

PARASITIC DISEASES OF CAMELS - AN UPDATE

2. HELMINTHOSES

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ABSTRACT

Despite being usually reared under harsh environment, unsuitable for propagation and transmission of helminths, camels are capable of harbouring a fairly large variety of these parasites. There is paucity of literature as helminthic infections of camels are generally regarded less of a problem than those in other ruminants. However, gastrointestinal nematodes (GIN) are known to undermine the overall health and productivity of camels. The camel stomach worm *Haemonchus longistipes* is the most pathogenic strongyle nematode of camels. A voracious blood sucker, it may be associated with clinical disease which can be fatal. Trichostrongyles are very common and may contribute to the debilitating effects of GIN. Extraintestinal nematodes commonly parasitising camels include *Onchocerca fasciata*, which characteristically produces subcutaneous nodules in the head and neck regions; the filarial worm *Dipetalonema evansi*, the eye worm *Thelazia* spp., and rarely the lungworms (*Dictyocaulus* spp. or *Protostrongylus* spp.). Among larval cestodes, hydatid cysts are commonly reported while *Cysticercus* and *Coenurus* are infrequent. This review combines information gleaned from recent reports on prevalence, epidemiology and clinical aspects of helminthoses of the dromedary camels. The compilation also includes progress in anthelmintics relevant to the control of helminths in camels. It is intended to serve as guide for planning future investigations in this field.

Key words: Camels, dromedary, helminth parasites, helminthoses, parasites

Traditionally, the camel has been playing a unique role in the desert ecosystem. Of late, this animal has shown a high degree of ability to adapt to intensive farming processes for dairy and meat production. This has resulted in increased focus on the improvement of its health status. In order to ensure a scientific outlook and contemporary integrated approach towards the control and management of potential challenges, it is desirable to take stock of new information and recent advances. This compilation is intended to cover the available reports on helminths and helminthoses of the camel since the publication of notable reviews on the subject (El Bihari, 1985; Dakkak and Ouhelli, 1987). Almost half of these reports relate to gastrointestinal nematodes including disease entities like strongyloses featuring the abomasal worm, *Haemonchus longistipes*.

Gastrointestinal Nematodoses (GIN)

Epidemiological data from various reports based on faecal samples or abattoir examinations indicate prevalence of multiple gastrointestinal helminths with *Haemonchus* spp. as the predominant infection. In Kuwait (Abdel-Salam and Farah, 1988), seasonal fluctuations were observed with high prevalence

during rainy season. In dry and hot season, low prevalence with predominance of immature and stunted parasites, was recorded. From Sudan, 37% of camels were reported (Yagoub, 1989) positive for *H. longistipes* on faecal examination and larval culture. In the Ogaden province of Ethiopia (Wosene, 1991), faecal examination of 180 camels showed prevalence rate of 95.6% gastrointestinal parasites while abattoir studies on 41 camels showed 88% *Haemonchus* spp. Faecal examination and larval culture of 115 racing camels in Qatar (Sharma, 1991) showed *Haemonchus* spp., *Trichostrongylus* spp., *Trichuris* spp. and *Strongyloides* spp. as common infections and *Impalaia* spp., *Nematodirus* spp. and *Ostertagia* spp. as occasional parasites. Camels in Saudi Arabia were commonly infected with *H. longistipes*, *Trichuris* spp., *Camelostongylus mentulatus*, *Trichostrongylus* spp. and *Parabronema skrjabini* while *Nematodirus* spp., *Strongyloides* spp., *H. contortus* and *Ostertagia ostertagi* were occasionally found (Banaja and Ghandour, 1992). Gastrointestinal parasites were recorded in 19.4% of 5256 faecal samples from racing camels in UAE (Kayum *et al*, 1992). The most commonly encountered were *Haemonchus* spp., *Trichostrongylus* spp. and *Nematodirus* spp., while others observed

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included *Oesophagostomum* spp., *Strongyloides* spp., *Camelostrongylus* spp., *Marshallagia* spp., *Trichuris* spp., *Bunostomum* spp. and *Ostertagia* spp. These workers regarded Willis flotation method as the best in a comparative evaluation of different methods of faecal examination. An abattoir survey in Mali (Tembely *et al*, 1992) revealed *H. longistipes* as the predominant parasite (85.7% prevalence) while genera like *Impalaila*, *Trichostrongylus*, *Cooperia* and *Oesophagostomum* were less frequent. Studies on the epidemiology of GIN of camels in India (Pathak *et al*, 1993; Partani *et al*, 1996) reported high prevalence during rainy and low in summer seasons. In the latter report the overall incidence was 85.39%, made up of predominantly strongyles (82.37%) followed by *Nematodirella*, *Strongyloides* and *Trichuris*. Amongst the strongyle infections, *H. longistipes* was the main contributor (86.43%) followed by *Trichostrongylus* spp. (13.56%). Intensity of infection in terms of EPG varied from 50 - 28,000 (874.15 ±73.83). Camels owned by villagers had higher prevalence than farm camels. Jacquet *et al* (1996) studied the adaptation of *H. longistipes* to arid environment of Saharo-Sahelian Mauritania. They concluded that the survival strategy of *H. longistipes* in the dry season was based on arrested larval development and patent infections occurred during the rainy season. In Saudi Arabia (Magzoub *et al*, 1997), coprological examination and faecal culture revealed the presence of seven nematode genera viz., *Haemonchus*, *Camelostrongylus*, *Nematodirus*, *Trichostrongylus*, *Strongyloides*, *Oesophagostomum* and *Cooperia*. Examination of gastrointestinal tracts of slaughter camels additionally revealed *Camelostrongylus mentulatus* and *Parabronema skrjabini* worms. The eggs of the latter are quite fragile and disintegrate in saturated solutions used in flotation techniques. *Physocephalus sexalatus*, *P. cristatus* and *Trichuris globulosa* were also identified. In Jordan (Sharrif *et al*, 1997) prevalence of gastrointestinal helminths in camels was high with 98% found carriers by faecal examination. Common gastrointestinal nematodes of camels in Pakistan (Hayat *et al*, 1998) were *Haemonchus longistipes*, *H. contortus*, *Trichostrongylus* spp., *Trichuris* spp., *Strongyloides* spp., *Oesophagostomum* spp., *Marshallagia* spp., *Ostertagia* spp., *Cooperia* spp. and *Chabertia* spp. Prevalence in young camels in Bahrain (Abubakr *et al*, 2000) observed by faecal samples comprised of *Haemonchus*, *Nematodirus* and *Trichuris*. Prevalence in camels in Egypt by faecal examination (El-Salahy *et al*, 2000) revealed *Trichostrongylus* spp. as highest (45.3%) followed by *Trichuris* spp., *Oesophagostomum*

spp., *Chabertia* spp., *Haemonchus* spp., *Ostertagia* spp. and *Nematodirus* spp. Magzoub *et al* (2000) reported that in Saudi Arabian camels, the abomasal worms *H. longistipes* and *P. skrjabini* and intestinal worms *Nematodirus* spp. and *Trichuris globulosa* were most frequently encountered. *Haemonchus longistipes* showed highest incidence in rainy season as well as the highest worm burden from a single camel. The intestinal worms occurred more frequently during the dry season. Tekle and Abebe (2001) regarded helminthoses alongside trypanosomosis as major health problem of camels in Borena, Ethiopia with overall 96.92% prevalence. A survey in eastern Ethiopia (Woldemeskel *et al*, 2001) recorded *Trichostrongylus probulurus*, *H. longistipes*, *N. spathiger*, *Trichuris globules* and *Strongyloides papillosus* as the common nematodes. The highest strongyle egg count per gram of faeces as well as highest point prevalence rate (85.7%) were observed in October, a rainy month while lowest egg count and lowest prevalence rate (61.5%) were recorded in April, a dry month (Zelege and Bekele, 2001). Detection of enteric parasites by faecal egg-identification in imported camels in Egypt (Wahab and El-Refail, 2003) revealed the presence of 7 species of strongyles viz., *Bunostomum*, *Chabertia*, *Ostertagia*, *Cooperia*, *Trichostrongylus*, *Strongyloides* and *Nematodirus*. An interesting epidemiological observation was the experimental transmission and establishment of *Haemonchus longistipes* and *Trichostrongylus colubriformis* of camel origin in sheep (Kumar and Yadav, 1993) and in goats (Singh *et al*, 1993).

Haematological studies indicated significant increase in eosinophil counts and decrease in PCV and Hb values. The latter effect was more pronounced in animals having concurrent infections of *Trypanosoma evansi* (Yagoub, 1989). Clinically camels carrying infection of *Trichostrongylid* and *Trichuris* (EPG 1000-2000) were observed having a rough hair coat, dull and lustreless eyes, pale conjunctiva, weakness and emaciation (Chandel *et al*, 1992). Infected animals also had lower biochemical values of minerals like Ca, P, Mg and total protein. Pathological studies on parasitic helminths in camel intestine (Nafady *et al*, 1995), showed granulomatous lesions associated with *Oesophagostomum* spp. Haematological changes in natural mixed infections of GIN (*H. longistipes*, *Trichostrongylus* spp, *Strongyloides papillosus*, *Nematodirella* spp. and *Trichuris* spp.) with EPG of 1400 - 28000 included significantly lowered TEC, Hb, PCV and TLC indicating normocytic normochromic anaemia with eosinophilia, neutrophilia and monocytosis (Partani *et al*, 1995c). Biochemical

observations revealed significantly low total serum proteins, albumin, globulin and urea nitrogen. Similar effects were observed by Haroun *et al* (1996) wherein adult animals showed additionally creatine phosphokinase activity. Partani and coworkers (1998) observed a direct correlation between epg and the severity of clinical symptoms. The most severely affected camels had epg of 7500 – 28,000 mainly due to strongyles especially *H. longistipes*. Much of the same haematobiochemical observations were recorded by later workers (Suchitra Sena *et al*, 2000) also. Pathological study of intestinal lesions in slaughter camels in Iran (Tafti *et al*, 2001) revealed that nematode infections contributed to 21% of the lesions, second only to *Eimeria* spp. Infection levels of approximately 1000 worms of *H. longistipes* and 15,000 in mixed infections of *T. colubriformis* and *Impalpia tuberculata* caused gross pathological lesions of ulcerated and hyperaemic mucosa and the odour of the fluid was foetid (Bekele, 2002). The microscopic lesions observed were sloughing of epithelium, necrosis of glands, atrophy and loss of villi, haemorrhages and cellular infiltration, mainly of eosinophils and lymphocytes.

Other Gastrointestinal Helminths

Examination of faecal samples of 283 camels in Iraq (Al-Khalidi *et al*, 1990) for trematode eggs by sedimentation method revealed 24 samples (8.3%) containing eggs of *Fasciola* spp. and *Eurytrema pancreaticum*. Fifteen samples (5.3%) contained eggs of *Fasciola* spp. and 9 (3.1%) contained *E. pancreaticum*. Post-mortem examination of 41 camels in Ethiopia (Wosene, 1991) showed *Stilesia* spp. (39%), *Avitellina* spp. (44%), *Moniezia* spp. (31%) and *Thysaniezia giardi* (4.8%). Banaja and Ghandour (1992) listed *M. expansa*, *M. benedeni*, *A. centripunctata* and *S. vittata* among common gastrointestinal helminths in camels in Saudi Arabia, while reports from UAE (Kayum *et al*, 1992), Bahrain (Abubakr *et al*, 2000) and Egypt (El-Salahy *et al*, 2000) included *Moniezia* as the only cestode among gastrointestinal helminths recorded. Necropsy of culled camels for cyclophyllid cestodiosis in India (Ranga Rao and Sharma, 1995) yielded *S. vittata*. Intestines of slaughter camels in Egypt (Nafady *et al*, 1995) when examined showed helminth parasites including *Stilesia* spp., *Avitellina* spp., *Moniezia* spp. and *Schistosoma* spp. Pathological changes of acute catarrhal, haemorrhagic and necrotic enteritis were found associated with *Schistosoma* spp. Magzoub *et al* (1997) reported only two cestodes viz., *M. expansa* and *S. vittata* among several gastrointestinal helminths found in camels in Saudi Arabia. First record of *Fasciola hepatica* in Jordanian camels was made by Sharrif *et al* (1997).

Cestode infections of *M. expansa* and *M. benedeni* were also reported from Pakistan (Hayat *et al*, 1998). Of the important intestinal lesions in slaughtered camels in Iran (Tafti *et al*, 2001) associated with parasitisms, 5% were due to cestodes. Unusual sighting of *Schistosoma* in the pulmonary vessels of a camel was reported by Sharma and Dadhich (1998). Faecal examination of camels of Borena, Ethiopia (Tekle and Abebe, 2001) for gastrointestinal parasites showed cestodes in 10%. Types identified in slaughtered animals were *Stilesia*, *Avitellina* and *Moniezia* species.

Treatment and Control of Gastrointestinal Helminths

Information on treatment of gastrointestinal helminths of camels is scanty, haphazard and generally extrapolated from studies carried out in cattle and small ruminants (El Bihari, 1985). Reported camel-specific anthelmintic trials include Ivermectin (Boyce *et al*, 1984; Kumar and Yadav, 1991; Sharma, 1991; Maqbool *et al*, 1994), oxfendazole (Saleh *et al*, 1987; Sharma, 1991), albendazole (Galhotra and Gill, 1987; Bansal *et al*, 1989; Partani *et al*, 1995 a), mebendazole (Yadav and Kumar, 1990), levamisole (Kumar and Yadav, 1991; Partani *et al*, 1995 a), fenbendazole (Saleh *et al*, 1987; Kumar and Yadav, 1991; Partani *et al*, 1995a; Joshi *et al*, 2001), thiophanate (Mukhwana and Mitama, 1997), tetramisole (Hayat *et al*, 1998). The results of most investigations indicated that benzimidazoles particularly fenbendazole or albendazole at the dose rate of 5 mg per kg b. wt. orally are the most effective preparations. However, resistance may be a developing problem (Partani *et al*, 1995b). Ivermectin has the advantage of parenteral administration and efficacy as end-ectoparasiticide against most parasites (Lumsden, 1992). Even this agent, once regarded as an ideal one-shot therapy is getting beset with resistance problem (Olaho-Mukani and Kimani, 1999). Combination of two anthelmintics viz. closantel at a dose of 10 mg/kg oral plus albendazole at 5 mg/kg was 100% effective for *H. longistipes* and *Ascaris* spp. and 98% effective against *Moniezia expansa* (Al-Qudah *et al*, 1999). Administration of the drug twice at two weeks apart raised the efficacy for clearing 100% in camels infected with various parasites. The treatment was well-tolerated by even pregnant females. Against ivermectin-resistant parasites, particularly GIN of camels, an alternative therapy in the form of injectable formulation of abamectin single administration was highly effective (Shubber *et al*, 2003). The efficacy of an injectable albendazole sulfoxide formulation was found highly effective against GIN of dromedaries

compared to an albendazole bolus, in a recent trial in Senegal (Kadja *et al*, 2005).

Extraintestinal Nematodes

Onchocercosis: *Onchocerca fasciata* is a specific camel parasite and is often prevalent in camel populations (El Bihari, 1985). Nasher (1986) studied the incidence and intensity of *O. fasciata* in local camels in Saudi Arabia and reported high incidence (59%). The disease is characterised by the presence of nodules (worm nests) in the subcutis of the head and neck regions or in the fascia of nuchal ligament. Nodule development in onchocercosis in camels was studied in Saudi Arabia (Ghandour *et al*, 1991). Detection of microfilariae in skin snips and nodules in the nuchal ligament was 10.9% and in subcutaneous tissues of the neck and shoulders was 33.3%. The prevalence rate was higher in young and adult camels than in old camels, although the number, size and weight of nodules per infected animal increased with age. The viability of worms decreased as degeneration and calcification progressed with increased age of the camels. According to Banaja and Ghandour (1992), *O. fasciata* is the most common (33-59%) extraintestinal helminth in indigenous camels in Saudi Arabia. In Egypt, examination of 3376 imported and 200 local camels (El-Massry and Derbala, 2000) for *O. fasciata* nodules and adult parasites, revealed 2.75% infection rate among imported camels but no palpable or detectable nodules in the local animals. Distribution of nodules was mainly on the two sides of abdomen, shoulders, nuchal ligament and thigh region. Despite high prevalence, the disease is not of much practical importance although onchocercal nodules often get mistaken for tubercular granulomas resulting in unnecessary and wasteful condemnation of carcasses.

Filariasis: Blood examination for microfilariae in 500 camels in Egypt (Karram *et al*, 1991) led to detection of filariasis in 12 camels, who exhibited severe weakness, pale mucous membranes, loss of appetite, elevated temperature and swollen scrotum and testicles. Haemoglobin and PCV were decreased and microcytic hypochromic anaemia was associated with leucocytosis and eosinophilia. Five injections of ivermectin at 1 mg/50 kg were successful to control filariasis. *Dipetalonema evansi* were present in the lungs of 17.5% of 40 camels in Iran (Moghaddar *et al*, 1992). An outbreak of cameline filariasis in the Sudan was described (Elamin *et al*, 1993). Sheathed microfilariae were detected in the blood of 7/14 housed camels. Microfilaraemic camels were inappetent, lethargic, reluctant to move

and exhibited weakness in the hind limbs; some remained in sternal recumbency. The microfilariae showed a biphasic pattern in the blood that peaked at 20:00 and plateaued between 04:00 and 06:00. Adult filarial worms were recovered from the mesenteric and femoral arteries. Marked clinical improvement within 1-2 weeks was seen in 3 camels treated at 10:00 with a single S.C. injection of 0.2 mg/kg of ivermectin. Treatment of 2 camels at the time of high microfilaraemia (06:30) resulted in adverse reaction and death. Blood samples from 196 dromedary camels in Iran (Rahbari and Bazargani, 1995) showed the presence of *D. evansi* in 28.1% (55 of 196). A significant inverse relationship between host age and prevalence of infection was observed. A study in Pakistan (Butt *et al*, 1996) found the prevalence ranging from 6.98% in winter to 17.92% in summer. The seasonal changes were thought to correspond to the seasonal fluctuations in the insect vector abundance. Pathak *et al* (1998) identified microfilariae of *D. evansi* in 118 (14.89%) of 792 dromedaries in western Rajasthan, India. Except for a few cases of scrotal swellings (possibly hydrocele), no clinical signs were observed.

Lungworms: Infections with larvae of *Protostrongylus* spp. (50%) and *Paragonimus* spp. eggs (0.8%) were found by faecal examination of 121 imported camels in Egypt (Wahab and El-Refail, 2003).

Extraintestinal Cestodes

Echinococcus granulosus : The camel is one of the commoner intermediate hosts of *E. granulosus* and hydatid cysts have been reported in camels from almost all countries (El Bihari, 1985). Camel strain of the parasite has since been recognised and dogs proven definitive hosts for it (Eckert *et al*, 1989; Derbala and El-Massry, 1999). Post-mortem examination of camels in Ethiopia (Wosene, 1991) showed 29.2% infected with hydatid cyst, in Saudi Arabia 2.7 – 6.4% (Banaja and Ghandour, 1992), 70% of liver and lungs examined in Iran (Moghaddar *et al*, 1992), 56.5% in India (Ranga Rao and Sharma, 1995), 77.5% in Pakistan (Anwar and Khan, 1998), 48% in Libya (Ibrahim and Craig, 1998), 61.4% in Kenya (Njoroge *et al*, 2002), 35.2% in Iran (Ahmadi, 2005). The lungs were found to be the most frequently infected organs, with bigger and more fertile cysts (Moghaddar *et al*, 1992; Ibrahim and Craig, 1998). In Iran, where *E. granulosus* is endemic, Hosseini and Eslami (1998) recorded significant morphological and development characteristics of *E. granulosus* derived from sheep, cattle and camel. The finding that the fertility rate of hydatid cysts in camel was

70% (against 88% and 19% recorded in sheep and cattle, respectively) was regarded of considerable epidemiological significance. Human cases of cystic hydatid disease associated with transmission cycle of camel genotype have been identified in endemic Iran (Fasihi-Harandi *et al*, 2002). A case of prenatal infection with hydatid cyst in a 4-week old female camel calf was described from Saudi Arabia (Elamin *et al*, 2001).

Cysticercosis: Lesions associated with *Cysticercus* spp. have been reported occasionally (Ranga Rao and Sharma, 1995; Woldemeskel *et al*, 2001). The recovery of the fringed tapeworm *Thysanosoma actinioides* from the liver of a slaughtered camel in Saudi Arabia was reported by Omer and Al-Sagair (2005) who regarded this as a new host record for the tapeworm.

Extraintestinal Cestodes

It is obvious from the foregoing that the camel is subject to a considerable range of helminth parasites, which in one way or the other; contribute to debilitation, loss of work-capacity and productivity. There is also an apparent under-reporting of the problem rather than its non-existence. The gastrointestinal nematodes of camel are widespread; *H. longistipes* is as injurious to camel as *H. contortus* is to sheep and should be accorded the same importance. Morbidity resulting from helminthoses predisposes the camels to the establishment and pathogenicity of other disease agents. It is not unusual to find trypanosomoses, helminthoses and sarcoptic mange concurrently. Anthelmintic resistance is another area waiting to be explored more intensively. The widespread and high prevalence of *Echinococcus granulosus* in the camel and high fertility rate of hydatid cysts of camel origin is of great public health significance in endemic areas. New helminth records from camel are being reported as a consequence of the on-going shift from a pastoral to farming system of husbandry in many countries.

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INTERNATIONAL CAMEL CONFERENCE ON 16-17 FEBRUARY 2007

INTERNATIONAL CAMEL CONFERENCE ON "Recent trends in Camelid Research and Future Strategies for Saving Camels" will be organised by College of Veterinary and Animal Science, Rajasthan Agriculture University, Bikaner 334001, Rajasthan State, INDIA from 16-17 February 2007 (2 days). All queries should be addressed to Dr.T.K.Gahlot, Organizing Secretary, International Camel Conference, College of Veterinary and Animal Science, Bikaner 334001 Rajasthan State, INDIA. tkedjcpr@datainfosys.net. Registration fee for Indian participants is Rs.3000, post graduate students Rs.2000, foreign participants US \$ 150, post graduate students US \$ 100 www.bikanercamelconference.com

ANTIBODIES IN CAMEL CAN TREAT COLON CANCER: ACCIDENTAL DISCOVERY

Professor Muyltermans, Department of Molecular and Cellular Interactions at Vrije University in Brussels, told that camels have unique antibodies in their blood. Discovery of these unnoticed antibodies was accidental as they were not actually doing research on camels. The already collected blood sample of an Arabian camel was used for the separation of antibodies simply because the students involved in the process had refused to kill a mouse or any other animal for the experiment. The research team has tested the antibodies on colon tumours in mice. The result was a 100% success. Unlike antibodies from other species these antibodies are devoid of light chains and are composed of a heavy chain dimer. The antibodies are easily purified from the serum and their researchers successfully raised an immune response in them. The research on the antibody obtained from Arabian camel has also succeeded in developing a solution to diagnose infections or to treat diseases like cancer or trypanosomiasis. Clinical trials on the drug treating colonic cancer is in progress this year.

(Gulf News 16 April, 2006)

PERUVIAN LETTUCE PROVES DEADLY FOR MOROCCAN CAMELS

LIMA, Peru (Reuters) - Healthy eating has proved fatal for a group of camels donated to Peru by Morocco's King Mohammed. Two camels died this week and another is sick after being fed a type of Peruvian lettuce that poisoned the animals with its high nitrate levels, initial tests showed on Thursday. "The animal feeders thought that the lettuce would have lots of protein and that's why they gave it to them," said William Raffo, head of animal hygiene in Peru's desert coastal city of Ica, which has a climate similar to North Africa's Sahara. Officials fear the other seven camels donated to Peru may have eaten the lettuce and could become ill. "It seems like an epidemic," said Moroccan embassy official in Lima Abdelilah Nejjari. King Mohammed donated the camels to Peru in 2003 to boost bilateral diplomatic and trade ties.

(Source:http://news.yahoo.com/s/nm/20061012/od_uk_nm/oukoe_uk_peru_camels_1)