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Important ectoparasites of Alpaca (*Vicugna pacos*)

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Summary

Background

Alpacas (*Vicugna pacos*), earlier named *Lama pacos*, belong to the family Camelidae of which there are 7 living species. Four are native to South America and of those four two are domestic species, the alpaca (*Vicugna pacos*) and the llama (*Lama glama*) and two are wild, the vicuña (*Vicugna vicugna*) and the guanaco (*Lama guanicoe*). These species are often referred to as the New World camels (NWCs) or the South American Camels (SACs) [1]. To the three Old World camels (OWCs) belong the bactrians or the two-humped camel (*Camelus bactrianus*). Lately it has been established that there are two different species of bactrians, one domesticated and one wild endangered species [2]. The latter lives on the border between Mongolia and China. The other domesticated OWC species is the more well known, the one-humped or the dromedary camel (*Camelus dromedarius*).

The Camelidae evolved and developed parallel to the Ruminantia over 35 million years ago in North America [1] and have developed special anatomical and physiological features which are of great significance to their biology, well adapted to the extreme climatic environments of the rough countries of deserts and semi-deserts of Asia, the Middle East and Northern Africa (OWC) and the high altitude country of the Andes in South America (SAC/NWC), respectively. The Camelidae (long neck and small head) are members of the order of Artiodactyla (even number of digits), suborder Tylopoda (modified ruminants with pad or callus on each foot).

All camelids have 37 pairs of chromosomes and the karyotypes are quite similar. The SACs can interbreed and produce fertile offspring.

Important livestock

The alpacas as well as the llamas were and still are very important livestock in large areas of South America, particularly in Peru, Bolivia, Ecuador, Chile and Argentina ([3,4,1]. Since the llamas and alpacas were domesticated about 4-5000 BC [1], they have been the most important resource of human culture and survival in the high altitude environments of the Andes. The SACs are better adapted than any other domesticated species to the very cold, hard and fragile areas with very low oxygen pressure (altitudes between 4-5000m).

Alpaca provide meat, hides, fuel, manure and particularly very fine fibres (wool), which are highly priced. Today more than 500,000 peasant families are raising SACs in the Andes and these livestock are the main source of income for the *campesinos*. Increasing numbers of alpaca are being imported to various countries outside of South America including Europe for wool production, breeding and as companion animals. This is a fairly recent phenomenon that started with larger exports from Chile in 1983-84, first to North America [1].

Ectoparasites

The alpacas as other livestock are exposed to and affected by a range of ectoparasites (see Table 1). Of particular importance are the mange mites, the burrowing *Sarcoptes scabiei* and the non-burrowing *Chorioptes* sp and *Psoroptes* sp and lice, both biting and sucking Phthiraptera. The mange mites have been reported to be common infestations on alpacas also in countries outside of South America. Problems with mange are reported frequently from several countries in Europe [5-10]. In the UK e.g. 23 % of alpaca owners were concerned [8] and in Switzerland alpaca owners regarded mange as one of the four most frequent health problems [11]. *Sarcoptes scabiei* var *aucheniae* is very prevalent in alpacas as well as in other SACs [3]. It is said to be responsible for 95 % of all losses due to ectoparasites in alpacas [12,13]. Infestations with

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Table 1 Ectoparasites of alpaca belonging to the Phylum, Arthropoda.

Order	Family	Species	Disease
Astigmata	Sarcoptidae	<i>Sarcoptes scabiei</i>	sarcoptic mange
	Psoroptidae	<i>Chorioptes</i> sp	chorioptic mange
		<i>Psoroptes</i> sp	psoroptic mange (ear canker)
Prostigmata	Demodicidae	<i>Demodex</i> sp	demodectic mange
Metastigmata	Argasida (Soft ticks)	<i>Otobius mengnini</i>	otitis
	Ixodidae (Hard ticks) ¹	<i>Ixodes holocyclus</i>	Tick paralysis
		<i>Dermacentor</i> spp	Tick toxicosis
Phthiraptera	Sucking lice ²	<i>Microthoracius</i> spp	
	Biting lice ³	<i>Bovicola (Damalinia) brevis</i>	
Siphonaptera	Flees	<i>Vermipsylla</i> sp	
Diptera (flies)	Culicidae (mosquitos)		
	Simuliidae (black flies)		
	Tabanidae	<i>Tabanus</i> spp (horse flies, deer fly)	
	Muscidae	<i>Musca domestica</i> (house fly)	
		<i>M autumnalis</i> (face fly)	
		<i>Stomoxys calcitrans</i> (biting stable fly)	
		Hydrotea spp	
	Haematobia spp		
	Sarcophagidae		
	Calliphoridae (blowflies)	<i>Calliphora</i> sp	
		<i>Cochliomyia hominivorax</i> (primary screw worm)	
		<i>Phaenicia</i> spp (green blow fly)	
		<i>Phormia</i> spp (black blow fly)	
Oestridae (Bot flies)			
	<i>Oestrus</i> sp		
		<i>Cephenomyia</i> sp	

¹ Alpacas are at risk to be infested by native ticks e.g. in Scandinavia by various *Ixodes* and *Haemophysalis* spp, many that are known vectors of pathogens

² Suborder; Anoplura

³ Suborder; Mallophaga

Chorioptes sp are also very common. Some regard *Chorioptes* mites as the most common ectoparasite infesting SACs [14]. The mite is assumed to be *C bovis* [15,16]. *Psoroptes (aucheniae) ovis* may also be found to infest particularly the earlaps (pinna) and the outer ear canals, but can also be found elsewhere on the body of alpacas. Mixed infections occur with two and even three of the mite species [9,17,16].

Mange

Sarcoptic mange

The early acute manifestation of sarcoptic mange include mild to severe pruritus with erythema, papules and pustules, developing soon to crusting, alopecia and lichenification and thickening of the skin (hyperkeratosis), the chronic stage. Lesions may be seen on the limbs (often between the toes), medial thighs, ventral

abdomen, chest, axilla, perineum, prepuce, the head including the lips and ears. Fibre-free areas are said to be more often affected. Damage to the fibre and loss of condition occur. In very severe infections the disease may result in death [3,17]. There are historical accounts of large epidemics of *S scabiei* var *aucheniae* affecting SACs in South America (1544, 1545, 1548, 1826, 1836 and 1839) causing havoc in SACs with mortalities of over two thirds of the populations [3].

Prevalence of the infection among the alpaca of peasant communities in the Andes is between 20-40 % [12]. The earlier high prevalence of the infection also seen in the alpacas imported and bred in USA has been substantially reduced, most probably due to the frequent use of ivermectin [18]. In Europe there are several case reports [11,17,10], but no proper study addressing the prevalence of sarcoptic mange infections.

A concern is that *S scabiei* has a zoonotic potential and that some variants are not host-specific.

Chorioptic mange

Previously *Chorioptes* sp infestations were considered relatively rare in SACs [18,15], although Cremers [19] was of the opposite opinion. Today chorioptic mange is a very common condition in many herds worldwide [14,20].

Clinical signs of chorioptic mange may mimic sarcoptic mange, but animals affected usually exhibit a milder pruritus and sometimes none at all (subclinical). Individuals with a heavy infestation may be free of any symptoms of mange although others in the same herd with lower infestations may show severe extensive skin lesions [20]. Often alopecia and scaling are seen on the feet – often as in sarcoptic mange between the toes and the base of the tail. Lesions may spread to the ventral abdomen, medial limbs and often the ears.

Psoroptic mange

Psoroptic mange is often seen at predilection sites; pinna and outer ear canals, as erythema, crusting, papules serum exudates and alopecia. Pruritus is evident emanating from these lesions. Typical lesions seen in the outer ear canals are big flakes. Pus occasionally appears which is most likely due to secondary infections. Ears and parotid regions may become grossly swollen in severe lesions [3]. However, lesions may be generalised as well as pruritus with or without involvement of the outer ear canal. Other sites with lesions reported include; nares, axillae, groin, neck and legs, abdomen, perineum, shoulders, back and its sides and the base of the tail [16]. Intermittent bilateral ear twitching and short-duration head shaking may indicate otitis due to *Psoroptes* sp infestations [6].

The *Psoroptes* sp of alpacas and llamas have previously been referred to as *P auchenia* or *P communis auchinae* [6], but adequate identifications of the different isolates of the mites have not yet been done. There is a concern that the *Psoroptes* sp isolated from SACs, referred to as *P communis*, the cosmopolitan ear mite of many herbivores [21], might be able to infest sheep and cattle i.e act as reservoirs for the very serious sheep scab. Psoroptic mange was reported recently in two alpacas in the UK [13]. One of the animals came from Chile and the other was born in the UK.

Cross-transmission

The possibility of cross-transmission of any of the other mange mites and other ectoparasites of alpacas to domestic sheep and other livestock and vice versa is a concern and, to my knowledge, has not yet been sufficiently investigated. *Sarcoptes scabiei* var *aucheniae* was reported to be able to infect sheep and horses [22].

Another *Sarcoptes scabiei* variant (var. *cameli*), a common pathogen in dromedaries, was shown experimentally to be able to infect sheep and goats [23], and *S scabiei* derived from goats and sheep readily infected dromedaries experimentally [24].

Some variants of *S scabiei* are known to cross-infect humans resulting in pseudo-scabies. Successful experimental infections of humans with *Sarcoptes scabiei* from alpacas have been reported [16,25]. Some authors do recognize that *S scabiei* var *aucheniae* should be regarded as zoonotic [16].

Diagnosis

The above highlights the importance of correct diagnosis. For all three mite species apply the same traditional skin scraping procedures, particularly deep skin scrapings for the burrowing *Sarcoptes* mites with microscopic identification of the species. In relatively acute infections the mites may be difficult to find. Multiple skin scrapings, employing a blunted scalpel blade often coated with liquid paraffin, are necessary to make on the same individual and on several animals in the affected herd, preferably on all animals. The thickly crusted parts of chronic lesions often yield high numbers of sarcoptic mites. Recommended procedures of taking skin scrapings and the following analytical procedures vary [14]. Often the recommendations are to place the skin scrapings on a glass slide and mix it either with a drop or two of the solution of potassium hydroxide (NaOH) followed by applying heat for a few minutes or mix the skin scraping material with liquid paraffin, followed by applying a glass cover slip. This is then examined for the presence of ectoparasites under low power.

Another laboratory procedure is to place the scrapings (scabs and debris) preferably in centrifuge tubes allowing the material to be soaked in a 10 % solution of potassium hydroxide and place the mix in a water bath (37°C) for a few hours after which the material is centrifuged at about 3000 r.p.m. Then the supernatant is discarded and the sediment examined in a microscope under low power after having added 1-2 drops of glycerine to the sediment.

One can often short-cut above procedure by first examining the collected skin scrapings in a small petri-dish which is left in room temperature or < 35°C for an hour or two followed by examining the scrapings under low magnification (stereo-microscope). The raised temperature (> +18°C) will stimulate any live ectoparasite present to move enhancing the possibility of detecting parasites which then may be isolated and identified. If no ectoparasite is found the previous described procedures follow.

In regards to *Chorioptes* sp animals may harbour a relatively low level of infestation showing no clinical

disease, while other individuals may experience a hypersensitivity reaction with moderate to severe skin lesions including pruritis, similar to a clinical reaction to acute *S scabiei* infections. A recommended site for performing skin scrapings in search of *Chorioptes* sp is the dorsal interdigital (between the toes) and axillae areas [14].

Low power microscopical examination of material from superficial skin scrapings and swabs rubbed into the outer ear canal may identify *Psoroptes* sp. For proper identification isolates should be sent to experts in the field.

When diagnosis is not conclusive skin biopsies are recommended in skin disease. Mites are seldom seen in acute cases in histological sections of the skin. However, in cases of chronic sarcoptic mange, *S scabiei* may often be seen in the epidermis.

Differential diagnosis

Any pruritic dermatitis may mimic infections/infestations by mange mites. There are several other causes of skin lesions which should be mentioned as differential diagnostic possibilities apart from dermatitis of bacterial, viral and fungal etiology; e.g. immune mediated skin disease, hypersensitivity reactions, pemphigus like conditions, nutritional/metabolic disease, idiopathic hyperkeratosis, mineral deficiencies i.e. zinc responsive dermatosis. Unfortunately the latter diagnosis (zinc responsive dermatosis) has become a very popular diagnosis that is seldom proven correct.

Phthiriosis (lice)

Bovicola (Lepikentron) breviceps Rudow, 1866 (the biting or more appropriate the chewing louse), varying in size from 0.5x1.2 mm to 1.5x4 mm, is more common in llamas than in alpacas. The colour of the body of the louse is white or light tan and it has a blunt broad head that is distinctly different from the elongated mouthparts of the sucking lice. Infestations are mostly seen on the dorsal midline, base of the tail, on the side of the neck and along the sides of the body.

Clinical signs of infestations are often a lack of lustre and a ragged looking coat. Infested animals exhibit pruritus. Heavy infestations result in matting and loss of fibres [15], but do not seem to have negative effects on the quality of the fibres or pose any health risk to alpacas [26].

Alpacas are more often infested with the sucking lice, *Microthoracius mazzai* Werneck 1932 characterized by its elongated spindle-shaped head, which is almost as long as its abdomen. Earlier in the literature the former species has been misnamed *M prealongiceps* [27]. Preferred sites of attachment are around the flanks, head, neck and withers. Although these lice are large enough to be seen with the naked eye, about two thirds the size of the biting lice, they are often partly imbedded in the skin taking a blood meal and thus may be difficult to see.

Clinical signs are pruritus, restlessness, hair loss and poor growth. Severe infestations can cause anaemia. The biting lice may be found by parting the fibres down to the skin using a bright light in search of tiny moving specks. Nits (eggs) may be seen attached to the fibres. The smaller sucking lice can be seen clinging to the fibres close to the skin or imbedded in it.

Treatment

A variety of insecticides and acaricides have been used on SACs with varying levels of success. In the past there have been several substances and dosage regimes employed to treat mange mites. The Peruvian Indian peasants believed that the fat of condors was a good cure. This practice was later replaced by used motor oil [3]. Relatively few of the commonly used acaricidal substances and insecticides have been scientifically tested on SACs. The modern macrocyclic lactones e.g. have been tried but not undergone proper testing for efficacy or safety on these animals that have such a unique physiology and metabolism compared to other domestic species. Pharmacokinetic studies of macrocyclic lactones as well as other well known therapeutic products are limited in SACs [28,29]. As yet there are few if any therapeutic products available licenced for these particular animals. This forces the clinicians to use off-label products licenced for other production animals, mostly ruminants. However, several well known therapeutic substances not licensed for use on camelids have been and are used on SACs, some with good results.

A number of authors have used ivermectin at 200 µg/kg by subcutaneous injection with variable but often good results against mange mite infestations and sucking lice in SACs [15,16]. Some have employed higher doses e.g. 400 µg/kg and with more frequent applications (even weekly) than the recommended standard dosages used for other livestock. Also topical use of products containing eprinomectin, doramectin and moxidectin have proved efficacious in some treatments, but not in others [16,10]. Applying injectibles (systemic therapy) in combination with topical treatments is often required to get better results [30]. Particularly patients with chronic lesions with thickened crusty hyperkeratotic skin need to be treated aggressively. In addition, perhaps an earlier recommendation to employ hand-dressing (with a brush) of the thick hyperkeratotic areas of the skin with tepid water with soap and keratolytic agents (e.g. salicylic acid solutions) would shorten the recovery time and reduce the amount of acaricides used [31,32].

Chorioptes sp infestations have often showed to be difficult to control and eradicate [9]. Also *Sarcoptes scabiei* infections have been very difficult to successfully treat [17]. Whether ``fomites`` play any significant role in regards to re-infection/infestation is debatable. *Sarcoptes*

scabiei outside their host will not survive more than about three weeks. However, *Chorioptes* spp may survive for a little more than 60 days.

The fibres of alpacas do not contain lanolin which is necessary for the effective spreading of topically applied products, i.e. pour-ons, formulations designed for other livestock than camelids e.g. cattle and small stock. This may partly explain therapeutic failures on alpacas [6]. When using pour-ons it is essential to apply the products direct on the skin.

There are numerous insecticides including pyrethrins, chlorinated hydrocarbons, carbamates and organic phosphates which may eradicate lice, but the problem is the administration of the products. The clue to successful treatment is to establish contact with the parasites. Lice infestations are easier to treat than the above mentioned mange mites.

Ivermectin at a dose rate of 200µg/kg body weight administered subcutaneously is effective against sucking lice [15], but not against the biting or chewing lice. Cypermethrin at a dose rate of 10 mg/kg has been used with good effect [33,34]. A single treatment is thought to be enough but two treatments 14 days apart is recommended as back-up [33]. Eradication of infestations require repeated treatments and isolation until the animals are found to be completely free of the parasites [33].

The results of several case reports indicate the need to treat more frequently and with higher dosages of some of the acaricidal substances used, compared to the formula for ruminants [16]. It is vital to closely monitor the results of treatment i.e. the clinical resolution following the therapies employed before deciding on whether to stop treatment or change the regimen. Successful treatment should be followed by effective biosecurity measures to prevent the risk of re-infection/infestations. In addition it is recommended to treat all the animals in the herd at the same time.

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