Eimeria macusaniensis

By Jill McElderry-Maxwell, April, 2010

INTRODUCTION

Coccidia are microscopic parasites that disrupt intestinal function. Although they are diagnosed on fecal examination, they are not worms. Instead, they are single celled organisms known as protists. Protists are obligate intracellular parasites — they must complete part of their life cycle in the cells of a host organism.

Coccidia are widespread organisms that affect not only alpacas, but almost every group of animals known. They are ubiquitous in the environment, and naturally infect most animals to some degree. Problems arise when their numbers exceed the ability of their host to carry them without suffering negative consequences.

There are numerous coccidia of veterinary significance, including *Eimeria*, *Cryptosporidium*, *Plasmodium*, and *Toxoplasma*. The following species of *Eimeria* coccidia have been identified in New World camelids: *Eimeria alpacae*, *Eimeria lamae*, *Eimeria punoensis*, *Eimeria peruviana*, *Eimeria ivitaensis* and *Eimeria macusaniensis* [Duzynski, et al., 1998a]. The first four species are typically grouped together as "small coccidia." Little information is available on *E. ivitaensis*, although this is apparently a large coccidian. It is unclear from my research whether this coccidian has been found in camelids living in North America.

This article deals with the large coccidian *Eimeria macusaniensis*, commonly known as E. mac or "Big Mac." E. mac was first described in South America in 1971 [Guerrero, et al., 1971] and was widely identified in the North American herd by 1999 [Jarvinen, 1999]. Dr. Jarvinen's work with Midwestern farms in the late 1990s showed that almost a third had E. mac present, with approximately 10% of all animals tested carrying the parasite. *Eimeria macusaniensis* is difficult to detect on fecal flotation, and sheds very infrequently; it also causes fewer clinical symptoms than small coccidia (i.e., diarrhea is not frequently associated with E. mac). Thus, a farm may have infected animals without ever diagnosing the parasite, despite fecal examination.

Dr. Cebra believes that the apparent recent surge in E. mac reports represents both an actual increase in numbers of animals infected, as well as more accurate reporting of infection due to better fecal sampling and owner awareness [Cebra, 2007]. Given the frequent movement of alpacas across country and their admixture, it may have been inevitable that "Big Mac" would spread across the country and eventually reach significant levels in previously naive populations.

LIFE CYCLE

Coccidia are present in the environment as oocysts, roughly equivalent to the egg stage of other parasites. The oocysts are usually passed from the host in the feces, and this is the form by which almost all coccidia are known and identified. *Eimeria macusaniensis* is distinct from the "small coccidia" by virtue of its large size (~90 microns versus ~30 microns) and piriform shape.

Oocysts do not become infective unless environmental conditions are appropriate, at which point sporocysts containing sporozoites develop. The encapsulated oocyst is then referred to as a sporulated oocyst, and it can persist in the environment in this stage for years. The thick walls of sporulated E. mac make this organism virtually impervious to environmental extremes and it can persist in the soil for years. Some owners have resorted to extreme means to attempt to destroy E. mac oocysts in their fields, including topsoil removal and burning, but these measures are neither effective [Cebra, 2007], nor likely to be warranted.

Once a sporulated oocyst is ingested by a host, the covering of the oocyst is broken down either by mechanical or chemical activity in the host's gut. After release, the sporozoites seek out and penetrate epithelial cells lining the gut. Inside the host's cells, the sporozoites begin to multiply asexually into merozoites. The proliferation of merozoites eventually bursts the host cell, and the released merozoites begin seeking out new cells in which to begin the process of multiplication again.

Each species of coccidian is believed to have a specific number of asexual replication cycles that it completes. The final generation of sporozoites again seeks out new host cells, but instead of making more sporozoites by fission, they develop into two types of gamonts: large, sessile macrogamonts (analogous to eggs) and smaller microgametocytes, which produce motile microgametes (analogous to sperm). When a macro- and microgamete fuse, a protective wall develops around the resulting zygote, which pushes free of the host cell and is excreted in the feces [Duzynski, et al., 1998b].

The prepatent period, the time between ingestion of a sporulated oocyst and passing oocysts in the feces, varies from species to species of coccidia. The prepatent periods for the two most common small coccidia in alpacas are ten days for *E. punoensis* and 16–18 for *E. alpacae* [Foreyt, 1992]. *Eimeria macusaniensis* is unusual in that its prepatent period is 33–42 days, meaning than an animal can be infected for over a month before any trace of the parasite is evident in the animal's feces. This unfortunately means that an animal may sustain considerable damage or even die from the activity of the parasite before there is any means of detecting the infestation.

ENVIRONMENTAL FACTORS PROMOTING OOCYST SURVIVAL

Oocysts are known to sporulate more quickly at higher temperatures than lower, within the range of 50°F to 122°F. Unsporulated oocysts do not survive outside of these temperature extremes, although sporulated oocysts can. Oocysts require moisture, oxygen and shade to sporulate. Direct exposure to sunlight will kill unsporulated oocysts [Duzynski, et al., 1998b]. Once sporulated, oocysts remain infective for anywhere from several weeks to several years in the natural environment, depending on species. *Eimeria macusaniensis* requires 13–21 days to sporulate [Cebra, et al., 2007].

In essence, coccidia thrive in damp, dark locations at moderate temperatures — accumulated dung and bedding that do not dry out are a haven for coccidia growth. You can

limit your animals' chances at (re)infection in several ways. Good manure management is important: remove manure from animal living areas regularly and consider allowing free range poultry to turn over your manure piles, since exposing the oocysts to sunlight prior to sporulating will kill them. The lengthy time period reqjuired for E. mac to sporulate means that prompt manure removal can be very beneficial in reducing the number of infective oocysts present in your animals' environment.

The better overall health your animals are in, the better able they are to resist infection and mitigate the effects of all coccidia, including E. mac. Keeping stocking rates low and removing stressors from your animals' environment will promote good health and reduce the effects of coccidia. A good plane of nutrition also permits an animal to carry a coccidia load without significant ill effects. Over time, alpacas will build immunity to the coccidia to which they have been repeatedly exposed, which is why clinical cases of coccidiosis are usually seen in young alpacas or older animals with compromised immune systems.

The same holds true for E. mac, although this species can be more virulent than the small coccidia, particularly in cria. However, it is entirely possible for an animal to carry subclinical loads of *Eimeria macusaniensis* and remain in good health. Although E. mac was initially viewed by many as a virtual death sentence, the emerging consensus among camelid veterinarians is that E. mac should be managed in the same way as small coccidia, but with greater vigilance [Cebra, et al., 2007]. Cria are particularly susceptible, and once an owner is aware of E. mac on their property, the parasite must be considered in any animal showing signs of ill thrift.

CLINICAL ILLNESS: COCCIDIOSIS

Coccidiosis caused by the "small coccidia" typically shows a clumped or ball stool in mild cases, progressing to diarrhea and weight loss in more severe infestations. In very severe infestations, portions of the intestinal lining may be shed, and the damage to the intestinal wall can be permanent, causing continued ill thrift or stunted growth. *Eimeria macusaniensis* is atypical in that diarrhea is not usually associated with even heavy loads of the parasite. Weight loss and weakness are symptoms of infection, but obviously are not diagnostic for E. mac alone. Bloodwork from an infected animal will reveal hypoproteinemia (low protein levels), but this is also not specific to E. mac infection.

E. mac oocysts are large and heavy, and can be easily overlooked in a fecal with a short float time, or one that is not centrifuged. *Eimeria macusaniensis* also sheds very few eggs (estimated at fewer than 100 in the first week of patency [Cebra, 2007]), so infrequent fecals are unlikely to find the parasite. If E. mac is suspected, multiple fecal examinations over a several week period, using centrifugation and a saturated sugar solution, are recommended as the best way to try to catch oocysts as they are shed.

TREATMENT

Animals with known or suspected E. mac can be treated in two different ways: with a coccidiostat that prevents additional reproduction of the coccidian; or with a coccidiocide, which kills the organisms outright. Coccidiostats include amprolium (Corid), which inhibits thiamine uptake in coccidia; sulfadimethoxine (Albon), which prevents the uptake of folic acid; and sulfamethoxazole/trimethoprim (SMZ-TMP), which also prevents the uptake of folic acid.

Without access to thiamine or folic acid, coccidia are unable to continue reproduction, and the alpaca's immune system will clear the remaining organisms on its own. Although dosages and protocols vary, most coccidiostats are used on an on-off-on rotation over several weeks. **It is important to note that alpacas are very susceptible to thiamine depletion, much more so than other ruminants. Thiamine depletion results in polioencephalomalacia (PEM), characterized by swelling in the brain, which can be fatal.** Symptoms include lack of appetite, poor coordination and other neurological signs. High doses of injected thiamine can reverse PEM.

For this reason, if using amprolium to treat coccidiosis, it is recommended that you concurrently administer thiamine subcutaneously every third day during treatment. It may seem counterintuitive to administer thiamine when amprolium works by blocking access to thiamine (the coccidia preferentially uptake the amprolium in place of thiamine). However, the injected thiamine is available to the alpaca's metabolism, but does not reach the gut where the coccidia are.

Another important consideration when using coccidiostats in cases of known or suspected *Eimeria macusaniensis* is that coccidiostats are most effective against the first stages of a coccidial infection. Given the long prepatent period of E. mac, these stages may be past by the time treatment is begun. For this reason, a coccidiocide may be preferable. Two coccidiocides are currently recommended for the treatment of E. mac, ponazuril and toltrazuril.

Ponazuril (Marquis) is a medication originally developed to fight a protozoan in horses. It is effective against later stages of coccidial infection. The medication is very expensive and requires careful dilution to an effective dosage for alpacas (40 gm ponazuril paste plus 60 gm distilled water to equal 100 gm; dosed at 9mg/lb once diluted). While equine veterinarians stock the drug in many areas of the country, it may not be available except by mail order in others. It must be administered for three days.

Toltrazuril (Baycox) is a relatively new treatment for cocciodiosis. It is a coccidiocide, which kills the intracellular life stages of coccidia. It must be imported from Australia, and is available in this country from Light Livestock Equipment (www.lightlivestockequipment.com) or can be ordered directly from Australian sources. Many farms have reported success with single treatments, while others indicate that two doses several days apart are more effective.

You should consult with your veterinarian to see which medication is recommended for your particular situation. In mild cases of clinical coccidiosis, coccidiostats may be preferred, as they do permit the animal to mount its own immune response to the nonreproductive coccidia. This will reduce the likelihood of future reinfection. In severe cases, where immediate relief from severe infection is required, a

coccidiocide's action may be more appropriate. It is important that the alpaca community refrain from overusing toltrazuril and ponazuril, in order to maintain their effectiveness for the future.

Proper hygiene and good husbandry to prevent coccidiosis are preferable to chemical intervention. Well cared for animals will typically develop an immunity to coccidia — including *Eimeria macusaniensis*. E. mac is now a widespread part of the parasite community affecting North American camelids, just as are the small coccidia. With proper management of your herd, the effects of this parasite on your own herd, as well as that of others, can be minimized. Proper quarantine and fecal testing of incoming and outgoing animals should take into consideration the longer prepatent period and low shedding rate of this organism, and animals should remain in quarantine for an appropriate duration.

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