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PARASITISMS OF CAMELS REVISITED: 3 – ECTOPARASITES

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ABSTRACT

Ectoparasites of camels and the injury and disease associated with them are more prevalent and more serious than is commonly realised. Through widespread distress and morbidity, and through their role as vectors of disease, they impact the economy of camel-rearing in diverse ways. Sarcoptic mange is a serious debilitating and dreaded disease throughout the camel world. It is known to predispose affected camels to other infections and is a good measure of herd health. Camel ticks notably *Hyalomma dromedarii* characteristically cause heavy infestations. Acaricidal control agents presently in use are not wholly satisfactory. Biting flies transmit the most important disease of surra apart from being a serious menace due to their blood sucking and annoyance. Myiasis–causing flies are widespread and readily infect wounds. The larvae of camel nasal bot *Cephalopina titillator* are highly prevalent obligatory parasites which can undermine the well-being of animals. The recent literature on these entities has been reviewed with the objective to focus attention and to stimulate enhanced reportage. The need to evolve camel-specific control strategies has been discussed.

Key words: Camels, dromedaries, ectoparasites, ectoparasitoses, parasitic diseases

Despite the growing awareness of the importance of camels and concern for the upkeep of their health and productivity, available literature on their diseases and parasites is rather sparse. Among parasitisms, ectoparasites and problems associated with them, with the notable exception of sarcoptic mange, are generally neglected. Camels are hosts to a wide range of external parasites which besides direct injury, irritation and debilitation, are transmitters of a variety of disease agents. While sarcoptic mange is acknowledged as the most serious ectoparasitic disease of camels, with the recent shift to more intensive farming systems, ticks parasitising camels are likely to assume greater economic significance. Biting flies are important mainly as transmitters of trypanosomosis. Among myiasis producing flies, larvae of nasal bot fly appear widespread. Higgins (1985) had reviewed the major ectoparasites of the camels. Later, a conference paper (Pegram and Higgins, 1992) dealt with the topic with greater emphasis on the effects of ticks, mites and insects including vectoral and zoonotic aspects. In the interim since then, individual published reports from many parts of the camel-rearing world have come up. Collectively, these are expected to contribute to a better understanding of the ectoparasites of camels and their direct and indirect association with impairment of health and productivity. The objective of this review is to take stock of the current status in the light of new information in this field.

Mange mites

Sarcoptic mange caused by the acarine *Sarcoptes scabiei* var *cameli* is often regarded as the second most important disease of dromedary camels, after trypanosomosis (Pegram and Higgins, 1992). It is a highly contagious chronic debilitating condition with high degree of morbidity. Infected camels may stop grazing and milk production may show a rapid fall (Dioli and Stimmelmayer, 1992). It also has zoonotic significance as cases of transmission to humans, particularly handlers, caretakers and riders had been reported (Raisinghani and Kumar, 1990; Tika Ram *et al,* 1991; Basu *et al,* 1996 a; Kinne and Wernery, 2003). Reports of high prevalence have continued to pour in from various camel – rearing countries. These include : Ethiopia (Zeleke and Bekele, 2000), India (Sena *et al,* 1999a; Parmar *et al,* 2005a), Jordan (Al-Rawashdeh *et al,* 2000), Nigeria (Basu *et al,* 1995), Saudi Arabia (Banaja and Ghandour, 1992) and Sudan

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(Agab and Abbas, 2001). Commonly associated with poor management and malnutrition, infection had been recorded throughout the year (Raisinghani and Kumar, 1990), and in all seasons (Sena *et al,* 1999a). The problem was more common in older (over 5 years age) camels (Parmar *et al,* 2005a). Clinical signs observed included pruritis manifested as rubbing and scratching resulting in loss of hair. The early lesions were hyperaemic papules often appearing on the medial aspects of the thigh or inguinal region, head and neck, flanks, udder and shoulders (Wernery and Kaaden, 2002). The lesions became red, moist and oozy spreading to surrounding areas (Kumar *et al,* 1992). Scabby patches formed within a few days. In chronic cases, alopecia, scab-formation, cutaneous hypersensitivity, proliferation of connective tissue lead to thickened corrugated skin, keratinisation and chalk-like covering of the scurf (Raisinghani and Kumar, 1990; Sena *et al,* 1999b; Mal *et al,* 2000). Extensive lesions on the ventral surface of the body, most frequently in the perianal and perineal regions (Parmar *et al,* 2005b), head, neck, facial region and medial aspects of limbs were observed. Histological examination of skin revealed epidermal hyperplasia, hyperkeratosis, acanthosis and mites embedded in some affected follicles (Mathur *et al,* 2005). Eosinophils and mast cells infiltrated the epidermis together with neutrophils and macrophages (Kinne and Wernery, 2003). Haematological changes noted were significant decrease in TEC, TLC, haemoglobin, neutrophils and monocytes, alongside a significant increase in lymphocytes (Mal *et al,* 2000). There was a significant decrease in Fe level while Na levels were increased (Mal *et al,* 2002). Another study recorded significantly higher levels of IgE in camels suffering from mange than in healthy animals (Kataria and Kataria, 2004). Diagnosis based on clinical symptoms supplemented with examination of deep and multiple skin scrapings, is difficult. It has been found possible to demonstrate specific antibody to *S. Scabiei* in an indirect ELISA and confirmed by Western blot analysis in camels suspected of sarcoptic mange (Bornstein *et al,* 1997). However, the test has not been evaluated in the field so far.

Treatment of sarcoptic mange with topical application of acaricides is often difficult due to the lodging of mites in the tunnels, after an initial acute phase. It may require 3 or more applications at 7 to 10 days' intervals with vigorous scrubbing, brushing or power-spraying over the body ensuring thorough wetting of each part (Pegram and Higgins, 1992). Harness, saddlery and bedding should also be treated where necessary. Despite the traditional acaricidal treatments being labourious and often problematic (Lumsden, 1992), they had been much in use with varying degree of success. Diazinon 0.1% and fenvalerate 0.05% were found 60 and 80% effective respectively, after 2 applications at 10 days interval and 100% effective after 3 applications (Chhabra and Singh, 1991). Similarly, the synthetic pyrethroid deltamethrin 0.005% spray was fully effective after 3 applications (Pathak *et al,* 1991; Makkar *et al,* 1993; Kumar *et al,* 2005). Efficacy of deltamethrin in combination with hexachlorocyclohexane (HCH) was also reported (Teame, 1997). Amitraz 0.05% after 2 applications resulted in partial (Singh *et al,* 1996) and after 3 applications, in complete clinical and parasitological recovery (Kumar *et al,* 2005). Premedication of lesions with 15% salicylic acid to remove scab and detritus was found to improve the acaricidal efficacy of Sebacil EC 50% and Gamatox (Gamma isomer of HCH or Lindane) but was not considered practicable (Abu-Samra, 1999). The often-reported poor efficacy of topically applied acaricides is more often a problem of poor application rather than genuine resistance. The regime of repeated applications is however, impractical for nomadic herds. Bramley (1992) regarded the 'pour-on' method as potentially beneficial. Ivermectin subcutaneous injection at dose level of 200 mg/kg body weight as systemic end-ectocide has several advantages over topical acaricides (Lumsden, 1992). Several reports have attested its utility and efficacy (Raisinghani *et al,* 1989; Makkar *et al,* 1991; Nayee *et al,* 1994; Hayat *et al,* 1997; Abu-Samra, 1999; Kumar *et al,* 2005). Parenteral doramectin at 200 mg/kg body weight intramuscular injection was not only effective (Singh and Gahlot, 2000) but required single treatment as against two required when using ivermectin and also had much longer residual protection (Singh *et al,* 2001). A study to investigate the efficacy of 3 formulations of another broad-spectrum agent abamectin on sarcoptic mange in camels found 100% reduction of infestation with injectable formulation and pour-on treatment but not with the oral formulation (Shubber *et al,* 2003). Ethno-veterinary practices among nomadic pastrolists include the use of old engine oil in the management of ectoparasite infestations particularly in treating mange infestations (Namanda, 1998). Various indigenous and plant based formulations had been tried as alternatives to toxic chemicals (Chhabra *et al,* 1994; Pathak *et al,* 1995, Sena *et al,* 1999a; Dixit *et al,* 2002, 2004a and 2004b). Although deficient in efficacy vis-à-vis chemicals and synthetic acaricides,

phytotherapeutic agents have obvious advantages in terms of cost, safety, cultural-acceptability, biodegradability, absence of undesirable residues and resistance problem (Chhabra and Saxena, 1998).

Ticks

All ticks, hard or soft are blood suckers and can cause debility and anaemia in camels as in other animals (Higgins, 1985). Infestations result in irritation, loss of production, impaired growth and damaged hides. Occasional cases of tick paralysis in camels are on record (Higgins, 1985). Traumatic injuries from tick bites can attract flies resulting in myiasis or bacterial infection. Conjunctivitis, keratitis and foot abscesses associated with lameness are common sequelae to tick infestations (Pegram and Higgins, 1992). A high prevalence of mastitis was observed in camels infested with ticks in Somali Region of Southeastern Ethiopia (Mohammad *et al,* 2005). Although incriminated as disseminators of arboviruses affecting man, the role of ticks as vectors of camel disease seems lesser than with other livestock.

Ticks were the most common and abundant ectoparasitic infestations of camels in Saudi Arabia, made up of many species (Banaja and Ghandour, 1992). *Hyalomma dromedarii*, the most commonly prevalent and camel-specific hyalommine species, is a desert-adapted 2 (occasionally 3) – host tick. It has been reported as the predominant tick species on Arabian camels in Sinai, Egypt (Straten and Jongejan, 1993), India (Khan and Srivastava, 1994; Singh and Chhabra, 1999), Saudi Arabia (El-Azazy, 1996) and Jordan (Al-Rawashdeh *et al,* 2000). Of the 16 other species of *Hyalomma* infesting camels, the important ones were *H. anatolicum excavatum* (mainly in Africa) and *H. Schulzei* (Pegram and Higgins, 1992). In Ethiopia, *Rhipicephalus pulchellus* had been reported (Zeleke and Bekele, 2004) as the most abundant species with highest tick load during the rainy months. In arid north India, the season for adult tick abundance appeared to be winter (Singh and Chhabra, 1999) due to intact hair coat facilitating lodgement of ticks and overcrowding of animals in the indoor night shelters resulting in increased contact and spread. In the months preceding winter (August to October), the nymph stage predominated (Chhabra, 1992). A report (Kennedy and Green, 1993) from Queensland, Australia indicated that the dromedary camels there can act as hosts of the cattle tick *Boophilus microplus.* Most mammalian tick species will parasitise camels where the animals mingle. Accordingly, in India the common cattle tick *H. anatolicum* was the second most frequent tick (after *H. dromedarii*), parasitising camels (Singh and Chhabra, 1999). Less frequently encountered species were *H. marginatum* isaaci and *B. microplus*. The argasid tick *Ornithodoros savignyi* was occasionally found hidden in the sandy resting places of camels, attacking the animals for brief spells to suck blood. The most frequent attachment sites for adult *H. dromedarii* ticks were groin, perineum, udder, axilla and facial regions while nymphs were found hidden in areas well-covered by hair coat, particularly along the back, around the hump and intermandibular region (Singh and Chhabra, 1999). Histopathology of tick *(Hyalomma)* infested camel skin (Patel *et al,* 1992; Basu *et al,* 1996b) indicated inflammatory reaction characterised by congestion, oedema, hyperplasia and cellular infiltration around the site of insertion of mouth parts. Transmission potential of *H. dromedarii* for *Theileria annulata* under experimental conditions (Khurana *et al,* 1988) was found to be higher than that of *H. anatolicum anatolicum*–the principal vector in nature.

In general, there is less motivation for camel owners and others to undertake specific tick control measures (Higgins, 1985). Acaricidal treatment should be applied when animals bear a high burden of ticks or if there are other non-specific clinical signs. The treatment for mange is also effective against ticks. At the same time, tick control measures for cattle are applicable for camels also. As such, there are very few reports on tick-specific acaricidal trials in camels. Ivermectin given subcutaneously at 0.2 mg/kg was not found effective against *Hyalomma* tick infestation in camels in date-palm plantations of a kibbutz in Israel (Straten *et al,* 1993). On the other hand, amitraz (Taktic) 250 ppm had efficacy in two sprays 10 days apart (Singh *et al,* 1992) and residual activity against adult *H. dromedarii* ticks on dromedaries (Jacquiet *et al,* 1994). Similar efficacy for deltamethrin (Butox) at 25 ppm was reported (Singh *et al,* 1992). Flumethrin (Bayticol) 1% used by pour-on method for the control of the camel tick *H. dromedarii* was found safe and effective (El-Azazi, 1996). Moreover, it had complete sterilising effect on engorged female ticks after a 12 h exposure (El-Azazi and Lucas, 1996).

Myiasis – causing flies

Larvae of calliphorine flies are responsible for cutaneous myiasis (maggot infestation) in camels just as they do in other animals. Traumatic wounds resulting from shearing, firing, surgery or even tick-bite sites can be invaded. The most common of these flies is *Chrysomyia bezziana* or the Old World

screw worm which is widely distributed in Asia, Arabia and Africa (Gabaj *et al,* 1989). The larvae are obligate parasites and affect all livestock species including camels. This species breeds only in living tissues attracted by any discharge from natural orifices or from wounds. Even the New World screw worm, *Cochliomyia hominivorax,* has been recorded infesting the arabian camel (Husni and Elowni, 1992). *Wohlfahrtia magnifica* is probably the most important myiasis-producing fly affecting camels (Higgins,1985; Pegram and Higgins, 1992). Apart from skin wounds, mucous membrane or tick bite, nasal and aural cavities can also be invaded by adult female flies for depositing larvae. According to Hadani *et al* (1989) larvae of *W. magnifica* are the major cause of nasal myiasis of Arabian camels in the peninsula of Sinai. Wohlfahrtiosis is also associated with genital myiasis (vaginal in the female and preputial in the male) in camel herds in Mongolia (Valentin *et al,* 1997).

Routine seasonal treatment for mange usually provides protection against fly strike for several weeks. Regular sprays with synthetic pyrethroids repels adult flies. Agents like Negasunt have been particularly useful in treating cutaneous myiasis (Higgins, 1985).

Cephalopina titillator (camel nasal bot fly) is an oestrid fly of which the larvae are obligate parasites specifically of the camel. It is widely distributed in camel-raising areas causing naso-pharyngeal myiasis. The prevalence rate is generally very high (often upto 100%) as per reports from various countries viz. Egypt (Zayed, 1998), Ethiopia (Wosene, 1991; Tekle and Abebe, 2001; Woldemeskel *et al,* 2001), Iran (Oryan *et al,* 1993), Iraq (Al-Ani *et al,* 1991), Jordan (Al-Rawashdeh *et al,* 2000), Nigeria (Desbordes and Ajogi, 1993; Nwosu and Wachy, 1998), Saudi Arabia (Banaja and Ghandour, 1992; Fatani and Hilali, 1994). High prevalence in camels in Sokoto State of Nigeria was recorded throughout the year but higher level during the rainy season (Desbordes and Ajogi, 1993). In Saudi Arabia (Fatani and Hilali, 1994), indications of 2 cycles per year were found. Bulk of the larvae were located in the pharyngeal cavity (Zayed, 1998) where they comprised mostly of third instar. Other sites in decreasing order of frequency were the labyrinth of the ethmoid bone, the turbinates and lower nasal meatus (Zayed, 1998). Occasionally larvae were present in lung tissue, some appearing as nodules on the surface (Oryan *et al,* 1993). The presence of large number of larvae may cause difficulty in breathing as well as considerable irritation. Mucous secretion and haemorrhagic spots on the nasal mucosa may occur (Nwosu and Wachy, 1998). The camels may sneeze, shake their heads and may avoid feed and drink. In extreme cases, neurological signs simulating cranial Ceneurosis had been reported (Higgins, 1985). Microscopic lesions of brain observed were mainly perineuronal demyelination, vascular congestion and thickening of meninges (Al Ani *et al,* 1991). Rarely, death may occur due to perforation of sinuses or due to secondary infection leading to meningitis. A study (Akbar *et al,* 1994) on exercise – induced pulmonary haemorrhage (EIPH) in racing camels found higher incidence of EIPH in animals with nasal bot infestation. Using the agar gel precipitation test as a diagnostic technique, larval antigens and antibodies could not be detected in either the serum or nasal mucous from parasitised animals (Nwosu and Wachy, 1998).

The traditional method of treatment in Nigeria (Desbordes and Ajogi, 1993) is to allow the camel to inhale tobacco powder which will induce sneezing and help expel the larvae. Nasal instillations or irrigations, on the analogy of nasal bots in sheep, had also been attempted. Rafoxanide at 7.5 mg/kg could be used. Successful treatment through use of ivermectin @ 0.2 mg/kg body weight in clinical cases of camel nasal bots had been reported (Sharma, 1992). *Bacillus thuringiensis* (BT H-14) and its toxin had marked toxic effect on the eggs and the 3rd stage larvae of *C. titillator in vitro* (Mazyad and Raheem, 2001).

Biting and nuisance flies

Many species of flies pester camels causing irritation and distraction from feeding, leading to decreased productivity. Additionally, biting flies pose a major risk to camels in trypanosomosis – endemic areas (Higgins, 1985). Horse flies or tabanids (genera *Tabanus* and *Haematopota*) are important vectors of *Trypanosoma evansi* (surra) in camels. They are vicious blood suckers and if large numbers attack a camel, the animal may become agitated and nervous. The outbreaks of trypanosomosis generally coincide with the season of fly-abundance, which in most countries is the wet season or just after it. Another biting fly viz. *Stomoxys calcitrans,* the so-called stable fly, prefers feeding from camel and is also known to be a major vector of surra in India. It is most active in summer and autumn. Like tabanids, *Stomoxys* may bite anywhere on the body and may shift between animals to complete a blood meal. To a lesser degree, the small biting flies *Lyperosia* spp. may attack camels and act as vectors of *T. evansi*. Camel pastoralists are fully aware of the disease – transmitting flies and have developed strategies to avoid exposure (Köhler – Rollefson, 1994).

Hippobosca camelina: This fly is well-adapted to its parasitic association with the camel and large numbers are more or less permanently associated with their hosts. In Kenya, it had been identified among important mechanical vectors of *T. evansi* (Ouma *et al,* 1996).

Pentastomida

Representatives of this class are considered as aberrant arthropods. They are not ectoparasites in the strict sense. The adults are parasitic in the upper respiratory tract of carnivores. The larval and nymphal stages develop in the herbivorous intermediate hosts. The sole member of veterinary importance is *Linguatula serrata* or the tongue worm. Of 40 camels examined at slaughter in Shiraz (Iran), 5 were infected with nymphs of *L. serrata* (Oryan *et al,* 1993). The parasite was found in lymph nodes of the liver of 2 camels and the mesentry of 3 animals. In Egypt (Wahba *et al,*1997) macroscopic examination of 61 camels at slaughter revealed 3 having *L. serrata* in the lymph nodes. The nymphs of the parasite were observed within the medulla of the lymph nodes and were accompanied by thickening of the trabaculae. Another study from Iran (Tafti *et al,* 2001) fond 5% of 100 slaughtered camels infected with *Linguatula* spp. Sections of *Linguatula* spp. nymphs and cavities due to migration of larvae were observed in affected mesenteric lymph nodes.

Concluding remarks

Although less spectacular in their effects than some protozoan diseases and helminthoses, the ectoparasites of camels are equally, if not more important as direct or indirect contributors to serious losses in productivity and performance. The overall paucity of reports other than those on sarcoptic mange, is indicative of an apparent, even if misplaced, apathy. One should not lose sight of the fact that the most important camel disease viz. – surra is spread by biting flies. Also, that morbidity resulting from mange predisposes the camels to the establishment and severity of other disease agents. It is not unusual to find sarcoptic mange, haemonchosis and trypanosomosis occurring concurrently in the herd or in individual animals. These problems have the potential to assume more significant role with change in husbandry and management systems. Perhaps there is a need for a paradigm shift to a more holistic approach toward prophylaxis and control of ectoparasitoses. Although, conventional application of insecticides is still the most prevalent and economic treatment, pour-on and other slow-release delivery systems, should find greater favour. Indigenous formulations–an obvious choice in remote inaccessible areas and compulsions of economy, should form part of an integrated ectoparasite control. Modern day end-ectoparasiticides, which target a broad spectrum of parasites, are an attractive prospect if they become more affordable. There is no gain saying that well-nourished, well-groomed and healthy stock is less prone to ectoparasitisms in general.

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I, Smt.Leela Devi hereby declare that the particulars given above are true to the best of my knowledge and belief.

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