Gastrointestinal helminths of camels (*Camelus dromedarius*) in center of Iran

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Abstract. Camels are multipurpose animals in Iran. As parasitic diseases are the major cause of impaired meat and milk production in this animal, the present study aimed at determining gastrointestinal helminthic infections of Iranian camels in the center of the country. Gastrointestinal (GI) tract of 144 carcasses of one-humped camels (*Camelus dromedarius*) slaughtered in Yazd, Esfahan and Kerman provinces' abattoirs were examined for adult helminths. Camels were from both sexes and different ages. Recovered parasites were identified according to described keys by light microscope. Of 144 tested camels, 117 were infected with at least one helminth species (81.3%). A total of 28 worm species from 14 genera were identified in the digestive tract of infected animals, including 26 species of nematodes and two species of cestodes. The infection rates in stomach, small intestine, and caecum/large intestine were 86.3%, 91.5% and 11.1%, respectively. However, no worm was found in the oesophagus. The recovered worms with infection rates are discussed in this paper. In the present study, *Haemonchus tataricus*, *Trichostrongylus hamatus* and *Trichuris infundibulus* are reported from Iranian dromedaries for the first time. Regarding high prevalence of infection, using anthelminthic drugs seemed necessary to improve the health and productivity of camels. On the other hand, the high rate of zoonotic species indicated that camels have important role in maintaining and transmitting infection to humans.

INTRODUCTION

Camels are important multipurpose animals of arid and semi-arid parts of the world, including Iran. Camel is the most important livestock that can live and produce in poor farms, and can be compared with high-yield animals of the same weight, like cattle, in productivity under manual feeding. Hence, there is a need to improve management of camels considering its prospect in the semi-arid and arid regions where livestock production is becoming more difficult due to climate changes (Sazmand, 2011).

Parasitism is one of the major causes of impaired milk and meat production, as well as impaired fertility and low calving rates of camels. Parasitic diseases may lower the working efficiency or result in death, and sometimes serve as potential danger for public health (Anvar & Khan, 1998).

El-Bihari (1985) and Dakkak & Ouhelli (1987) have described parasitic infections of camels in camel-raising countries. The helminth fauna of the gastrointestinal (GI) tract of camelids is particularly rich, up to almost 50 species (Dakkak & Ouhelli, 1987). Signs and symptoms of GI helminths in camels are numerous, mainly weight loss, diarrhoea, anemia, gastritis and enteritis (Fowler, 1996). However, the clinical manifestations of helminthosis may be
subclinical or asymptomatic, in which case
the animal appears normal but performs
below its full potential (Borji et al., 2010).

Epizootic study of the parasite species
occurring in a host is of paramount
importance for the planning of an efficient
control program and for preventing economic
loss due to parasitic infections. Most of the
epizootological studies on camel parasites
were based on examination of worms’ eggs
in faeces (Chhabra & Gupta, 2006). The
available information about camels in Iran
is just the investigations based on post-mortem
examinations with limited numbers of
dromedaries. Mirzayans & Halim (1980) were
the first to report helminths of camel from
Iran. Also, Etminan (1995), Radfar et al.
(2006) and Borji et al. (2010) conducted
studies on camels from Yazd, Mashhad and
Kerman abattoirs in central, North-East and
South-East provinces of country, respectively.
There is also one report on GI helminths eggs
of bactrian camels of Iran (Tajik et al., 2011).
The present study was designed to provide
preliminary information on the prevalence
rates and type of camel helminths in the
center of the country.

MATERIAL AND METHODS

We referred to slaughterhouses of Yazd, Najaf-
Abad and Rafsanjan cities, which are located
in hot and dry provinces of Yazd, Esfahan and
Kerman in the center of Iran. The sample size
(n=144 camels) was calculated based on the
87% helminth infestation rate which was
obtained in a past study (Etminan, 1995), with
\( \alpha = 0.05 \), 95% confidence interval and \( d = 5.5\% \).
Different parts of the GI tract (including
oesophagus, stomach, small and large
intestine and caecum) of 144 one-humped
camels (Camelus dromedarius) of different
ages and both sexes (65 males and 79
females) were separated by ligature, and
transported to the laboratory under cold
chain. Each part was cut longitudinally and
the mucosa examined and scraped carefully
to remove any adhering worms. Contents of
digestive tract were washed using tap water
and sieved. The entire washings of organs
were completely examined to find the
parasites. The recovered adult worms were
picked up with forceps, washed two or three
times in distilled water, collected in
physiological normal saline solution, and
examined in fresh state. They were then
preserved in 10% formalin and 70% alcohol-
glycerin for further detailed examination and
identification. Nematodes were cleared
in lactophenol, and stained with Azocarmen.
Cestodes were collected, washed, placed
between two slides (or two pieces of flat
glass), fixed, stained with Carmen alum, and
then identified. Species identification was
done according to the criteria described by

RESULTS

Out of the 144 camels examined, 117 cases
(81.3%) were positive for adult helminth
infection, of whom 53 were male (45.3%)
and 64 were female (54.7%). Camel is a
polygastric animal, but not a true ruminant
(Fowler, 1996). True ruminants have four-
compartment stomach, whereas there are
three compartments in the camel stomach,
called C1, C2 and C3. The infection rates
in stomach, small intestine and caecum/
large intestine were 86.3%, 91.5% and 11.1%,
respectively. However, no worm was found
in the oesophagus. A total of 28 worms
species from 14 genera were identified in
their digestive tract, including 26 species of
nematodes and two species of cestodes.
Types and prevalence of recovered worms
from the GI tracts of the 144 camels are given
in Table 1. Camelostrongylus mentulatus
(41.7%) and Parabronema skrjabini
(34.7%) were the most prevalent worms in C3.
The most prevalent worms in small intestine
were Stilesia globipunctata (41.7%) and Parabronema skrjabini (34.7%)
were the most prevalent worms in C3. The
most prevalent worms in small intestine
were Stilesia globipunctata (38.9%) and Trichostrongylus probolorus (37.5%).
Trichuris globulosa was the dominant
species in the large intestine.

DISCUSSION

In the present work, we have carried out an
abattoir-based study aimed at determining
the prevalence of GI helminths of camels in
Table 1. Prevalence of adult helminths recovered from camels slaughtered at abattoirs of central Iran (n = 144)

<table>
<thead>
<tr>
<th>Adult Helminths</th>
<th>Number of Infected Camels</th>
<th>Prevalence</th>
<th>Organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camelostongylus mentulatus</td>
<td>60</td>
<td>41.7%</td>
<td>C3</td>
</tr>
<tr>
<td>Stilesia globipunctata</td>
<td>56</td>
<td>38.9%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Trichostrongylus probolurus</td>
<td>54</td>
<td>37.5%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Parabronema skrjabini</td>
<td>50</td>
<td>34.7%</td>
<td>C3</td>
</tr>
<tr>
<td>Haemonchus contortus</td>
<td>22</td>
<td>15.3%</td>
<td>C3</td>
</tr>
<tr>
<td>Haemonchus longistipes</td>
<td>21</td>
<td>14.6%</td>
<td>C3</td>
</tr>
<tr>
<td>Trichostrongylus colubriformis</td>
<td>21</td>
<td>14.6%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Physaecephalus secalatus</td>
<td>20</td>
<td>13.9%</td>
<td>C3</td>
</tr>
<tr>
<td>Nematodirus spathiger</td>
<td>10</td>
<td>6.9%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Nematodirella camelii</td>
<td>9</td>
<td>6.3%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Nematodirus mauritanicus</td>
<td>7</td>
<td>4.9%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Trichurus globulosa</td>
<td>7</td>
<td>4.9%</td>
<td>L.I.</td>
</tr>
<tr>
<td>Nematodirella longissimespiculata</td>
<td>6</td>
<td>4.2%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Moniezia expansa</td>
<td>6</td>
<td>4.2%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Trichurus lani</td>
<td>5</td>
<td>3.5%</td>
<td>L.I.</td>
</tr>
<tr>
<td>Trichostrongylus vitrinus</td>
<td>5</td>
<td>3.5%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Nematodirus dromedarii</td>
<td>5</td>
<td>3.5%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Cooperia pectinata</td>
<td>4</td>
<td>2.8%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Impalaia tuberculata</td>
<td>3</td>
<td>2.1%</td>
<td>C3</td>
</tr>
<tr>
<td>Nematodirus abnormalis</td>
<td>3</td>
<td>2.1%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Trichurus skrjabini</td>
<td>2</td>
<td>1.4%</td>
<td>L.I.</td>
</tr>
<tr>
<td>Haemonchus tataricus</td>
<td>1</td>
<td>0.7%</td>
<td>C3</td>
</tr>
<tr>
<td>Marshallagia marshalli</td>
<td>1</td>
<td>0.7%</td>
<td>C3</td>
</tr>
<tr>
<td>Nematodirus helvetianus</td>
<td>1</td>
<td>0.7%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Oesophagostomum radatum</td>
<td>1</td>
<td>0.7%</td>
<td>L.I.</td>
</tr>
<tr>
<td>Oesophagostomum venulosum</td>
<td>1</td>
<td>0.7%</td>
<td>L.I.</td>
</tr>
<tr>
<td>Trichostrongylus hamatus</td>
<td>1</td>
<td>0.7%</td>
<td>S.I.</td>
</tr>
<tr>
<td>Trichurus infundibulus</td>
<td>1</td>
<td>0.7%</td>
<td>L.I.</td>
</tr>
</tbody>
</table>

C3: Third compartment of stomach, S.I.: Small Intestine, L.I.: Large Intestine

the central provinces of Iran. There are a few reports based on adult helminthes of camels worldwide, and most of the scientists have investigated eggs of worms in fecal examination. According to our results, 81.31% of dromedaries harboured at least one type of helmint in their gastrointestinal tract. This finding is almost in agreement with the report by Borji and colleagues (75.1%, in 2010) in Iranian camels, Bekele (75%, in 2002) in eastern Ethiopia, and Abubakr et al. (76.2%, in 2000) in Bahrain, but lower than prevalence rates in Jordan (98%, by Sharrif et al., 1997), Ethiopia (96.92%, by Tekle & Abebe, 2001), and Nigeria (92.4%, by Bamaiyi & Kalu, 2011). In contrast, lower rate of 68.9% was reported from dromedaries in Nigeria (Kamani et al., 2008).

Some nematode genera recovered at necropsy during the present study have been recorded previously from Camelus dromedarius in some parts of Iran (Mirzayans & Halim, 1980; Etminan, 1995; Radfar et al., 2006; Borji et al., 2010). Some nematode species like Teladorsagia circumcincta, Nematodirus oiratianus, Moniezia benedeni, Trichuris barbetonensis, Cooperia punctate, Trichostrongylus axei, Gongylonema pulchrum and Ascarops strongylina recovered from the GI tract in previous reports were not encountered in the present study. Some genera of observed helminthes in this study were also reported from other regions (El-Bihari & Kawasmeh, 1980; El-Bihari, 1985; Abdul-Salam & Farah, 1988; Sharrif et al., 1997; Bekele, 2002). However, our study reports Haemonchus tataricus, Trichostrongylus hamatus and Trichuris infundibulus for the first time from Iranian dromedaries.
In the present study, *C. mentulatus* had the highest prevalence rate in the C3. This parasite is commonly found in the Middle East (Kauffman, 1996), particularly in animals that share grazing with sheep (Dakkak & Ouhelli, 1987). However, epidemiological data from various reports based on fecal samples or abattoir examinations indicate that the most common pathogenic infection is *Haemonchus* spp. causing multiple GI helminthic infections with almost 100% morbidity (Chhabra & Gupta, 2006). Symptoms of haemonchosis include diarrhea, anorexia, anemia, edema of the lower limbs, emaciation and death (Arzoun et al., 1984). *Haemonchus longistipes* is specific to camels but *Haemonchus contortus* is also frequently found in camels (Dakkak & Ouhelli, 1987). Besides those nematodes that have already been reported in Iranian camels (Mirzayans & Halim, 1980; Etminan, 1995; Borji et al., 2010), we identified *Haemonchus tataricus* for the first time in camels of Iran.

*Parabronema skrjabini* ranks 4th among the common worms in the present work. This worm is rarely found in the abomasum and C3 in dromedaries, sheep, goats and cattle (Wernery & Kaaden, 2002), but according to reports from Iran, it is prevalent in camels (Mirzayans & Halim, 1980; Borji et al., 2010), we identified *Haemonchus tataricus* for the first time in camels of Iran. *Marshallagia marshalli* is very common in sheep in the Mediterranean area, and has been reported from camels of India, USSR, Pakistan and Iran (Dakkak & Ouhelli, 1987; Hayat et al., 1998; Borji et al., 2010). In the present work, one camel had C3 infected with *M. marshalli*. *Physocyclus sexalatus* is a spirurid worm of the stomach of pigs, and is considered to be accidental parasite of camel. Infection with this helminth has been reported from Iran, although pigs are not raised in this country (Mirzayans & Halim, 1980; Elminan, 1995). As camels of Iran may share their pasture with Indian, Pakistani and Afghan camels, this infection may be transmitted to them. It is possible that this nematode has wider range of hosts than those reported.

*Trichostrongylus probolurus* and *Trichostrongylus colubriformis* are two other parasites with high prevalence that were found in this work, which is in accordance with the report by Borji et al. (2010) who found parasites of this genus as dominant worms of GI tract. *Trichostrongylus vitrinus* is also found frequently in camels. However, to the best of our knowledge this is the first report of *Trichostrongylus hamatus* in Iranian camels. *Nematodirus* spp. are small intestinal parasites that are found worldwide. Reported *Nematodirus* species in the Old World camelids are *Nematodirus spathiger*, *Nematodirus dromedarii*, *Nematodirus mauritanicus*, *Nematodirus abnormalis*, *Nematodirus helvetianus* and *Nematodirus oriatianus* (Mirzayans & Halim, 1980; Wernery & Kaaden, 2002). In addition, species closely related to *Nematodirus* spp. are found parasitizing dromedaries: *Nematodirella dromedarii*, *Nematodirella longissimespiculata*, *Impalaia tuberculata* and *Impalaia nudicollis* (Mirzayans & Halim, 1980; Wernery & Kaaden, 2002). In the present study, helminths of *N. spathiger*, *Nematodirella cameli*, *N. mauritanicus*, *N. longissimespiculata*, *N. dromedarii*, *I. tuberculata*, *N. abnormalis* and *N. helvetianus* were identified. Most of these nematodes have been isolated previously from camels of Iran. *Cooperia oncophara* and *Cooperia pectinata* are small nematodes that parasitize small intestine of camelids throughout the world (Dakkak & Ouhelli, 1987). Mirzayans & Halim (1980) also reported *C. punctata* as camel parasites. In the present work, *C. pectinata* was seen in 4 of 114 camels' GI tract.

Whipworms (*Trichuris* spp.) are significant parasites of camelids, and are resistant to treatment with the usual doses of anthelmintics which are effective for other GI nematodes. Adult parasites are found in the caecum and large intestine. Whipworms cause marked enteritis, leading to diarrhoea, dehydration and weight loss (Fowler, 1996). *Trichuris globulosa* is the most prevalent and widespread trichurids of camels (Dakkak & Ouhelli, 1987). Other *Trichuris* spp. have occasionally been reported to occur in camels: *Trichuris ovis*, *Trichuris camelii,* and
Trichuris raoi, Trichuris skrjabini and Trichuris affinis (Kaufmann, 1996). Other trichurids that have been reported from Iranian camels are Trichuris barbetonensis, Trichuris tenius and Trichuris vulpis (Borji et al., 2010; Moghaddar et al., 2012). In the present study, identified Trichuris species in order of prevalence were T. globulosa, Trichuris lani, T. skrjabini and T. infundibulus. Nematode Trichuris infundibulus is reported for the first time from Iranian dromedaries. Oesophagostomum columbianum and Oesophagostomum venulosum are two nematodes that are found in the large intestine of livestock including camels. They are distributed worldwide, but are more important in tropical and subtropical regions (Wernery & Kaaden, 2002). In the present work, only two cases of infection with O. venulososum and Oesophagostomum radiatum were found. These nematodes have been identified previously in the large intestine of Iranian camels by Etminan (1995) and Moghaddar et al. (2012).

Moreover, cestodes such as S. globipunctata had a high prevalence rate, but Moniezia expansa was relatively rare. Same results were found in works by Mirzayans & Halim (1980) and Borji et al. (2010).

In conclusion, as most of the gastrointestinal helminth species in camels are also common to cattle, sheep and goats, so strategic deworming of camel using broad-spectrum anthelmintics seems necessary for enhancing productivity of camels as well as other livestock kept near them. Moreover, human infection with Trichostrongylus spp. (Ghadirian & Arfaa, 1975), Haemonchus contortus, M. marshalli (Ghadirian & Arfaa, 1973), Oesophagostomum spp. (McCarthy & Moore, 2000) and M. expansa (el-Shazly et al., 2004) indicates that camels have important role in maintaining and transmitting zoonotic helminthic infections in dry regions of Iran.

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REFERENCES


