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Parasitic Helminths of Domesticated and Wild Ruminants in Cholistan Desert of Pakistan

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ABSTRACT

The present study was carried out to assess the prevalence of gastrointestinal helminths infections among wild and domestic ruminants in Cholistan desert of Pakistan. For this purpose, 1010 faecal samples of different species of ruminants including cattle (n=300), sheep (n=250), goat (n=100), camel (n=200), chinkara (n=150) and blackbuck (n=10) were examined using standard parasitological procedures. The highest prevalence was recorded in cattle (44.7%) followed by sheep (43.6%), goats (39%), camels (37%), chinkara (26.7%) and black bucks (20%). Maximum number of the helminth species were recorded in sheep (n=14) followed by camels (n=13), cattle (n=09), goats (n=08), chinkara (n=07) and black bucks (n=02). Nematodes were the predominantly occurring (n=18) helminths followed by trematodes (n=6) and cestodes (n=3). *Haemonchus* and *Trichostrongylus* were the most frequently recorded genera followed by *Chabertia*, *Oesophagostomum*, *Schistosoma*, *Moniezia*, *Cooperia*, *Bunnostomum*, *Toxocara*, *Ostertagia*, *Nematodirus*, *Trichuris*, *Strongyliodes*, *Avitellina*, *Fasciola*, *Thelazia* (n=02), *Syngamus*, *Gaigeria*, *Skrjabinema*, *Cotylophoron*, *Metastrongylus* and *Gongylonema* as mixed or single species infections in different species of animals. It was concluded that wild and domesticated ruminants of the Cholistan desert of Pakistan suffer with heavy infections of a variety of helminths including those of high economic significance. Therefore, high prevalence of helminthes warrants immediate attention of the stakeholders for devising an effective worm control program in the Cholistan desert. © 2012 Friends Science Publishers

Key Words: Parasite; Helminth; Chinkara; Blackbuck; Ruminants; Cholistan; Pakistan

INTRODUCTION

Pakistan spawns a remarkable number of the natural resources regarding all ecological pyramids and regions. The desert of Cholistan is one of the key ecological arid zones with extreme seasonal variation and consists of wide variety of edaphic conditions. The whole desert of Cholistan is covered with little vegetation, have severe climatic conditions and great thrust of grazing animals (Khan, 2006). Integrity, productivity and sustainability of the animal population is experiencing profound ecological and physiological threats due to rapidly disappearing plant species, traditionally grazed by the animals and logistic difficulties in delivering proper healthcare facilities. The animals suffer from a variety of infectious and non-infectious diseases, particularly that of parasitic origin (Iqbal *et al.,* 2000; Akhter & Arshad, 2006; Siddiki *et al*., 2010). Parasitisim is a universal problem of livestock leading to lowered productivity (Dhar *et al*., 1982; Lashari & Tasawar, 2011; Hossain *et al*., 2011). The nature and extent of production losses; however, vary from one parasite to the other. Helminthiasis is however, of high economic siginificance and is highly prevalent in different parts of Pakistan (e.g., Iqbal *et al*., 1993; Khan *et al*., 1989; Sajid *et al*., 1999; Athar *et al*., 2011; Zaman *et al*., 2012). The livlihoods of poor resource farmers, like pastoral nomads of the Cholistan desert, having limited access to the modern animal health care facilities are, therefore, are at a greater risk due to parasitic infcetions of their animals. The present study was conducted to determine the prevalence of gastrointestinal helminths of wild and domestic ruminants in Cholistan desert, (Punjab), Pakistan in view of their high economic significance due to production losses associated with them.

MATERIALS AND METHODS

Characteristics of study area: The Cholistan desert is located in southern Punjab extending through the Nara and Thar desert of Sindh (Pakistan) between latitudes 27° 42′ and 29° 45′ N and longitudes 69° 52′ and 75° 24′ E, covering about 2.6 million hectares (FAO, 1993; Chaudhry *et al*., 1997). The mean annual rainfall varies from 100 mm in the west to 200 mm in the east, chiefly falling during monsoon (July through September). Rainfall is very inconsistent in quantity and duration, and prolonged droughts are common once every 10 years. The mean summer temperature ranges from 34 to 38˚C, while the maximum temperature during May and June may shoot up to 51.6˚C. The winter temperature ranges between 14 to 16˚C, while the minimum temperature during December and January may fall below zero. The mean relative humidity varies from 30 to 45% (Mughal, 1997; Arshad *et al*., 2002). Cholistan is a wind-resorted sandy desert and comprises of old river terraces, large sand dunes and less interdunal flat areas (Baig *et al*., 1980; Arshad & Rao, 1994; Chaudhry *et al*., 1997; Akbar & Arshad, 2000). There are no permanent, natural bodies of surface water in Cholistan. Factors like low rainfall, high rate of water infiltration and high evaporation rate prevent the natural accumulation of surface water. Underground water is at a depth of 30-50 m, generally brackish, containing salts 9,000-24,000 mg/L (Akbar *et al*., 1996).

The interior desert area is not connected by a modern communication system and sandy desert tracks are used for travel by camels. Habitations are small and extremely scattered around the "*tobas*", which are man-made dug out rainwater collection ponds (Akbar *et al.,* 1996). These are made in clayey flats (locally called *dahars*) with a large catchment area to avoid the loss of runoff and water percolation. Geographically, Cholistan comprises of parts from district Bahawalnagar on the east, district Ghotki of Sindh province on the west, district Jasilmir and state of Bikanir (India) on the south and district Bahawalpur and Rahim Yar Khan on the north. Various locations within the Cholistan desert are named after the owners of "*tobas*" or historical forts. For this study, the following 35 tobas/forts were selected randomly including 15 each from district Rahim Yar Khan and Bahawalpur and five from district Bahawalnagar: Derawar, Dahri wala, Channan Pir, Kalay paharr, Janu wala, Kheersar, Mouj Garh, Habib wala, Din Garh, Tawe wala, Kandi wala, Akmal wala, Balwatta, Bijnot, Salamsar, Chachran, Sure wala, Khair Garh, Kot Murid, Khipla Dahar, Baghla, Khabbar, Tahir wala, Kandera, Bahu, Islam Garh, Gunyan wala, Lakhan wala, Kakki wala, Khara, Morot, Fort Abbas, Dodhlan, Mahar wala and Modi. The selection of tobas was based on simple proportionate sampling and the minimum distance between them was probably 15 km.

Livestock production and health management: The total livestock population in Cholistan has been estimated at 1,295,462 heads (Livestock Census of Pakistan, 2006). Herd reproductive performance is generally poor with low birth and high mortality rate due to starvation and malnutrition, lack of healthcare and climatic stresses (Mumtaz, 1982; FAO, 1993; Akbar *et al.,* 1996). Three inter-related aspects of animal health i.e., feed, water and disease have been encountered in Cholistan desert. Deficiencies in the availability of forage (quantity & quality), drinking water (saline or polluted) and free mixing of diseased animals with healthy ones during grazing expose livestock to various types of disease. Veterinary health centers are not available towards the interior of the desert and very few poorly-equipped small units are available in peripheral cities. Livestock owners often become distressed and helpless when their livestock fall seriously ill. Therefore, local people are rich in traditional knowledge of animal husbandry practices, which they have inherited from their fore-fathers. Like domesticated animals, wild ruminants, i.e., Chinkara (*Gazella bennetti*); Blackbuck (*Antilope cervicapra*) and Nilgai (*Boselaphus tragocamelus*) also have low reproduction performance and high mortality rate due to starvation, malnutrition, population and hunting pressure, and ecological haphazard (Chaudhry *et al.*, 1997).

Prevalence of Helminths

Sample collection: Faecal samples (n=1010) of different species of ruminants including cattle (n=300), sheep (n=250), goat (n=100), camel (n=200), chinkara (n=150) and blackbuck (n=10) were randomly collected in sterile polythene bags directly from rectum or from fresh excreta on the ground (especially wild animals). These faecal samples were brought to District Diagnostic Laboratory Bahawalpur for examination.

Faecal examination: Faecal samples were examined for helminth eggs/larvae by using standard direct and indirect parasitological procedures (MAFF, 1979; Soulsby, 1987). Eggs were identified with the help of keys (MAFF, 1979; Soulsby, 1987). For identification of certain nematodes, coprocultures were performed to obtain larval stage as described by MAFF (1979). Faecal cultures provide an environment suitable for hatching of helminth eggs and for their development. Faeces found positive for parasitic eggs but confusing for exact identification were broken up finely, using either a large pestle and mortar or spatula and were placed in a glass jar or Petri dish which were closed and incubated at 27ºC for 7 days. After incubation, samples were examined for larvae. Larvae were identified with the help of keys (MAFF, 1979).

Data analyses: Percent prevalence of different species of helminths was calculated by the following formula:

% Prevalence = [Number of samples positive/Total number of samples examined] x 100

RESULTS

Prevalence of helminths among different species of ruminants ranged from 20 to 44.7% (Table I). The highest prevalence was recorded in cattle (44.7%) followed by sheep (43.6%), goats (39%), camels (37%), chinkara (26.7%) and black bucks (20%). Majority of the animals were found to have nematode infections. Maximum number of the helminth species were recorded in sheep (n=14) followed by camels (n=13), cattle (n=09), goats (n=08), chinkara (n=07) and black bucks (n=02) (Table I).

Majority of the infected cattle (n=72/134), goats (n=21/39), camels (n=44/74) and chinkara (n=32/40) harbored mixed species of helminths; whereas, majority (n=57/109) of the infected sheep harbored single helminth

Table I: Prevalence of different species of helminths in ruminants in Cholistan desert

Species of animal	Prevalence of Helminths				
	% Faecal samples negative	% Faecal samples positive	Number of Nematode species	Number of Trematode species	Number of Cestode species
Cattle	55.3 (166/300)	44.7 (134/300)	06	03	NIL
Sheep	56.4 (141/250)	43.6 (109/250)	09	02	03
Goat	61 (61/100)	39 (39/100)	05	01	02
Camel	63 (126/200)	37 (74/200)	09	02	02
Chinkara	73.3 (110/150)	26.7 (40/150)	06	NIL	01
Black buck	80 (8/10)	20 (2/10)	02	NIL	NIL

Figures in parenthesis are the number of animals negative or positive/total number of animals examined

infections (Table II). Nematodes were the predominantly occurring (n=18) helminths followed by trematodes (n=6) and cestodes (n=3). Data (Table II) indicate that *Haemonchus* and *Trichostrongylus* were the most frequently (n=13) recorded genera followed by *Chabertia*, *Oesophagostomum* (n=08), *Schistosoma* (n=07), *Moniezia* (n=05), *Cooperia*, *Bunnostomum*, *Toxocara*, *Ostertagia*, *Nematodirus, Trichuris, Strongyliodes, Avitellina* (n=03), *Fasciola, Thelazia* (n=02), *Syngamus, Gaigeria, Skrjabinema, Cotylophoron, Metastrongylus*, and *Gongylonema* (n=01) as mixed or single species infections in different species of animals. Of the 27 helminth species recorded in the present study, 13, 08, 03, 01 and 02 were found to infect one, two, three, four and five species of the animals, respectively (Table III).

DISCUSSION

Helminths having direct life cycles were the most common parasites in the study area. *Haemonchus* (H.) *contortus* and *Trichostrongylus* species were of the highest concern as they infected majority of the ruminants with a prevalence range of 8.7 to 20% in the study area. For cattle, however, *Oesophagostomum radiatum, Bunostomum phlebotomum, Cooperia pectinata* and *Schistosoma bovis* were the most significant in view of their prevalence (9.2 to 25.1%). Of the wild animals, Chinkara harboured five helminthes (*Gongylonema pulchrum, Oesophagostomum columbianum, Chabertia* (Ch.) *ovina, Strongyliodes* (S.) *papillosus, H. contortus* & *Trichostrongylus spp.*); whereas only ova of two species of helminths (*H. contortus* & *Trichostrongylus spp.*) were identified from blackbuck. Chinkara shared *Ch. ovina, S. papillosus, H. contortus* and *Trichostrongylus spp.* infections with domesticated animals; whereas black buck shared only *H. contortus* and *Trichostrongylus spp.* Three species of helminths (*Schistosoma japonicum, Gongylonema pulchrum* & *Gaigeria pachysoelis)* were found as single infections; whereas 24 species occurred in combinations of two and/or

Table II: Prevalence of different species of helminths in cattle, sheep, goats, camels, chinkara and black buck in Cholistan desert

Species of animal/helminth	Prevalence (%)
Cattle (n=300)	
Oesophagostomum radiatum	9.3
Oesophagostomum radiatum; Cooperia pectinita	7.6
Schistosoma bovis	5.6
Bunnostomum phlebotomum; Schistosoma bovis	4.3
Bunnostomum phlebotomum; Oesophagostomum radiatum	4.3
Schistosoma japonicum	3.7
Bunnostomum phlebotomum; Schistosoma indicum	3.0
Toxocara vitulorum; Oesophagostomum radiatum	2.3
Thelazia rhodesii	2.0
Thelazia rhodesii; Oesophagostomum radiatum; Cooperia pectinita	1.6
Toxocara vitulorum; Schistosoma indicum; Syngamus laryngeus	0.7
Sheep (n=250)	
Haemonchus contortus	10.4
Trichostrongylus spp.	7.2
Haemonchus contortus; Ostertagia circumcincta	4.4
Trichostrongylus spp.; Nematodirus spathiger	4.0
Trichuris globulosa; Chabertia ovina	4.0
Haemonchus contortus; Trichostrongylus spp.	3.2
Fasciola hepática	2.8
Gaigeria pachysoelis	2.4
Strongyliodes papillosus; Avitellina centipunctata	2.0
Chabertia ovina; Skrjabinema ovis	1.2
Haemonchus contortus; Moniezia benedeni	0.8
Trichuris globulosa; Cotylophoron cotylophorum	0.8
Chabertia ovina; Moniezia expansa	0.4
Goats (n=100)	
Trichostrongylus spp.; Ostertagia circumcincta	9.0
Haemonchus contortus	9.0
Trichostrongylus spp.	8.0
Strongyliodes papillosus; Avitellina centipunctata	6.0
Haemonchus contortus; Trichostrongylus spp.	4.0
Ostertagia circumcincta; Fasciola hepatica	2.0
Moniezia expansa	1.0
Camels (n=200)	
Haemonchus contortus; Trichostrongylus spp.	8.5
Trichostrongylus spp.; Chabertia ovina; Schistosoma nasalis	4.5
Trichuris globulosa	4.5
Avitellina centipunctata	3.5
Haemonchus contortus; Trichostrongylus spp.; Schistosoma bovis	3.0
Metastrongylus spp.; Moniezia expansa	3.0
Oesophagostomum radiatum	3.0
Trichostrongylus spp.	2.5
Oesophagostomum radiatum; Cooperia pectinita; Chabertia ovina	2.0
Nematodirus spathiger	1.5
Nematodirus spathiger; Toxocara vitulorum	1.0
Chinkara (n=150)	
Haemonchus contortus	6.0
Haemonchus contortus; Trichostrongylus spp.; Oesophagostomum columbianum	4.7
Haemonchus contortus; Trichostrongylus spp.	4.0
Chabertia ovina; Strongyliodes papillosus	3.3
Gongylonema pulchrum	3.3
Chabertia ovina	2.7
Chabertia ovina; Moniezia expansa	2.7
Blackbucks (n=10)	
Haemonchus contortus; Trichostrongylus spp.	10.0
Haemonchus contortus	10.0

three parasites. Majority of the combined infections were those of nematode species. As far as could be ascertained, *Thelazia, Syngamus, Gaigeria, Skrjabinema, Cotylophoron,*

Table III: Distribution and per cent prevalence of helminth species (n=27) in different hosts in Cholistan desert

Species of Helminth	Per cent prevalence					
	Cattle	Sheep	Goat	Camel	Chink-ara	Black buck
Single host helminthes	-	-	-	-	-	-
Bunnostomum phlebotomum	11.6	-	-	-	-	-
Cotylophoron cotylophorum	-	0.8	-	-	-	-
Gaigeria pachysoelis	-	2.4	-	-	-	-
Gongylonema pulchrum	-	-	-	-	3.3	-
Metastrongylus spp.	-	-	-	3.0	-	-
Moniezia benedeni	-	0.8	-	-	-	-
Oesophagostomum columbianum	-	-	-	-	4.7	-
Schistosoma indicum	3.7	-	-	-	-	-
Schistosoma japonicum	3.7	-	-	-	-	-
Schistosoma nasalis	-	-	-	4.5	-	-
Skrjabinema ovis	-	1.2	-	-	-	-
Syngamus laryngeus	0.7	-	-	-	-	-
Thelazia rhodesii	3.6	-	-	-	-	-
Two host helminthes	-	-	-	-	-	-
Cooperia pectinita	9.2	-	-	2.0	-	-
Fasciola hepatica	-	2.8	2.0	-	-	-
Nematodirus spathiger	-	4.0	-	2.5	-	-
Oesophagostomum radiatum	25.1	-	-	5.0	-	-
Ostertagia circumcincta	-	4.4	11.0	-	-	-
Schistosoma bovis	9.9	-	-	3.0	-	-
Toxocara vitulorum	3.0	-	-	1.0	-	-
Trichuris globulosa	-	4.8	-	4.5	-	-
Three host helminths	-	-	-	-	-	-
Avitellina centipunctata	-	2.0	6.0	3.5	-	-
Chabertia ovina	-	5.6	-	6.5	8.7	-
Strongyliodes papillosus	-	2.0	6.0	-	3.3	-
Four host helminthes	-	-	-	-	-	-
Moniezia expansa	-	0.4	1.0	3.0	2.7	-
Five host helminthes	-	-	-	-	-	-
Haemonchus contortus	-	18.8	13.0	11.5	14.7	20.0
Trichostrongylus spp.	-	14.4	21.1	18.5	8.7	10.0

Metastrongylus and *Gongylonema* were the new records of the helminths from the Cholistan desert.

Occurrence and the rate of prevalence of different species of helminths in animal population is quite a complex subject like worms themselves. It is governed by a variety of factors. Most important, however may be the climatic conditions supportive to the perpetuation of life cycles of these parasites. Naturally, sub-tropical climates in the temperate and humid regions are more conducive for the development and survival of larval forms and also for the vectors/intermediate hosts. As mentioned above, nematodes dominated in overall landscape of the helminth infections in ruminants of Cholistan as many of them do not require an intermediate host for completion of their life cycle. Nevertheless, for egg hatch and larval development they find suitable conditions around "*tobas*" i.e., natural water collections. Interestingly, the number of helminth species recorded from domestic ruminants was quite high compared with the wild animals, particularly in sheep, camel and cattle. This may be due to differences in the grazing pattern and time. For instance, domestic animals are found grazing as a herd and often mix up with other herds on communal type of pastures. In contrast, wild animals graze during nights and remain captive during day light. Therefore, there is remote possibility for their mingling with other animals. The wild animals shared good number of helminths with their domestic counterparts. This indicates that these parasites may use more than one host in the Cholistan desert and possibility of sylvatic strains of such helminths can not be ruled out, and may have some epidemiological implications.

The epidemiology of helminth diseases is determined by several factors governed by the environment-host-parasite interaction. As indicated above, majority of the hosts had mixed helminth infections, which reflect upon animal production losses due to these parasites. The trichostrongylid nematode species of economic importance, which have been most frequently identified from tropical areas include *H. contortus*, *Trichostrongylus* spp. and *Ostertagia* spp. (Suarz & Busetti, 1995; Maqsood *et al.*, 1996; Ankers *et al.*, 1997; El-Sayed, 1997).

The helminths recorded in the study area have also been reported previously by Siddiqi and Ashraf (1980), Shah *et al.* (1980), Mohiuddin *et al.* (1984) and Khan *et al.* (1989) from different areas of Pakistan and by Van Aken *et al.* (1990), Pandey *et al.* (1994), Jacquiet *et al.* (1995) and Dorny *et al.* (1995) in different parts of the world. However, these workers have also reported some other helminths in addition to those recorded in the current study. Variations also exist in the rate of prevalence of different helminths in different regions. Such a regional variation in the record of various species has been widely reported. A variety of factors like age, sex and breed of the host, grazing habits, level of education and economic capacity of the farmers, standard of management and anthelmintic used (Komoin *et al.*, 1999; Valcarcel & Romero, 1999; Ouattara & Dorchies, 2001) can influence the prevalence of helminths.

The most prevalent nematode recovered in this study was *H. contortus*. This is in the agreement with findings of Ahmed and Ansari (1987), and Gupta *et al*. (1987). They also observed that *H. contortus* was the most prevalent nematode species in small ruminants of their respective study areas. The higher prevalence could be due to the fact that this nematode has a relatively short generation interval and ability to take the advantage of favorable environmental conditions (Grant, 1981). The mean monthly maximum temperature of 18°C or above and total monthly rainfall of 50 mm are conducive for translation and transmission of *H. contortus* (Gordon, 1953). Therefore, climate of the study area for a larger part of the year is conducive for the propagation of *H. contortus* larvae. A warm and moist summer is well suited to the development and survival of the free-living stages of nematodes (Grant, 1981). Though, data have not been shown here, prevalence of some species of helminths like *H. contortus* and *Trichostrongylus* spp. decreased during some months of the year. This decrease was due to low temperature and rainfall in some months and low resistance of the free-living stages of this parasite to quick varying weather conditions (Kates, 1950), which were not conducive for the propagation of infective larvae.

The pre-patent period for *H. contortus* in sheep is on an average of 15 days (Soulsby, 1982). The larval development of *H. contortus* occurs optimally at relatively high temperatures, high humidity, microclimate of faeces and herbage and high rainfall (Urquhart *et al.*, 1987). Generally, temperature favorable for the development and translation of the free-living stages of *H. contortus* may have a diurnal fluctuation between 23.3°C and 11.6°C (Dinnik & Dinnik, 1961) and mean monthly rainfall exceeding 50 mm (Grant, 1981). Therefore, all these factors were favorable for the larval development of *H. contortus* in Cholistan.

Trichostrongylus species (the 2nd most important parasites recorded in this study) are generally considered as cool-season parasites (Southcott *et al*., 1976), thrive best at mean monthly temperatures ranging from 2.8°C to 18.3°C and disappear when temperature exceeds 20°C (Gordon, 1953). The eggs and infective larvae of *Trichostrongylus* species have been reported to have a high capacity of survival under adverse weather conditions like cold or desiccation (Urquhart *et al.*, 1987). However, findings of the present study regarding relatively low prevalence of *Trichostrongylus* species during winter months do not support the theory of being cool-season parasites. Rather, these findings are consistent with those of Gupta *et al*. (1987), who have reported non-conducive effects of cool season on the *Trichostrongylus* species.

An other important factor, which may influence the prevalence of helminths is the peri-parturient stress, having important epidemiological significance (Yazwinski & Featherstone, 1979; Gibbs & Barger, 1986). Stress due to parturition, lactation, weather and poor nutritional status of the animals is also a contributory factor for peri-parturient rise in egg/worm counts (Crofton, 1958). High fecal egg counts result in pasture contamination; therefore, they have direct influence on the population dynamics of nematodes like that of *Trichostrongylus colubriformes* (Barnes & Dobson, 1990). This is particularly true for the nematodes, which are highly prolific like *H. contortus* laying up to 10000 eggs per day for several months and under optimum climatic conditions, gross contamination of the pasture can occur in a very short time (Radostits *et al.*, 1994).

In conclusion, wild and domesticated ruminants of Cholistan desert of Pakistan suffer heavy infections of a variety of helminths including those of high economic significance. There is no strategic deworming program for the animals in the study area and pastoralists have to rely on the traditional veterinary practices mainly based on the use of plants. The government should take necessary steps to provide on-site training to the native farmers to enhance their skills for the ideal management husbandry practices and preventing/ reducing the worm infections in animals.

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