UNIVERSITY OF MARYLAND EXTENSION
SMALL RUMINANT PROGRAM

Livestock Parasitology 101

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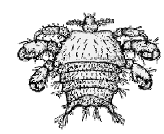
Parasites
A parasite is a (generally undesirable) organism that exists by stealing the resources from another living organism. Ruminants and other livestock are affected by many different kinds of parasites. Some are pathogenic (disease-causing) at certain levels of infection. Some aren't.

Most parasites are species-specific, meaning the parasites that infect one species of livestock usually do not infect another species. There are two categories of parasites: internal (endo) and external (ecto).

External parasites
External parasites live on the blood of their host or lay eggs on their hide or inside their nose. Numerous external parasites can affect livestock: lice, ticks, mites, mosquitoes, and flies.



External parasites can cause hair and wool loss, pelt damage, reduced performance, respiratory problems, and sometimes even death. External parasitism can usually be controlled with permethrin-based and other insecticides. Some anthelmintics (e.g. ivermectin) are effective against external parasites.

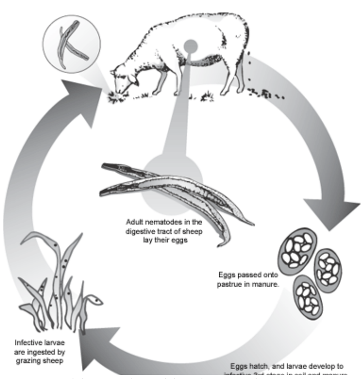
Internal parasites
Internal parasites live inside their host. There are two general kinds of internal parasites: helminths and protozoa. Helminths are worm-like, multi-cellular organisms that can further be divided into three general categories: 1) nematodes (roundworms); 2) cestodes (tapeworms); and 3) trematodes (flukes).

<u>Nematodes (roundworms)</u>
Nematodes are more commonly called roundworms. There are over 20,000 species of roundworms. Roundworms are long and round. They are not segmented like tapeworms Nor are they visible in the feces. Most are microscopic. Roundworms reproduce sexually. There are both male and female roundworms.

Most, but not all, roundworms live in the digestive tract of the animal. Some roundworms (e.g. lungworms, meningeal worm) are initially ingested by the animal before migrating to a different body system.

There are many species of roundworms (nematodes) known to infect ruminants and other livestock. Different species usually affect different livestock. Most roundworm life cycles are direct, meaning an intermediate host is not required for the worm to complete its life cycle (egg to larval stages to adult worm).

Scientific name	Common name
Haemonchus contortus	Barber pole worm
Trichostrongylus spp.	Hair worm
Nematodirus sp.	Threadneck worm
Oesophagostomum	Nodule worm
Ostertagia (*Teladorsagia)* spp.	Brown stomach worm
Cooperia spp.	Intestinal worm
Strongyloides	Intestinal threadworm
Trichus spp.	Whipworm
Bunostomum	Hookworm
Dictyocaulus spp. *Muellerius capillaris*	Lungworm
Paralaphostrongylus tenius	Meningeal worm deer worm brain worm



Life cycle of barber pole worm
(Virginia Tech image)

The main roundworm affecting sheep and goats is *Haemonchus contortus*, better known as the barber pole worm. This large, blood-sucking parasite causes anemia and "bottle jaw." It does not cause diarrhea, unless it is part of a mixed infection that includes "scour" worms. Infected animals usually look poor and underfed. Sometimes, they are simply found dead.

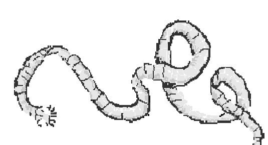
The main roundworm affecting cattle is *Ostertagia ostertagi*, the brown stomach worm. *Ostertagia* cause scouring and ill thrift in cattle, mostly calves.

Llamas and alpacas can be affected by any of the roundworms that infect sheep and goats, as well as cattle. They seem particularly susceptible to the often deadly meningeal worm, serving as an unnatural host to it, similarly to sheep and goats. Otherwise, llamas and alpacas tend to be more resistant to internal parasites than their small ruminant counterparts, due in large part to their defecating habits.

Pigs can be affected by large roundworms, whipworms, and nodule worms.

<u>Cestodes</u>

Cestodes are more commonly called tapeworms. There are more than 1,000 species of tapeworms; in fact, a species to infect every known vertebrate species. Tapeworms are flat, ribbon-like worms that are composed of various



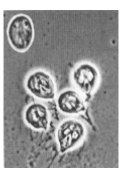
segments. Tapeworm segments are passed in the feces and are visible to the human eye.

Unlike roundworms, tapeworms are usually hermaphrodites, having both male and female parts. An intermediate host (pasture mite) is required for the tapeworm to complete its life cycle. Sometimes, livestock serve as the intermediate host for tapeworms affecting other animals.

Tapeworms tend to be non-pathogenic, especially in mature animals. It is rare for them to cause disease, unless they cause a blockage in the intestines. Repetitive research done with sheep has shown no advantage to treating for tapeworms. Tapeworms are far less of a problem than roundworms.

<u>Trematodes</u>
Trematodes are more commonly called flukes (e.g. liver flukes). They are flat, oval-shaped worms. Like tapeworms, flukes are hermaphrodites. They require a intermediate host (gastropod) to complete their life cycle. Flukes are most common in wet climates (primarily the Gulf states and Pacific Northwest) and are generally not considered to be a problem in Maryland livestock.

Protozoa



Protozoa are single-celled, spore-forming, microscopic organisms. Examples of protozoan parasites include coccidia, *giardia*, and *cryptosporidium*. Protozoa can reproduce both sexually and asexually. They are species-specific. Even sheep and goats are not infected by the same species of coccidia.

Coccidia can be a major problem in livestock, especially young stock. Good management and sanitation will go a long way towards preventing disease. Oocyte levels (in the feces) may not correlate well with severity of infection.

Coccidiostats can be added to feed, mineral, or water to prevent disease outbreaks. Coccidiosis is treated with Corid or sulfa antibiotics.

Controlling internal parasites in livestock

The control of internal parasites in a flock or herd starts with good management, sanitation, genetics, and nutrition. Unsanitary conditions help to spread parasites and other diseases. Poorly fed animals are more susceptible to parasitic infections. Some breeds and individual animals are more resistant to internal parasites than others.

Because internal parasites affect primarily grazing animals, good pasture and grazing management is essential to controlling parasitism. Pastures need to be sub-divided, so that paddocks can be rotated and rested. Overgrazing should be avoided. Livestock should not be allowed to graze short pastures, as most infective worm larvae is in the first two inches of vegetative growth.

Multi-species grazing may help to control parasites, as most parasites are species-specific. Some forages have "anthelmintic-like" properties, e.g. Sericea lespedeza and chicory. Livestock that browse have fewer parasite problems. Livestock grazing legumes are less likely to get infected with parasites than those grazing mostly grass stands. Zero grazing usually limits infection and re-infection with parasitic larvae.

If and when parasites cannot be controlled by management alone, it is usually necessary to administer anti-parasitic drugs called anthelmintics. The more common name for an anthelmintic is dewormer. If an anthelmintic is effective, it will kill 95 percent or more of the adult worms in the animal's gut. Some dewormers are also effective against immature worms and hypobiotic (arrested) larvae. Sometimes, specific dewormers are needed to kill specific kinds and life stages of worms.

One of the most important decisions livestock owners must make is "when to deworm." There really aren't any standard recommendations for deworming livestock, as the need for deworming depends upon the species, class, farm, season, and year. Because of the development of drug-resistant worms, it is now recommended that dewormers be administered therapeutically (for treatment) vs. prophylactically (for prevention), especially for small ruminants.

Clinical signs, history, and fecal egg analysis should all be used to diagnose worm problems and determine the need for deworming. Livestock owners need to become familiar with the symptoms of worm infections common to their species. The FAMACHA© eye anemia system was developed to help sheep and goat producers evaluate the level of anemia in their animals to determine the need for anthelmintic treatment. For parasites causing more generic symptoms (such as diarrhea and ill thrift), fecal egg counts will be more useful.

Fecal egg analysis

Fecal egg analysis can be an important tool in a parasite control program. Most veterinarians and diagnostic labs perform qualitative fecal analyses, also called fecal flotations. A simple fecal flotation can be used to determine which kind(s) of parasite eggs are present in the sample and approximately how many eggs the animal is passing it its feces.

In contrast, a quantitative analysis (Fecal egg count; FEC) will let you know the quantity of eggs that are present. This is important because the simple presence of worm eggs in a fecal sample does not mean that the animal is parasitized or requires anthelmintic treatment. It is normal for animals (including humans) to have some parasites in the gut. Thus, it is important to know how many eggs are in the fecal sample. The number of eggs is usually expressed as eggs per gram of feces (EPG).

There are many ways to analyze fecal samples to determine levels of infection. The most commonly-used method is the McMaster procedure, and there are different methods for doing it. The McMaster procedure utilizes a gridded slid for counting eggs. The slide can be purchased from the Chalex Corporation (www.vetslides.com). A McMaster slide with green grid lines is easier to read than one with black lines.

A microscope with at least 100x magnification is needed to view worm eggs. The 10x objective is used to visualize the slide. Combined with the 10x magnification of the eye piece, this results in 100x magnification.

A scale that can measure in grams is needed to weigh out the feces. A sample of 4 g (approximately 1 tablespoon of fecal material) is recommended for the McMaster egg counting procedure.

The first step is to collect a fecal sample from the livestock. The sample should be fresh, either recently excreted or collected directly from the rectum of the animal. A lubricated glove should be used to collect a fecal sample. If the samples cannot be examined immediately, they can be refrigerated for up to two weeks. Fecal samples should not be frozen.

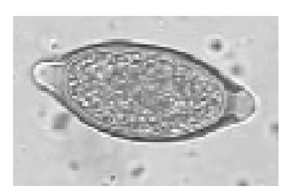
After examining the fecal sample for its consistency, color, and presence of blood or mucous, 4 grams of fecal matter should be weighed out. After the fecal matter is thoroughly broken up (using a wooden stick), it should be added to a cup or vial containing 26 ml of a fecal flotation solution.

Flotation solutions can be purchased commercially or made on the farm. They are usually saturated solutions of sugar or salt. Fecal flotation solutions must have a specific gravity higher (usually $\geq$1.3) than the parasite eggs or oocytes so that the "lighter" eggs will rise to the top.

After the fecal sample is thoroughly mixed with the flotation solution, the slurry needs to be strained into another container (such as a plastic cup). A tea strainer or cheese cloth can be used for straining.

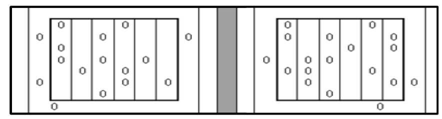
A pipette or syringe should be filled with the fecal slurry and each chamber in the McMaster slide should be filled with the slurry. Air bubbles must not be present in the chambers. After the chambers are both filled, the slide should be allowed to sit idle for 2 to 5 minutes. This will allow the eggs to float to the top of the surface.

The slide should be placed under the microscope and the 10x objective should be selected. The eggs can be counted by focusing on the top layer and going up and down the grid of the slide for each chamber. Different types of parasites should be counted separately. The number of eggs counted in each chamber should be added and multiplied by 25. The resulting number is worm eggs per gram of feces. If different amounts of feces and flotation solution are used, the calculation will be different.

			
Strongyle-type	Coccidia	Tapeworm	Whipworm

Step-by-step directions

1. Collect fecal sample
2. Weigh 4 g of feces
3. Break up sample
4. Add to 26 ml of flotation solution
5. Mix sample with flotation solution
6. Strain slurry into another container
7. Fill pipette or syringe with slurry
8. Fill both chambers of slide with slurry
9. Let sample sit for 2 to 5 minutes
10. Count eggs on both sides.
11. Add number of eggs on both sides and multiple by 2



Understanding fecal data

While fecal egg counts are useful, it is important to understand their limitations. Fecal egg counts are not always well-correlated with disease. They are simply a tool to help livestock owners diagnose worm problems and make deworming decisions.

Limitations to fecal egg analysis

1. Some parasite eggs look the same and cannot be identified at the egg stage (e.g. Strongyle-type worms)
2. There is a fairly regular fluctuation in fecal egg output.
3. Egg output varies by season of the year.
4. Eggs are not always evenly distributed in the feces.
5. Parasite species vary in their egg producing capacity
    a. Some parasites are prolific egg producers (e.g. *Haemonchus*)
    b. Some parasites do not produce very many eggs. (e.g. *Nematodirus*)
    c. Some parasites produce eggs intermittently
    d. Some parasites can produce asexually
    e. Immature worms do not lay eggs
    f. Inhibited larvae do not lay eggs
6. Not all parasites are pathogenic (disease-causing)
7. Total egg counts may include a mixture of species with different levels of fecundity and pathogenicity.
8. Diarrhea increases fecal moisture and may dilute the number of eggs.
9. Human error.

While opinions vary on the clinical significance of egg counts and the levels at which deworming is necessary, the following table provides some general guidelines on interpreting FEC levels in sheep and cattle.

Livestock species	Worm species	Clinical significance*
Sheep	*Haemonchus contortus*	2,000+ epg clinically significant
Sheep	*Teladorsagia* spp.	500+ epg clinically significant Disease can occur with lower FECs
Sheep	*Trichostrongylus* spp.	500-2,000 epg
Sheep	*Nematodirus* spp.	500-2,000 heavy infections light infections 50-300 epg
Sheep	*Oesophagostomum*	500-1000 epg heavy infections
Sheep	*Moniezia spp.*	Variable numbers Questionable importance
Cattle	*Ostertagia* spp.	300+ clinically significant Disease can occur with lower FECs
Cattle	*Haemonchus placei*	700-1,500 epg may be clinically significant
Cattle	*Nematodirus*	Rare
Cattle	*Cooperia spp.*	1,000-5,000
Cattle	*Bunostomum*	100-500 epg may cause ill thrift
Source: Love and Hutchinson, Pathology and Diagnosis of internal parasites in ruminants. In Gross Pathology of Ruminants, Proceedings 350 (2003)		

*Also need to consider nutritional and physiological status and age of animal.

<u>Fecal egg count reduction test</u>

One of the most useful uses of fecal egg counts is to determine the effectiveness of an anthelmintic treatment. This can be done by comparing the egg counts of fecal samples collected before and after anthelmintic treatment. Ideally, this procedure is repeated on several animals, including some that have not been treated with the drug.

If the anthelmintic failed to reduce the fecal egg county 95 percent or more, drug resistance is present. In some cases, drug resistance will be so high that deworming will fail to successfully treat a parasitized animal. Drug resistance is widespread among small ruminants and is developing in other species, especially equine.