Why Do Sheep and Goat Fecal Egg Counts

Quantitative fecal egg counting is a procedure that determines the number of eggs per gram (EPG) of strongylid eggs, including barber pole worm (*Haemonchus contortus*), in a fecal sample. Quantitative fecal egg counts can be used along with other information, to design and evaluate a parasite control program. It can also help a producer make breeding decisions and determine the effectiveness of a dewormer.

Modified McMaster Test

The most common and efficient way to obtain fecal egg counts for sheep, goats, young cattle and horses is to use the Modified McMaster Test. This is a flotation test based on density; the eggs float to the surface of the counting chamber.

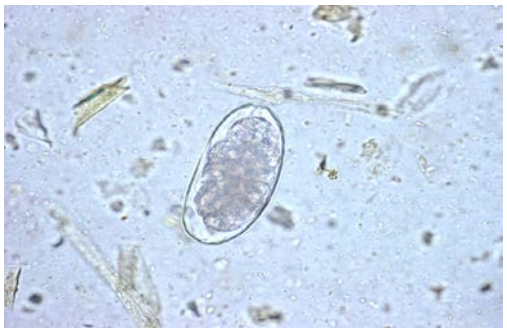


Figure 1. A photo of a microscope slide showing a strongylid egg.

This test uses a special microscope slide with a grid which makes counting easier. Manure and flotation fluid is measured and mixed and only a small portion of the total mixture is counted. A calculation is performed to determine the number of eggs/gram in the manure. The counting techniques for ruminants are designed to count strongylids or gastrointestinal nematode worms including the barber pole worm (*H. contortus*), but can be used for other parasites as well.

For more information view our information sheet, *How To Do The Modified McMaster Fecal Egg Counting Procedure*; and our demonstration video on fecal egg counting available on our website, ***http://web.uri.edu/sheepngoat*.**

This information sheet will provide guidance on:

1) Interpreting FEC results
2) The Fecal Egg Count Reduction Test (FECRT)
3) Improving drug efficacy

Interpreting Fecal Egg Count Results?

Using the McMaster procedure described in our information sheet, *How To Do The Modified McMaster Fecal Egg Counting Procedure*, each strongylid egg counted represents 50 eggs/gram of feces; therefore, a FEC result of "0" means that there were fewer than 50 eggs/g in the sample analyzed, not that the animal is free of worms.

All grazing sheep and goats will have some worms. If one animal in the flock/herd is infected with parasites, all of the remaining animals are exposed.

Major Strongylid Nematodes in the U.S.

Haemonchus (barber pole worm)
Lives in abomasum
Dominant in summer
Spends winter as arrested larvae

Teladorsagia Ostertagia (brown stomach worm)
Lives in abomasum
Prefers cooler weather
Spends winter as arrested larvae

Trichostongylus
Lives in small intestine
Very common
Most likely to over-winter as an adult

DO NOT use the FEC as a sole indicator of when to deworm an animal or to diagnose the parasitic disease state in individual animals. Use the FEC in conjunction with FAMACHA© (anemia) scores, body condition scores, presence of diarrhea, and overall animal health. Are there signs of disease? What is the time of year and what is the animal's treatment history?

The number of eggs in manure varies seasonally so learn the pattern in your region. For those worms that spend winter as arrested (hypobiotic) larvae, a FEC in the winter won't reflect the number of worms in the animal. However, as pregnant ewes/does prepare to lamb/kid, the larvae will come out of hypobiosis over a short time period and resume development to the adult stage.

For example, a lamb with a FEC of 1000 eggs/g and a FAMACHA© score of 2 is very different from a lamb with a FEC of 1000 eggs/g and a FAMACHA© score of 4. As long as the FAMACHA© scores are good and overall clinical condition is good then you probably wouldn't need to deworm the first animal as you would the second animal. You would, however, continue FAMACHA© scoring every 2 weeks during parasite season and monitor any changes that might ultimately lead to deworming.

Resilient animals have higher FEC results but low FAMACHA© scores and lack other signs of disease. These animals are better able to tolerate the worm load. Resistant animals will have fewer worms and lower FEC results. Under normal conditions, most animals control their parasites, but a few have a higher genetic susceptibility. As a general rule: **30% of the animals in a flock / herd have 80% of the worms.**

Where the barber pole worm (*H. contortus)* is the dominant worm, FAMACHA© anemia scores are good for showing us which animals are the most susceptible to barber pole worm infection. Since most animals should not develop disease, FAMACHA© is not as effective at identifying animals with the best immunity and FEC is one tool that can help to narrow it down.

When using FEC for selective breeding, test young animals twice and do it during the summer months when the worm activity and fecal egg counts will be higher. Small differences between FEC results are not meaningful. The table at the right (Figure 2) shows an example of fecal egg counts from lambs in the summer months.

Lamb #	Eggs/g June	Eggs/g July	
101	**50**	**none seen**	**More resistant**
110	**3000**	**6000**	**More susceptible**
192	500	400	
64	600	1150	
105	800	750	
120	500	1650	
89	350	1050	
95	**1000**	**4050**	**More susceptible**
116	300	850	
100	500	1900	
75	**150**	**100**	**More resistant**
88	100	1050	
108	400	900	

Figure 2. Table showing fecal egg count results for lambs taken in June and July – a time of high worm activity. The results can help to narrow down animals that are more resistant and those that are more susceptible to worms and aid in selective breeding decisions.

The Fecal Egg Count Reduction Test (FECRT)
Tests for Drug Resistance

Good parasite management for small ruminants includes testing the efficacy of anthelmintics (dewormers) used on a farm. This can be done either through a Fecal Egg Count Reduction Test (FECRT) or by the DrenchRite Test® available at the University of Georgia by Dr. Kaplan's laboratory (706-542-5670). The DrenchRite Test provides information on susceptibility to all major drug groups based on a single composite sample.
***http://www.wormx.info/#!storeyhowell2012/c4qh*.**

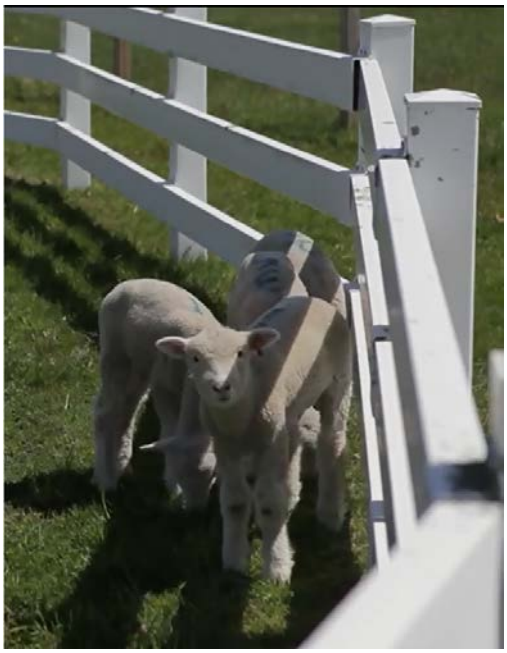
FECRT

This test compares FEC results before and after a dewormer treatment from the **same** group of animals. The first set of fecal samples is collected immediately before the deworming treatment and the second set of fecal samples is collected 10 to 14 days after deworming treatment. Waiting for at least 10 days after the treatment allows worms that had been impacted but not removed by the drug to reach full egg production again. If the second set of samples is collected more than 14 days after treatment, worms that infected the animals after they were treated would have a chance to mature and start producing eggs. A mathematical calculation is performed to determine the overall drug efficacy.

$$\%\ \text{Fecal Egg Count Reduction (FECR) Estimate} = 100 \times \left(1 - \frac{\text{Post-deworming FEC}}{\text{Pre-deworming FEC}}\right)$$

Example: Pre-deworming FEC is 500 eggs/g
Post-deworming FEC is 150 eggs/g

$$100\ X\ (1\text{-}150/500) = 70\%\ FECR$$



For small groups of animals it is probably more accurate to determine the FEC reduction for each animal and then average those percentages rather than averaging pre-treatment results and post-treatment results and using those averages to perform the calculation.

It is recommended that at least 10-15 animals be tested to determine drug efficacy, but in smaller flocks fewer animals could be used with the understanding that the results will be less accurate. All animals included in the test must have a pre-treatment FEC of >150 eggs/gram (collected just prior to the deworming treatment). Animals being used in the test should be weighed so they can be given the correct amount of dewormer. If they can't be weighed then they should be dewormed for the heaviest possible weight in each group (adult animals, young animals, etc.)

In general, we want to look for a drug efficacy (egg count reduction) greater than 90%-95%. If the efficacy is less and the test was performed correctly, it suggests that there are some resistant worms present. However, we also need to consider the following confounding factors:

- Were animals given the correct dose?
- Had the drug expired?
- Were there enough animals in the group to make the results meaningful?

Interpreting FECRT Results

The FECRT is only an estimate of the efficacy of the dewormer and is far from 100% accurate. FECRT results are not as straightforward as the DrenchRite test.

Macrolides (ivermectin, moxidectin), benzimidazoles (BZD, e.g. albendazole, fenbendazole) and levamisole are highly effective against trichostrongylid parasites. In a perfect FECRT, you would expect to see at least 95% reduction in fecal egg counts for macrolides and benzimidazoles (a bit lower for levamisole). However, in an on-farm test lots of things can happen:

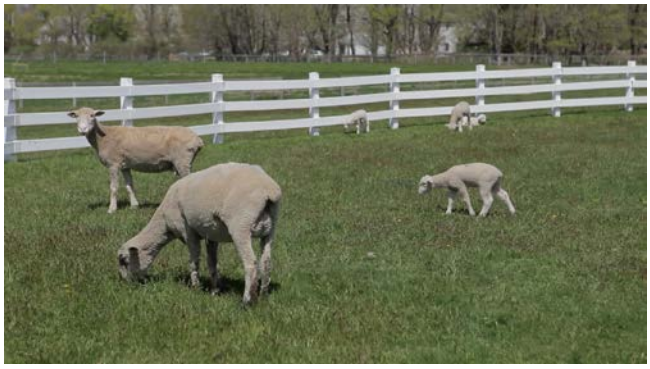
- animal variation (age, condition, immune function, resident parasite population)
- small numbers of animals tested
- initial low fecal egg counts
- variation in drug delivery

All these variables make the test less than perfect. Some very broad guidelines are as follows:

FECR > 90% - the drug you are using is probably okay and working as intended. Keep monitoring animals.

FECR from 50 % to 90% - LARGE GRAY AREA!!!!! - When egg count reductions fall below 90%, you can conclude that the proportion of resistant worms has probably increased to a level where the drug is no longer fully effective. However, there is no direct relationship between the FECRT and the number of resistant worms. For example, a 70% fecal egg count reduction **does not** mean that 30% of the worms are resistant. It just suggests that the proportion of resistant worms in this population of animals is increasing and you may need to consider, **in consultation with your veterinarian**, an alternative drug to use or different ways of using the drug (see below). Keep monitoring animals.

FECR < 50% - there are probably enough resistant parasites present to seriously reduce the effectiveness of drug treatment and you may want to consider, **in consultation with your veterinarian**, alternative drug use. Keep monitoring animals.



We have developed an information sheet that provides instructions on how to conduct the Modified McMaster Fecal Egg Counting Procedure as well as a demonstration video on fecal egg counting. All these resources are available on our website, ***http://web.uri.edu/sheepngoat*.**

Improving Drug Efficacy

What do I do when testing shows that a dewormer may no longer be fully effective? Always:

- **Consult with your veterinarian**
- **Consider the whole parasite control program and how principles of integrated parasite control can be utilized and optimized to reduce the need for deworming.**

Whether or not to continue using a drug once a FECRT indicates that a substantial population of resistant worms may be present depends on the situation. Always use an effective treatment for animals with parasitic disease or especially vulnerable animals. Treatment for these animals should also be accompanied by removal from a heavily infected pasture. However, a drug that produces a less than optimum fecal egg count reduction might still have some use. For example, a producer might use a drug that produced a 75% fecal egg count reduction to treat some clinically normal animals to reduce fecal egg counts. Under these circumstances, use of the drug will continue to select for resistant worms, but using the drug in only a portion of the animals will slow the rate of increase in the resistant population.

Even in the face of reduced drug efficacy, the anthelmintic activity of benzimidazoles (BZD i.e. albendazole, fenbendazole) and macrolides (ivermectin, moxidectin) can be restored for a variable period by the following practices:

a. For both BZDs and macrolides, take animals off feed for 12 hours before treatment. This practice slows down movement of the drug through the rumen and enhances absorption. Do not remove water and do not take sick animals or those in late pregnancy or lactating off feed.

b. For BZDs, continue to leave animals off feed and treat again in 12 hours—so you are giving 2 treatments in a 24 hour period, during which the animals are off feed. In one goat herd the activity of fenbendazole was restored for a year with this strategy, even though there was a 0% reduction in fecal egg counts after a single treatment. However, the increase in activity and its duration will vary from farm to farm and should be monitored.

c. If using oral ivermectin, a second treatment as described for BZDs may be of some value. Increasing the dose may also temporarily improve efficacy.

NOTE OF CAUTION TO GOAT PRODUCERS!!!
Morantel and fenbendazole, at the 5 mg/kg dose, are the only drugs approved by the Food and Drug Administration (FDA) for use in goats. **All other drugs** and **fenbendazole at 10 mg/kg** are considered extra-label use by the FDA. The FDA regards extra-label use of drugs an exclusive privilege of the veterinary profession and is only permitted when a bona fide veterinarian-client-patient relationship exists and an appropriate medical diagnosis has been made.

If you need a fully effective treatment you have 2 options:

1. Switch drug classes. This strategy is the easiest change to make, but is becoming harder to do successfully as multiple drug resistance in worms increases. The efficacy of the new drug class should also be tested because so many worms are now resistant to more than one drug.

2. Use drug combinations. In Australia and New Zealand, where resistance is a huge national problem, it has become common to use combination treatments. Animals are treated at the same time with 2 drugs at the normal dose, each drug from a different class. Even if resistance is present to each drug individually, using them together will result in a high level of activity and should help slow the rate of development of resistance to each one for a period of time. If no information about drug efficacy is available, using a combination is an appropriate choice for animals affected by parasites. However, it is important not to use a combination treatment on all animals routinely because this practice will select strongly for resistance to both drugs.

Always monitor the efficacy of the drugs when you use these protocols since the effect will not always be the same and will not last indefinitely. Use of these practices with a fully effective drug would also slow the development of resistance.

For more information including our information sheet on the Modified McMaster Fecal Egg Counting Procedure and our demonstration video on fecal egg counting, visit our website at ***http://web.uri.edu/sheepngoat*.** The video can also be viewed directly from the URI YouTube channel page (**UniversityOfRI**): ***https://www.youtube.com/watch?v=ZZQymZKe_hs***

Program contact: Katherine Petersson, Ph.D., Associate Professor
Dept. Fisheries, Animal & Veterinary Sciences, University of Rhode Island
Phone: 401-874-2951; Email: ***kpetersson@uri.edu***

This information sheet was developed by Anne Zajac, DVM, Ph.D. Parasitologist, Virginia-Maryland Regional College of Veterinary Medicine / Virginia Tech; Katherine Petersson, Ph.D, Animal Scientist, Dept. Fisheries, Animal and Veterinary Sciences, and Holly Burdett, Cooperative Extension, College of the Environment and Life Sciences, University of Rhode Island.

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