Common gastrointestinal parasites of indigenous camels (*Camelus dromedarius*) with traditional husbandry management (free-ranging system) in central deserts of Iran

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Abstract Gastrointestinal parasites of domesticated animals, especially in animals with traditional husbandry management cause reduction in production and performance of them. Aim of our study was to determine prevalence of gastrointestinal parasites in indigenous camels, with traditional husbandry management that have no direct contact with other livestock. This study was carried out between Kerman and Yazd provinces of Iran, midsummer 2011. Fecal samples of 100 randomly selected camels of all age and sex, collected directly from their rectum. The fecal samples were examined by direct smear, simple flotation technique, centrifugal sedimentation technique, and McMaster egg counting technique and fecal culture to identification and determine the burden of parasites in different age groups. Nematode eggs and *Eimeria* oocysts were found (64 %) and (24 %) in fecal samples respectively. Parasite eggs that observed in camel feces were belong to *Nematodirus* spp. (52 %), *Trichostrongyle* type eggs (49 %), *Haemonchus* spp. (38 %), *Trichuris* spp. (14 %) *Marshallagia* spp. (10 %) and *Eimeria cameli* (24 %), the age of infected camels with helminthic infections was significantly higher than non-infected camels ($p < 0.05$), there was also a significant correlation between age and severity of coccidiosis ($p < 0.05$). Camel calves and camels below 5 years old were more infected with the *Eimeria* sp. than older ones. This study revealed gastrointestinal parasites is a major problem of indigenous camels

with traditional husbandry, so parasite control programs must be established for increasing the productivity of this useful animal and industrial system for breeding camels recommended to increase productivity of them, especially where harsh climatic condition affected other livestock.

Keywords Gastrointestinal parasites · Prevalence · Indigenous camels · Iran

Introduction

The dromedary or one humped camel (*Camelus dromedarius*) is the largest member in camel family. The term dromedary is derived via Greeks from dromos meaning road and thus it is directly applicable to racing and riding. This term has been use throughout the world to describe this species.

The place where this animal became domesticated is uncertain but it is probably the Arabian Peninsula. To the Bedouin of the Arabian Peninsula and northern part of Africa, the dromedary was and still is, in some parts, vital for survival in inhospitable environment. They have served the needs of Bedouin tribes, help them for thousands of years, and have provided them with food, hide, and fuel (Wernery and Ruger Kadden 2002).

Dromedaries also used as beast of burden and in wars. It is written in the bible that around 1100 BC, the Bedouin tribes used dromedaries to occupy Palestine. In that time, this animal should play a more important role than in the twenty-first century, when motorized transportation became popular and food and energy reserves are dwindling (Wernery and Ruger Kadden 2002).

Today there are almost twenty million dromedaries found mainly in the areas from western India via Pakistan

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through Iran to northern Africa and Australia. Upon the annual report of Iranian veterinary organization (IVO) in 2004, the average populations of camels in Iran were 108,000 individuals. They distributed over too many herds and camel raising areas. Most of these camel herds spread through eastern and central provinces, and ordinarily have been raised for meat purpose (Yakhchali and Athari 2010).

One of the major problems of livestock production, camel inclusive, is parasites. Numerous of parasites infected camels, many of them are responsible for enteric infection (Parsani et al. 2008).

Helminthic infections of camelids gastrointestinal (GI) tract are classified into two groups: common and occasional. A number of helminthes are camelids specific, but some are also common to other hosts, especially domestic ruminants and wild animals (Wernery and Ruger Kadden 2002). As an instance among the nematodes, some appear to be practically specific to the dromedary. Camel specific nematodes are included; *Haemonchus longistipes*, *Nematodirus mauritanicus*, *N. dromedarii* but most of camel nematodes are also common to sheep and goats, as an instance: *Trichostrongylus prololurus*, *T. vitrinus*, *Ostertagia mongolica*, *Marshallagia mentulata*, *N. spathiger*, *Oesophagostomum venulosum* (Banaja and Ghadour 1994; Wernery and Ruger Kadden 2002; Parsani et al. 2008). Between these nematodes, *Haemonchus* spp. is the main causative agent in gastrointestinal disorder in camels. It seems that infection with other domestic animal parasites is due to grazing on common pastures (Parsani et al. 2008).

Among gastrointestinal protozoan parasites, *Eimeria* spp. is a major problem in camels. Five reported *Eimeria* spp. have capability to infected camels. these are included: *E. cameli*, *E. pllerdyi*, *E. bacteriani*, *E. dromedarii*, *E. rajasthanii* (Yakhchali and Athari 2010; Wernery and Ruger Kadden 2002). According to previous study *E. droemdarii*, *E. rajasthanii* and *E. cameli* are pathogenic species to young camel calves (Yakhchali and Cheraghi 2007). Infection with these species might be contributing to enteric syndromes affecting camels. Coccidiosis may be seen in camel calves with symptoms like diarrhea and dysentery. There are also signs of dehydration, rough hair coat, and anemia (Parsani et al. 2008).

These gastrointestinal parasites, may assume much more significant role in camel husbandry because Parasites not only reduce the productivity and performance of camels but also predispose them to other infection diseases. Knowledge on camel husbandry management and parasitic diseases control is still very unreliable and insufficient. In Iran most available information about gastrointestinal parasites of camels are based on post mortem examination of limited numbers (Borji et al. 2010). Camel husbandry is done in different ways, however industrial breeding system in countries like Iran with wide deserts and low rainfall

more profitable and this animal can be a stable supply of meat and milk by good management but most of camel owners prefer the traditional method or free-ranging system to reduce feeding costs and obtain more profits. Aim of our study was to determine prevalence of gastrointestinal parasites in indigenous camels with traditional husbandry management in central deserts of Iran.

Materials and methods

This study was carried out in the middle of summer, 2011. A total of 100 seemingly healthy camels of both sexes, from different herds selected randomly over a geographic region between Kerman and Yazd provinces. This region located in center of Iran between latitude 30°0.15"N. and longitude 54°0.63"E. and it was about 1,850 m altitude above the sea level. Camels were indigenous and followed traditional husbandry practices or free-range system. The camels were over 1–20 years old. They had no antihelminthics treatment in the previous years and there were not any direct contacts between these camels and other livestock. After clinical examination, fecal samples were collected directly from the rectum by disposable rectal gloves and placed into plastic fecal containers with lid containing formalin 10 % and labeled with different data such as age, sex and feces consistency. The samples then transferred to veterinary parasitology library belong to Shahid Bahonar University of Kerman for parasitological examination. Each fecal sample were examined by direct smear, simple flotation method using saturated sodium nitrate (SpG: 1.33) and centrifugal sedimentation technique and fecal culture as described by (Zajac and Conboy 2006). Fecal egg counts (EPG) were determined by modified McMaster egg counting technique as stated by Zajac and Conboy (2006). In addition, all the samples were also examined for presence of *Eimeria* spp. and the oocysts were counted (OPG) by the modified McMaster egg counting technique as describe by (Zajac and Conboy 2006).

In each case, 2 g of feces were mixed in 28 ml of saturated solution as the floating medium and the number of helminth eggs and oocysts per gram of feces was obtained by multiplying the counted eggs and oocysts in the counting chambers of the McMaster slide by dilution factor and fecal consistency factor (Zajac and Conboy 2006). Helminth eggs and *Eimeria* spp. oocysts were identified based on morphological characters as described by Soulsby (1982).

Statistical analysis was performed using IBM SPSS statistics 19. The χ square test was used for comparison of the infection rate between the two sexes, age groups, and correlation between them.

Results

Examination of 100 free-range camels including 56 male and 44 female, that categorized into four groups according to their age (Table 1) revealed, that 64 (64 %) were positive for different type of nematode eggs. All of these infected camels harboring more than one parasite. There were no significant differences between female and male camels in parasitic infection and severity of infection according to EPG ($p > 0.05$) (the egg counts were varied from 100 to 1,000 per gram of feces), but the age of infected camels were significantly higher than none infected camels ($p < 0.05$). The GI parasite eggs recovered from the samples belonged to *Haemonchus* spp., *Nematodirus* spp., *Trichuris* spp., *Marshallagia* spp., and genus of intestinal parasites in the family Trichostrongylidae. Figures 1, 2, 3 and 4 presents detected eggs in the samples, the morphological characters, and prevalence of nematode eggs and oocysts recovered from the samples are given in (Table 2). The highest percentage belonged to *Nematodirus* spp. (52 %) followed by Trichostrongyle eggs (49 %), *Haemonchus* spp. (38 %), *Trichuris* spp. (14 %) and *Marshallagia* spp. (10 %). Trematode eggs were not found in the samples. In addition, 24 (24 %) samples were positive for *Eimeria* spp. (Table 2). Oocysts of *E. cameli* or the large *Eimeria* (Figs. 5, 6) were the only oocysts that identified in the samples (OPG range 100–2,000 per gram). There was a significant correlation between age and severity of infection ($p < 0.05$) Camel calves and camels below 5 years old were more infected with the *Eimeria* sp. than older ones but older camels (more than 5 years old) that passing oocysts in their feces have a normal fecal consistency and don't have any sign of coccidiosis.

Discussion

However it proved that, due to its typical browsing habit camels are less liable to helminthic diseases in contrast to other ruminants (Parsani et al. 2008; Borji et al. 2010), but Gastrointestinal parasites of camels had received the attention of many scientists in recent years (Moustafa et al. 2003). Camel husbandry management covers different subjects, which have direct or indirect impact on the final

Table 1 Four camel groups according to their age (G = group)

Camels age	G ₁ ≤ 5	G ₂ (6–10)	G ₃ (11–15)	G ₄ ≤ 20
Male	16	19	14	7
Female	7	8	21	8
Total	23	27	35	15

Fig. 1 *Marshallagia* spp. egg recovered from camels feces

Fig. 2 *Nematodirus* spp. egg recovered from camels feces

products of this animal. These are included feeding, breeding and diseases control.

All of these factors affect the growth and production of the animals. The present study was carried out to get clear picture of gastrointestinal helminthes and *Eimeria* spp. in indigenous camels with traditional management in central deserts of Iran.

Prevalence of gastrointestinal nematode in this study is incoherence with Radfar et al. (2006), who reported much lower incidence with different species of parasites among

Fig. 3 *Haemonchus* spp. and *Trichuris* spp. eggs recovered from camel feces

Fig. 4 Trichostrongyle type egg recovered from camels feces

60 slaughtered camels in Kerman slaughterhouse central part of Iran (Radfar et al. 2006). This might be because of examination of non-indigenous camels, differences in the age, season, and different husbandry management that sampled camels had. Our result also is lower than reported of 75.1 % in the dromedary in Mashad slaughterhouse northeast of Iran by Borji et al. between October (2007) and September (2008) (Borji et al. 2010) and higher than the prevalence of 52 % in bactrian camels in northwest of

Iran. The prevalence of *Nematodirus* spp. in current study was higher than other nematodes, this was similar with Tajik et al. They reported that prevalence of this genus is higher than other nematodes in bactrian camels (Tajik et al. 2011). The incidence of positive cases in current study were much low compared with that reported in Saudi Arabia (89 %) in (1985), in Kuwait (93.8 %) in (1988) and in Jordan (98 %) in (2000) (Moustafa et al. 2003). Our results were nearly similar to those obtained by Mahfooz et al. (2006) In Pakistan (60 %) (Mahfooz et al. 2006) in Tanzania (62.7 %) (Swai et al. 2011; Bakhsh Alhendi 1995) in Saudi Arabia (64.5 %) (Bakhsh Alhendi 2000).

The differences between the results of these studies might be due to differences in the age, species, the method of husbandry that the examined camels had, and the climatic condition of the areas.

The achieved collected data from above studies pointed out the list of common helminthes existed in camels in Iran, which match with that recorded in another studies in other Asia countries with much or less variation in the incidence proportions.

Moreover, the present study investigated that 24 % of sampled camels infected only with *Eimeria cameli*. The prevalence of the *Eimeria* spp. in our study was higher than those obtained by Yakhchali et al. (12.8 %) between January to December 2005 in Miandoab region among 40 dromedary (17.5 % infected) and 85 bactrian camel (10.6 % infected) and was higher than those obtained by (Yakhchali and Athari 2010) in Tabriz region (20.73 %). Variety of spices were identified in these studies were not agreed with ours (Yakhchali and Cheraghi 2007). our result was not agree with previous studies in other countries with prevalence rate of 14 % in Saudi camels, 17.4 % in Sudanese camels, 41.6 % in Saudi Arabian camels and 12.5 % in Pakistan camels, respectively (Yakhchali and Athari 2010). Our result were nearly similar to those obtained by Omar et. al. (2000), who concluded that the infection rate of *Eimeria* species in camels were 22.2 % in Egypt (Karima 2009). Varieties of species in these studies were not agreed with that obtained in our study.

Eimeria cameli is one of the pathogenic species in camels. A study on *E. cameli* in Saudi camels revealed that this parasite occurs throughout the year, but is commonest during September. The differences among *Eimeria* species and their prevalence depend on different factors. These factors vary from the environmental conditions, animal factors, husbandry management, and other factors like illness and stress. Clinical eimeriosis appears mostly under stressful conditions and if the host is subject to heavy infection particularly after weaning (Yakhchali and Cheraghi 2007).

Camel's products can be an important sector of food supply in most countries. This animal can provide a

Table 2 Morphological characters and prevalence of gastrointestinal parasites in the samples

Species	Length (μ)	Width (μ)	Remarks	Infection in different age groups (G = group)				Prevalence in sampled camels (%)
				G ₁	G ₂	G ₃	G ₄	
<i>Nematodirus</i> spp.	175–260	106–110	Eggs are large containing eight cells	7	13	23	9	52
<i>Trichostrongyle</i> type eggs	80–120	55–70	Oval, thin-shelled eggs with cells inside	6	14	21	8	49
<i>Haemonchus</i> spp.	70–85	41–48	Embryonated eggs containing 16–32 cells	5	15	15	3	38
<i>Trichuris</i> spp.	70	35	Barrel shape eggs with plug at either pole	3	5	6	–	14
<i>Marshallagia</i> spp.	160–200	75–100	Large eggs with thin shell and many cells	–	1	5	4	10
<i>Eimeria cameli</i>	81–100	63–94	Dark brown to black piriform oocysts	18	5	1	–	24

Fig. 5 *Eimeria cameli* oocyst recovered from camel feces **Fig. 6** *Eimeria cameli* oocyst recovered from camel feces

substantial amount of meat and milk where climatic conditions affected other animals. Camels can provide suitable and continuous supply of food in countries with harsh climate when famine becomes widespread.

Camel meat and milk yield depends on the general health, feeding condition and animal sex. Parasitic infection can cause considerable losses in camels (Rewatkar et al. 2009). Losses are due to mortality, lowering of reproductive, growth rate, weight loss and increased in production cost because of additional veterinary bills (Swai et al. 2011; Wernery and Ruger Kadden 2002).

Previous studies in Iran and current study revealed that camels affected by different parasites and parasitosis is a major problem in this animal. To control parasitic diseases and increase the productivity, health, and performance of these camels, anthelmintic drugs must be used, in addition, traditional camel husbandry must be change, because it has

no future and industrial system must be initiated in countries that climatic condition affected other livestock to obtain a suitable supply of food.

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