Most camelid owners I know provide their llamas and alpacas a dewormer once monthly to prevent aberrant migration of *Parelaphostrongylus tenuis*. This parasite has a complex life cycle including the definitive host (White tailed deer - *Odocoileus virginianus*), intermediate hosts (slugs and snails; *Deroceras laeve, Zonitoides arboreus, and Z. nitidus*). In species such as camelids, sheep, goat, moose and Elk, the infection does not become patent, yet larval migrans causes paralysis and even death. South American camelids characteristically become paretic or paralyzed in the rear limbs when the larvae migrate from the gut to the spinal canal. Most camelid owners administer some deworming agent monthly to prevent larval migration and disease in their animals. There are farms that have never had a clinical meningeal worm case!

A major drawback to the use of anthelmintics once monthly include: 1) selection of parasites for resistance to pharmacologic agents; In one year, the percentage of resistant parasites may be near 100% in a group of animals dewormed monthly. 2) There are nematodes that are not responsive to typical anthelmintics used for P. tenuis larval migration prevention. Using Ivermectin will lead to increased numbers of *Trichuris* spp., *Nematodirus* spp., and clinical disease.

Camelid clients routinely deworm all animals, in many circumstances, without evidence of significant nematode burden. Using the “best” dewormer has led to the use of anthelmintics which should: 1) Not be used as first-line agents; 2) Should be reserved for those animals with severe disease. Using albendazole for “tapeworms” has led to a number of cases of death due to pancytopenia and radiomimetic lesions of the bone marrow and GI tract.(Gruntman *et al* 2009) Many llamas and alpacas have died horribly due to the use of albendazole at high doses over multiple days.(Gruntman *et al* 2009) In Dr. Fowlers most recent edition of his book (several years ago) he recommends administration of albendazole at 10 – 15 mg/kg ONCE!(Fowler 1998) Several cases I have been involved with were treated with 30 – 100 mg/Kg body weight doses over a period of 5 – 10 days. These animals died.

Resistance of parasites are as bad in South American Camels as they are in sheep and goats. Clinically, we see 8-10 camelids (both llamas and alpacas) monthly in the summer with severe parasite burdens. In many cases, lactating females stop lactating, their crias lose weight and we see them because the dam has become recumbent. Their PCV is generally < 10%. The parasite quantification is generally > 4000 epg (although in some cases there were no eggs in the feces – more on this later). Serum iron concentrations range from 2 – 40 mg/dL and TIBC varies from 200 + to 150. Their CBC are generally very regenerative, with marked anisocytosis, marked hypochromasia, some polychromasia, and massive nRBC responses. These animals (those that eat dirt) are iron deficient.

**So what should we as Veterinarians do?**

First, as part of a complete physical examination on any farm (preventative), or with camelids brought to you to diagnose lack of doing well, we should ALWAYS perform a fecal examination. Use the appropriate fecal technique.(Cebra and Stang 2008) The modifications of the double centrifugation, floatation technique are required due to the characteristics of the eggs camelids have problems with (Trichostrongylids, Trichuroids, Nematodirus). Use a
floatation media with specific gravity > 1.025. Sugar is likely the most appropriate, however others using saline or zinc sulfate may work, as long as the specific gravity is high.

Second, float the eggs for up to 1 hour after the 2nd centrifugation. Worm egg counts have been shown to decrease when floated for longer. (Cebra and Stang 2008) Teach your clients to liquefy the fecal pellets for 24 hours, centrifuge the feces in water and then float pellet in sugar solution after the 2nd spin. Most that I have spoken to modify this (leave coverslip on slides over night to allow eggs, oocysts to float up). There are problems with this derivative.

Third, perform fecal exams prior to and 1-2 weeks after deworming. There is absolutely no reason to deworm an animal with 3 epg trichostrongyle eggs. Check before they go to the internet for the current “best” treatment. In conjunction with fecal examination prior to deworming, examine the animals. Using eye color (FAMACHA) and other schema such as Targeted, selective treatment (TST) will provide the owner and the Veterinarian with the ability to select those animals with parasite burdens resulting in loss of production. (Bath and van Wyk 2009)

Modified grazing schemes should help. Using multiple species grazing should provide non-resistant parasites to camelids to limit development of resistance. Pasture management including mowing pastures less frequently can decrease the intake of infective larvae. Allowing camelids to browse or feeding hay off the ground constantly will decrease worm burdens. Decreasing the animal stocking density would be a great start. Working with clients to define protocols for drug treatments is likely a difficult task, but could prove fruitful with the right client. Providing input to clients on first line dewormers (i.e. deworming program), will allow the use of specific dewormers for severe problems. Keep levamisole or pyrantel around for these cases.

What about Emac?

There is very little data regarding anti-coccidial agents and the treatment of the large Eimeria species. Clinically, sulfas and amprolium appear to work. This means in cases where one of these species is documented in a non-clinically ill animal you can treat them and document reduced shedding. However, there are no objective studies to support this. Most people currently use ponazuril (Marquis) at 4-5 times the horse dose. This is a very expensive treatment for whole herd or larger camelids. However, clients will purchase this drug as it seems to be the “best.” Investigators at the University of Tennessee have performed a pharmacokinetic study and dosing an animal at 20 mg/Kg body weight does result in decent pharmacokinetics. However, efficacy data is still being collected. Another “hot” item in the industry is to purchase Baycox (toltrazuril) instead of ponazuril. It is less expensive and because it is a pro-drug (toltrazuril is metabolized rapidly to ponazuril) the PK should be similar, perhaps with a longer half-life.

There have been a number of studies demonstrating severe disease, emaciation and death in camelids with longstanding infestations. (Chigerwe et al 2007, Palacios et al 2006) These did not respond to drug therapy. These two studies document the presence of severe GI disease, with parasite stages visible in the intestinal wall, and parasite stages shed within the feces.

What about skin lesions?

I have done skin scrapes and biopsies and although the lesion resembles Sarcoptes spp., or Psoroptes in their distribution or histopathologic lesions, we never see mites! Perform skin scrapes on these animals (and several herd mates), generally of the digits, distal limb, perineum repeatedly. Chorioptic mange is peculiar in that the mites spend most of their life-cycle off of
the host. You need to keep looking. Dr. McCaslin in Ohio has done more examinations (even animals I missed this on) and found Chorioptic mange mites. These do not respond to ivermectins and potentially other treatments as they live of the superficial skin materials, cause pruritis and hair/fiber loss and live happily in the environment where no drug is present. Fipronil is effective in removing these agents well (if you can purchase it).
What else should we as Veterinarians do?

**Diagnostics** - Examine animals physically for clinical signs of anemia (palor of mucous membranes), hypoproteinemia (submandibular edema, diffuse edema), diarrhea, poor body conditions. Treat those appearing anemic, or if the owner requests further work-up, run PCV, TPP prior to deciding on treatment. If you plan to treat animals, perform fecals before treatment. Use the appropriate fecal methods for large animals. Send fecals off to Oregon State University for the fluorescein-peanut lectin stain for Haemonchus in cases of severe parasitism OR anemia.

**Treatment** – Develop protocols that work on a specific farm. Application of the one protocol fits all is not going to work anymore. Treat only those animals that need treatment.

Environmental control of deer, snails and slugs – For a long time, I have pondered why there is an increase in numbers of meningeal worm cases in the winter in Ohio. Up until recently I was emphatically told that camelids must eat a snail or a slug to become infected with the larval stages of P. tenuis. For most cases, this is probably true. However, why would snails and slugs cause problems in snow? Recently, Dr. Steve Purdy, demonstrated that snail(slug slime trails may leave larval stages on vegetation. Outbreaks can occur. On one Alpaca farm (6 cases in 2 weeks), stored hay appears to have been involved in an outbreak. 2-3 of 6 alpacas died due to permanent paralysis.

Guinea fowl, peacocks, other avian can reduce the number of pests on a farm (snakes, slugs, snails). Remove low lying areas, by fencing or filling them may also help. Placing a vegetation break around the fencing should keep this area dry. Deer proof fencing, to keep deer out of pastures. Caffeine is a tremendous slug repellant. Placing coffee grounds around moist damp areas benefits the soil and repels these pests.

References