Parasites of new world camelids

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Llamas and alpacas originate from South America and are widely kept in many countries (Figure 1; Panel 1**).**

Panel 1. Origins and characteristics

Llamas (*Lama glama*) are the largest new world camelid and were domesticated from the guanaco (*Lama guanicoe*) some 5,000 years ago. The guanaco is undomesticated in South America, but a few domestic herds exist in the UK.

The **vicuña** (*Vicugna vicugna*) is the smallest of the camelid family. It is undomesticated and considered an endangered species. A small number are kept in the UK, but only in zoos or wildlife parks as they require a dangerous wild animal licence to keep them.

Alpacas (*Vicugna pacos*) are descendants of the vicuña and originate from the Andes of Ecuador, southern Peru, northern Bolivia and northern Chile. They are valued for their fleece, which comes in two types – huacaya, the predominant alpaca type known by its fine and bulky fleece, and suri, the least predominant alpaca type known by its long, curly, shiny and silky fibre.

The number of llamas and alpacas kept in the UK has been growing steadily and was estimated at around 11,000 in 2014, based on agricultural statistics (Defra, 2014).

Llamas and alpacas are host to several internal and external parasites. Few published studies exist on the incidence, prevalence and pathogenic effects of many parasites reported in these animals. Treatment and control is further complicated by a lack of licensed antiparasitic products or specific guidelines on their use, nor recommended dose rates based on efficacy and pharmacokinetic studies.

Internal parasites

Several species of gastrointestinal parasite are unique to new world camelids.

The nematodes *Graphinema aucheniae*, *Spiculopteragia peruvianus* and *Camelostrongylus mentulatus* have been reported in the third stomach of wild and domesticated camelids in their countries of origin. Their pathogenicities are largely unknown and it is unlikely they will be encountered in the UK, although *Camelostrongylus* has been reported in an alpaca (VLA, 2008).

Llamas and alpacas are, however, subject to infestation with intestinal parasites common to domestic ruminants or deer. As with sheep and cattle, infections with abomasal nematodes are generally the most significant. Reported species include *Teladorsagia circumcincta*, *Ostertagia leptospicularis*, *Haemonchus contortus* and *Trichostrongylus axei*.

Intestinal species reported in camelids are generally of lesser clinical significance, although one species, *Lamanema chavezi*, may cause haemorrhagic enteritis in native alpacas and vicuñas in South America with heavy infections. Larval migration reportedly leads to respiratory or hepatic failure.

Figure 1a. Alpacas are widely kept in the UK. Image: Wikimedia Commons/Notnoisy.

Figure 1b. Llamas are increasingly popular in the UK. Image: Wikimedia Commons/Liné1.

New world camelids have their own species of *Nematodirus* (*N lamae*), but are more likely to be infected with *N battus* or *N helvetianus* in the UK.

Other small intestinal parasites reported in llamas and alpacas include *Trichostrongylus* (*T vitrinus*, *T colubriformis* and *T longispicularis*), *Cooperia surnabada*, *Bunostomum trigonocephalum* and Strongyloides papillosus. The tapeworm *Moniezia expansa* may also be found in the UK.

Large intestinal species that may be seen include *Oesphagostomum venulosum*, *Chabertia ovina*, *Trichuris ovis* and *Skrjabinema ovis*. For more detailed information and descriptions of these species, see Taylor et al (2016).

Clinical signs with gastrointestinal nematodes are similar to those seen with livestock and include anorexia, weight loss and diarrhoea, as well as production losses due to reduced fibre quality.

Infections with *Haemonchus* species can cause anaemia and pallor in clinically infected animals. Diagnosis of parasitic gastrointestinal nematode infections can be confirmed by faecal egg count (FEC) and the presence of trichostrongyle eggs.

Species identification will usually require larval culture, although haemonchosis is usually characterised by high FECs; often more than 2,000 eggs per gram. A lectin-binding assay can be used for rapid identification of *Haemonchus* eggs in faecal samples (Colditz et al, 2002).

Protozoa

Several *Eimeria* species have been described from the faeces of alpacas in Peru.

E lamae, *E alpacae* and *E punaoensis* are of unknown pathogenicity, but a fourth species, *E macusaniensis*, found in the faeces of alpacas, llamas and vicuñas, can cause diarrhoea in young alpaca crias (baby camelid; Cafrune et al, 2009).

Oocysts of all four species have been observed in camelid faeces in the UK (Schock et al, 2007). The oocysts of *E macusaniensis* are fairly large (approximately 100µm) and distinctive, with a thick wall and brown in colour (**Figure 2**). They can be seen on faecal examination using a FEC flotation method.

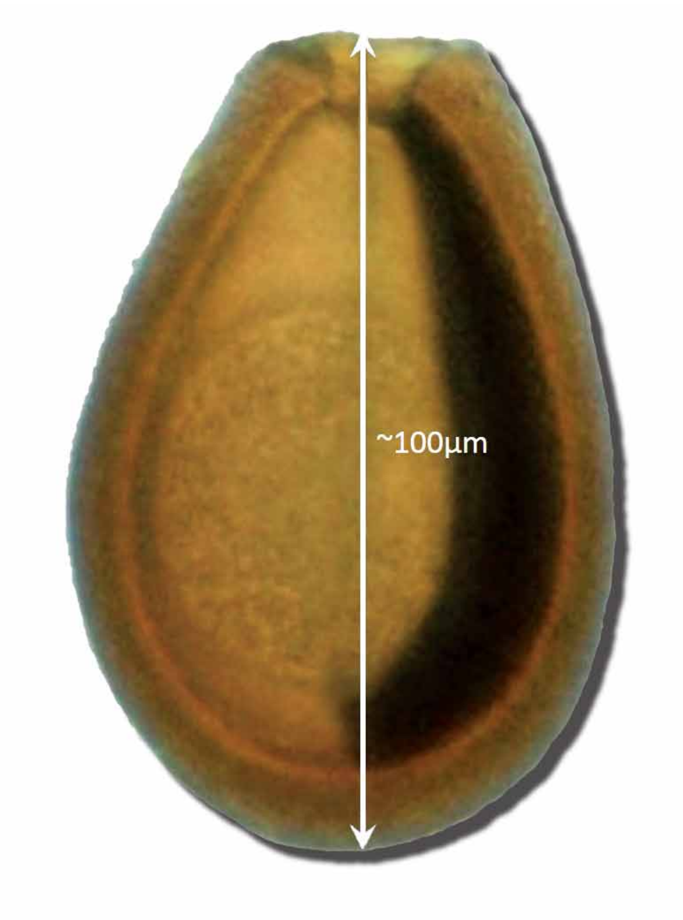

Figure 2. Oocyst of *Eimeria macusaniensis*.

Oocysts from a fifth species, *E ivitaensis*, were reported in two British alpaca herds (Twomey et al, 2010). The pathological significance of this species is unknown.

Oocysts of *Cryptosporidium parvum* have been detected on two holdings in south-west England, from young, healthy alpaca crias and in crias associated with diarrhoea (Twomey et al, 2008).

Liver fluke

Liver fluke infection with *Fasciola hepatica* can cause severe pathology in camelids, similar to that seen in sheep. Both acute and chronic forms of fasciolosis occur.

Clinical signs of disease include reduced appetite, general weakness, recumbency and anaemia. Diagnosis is based on clinical signs, history (being more prevalent in known fluke-infested areas of the country) and may be confirmed by faecal examination for the presence of fluke eggs using a sedimentation method.

Ectoparasites

In their native countries, llamas and alpacas are subject to lice infestations with the llama louse *Microthoracius mazzai*, particularly around the face, neck and withers. No reports of infestations exist in the UK.

These lice are 1mm to 2mm in length and have a very characteristic elongated, spindle-shaped head almost as long as its swollen, rounded abdomen (**Figure 3**).

Signs of infestation are variable. Light infestation may have no obvious effects, but pruritus is usually evident in heavy infestations. The lice are blood feeders and heavy infestations can significantly reduce weight gain and fibre damage.

Infestation with chewing lice (*Bovicola breviceps*) has been reported in the UK (Duff et al, 1999). Lesions are most likely to be observed at the base of the tail and along the neck and trunk.

Figure 3. The llama louse, *Microthoracius mazzai*.

New world camelids can also be infested with mites. *Sarcoptes, Chorioptes* and *Psoroptes* mites have all been observed in alpacas in the UK (Bates et al, 2001), including concurrent infestations with several or even all three genera of mites. However, *Chorioptes* mites appear to be the most common ectoparasite found in these animals (D'Alterio et al, 2005a).

Chorioptic mange caused by *C bovis* is found particularly on the legs, feet and tail. Clinical signs may include mild pruritus, alopecia and scaling of the feet and tail base with extension to the ventral abdomen, medial limbs and ears. It has been suggested alpacas may be more susceptible to infestation than llamas (Foster et al, 2007).

Diagnosis is made by skin scraping from the interdigital and axillae using a blunted scalpel blade and mounting on to a slide in liquid paraffin. Species identification is based on morphology and the presence of bell-shaped suckers (**Figure 4a**).

Psoroptes mites can infect camelids causing lesions similar to those seen in sheep, but are generally more confined to the ears, causing head shaking and scratching.

Lesions are characterised by crusting, papules and serum exudate at sites where the mites have been feeding. It is now thought *Psoroptes* mites from different hosts are all the same species – *P ovis* – and, as such, infected new world camelids may be a potential reservoir for psoroptic mange (sheep scab) in sheep.

The mites can be differentiated from *Chorioptes* mites based on their morphology and the presence of a funnel-
shaped sucker on a three-jointed pedicel (**Figure 4b**).

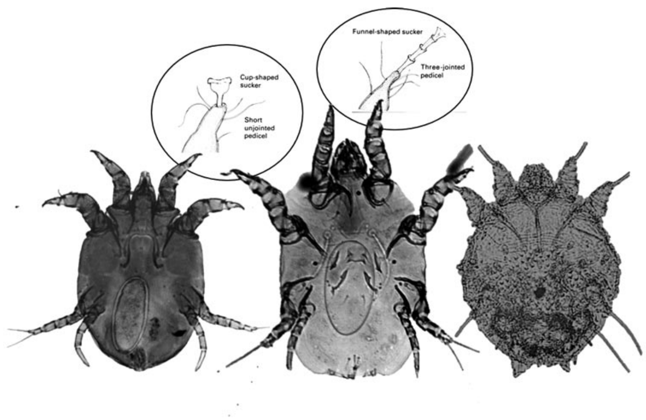

Figure 4. Adult female mites *Chorioptes* (**4a**, left), *Psoroptes* (**4b**, centre) and *Sarcoptes* (**4c**, right). The inserts show the characteristic pedicels and suckers that aid species differentiation.

Sarcoptic mange caused by infestations of *S scabiei* is characterised by intense pruritus, hyperaemia, papules, pustules and crusting present on the limbs, ventral abdomen, chest, axilla and perineum.

Scabies presents a significant zoonotic risk. Microscopic examination of skin scrapings should allow identification of mites, which have a characteristic round body with short legs (**Figure 4c**).

Treatments and control

As with sheep and cattle, knowledge of the parasites present and the patterns of disease that may be encountered are important when contemplating or advising on control.

The life cycles of nematodes and fluke infections are essentially similar to those seen with the reported species in either cattle or sheep. The epidemiology of these infections may differ though, because of differences in management practices and the camelids' behaviour in forming "dung piles", which will influence the build-up and spread of infective larvae over grazing paddocks or fields.

Removing dung piles allow pastures to be cleaned effectively and efficiently on a regular basis, providing a potentially effective means of reducing worm burdens.

Where worm infections are identified and anthelmintic treatments are considered necessary (**Table 1**), it should be borne in mind drenching camelids can be difficult due to their habit of spitting out orally administered drugs. Injectable products are, therefore, the preferred route.

Consideration should also be given to the administered dose rate. Anecdotal evidence suggests treating at 1.5 times the dose rate for ivermectin and at the higher sheep dose rate for doramectin injection (both 300µg/kg). As with other farmed ruminants, such as deer, pharmacokinetic studies suggest drug absorption is somewhat lower compared with sheep and cattle, irrespective of the route of administration. Pour-on products, in particular, are not recommended for alpacas or llamas as the dense fibres prevent skin penetration and uptake; as a consequence, results can be quite variable.

Little information exists on persistence of activity and treatments should be repeated based on FEC monitoring.

Due to the differences in pharmacokinetic behaviour, stated periods of persistency for cattle or sheep products, particularly for those containing macrocyclic lactones (MLs), will differ in camelids and cannot be relied on.

Suboptimal dosing, particularly through either underestimating bodyweight or the application of incorrect dose rates, will also lead to apparent treatment failures. These may manifest as either failure to resolve clinical symptoms, or the presence of worm eggs in faeces on post-treatment FEC.

Table 1. Reported anthelmintics and dose rates used in llamas and alpacas

Anthelmintic	Dose	Active against	Reference
Albendazole (1-BZ)	10mg/kg orally	Gastrointestinal nematodes	Rickard (1992).
Fenbendazole (1-BZ)	5-10mg/kg orally (or daily for 3 days)	Gastrointestinal nematodes, tapeworms	Rickard (1992).
Ivermectin	300µg/kg sc	Gastrointestinal nematodes	
	400µg/kg sc weekly	Sarcoptic and psoroptic mange	Foster et al (2007).
Doramectin	300µg/kg sc	Gastrointestinal nematodes, sucking lice	
Eprinomectin	500µg/kg pour-on	Chorioptic mange	D'Alterio et al (2005b).
Triclabendazole	10mg/kg	Immature and adult fluke	Leguía Puente (1997); Duff et al (1999).

Table 1. Reported anthelmintics and dose rates used in llamas and alpacas.

As seen with sheep and cattle, underdosing and frequent repeat treatments can also lead to potential anthelmintic resistance problems. Resistance to benzimidazoles (albendazole, fenbendazole) and avermectins (doramectin) has been reported in alpacas in North America (Galvan et al, 2012). Based on clinical signs, postmortem findings and FEC results the parasite involved was *Haemonchus contortus*.

Resistance with this parasite to ivermectin in alpacas has also been reported from Australia (Jabbar et al, 2013) and to doramectin in Belgium (Sarre et al, 2012). *Haemonchus* infections have been increasingly reported in alpacas in the UK, with warnings published on the British Camelid Veterinary Society website. Resistance to other gastrointestinal nematodes has not been reported in camelids, but, given the resistance situation with sheep nematodes, particularly *Teladorsagia circumcincta*, co-grazing with sheep or grazing sheep paddocks may pose a significant risk.

Treatment for liver fluke with triclabendazole has been shown to be effective in alpacas (Leguía Puente, 1997) and was used to control an outbreak of fasciolosis in llamas on a Cumbrian farm using a 10% cattle formulation (Duff, 1999).

From a practical point of view, it was reported initial dosing proved difficult for the owner as the llamas regularly spat out the drench when it was administered with a sheep drenching gun. Oral dosing, using a normal disposable syringe and at least two people to restrain the animals and administer the dose, solved the problem.

Injectable ML-based products containing ivermectin, doramectin or moxidectin are generally only effective against sucking lice and may have to be given in a repeated programme of 7 to 10 days.

The range of topical treatments for chewing lice (*Bovicola*) is limited. Alpacas can be treated in the UK with topical pyrethroids, such as deltamethrin or cypermethrin-containing products, as spot-on or pour-on formulations. However, it should be noted llama and alpaca fibre does not contain lanolin, so topical applications of insecticidal/acaricidal products licensed for use on sheep or cattle may not be as effective.

ML products can also be used to control sarcoptic and psoroptic mange, and using higher doses of ivermectin-based products (for example, 400?g/kg subcutaneously on a weekly basis) has been suggested based on the perceived ineffectiveness of standard dosages used in other ruminants (Foster et al, 2007).

In the case of chorioptic mange, repeated administration of injectable or topical ML products may not always totally eradicate mite infestations in a herd. One study showed a good response to weekly topical application of an eprinomectin-based product at the cattle dose rate of 500?g/kg for four treatments, though mites were not completely eradicated (D’Alterio et al, 2005b). It should also be borne in mind repeated use of topical products for ectoparasite control may temporarily stain the hair and may pose problems when treating show animals.

- None of the products mentioned are licensed for use in new world camelids in the UK. All use is under the cascade.
- The author strongly advises to consult the RCVS and VMD guidelines on the use of veterinary medicinal products.

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