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MANGE IN THE CAMELIDS: A REVIEW

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ABSTRACT

Camelids, both old world and South American, are subject to skin parasitism by three genera of mange mites viz. *Sarcoptes, Chorioptes* and *Psoroptes.* A single species *S. scabiei* var. *cameli* is responsible for an extremely common contagious skin disease. Rated second only to trypanosomiasis in importance, sarcoptic mange, through its high morbidity, affects camels of all ages, seriously impacting their health, productivity and economy. Reports in literature indicate widespread prevalence in practically every camel-rearing country. Clinico-pathological and haemato-biochemical changes cover a wide spectrum. Diagnosis based on demonstration of mites is difficult. Successful detection of specific antibody to *S. scabiei* in mange affected dogs, pigs and human scabies, holds promise for serological tests being developed for camelid mange. For therapy, reported success of indigenous formulations and herbals has resulted in a trend for their promotion as safe, easily available alternatives. As recommended by OIE (Paris), development of a vaccine for prophylaxis of mange should be a high priority. Taking into account the recent technological advancements, that seems to be a distinct possibility in the foreseeable future. Reference has also been made to recent reports on salient aspects of mange in the New-world Camelids, in this review.

Key words: Camelids, *Chorioptes,* mange, parasitic disease, psorptes, *Sarcoptes*

Mange is a contagious skin disease, characterised by crusty, pruritic dermatitis and hair/ feather loss. It is caused by a variety of parasitic mites burrowing in or living on the skin. The Acari are a diverse and ubiquitous group of arachnid arthropods. There are several economically important genera of which as many as 3 viz. *sarcoptes*, *chorioptes* and *psoroptes* are known to parasitise camelids. *Sarcoptes scabiei* is an obligate burrowing skin parasite with more than 100 known host-adapted variants (Bornstein *et al,* 2001). *Sarcoptes scabiei* var *cameli* is by far the most common and widespread mange mite of camelids (Wilson, 1984). Sarcoptic mange is a serious, chronic and debilitating disease affecting the dromedarian (*Camelus dromedarius*) as well as bactrian camels (Higgins, 1985; Kumar *et al,* 1992; Chaudhary and Akbar, 2000). In economic importance, it is ranked second only to trypanosomosis (Pegram and Higgins, 1992; Mochabo *et al,* 2006). However, sarcoptic mange in camels is frequently a herd problem, predisposing the affected animals to other pathogens through long-term morbidity. As such, this review aims to draw attention to the continuing significance of this disease to the camelid world.

Epidemiology

While transmission between individuals of the same host species occurs easily by close contact, taxonomically unrelated hosts are not readily infested. Although cases of transmission of *S. scabiei* var *cameli,* to humans particularly handlers, caretakers and riders had been occasionally reported (Raisinghani and Kumar, 1990; Tikaram *et al,* 1991; Basu *et al,* 1996; Kinne and Wernery, 2003), they are no more than transient hosts. The syndrome termed as 'pseudo-scabies', does cause some disturbance in the affected humans but is self-limiting and should not be regarded as a true zoonosis. Molecular analyses (Zahler *et al,* 1999) support the conspecificity of all *Sarcoptes* variants.

Survey reports on prevalence of camel mange exist in literature from virtually every camel-rearing country of the world, highlighting the global reach and importance of the disease. These include: Somalia (Abdurahman and Bornstein, 1991), Libya (Gabaj *et al,* 1992), Nigeria, 72% of 200 camels (Basu *et al,* 1995), India (Sena *et al,* 1999a; Parmar *et al,* 2005), Jordon, 83% of 32 examined camels (Al-Rawashdeh *et al,* 2000), Eastern Sudan, where it was found as the most prevalent (31.36%) camel disease (Agab

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and Abbas, 2001), Kenya (Mochabo *et al,* 2005, 2006), Saudi Arabia, where it was the most common diseases (22.6% of 942 camels) at a dairy farm (Agab, 2006) affecting all ages from suckling calves to adults, Pakistan, 35% of 200 camels (Muhammad *et al,* 2006), Egypt (Mahran and Saleh, 2004; Amin *et al,* 2006), Burkina Faso (Dia, 2006), Ethiopia (Ahmed and Hegde, 2007). Some other workers regarded mange as a major constraint to camel pastoralism in North-eastern Sudan (Agab, 2007), Indian Thar desert (Bhakat and Sahani, 2007), North-western Nigeria (Chafe *et al,* 2008). According to some reports, all camels, regardless of age and sex, may be affected by *S. scabiei* (Nayel and Abu-Samra, 1986) while some others stated that the infection is more prevalent in younger animals (Rathore and Lodha, 1973; Kumar *et al,* 1992) and some even found the problem more common in older (over 5 years age) camels (Parmar *et al,* 2005a). Commonly associated with poor management and malnutrition (Higgins, 1985; Kinne and Wernery, 2003), infection had been recorded throughout the year (Raisinghani and Kumar, 1990) and in all seasons (Sena *et al,* 1999a). However, as per predominant consensus, both the incidence and severity of disease are higher in winter (Rathore and Lodha, 1973; Amin *et al,* 2006). Stress, debilitating conditions such as surra and excessive worm burden may predispose the camel to mange.

Clinicopathology

Sarcoptic mange is recognized both as an acute and chronic debilitating disease causing the affected animals a lot of stress and discomfort. Infected camels may stop grazing and milk production may show a rapid fall (Dioli and Stimmelmayer, 1992). In most cases of mange in camels, the initial signs are small hyperaemic papules often appearing on the medial aspect of the thighs or inguinal region, the head and neck, medial areas of the flanks, udder and shoulder (Wernery and Kaaden, 2002). These are followed by intense pruritis, alopecia, excoriation with moist and oozy lesions which tend to spread to surrounding areas, crusting and scab formation (Kumar *et al,* 1992; Kinne and Wernery, 2003). Cutaneous hypersensitivity and proliferation of connective tissue lead to skin becoming thickened, fissured, corrugated and hypermelanotic (Raisinghani and Kumar, 1990; Sena *et al,* 1999b; Mal *et al,* 2000). Lesions may be found in any part of the body but more commonly involve perineum, flanks, root of tail, preputial and vulvar regions, head, neck, sternum and brisket (Pathak *et al,* 1995; Singh and Gahlot, 2000; Parmar *et al,* 2005b; Dixit *et al,* 2009). Histological examination of skin revealed epidermal hyperplasia, hyperkeratosis, acanthosis and mites embedded in some affected follicles (Mathur *et al,* 2005). In another study (Parmar and Singh, 2008), histopathological observations of 50 skin biopsies revealed subacute necrotizing dermatitis in 46%, chronic sclerotising dermatitis in 34% and acute proliferative dermatitis in 20% cases. Eosinophils and mast cells infiltrated the epidermis together with neutrophils and macrophages (Kinne and Wernery, 2003). Haematological changes noted were significant decrease in total erythrocyte count, haemoglobin, PCV and lymphocyte counts and an increase in total leucocyte counts (TLC), neutrophils and eosinophil counts in infected camels (Sena *et al,* 1999b; Mathur *et al,* 2005; Rathod *et al,* 2008). The findings of Mal *et al* (2000) were largely in sync with the above except that a decrease in TLC was noted in the suffering camels. The accompanying anaemia was microcytic hypochromic type (Mahran and Saleh, 2004). Study of biochemical parameters (Hafez, 1994; Mal *et al,* 2001, 2006) revealed an increase in alanine transaminase (ALT), aspartate transaminase (AST), total protein, globulins, triglycerides and urea along with a decrease in albumin and cholesterol. Other studies (Singh *et al,* 2003; Mahran and Saleh, 2004) observed significant reduction in serum urea and zinc levels. Parmar *et al* (2005b) in their study of haemato-biochemical changes had noted deficiency of serum calcium among other parameters. 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

In the early stages, it is difficult to find the mites from *S. scabiei* infected camels (Higgins, 1984). Lodha (1966) had remarked that in acute infections, mites are rarely found. As such, diagnosis based on clinical symptoms supplemented with examination of deep and multiple skin scrapings, remains difficult. Usually, there is no problem in confirmation of chronic cases of mange, since numerous mites are found in thickened skin (Kinne and Wernery, 2003). The circulatory antibody response to *S. scabiei* in human infection had been demonstrated (Arlian *et al,* 1994). Researchers have shown that *S. scabiei* infestations cause measurable specific antibody response in hosts like dogs and pigs (Bornstein *et al,* 1996; Lower *et al,* 2001). Accordingly, it has been found possible to detect specific antibody to *S.*

scabiei in an indirect serological method (ELISA) and confirm it by Western blot analysis in camels naturally infected with sarcoptic mange (Bornstein *et al,* 1997). Further, DNA of *S. scabiei* has been successfully amplified and detected by polymerase chain reaction (PCR) from human cutaneous scales (Bezold *et al,* 2001). This technique holds promise as an additional procedure for detecting specific mange mites that are hard to find in skin scrapings. Raman *et al* (2004) identified two seroactive protein fractions of 17 and 97 KDa in the purified whole mite extract antigen of *S. scabiei* by Western blot analysis.

Treatment and Control

The success of a control regime for sarcoptic mange in camels is dependent on the thoroughness of operation in applying the acaricides. As such, reports of resistance or poor efficacy of chemical washes probably reflect deficiency of application (Higgins, 1984). According to Pegram and Higgins (1992), repeated applications at 7 to 10 days intervals, with vigorous scrubbing, brushing or power spraying to cover each part of the body may be required. Harness, saddlery and bedding should also be treated. Topical chemical acaricides were much in use despite such problems and limitations of repeated applications which are obviously impractical for nomadic herds. Some reports of such usage with varying degree of success are: Diazinon 0.1% and fenvalerate 0.05% (Chhabra and Singh, 1991), the synthetic pyrethroid deltamethrin 0.005% spray (Pathak *et al,* 1991; Makkar *et al,* 1993; Kumar *et al,* 2005), deltamethrin in combination with HCH (Teame,1997), Amitraz 0.05% (Singh *et al,* 1996; Kumar *et al,* 2005), Sebacil EC 50% and Gamatox (Abu-Samra, 1999). Bramley (1992) regarded the "Pour-on" method as potentially beneficial. Ivermectin as systemic endectocide (200 µg/kg body weight S/C and repeated after 15 days) offered several advantages over topical acaricides (Lumsden, 1992), and was found efficacious and safe by many investigators (Hashim and Wasfi, 1986; Chellappa *et al,* 1989; Raisinghani *et al,* 1989; Makkar *et al,* 1991; Njanga, 1991; Nayee *et al,* 1994; Maqbool *et al,* 1996; Hayat *et al,* 1997; Abu-Samra, 1999; Kinne and Wernery, 2003; Saleem and Hadidi, 2004; Kumar *et al,* 2005). In general, healing of scabies lesions following therapy is gradual. Pruritis ceases 7-10 days following the first injection and alopectic areas get covered with growing hair four weeks after the second injection.

However, this treatment protocol may not eradicate the disease (Kinne and Wernery, 2003). Parenteral doramectin 200 µg/kg body weight I/M 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). Another broad spectrum agent abamectin used against sarcoptic mange in camels gave 100% reduction of infestation with injectable formulation and pour-on treatment (Shubber *et al,* 2003). In a comparative study (Singh *et al,* 2007) of parenteral ivermectin and doramectin, in two injections at two weeks interval, both were found equally effective, although recovery and elimination of mites from skin scrapings was somewhat faster in doramectin treated group. Deosi and Sandha (2007) reported equal success with injectable ivermectin and cypermethrin 100 EC @ 2 ml/l of water locally by three weekly treatments.

Individual pastoralists in remote areas and nomadic herds are often inaccessible to the benefits of new-age acaricides and health care. Quite often they rely on traditional ethno-veterinary practices which seem to work in their situation (Kohler Rollefson, 2000). Some examples are: use of old engine oil locally (Namanda, 1998), sulphur with oil of Taramira (*Eruca sativa*) or Karanja (*Pongamia glabra*) oil (Muhammad *et al,* 2005), application of wood oil and feeding of plant of Brassica spp. or oil of rapeseed mixed 1:1 with raw oil from mountain spring (Raziq and Younas, 2007).

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). These have several advantages in terms of safety, easy accessibility, cultural acceptability, low cost and absence of resistance (Chhabra and Saxena, 1998). A formulation prepared from juices of onion, garlic and lemon mixed manually with camphor and turmeric when applied on the affected parts after bathing the animals with decoction of bark of babool (Dixit *et al,* 2002), was found effective in relieving the symptoms as well as making the animals negative for mites. The indigenous formulation was re-evaluated with levamisole (Dixit *et al,* 2004a) or alone (Dixit *et al,* 2004b) with success in management of sarcoptic mange. Further, its miticidal properties were proven (Dixit *et al,* 2004c) in all clinical and haemato-biochemical parameters. In another study (Hassan *et al,* 2005), camel mange was treated by rubbing aloe-vera leaves topically on the affected skin lesions every day. A herbal preparation developed at the National Research Centre on Camel, Bikaner, was therapeutically evaluated and gave encouraging results ((Dixit *et al,* 2005, 2006a). Containing

ingredients like lemon, onion, camphor, turmeric and sweet oil, its therapeutic efficacy was further evaluated (Rathod *et al,* 2006 and Dixit *et al,* 2007, 2009) with or without immunomodulation. On the other hand, the use of neem (*Azadirachta indica*) and tobacco (*Nicotiana tobaccum*) applied locally failed to yield satisfactory results (Dixit *et al,* 2006b).

Mange in the New-World Camelids (NWC)

Foreyt *et al* (1992) reported *Psoroptes* sp. in two llamas (*Lama glama*) in Washington, USA while Petrikowski *et al* (1996) reported chorioptic mange in an alpaca (*Lama pacos*) herd. In a book chapter on medical management of NWC, all 3 types of mange viz. sarcoptic, chorioptic and psoroptic were listed under external parasites of NWC (Fowler, 2000). Bates *et al* (2001) reported the incidence of mange mites affecting NWC (alpacas, llamas, vicunas and guanacos) in the UK including *Psoroptes cuniculi*, *Sarcoptes scabiei* var. *auchinae* and *Chorioptes bovis*. Of these, *Chorioptes* sp. mite infestation is predominant in alpaca, with high prevalence reported of mite infestation as well as clinical signs of thickening, crusting and scaling of skin (D'Alterio *et al,* 2005a). According to a Libyan group (Abdouslam *et al,* 2003), *Sarcoptes* appears to be most common and particularly important especially in llamas. There was a case report of severe *S.scabiei* mange in llamas in Belgium (Leroy *et al,* 2003) along with typical symptoms. Treatment was achieved using doramectin (0.2 mg/kg b.wt.) accompanied by topical application. As regards treatment, eprinomectin was reported as more effective than ivermectin as treatment of chorioptic mange in alpacas and llamas (D'Alterio *et al,* 2005b; Plant *et al,* 2007) while sarcoptic mange in alpacas was successfully treated with Amitraz in UK (Lau *et al,* 2007). According to a more recent report, mange continues to be a major problem for NWC in the UK (Lusat *et al,* 2009). All three types of mange are prevalent but chorioptic is reported most frequently.

Concluding remarks

In its report of the adhoc group meeting on camelid diseases, Office Internationale des Epizooties (OIE, Paris) has listed five out of the parasitic diseases in the significant category. Of these five, sarcoptic mange has been placed second after trypanosomosis, with recommendation for differential diagnosis from other skin diseases (*Psoroptes*, ringworm, etc.) along with development of a good drug or a vaccine (OIE, 2008). Apparently, sarcoptic mange in camelids has not received its due recognition, having been eclipsed by trypanosomosis. As such, there is need for improvement of disease surveillance system. Disease control and management programmes need to be re-oriented by the veterinary department and farmers, so as to help reduce the prevalence and economic impact of mange for improved camel productivity (Chemuliti *et al,* 2003). Additional means for specific diagnosis should now be possible through development of technologies for antibody detection, DNA amplification and PCR. For therapy, indigenous and herbal applications will play better role as convenient alternatives or as part of an integrated control strategy. The issue of development of a vaccine can also be addressed as experimental inoculations and resultant antibody response (Nesbet and Huntley, 2006) hold promise for the future possibility of controlling the effects of mange without the use of acaricides.

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News

AUSTRALIA'S WILD CAMEL – MENACE OR INDUSTRY

Australia has the only single-hump feral camel population in the world, spread over an estimated 3 million square kilometers, or 1.2 million square miles — an area close to one-third the land mass of the United States. Australia has become home to the world's largest wild camel population. There are 1.2 million camels roaming through vast tracks of desert and rangeland in central Australia, and government is keen over control of these rising numbers. Camels cause millions of dollars of damage to farms and native wildlife — and the Australian government has invested $18.8 million (AUD 19 million) to reduce their numbers, mainly through controlled shooting.

A commercial camel industry in Australia was construed as a more sustainable alternative to culling. Some farmers are living happily with camels — which were introduced to Australia in the 19th century and used originally as draught animals. Some cattle dairy owners in Australia's northern state of Queensland introduced camels to their ranch. Carter said the camels are a cost effective way for him to manage the woody weed on his 48,000 acres of land, which is essential for growing the grass that his cattle feed on.