandey 1989, Pandey and Eysker 1991), Morocco (Pandey 1980, Khallaayoune 1991), Ethiopia (Feseha *et al.* 1991), Chad (Graber 1970) and South Africa (Malan *et al.* 1982, Wells *et al.* 1998, Matthee *et al.* 2000). In addition, the community of strongylid nematodes of donkey in Ukraine was studied (Kuzmina and Kuzmin 2008). In these surveys, more than 20 species of strongyloid nematodes have been identified.

Although donkeys are very widespread in China, parasite surveys of them are scant. K'ung *et al.* (1959, 1963) studied the helminths of the donkeys in Peking, and reported 23 species of strongyles. Also, Zhou (1990) found 31 species of strongyloid nematodes in seven donkeys in Sichuan Province. These investigations concentrated mainly on taxonomy, but did not consider epidemiological or ecological aspects. In the present study, we undertake the first study of strongyloids in the caeca of the donkeys in Henan Province in China.

Materials and methods

From February 2006 to January 2007, 34 donkeys (21 females and 13 males) from Henan Province of China were ex-

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amed. The age of the donkeys studied ranged from 6 months to 12 years. After each animal was slaughtered, the caecum was collected. Each caecum was opened lengthwise, and the contents were placed in a bucket. In another bucket, the wall of the caecum was washed with water to collect any attached worms; the supernatant was decanted after 5–10 min. For each sample, the sediment was homogenized, and a subsample of ~20% was taken and fixed in hot 10% formalin (Bucknell *et al.* 1995, Gawor 1995, Silva *et al.* 1999). The nematodes collected from both samples were subsequently preserved in 70% ethanol. They were first cleared with lactophenol and then identified using light microscope, according to existing keys and descriptions (Lichtenfels 1975, Georgi 1982, Lichtenfels *et al.* 1998, Zhang and K'ung 2002). The numbers of donkeys infected, numbers of adult worms representing each species, and the numbers of species per donkey were recorded; the mean intensity and mean abundance of the species were calculated according to Bush *et al.* (1997) using the program Statistica 5.0 (StatSoft). The data were expressed as mean $\pm$ standard deviation (SD).

Results and discussion

Twenty-two species of strongyles, including 18 Cyathostominae (small strongyles or cyathostomins) and 4 Strongylinae (large strongyles) were identified in the caeca from 34 donkeys (Table I). Cyathostominae were recovered from 32 caeca (94.1%) and large strongyles from 31 (91.2%). The species dis-

tribution ranged from 1 to 15 worms per donkey, with 30 different combinations (Table II). Total numbers of strongyles ranged from 120 to 1939 worms, with a mean of 499 worms per donkey. Of the 18 small strongyles, the five most prevalent species were *Cylicocycylus nassatus* (73.5%), *Coronocycylus labratus* (70.6%), *Coronocycylus labiatus* (67.6%), *Cyathostomum tetracanthum* (61.8%) and *Coronocycylus coronatus* (52.9%), representing 70.2% of all species. *C. labratus* (175.9 ± 291.3), *Cyathostomum tetracanthum* (156.0 ± 251.7), *Cylicocycylus auriculatus* (127.2 ± 221.7) and *C. nassatus* (110.1 ± 124.4) were the species with the highest mean intensity of infection. The three species with the highest mean abundance were *C. labratus* (124.2 ± 256.4), *C. tetracanthum* (96.4 ± 210.5) and *C. nassatus* (80.9 ± 117.1). *Strongylus vulgaris* was the most prevalent (88.2%) species of the 4 large strongyles recorded, with the highest mean intensity (39.6 ± 37.9) and mean abundance (34.9 ± 37.8). The other 3 species of large strongyle had a lower prevalence (8.8%) and mean abundance (0.8 ± 3.1 , 0.3 ± 1.0 and 0.2 ± 0.8 , respectively).

The present study reports on the structure of the community of strongyloid nematodes in the caeca of donkeys from Henan Province, China. Twenty-two species of strongyloid nematodes were found in 34 donkeys (Table I). The numbers of species per donkey ranged from 1 to 15, with a mean of 7.1. Only 5.9% of donkeys were infected by a single species, the others were infected with multiple species. The same studies were also investigated in the caecum of the horse by other workers. For instance, the number of species of small strongyles reported in previous studies ranged from 11–18 (Krecek

Table I. Percentage of donkeys infected with strongyloid nematodes; range, mean intensity and mean abundance of strongyloid nematodes in the caeca of the donkeys from Henan Province, China

Strongyloid species	Percentage of 34 donkeys	Adult worms/donkey (range)	Mean intensity $\pm$ SD	Mean abundance $\pm$ SD
Cyathostominae				
<i>Cylicocycylus nassatus</i>	73.5	2–426	110.1 ± 124.4	80.9 ± 117.1
<i>Coronocycylus labratus</i>	70.6	8–1158	175.9 ± 291.3	124.2 ± 256.4
<i>Coronocycylus labiatus</i>	67.6	2–198	27.2 ± 39.8	18.4 ± 34.9
<i>Cyathostomum tetracanthum</i>	61.8	6–1035	156.0 ± 251.7	96.4 ± 210.5
<i>Coronocycylus coronatus</i>	52.9	1–26	8.9 ± 7.3	4.7 ± 6.9
<i>Cylicocycylus auriculatus</i>	44.1	1–803	127.2 ± 221.7	56.1 ± 157.9
<i>Cyathostomum catinatum</i>	44.1	1–321	82.5 ± 112.7	36.4 ± 84.3
<i>Cylicostephanus longibursatus</i>	41.2	3–175	48.9 ± 50.4	20.1 ± 39.9
<i>Cylicocycylus radiatus</i>	41.2	1–82	22.6 ± 30.7	9.3 ± 22.4
<i>Cylicostephanus minutus</i>	17.6	1–67	16.0 ± 25.4	2.8 ± 11.7
<i>Cyathostomum pateratum</i>	14.7	2–42	23.8 ± 20.4	3.5 ± 11.1
<i>Cylicostephanus goldi</i>	14.7	4–75	20.2 ± 30.7	2.9 ± 12.9
<i>Cylicocycylus elongatus</i>	14.7	1–14	6.8 ± 5.9	1.0 ± 3.2
<i>Cylicocycylus ashworthi</i>	8.8	24–40	29.3 ± 9.2	2.6 ± 8.7
<i>Cylicocycylus insignis</i>	8.8	1–35	17.3 ± 17.0	1.5 ± 6.5
<i>Cylicostephanus calicatus</i>	8.8	6–11	7.6 ± 2.8	0.7 ± 2.3
<i>Cylicocycylus adersi</i>	8.8	4–13	7.0 ± 5.2	0.6 ± 2.4
<i>Parapoteriostomum euproctus</i>	2.9	3	3	0.1 ± 0.5
Strongylinae				
<i>Strongylus vulgaris</i>	88.2	2–120	39.6 ± 37.9	34.9 ± 37.8
<i>Strongylus edentatus</i>	8.8	2–3	2.7 ± 0.6	0.2 ± 0.8
<i>Triodontophorus nipponicus</i>	8.8	3–17	9.0 ± 7.2	0.8 ± 3.1
<i>Triodontophorus serratus</i>	8.8	2–4	3.3 ± 1.2	0.3 ± 1.0

Table II. Strongyloid species in different associations recovered from the caeca of 34 donkeys from Henan Province, China

[illegible]

et al. 1989, Bucknell *et al.* 1995, Gawor 1995, Collobert-Laugier *et al.* 2002, Kuzmina and Kuzmin 2008). Additionally, 4 large strongyle species were reported by Bucknell *et al.* (1995). The present study also revealed a low mean richness of strongyloid nematodes in the caecum of the donkey, agreeing with previous investigations of horses (Reinemeyer *et al.* 1984, Krecek *et al.* 1989, Gawor 1995, Collobert-Laugier *et al.* 2002).

Eighteen species of cyathostomin were found in 94.1% donkeys examined in this study. Previous studies showed that the numbers of small strongyle species recorded in the large intestine of donkeys varied from 6–24 (K'ung *et al.* 1959, 1963; Vercruysse *et al.* 1986; Eysker and Pandey 1989; Zhou 1990; Oliveira *et al.* 1994; Matthee *et al.* 2000). In the present study, the genera *Cylicocyclus*, *Coronocyclus*, *Cyathostomum*, *Cylicostephanus* and *Parapoteriostomum* were recorded. A total of seven species of *Cylicocyclus* were identified. The most prevalent and abundant species of *Cylicocyclus* was *Cylicocyclus nassatus*, similar to the findings for the horse (e.g., Reinemeyer *et al.* 1984, Mfitilodze and Hutchinson 1990, Silva *et al.* 1999; Collobert-Laugier *et al.* 2002). *Cylicocyclus auriculatus* was the second most dominant species in donkeys, in agreement with previous studies (Tolliver *et al.* 1985, Eysker and Pandey 1989, Matthee *et al.* 2000). *C. labratus* and *C. labiatus* were the most prevalent and abundant species within the genus *Coronocyclus*, which is also in agreement with previous findings for donkeys from other countries (Tolliver *et al.* 1985, Oliveira *et al.* 1994, Matthee *et al.* 2000). Of the genus *Cyathostomum*, *C. tetracanthum* was the most prevalent and abundant species. Eysker and Pandey (1989) and Matthee *et al.* (2000) reported that *C. montgomeryi* was the most prevalent species in the caecum of the donkey, but this species was not recorded previously in China. The numbers of donkeys infected with species of *Cylicostephanus* was small in the present study, which agrees with some previous studies of cyathostomins from the caecum of the horse (Gawor 1995; Bucknell *et al.* 1995, 1996; Collobert-Laugier *et al.* 2002). Only one species of the genus *Parapoteriostomum* was found in a donkey in the present study.

Of the large strongyles known to infect the donkey, *Strongylus vulgaris* was the most prevalent and abundant species in the present study (see Table I). In spite of the relatively small number of adult worms per donkey (2–120), the high prevalence (88.2%) of *S. vulgaris* indicates that it may impact on the well-being of donkeys. *S. vulgaris* is recognized as the most pathogenic species of the Strongylinae. Following infection with third-stage larvae, the fourth and fifth stage larvae of this species migrate through the arterial system and cause “verminous arteritis” with marked intimal thickening infiltrated with inflammatory cells (Duncan 1973). Thrombus formation can block arteries, causing infarction of intestinal walls and/or intermittent lameness, and is commonly associated with clinical signs of marked pyrexia, anorexia, severe colic and death (Drudge *et al.* 1966, McCraw and Slocombe 1976, Ogbourne and Duncan 1985). Adult worms, using their buccal capsules, attach to the intestinal mucosa, withdraw a plug of tissue, di-

gest the host cells, rupture the blood vessels and suck blood (Owen and Slocombe 1985). A normocytic, normochromic anaemia can be observed in affected equids (Ogbourne and Duncan 1985). The pathogenic effects of adult cyathostomins have been confirmed by experimentally infecting horses with L3s (Murphy and Love 1997). Like Strongylinae, some larger species within the Cyathostominae, such as *Cylicocyclus insignis*, *C. elongatus* and *Poteriostomum* spp., can damage the deeper layers of the gut wall (Ogbourne 1978). For the cyathostomins, encysted larvae can emerge synchronously from the gut wall, leading to the clinical disease called “larval cyathostomiasis”, which is associated with clinical signs of oedema, diarrhoea, pyrexia, weight loss, colic and can be fatal in up to 50% of cases (Giles *et al.* 1985; Herd 1990a, b; Uhlinger 1991; Reinemeyer 1992; Love 1992; Reilly *et al.* 1993; Mair 1994; Love *et al.* 1999). In horses, this disease has been reported to occur more frequently in winter and early spring than other seasons (Giles *et al.* 1985) and may be triggered by anthelmintic treatment (Uhlinger 1991, Mair 1994, Gasser *et al.* 2004). However, nothing is known about the pathogenesis of larval cyathostomiasis in donkeys. Due to the difficulties in the specific identification of the L4s emerging from the gut wall (using morphological features) (Ogbourne 1975; Reinemeyer 1986, 1992; Uhlinger 1991; Abbott, 1998a, b; Klei and French 1998), it is not known which species causing larval cyathostomiasis are most pathogenic. In conclusion, the findings of the present study suggest that strongyloid nematodes are likely to have a significant impact on the health, well-being and performance of working donkeys in Henan Province, China. Future work should establish the seasonal occurrence of the species reported using larger numbers of donkeys, investigate the distribution and intensities of strongyloids in all parts of the large intestines and investigate the prevalence and clinical relevance of verminous arteritis and larval cyathostomiasis in donkeys. There is also significant scope to investigate other parasite groups in donkeys. Overall, such studies will contribute significantly to understanding of the health and welfare of the working donkey in developing countries.

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