Parasite Management Programs for Small Ruminants

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Abstract

Implementation of effective parasite control programs in small ruminants requires the ability to monitor live animals for anemia and body condition score. The effectiveness of the program and of the drugs being used can be further monitored by qualitative and quantitative fecal examinations and fecal egg count reduction tests. Additional tests that may be needed occasionally are the Baermann for collection of lungworm larvae from the feces and larval culture to identify the species of strongyles that are present, especially when resistance has developed.

Introduction

Coccidiosis and intestinal strongyles cause significant interference with growth and production in small ruminants. Under poor environmental and nutritional conditions, these parasitic infections may even be fatal. Because they cannot be eradicated, parasites must be monitored and managed. Monitoring often falls to the veterinary technician, who needs to understand not only the techniques for fecal flotation, but also how to evaluate the well-being of the animals and what drugs to use when treatment is deemed necessary. A well illustrated text, such as *Georgi's Parasitology for Veterinarians*[1], is an indispensable reference. The Southern Consortium for Small Ruminant Parasite Control has a very useful website at <http://www.scsrpc.com/> with information on FAMACHA and treatment principles ("Smart Drenching").

Monitoring the Live Animal

A new system of controlling *Haemonchus* in small ruminants while delaying the development of parasite resistance to anthelmintics originated in South Africa. This is the FAMACHA system and is based on treating, and marking for possible culling, animals that are anemic based on the color of the conjunctiva.[4] The system uses a plasticized card that is held next to the everted lower eyelid and compared with it to determine a color score of 1 to 5. Only animals judged to be anemic are dewormed, but the monitoring most be repeated every few weeks to avoid losses during times favorable for parasite transmission. FAMACHA has been evaluated for use in sheep and goats in the southeastern United States.[2]

In sheep, the approximate packed cell volume (PCV) for each conjunctival color score is: 1 = >27 (average 35); 2 = 23-27 (average 25); 3 = 18-22 (average 20); 4 = 13-17 (average 15); and 5 = <13 (average 10). In goats, using a PCV value less than 19% as evidence that the animal was anemic and needed deworming, and then calling conjunctival scores of 3, 4, and 5 positive test results, the sensitivity of the FAMACHA system for detecting anemic goats was approximately 80% and the specificity was about 54%. If only scores 4 and 5 were called positive, the sensitivity was about 25%, but the specificity increased to 91%. In the validating goat study[5] in South Africa, about 11% of the goats were treated using 4 and 5 as positive, while 50% were treated if scores 3, 4 and 5 were called positive. This puts substantially less pressure on the *Haemonchus* population to develop resistance compared with treating the entire herd.

Body condition score should also be monitored, as strongyles other than *Haemonchus* can cause serious loss of condition and even death in the animal that is not markedly anemic. Animals are scored on a 1 to 5 scale by palpating the loin area. An emaciated animal with a score of 1 has no lumbar muscles or subcutaneous fat, but instead skin is stretched over the vertebrae and sharp transverse processes can be felt as a horizontal shelf. An obese animal with a score of 5 has muscles and fat bulging on each side above undetectable dorsal spinous processes and the tips of the transverse processes also cannot be detected. A desirable score of 3 is present when muscle and fat filling in the loin area can be palpated to form approximately a straight line between the dorsal and transverse spinous processes of the vertebrae. The scoring system can be further refined by using half or even quarter points. As most breeds of dairy goats, even when obese, have less subcutaneous fat than do sheep, the vertebrae appear sharper in goats than in sheep with the same score.

Qualitative Fecal Flotations

A simple flotation to detect the presence but not the precise number of parasites in the fecal sample is often done first, and is followed by a quantitative examination if parasites appear to be numerous. Zinc sulfate, specific gravity (SG) 1.18, is used for flotation of thin-shelled protozoal cysts, such as amoebas and *Giardia* cysts, and for nematode larvae which tend to be

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crenated beyond recognition by flotation solutions of a higher specific gravity. Magnesium sulfate, sold as "Epsom Salt" in drugstores, is used as an inexpensive and cheaper substitute for zinc sulfate. Sugar solutions, SG 1.2, are used for routine flotation, while SG 1.3 is used for *Cryptosporidium*, fluke eggs and *Trichuris* eggs.

Centrifugal Flotation

In the centrifugation method, which is preferred, the sample is first dispersed in tap water, then strained through cheese cloth or an opened gauze sponge, then centrifuged to wash it. After the wash solution has been poured off the flotation solution is added and the sample is centrifuged again. The parasite eggs and cysts are harvested from the film at the top of the centrifuged sample.

Procedure:

1. Measure out approximately 1 gm (1 cc) of feces into a paper cup, using two applicator sticks or a tongue depressor to move feces.
2. Add about 15 ml tap water and disperse the feces in the water vigorously with the applicator sticks.
3. While swirling, sieve the fecal matter by pouring the contents of the cup through a layer of cheesecloth into a second cup.
4. Pour the sieved fecal matter into a 13 x 100 mm test tube. For these tubes use short sleeves in the centrifuge.
5. Balance with a similar tube and centrifuge at 600-800 x g; 1 min.
6. Decant.
7. Add flotation medium to fill the tube approximately 2/3 full and resuspend the pellet vigorously with two applicator sticks.
8. Fill the tube with the same flotation solution to 1 cm from the top.
9. Centrifuge for three minutes if using ZnS04 or MgS04.
10. Leave the tube in the centrifuge, and without otherwise disturbing the surface, use a small handmade loop (a 28-gauge, flame-resistant wire made into a 5 mm diameter loop) to dip just below the surface in the middle of the tube, lifting straight up so that a drop adheres to it. Touch the loop flat on a slide so that a fat drop is transferred to the slide. Examine the drop without a coverslip (unless examination will be delayed), using a compound microscope at 4X.

There is also an alternative technique. In step 8, slightly overfill the tube so there is a slight bulging of the surface film about the rim of the tube, and add a coverslip before centrifuging. If sugar solution is used, centrifuge for 8-10 minutes. Remove the coverslip by lifting straight up so that a drop adheres to it; place the coverslip on a slide, and examine with a compound microscope at 10X.

Stationary Flotation

This method is used for routine screening in situations where a centrifuge is not available. Commonly used flotation solutions such as NaNO3, 1.2 SG or saturated NaCL distort parasites markedly after 15-20 min. Zinc sulfate, 1.18 SG, is more expensive but does not cause marked distortion. Sugar solution, 1.2 SG is used, but the flotation time must be increased as it is more viscous than the salt solutions.

Procedure:

1. Load the device with approximatley 1 gm (1 cc) feces. This step may be done by the animal owner if provided with the device in advance.
2. Add flotation medium to the stationary flotation chamber to about halfway full.
3. Mix gently (Note: Fecalyzer®[a] device rotates easier than Ovassay Plus®[b] device.)
4. Remove large debris pieces; if using Fecalyzer® or Ovassay Plus®, seat the insert by pushing it down very firmly until it clicks into place. If using pill vial or film container, pour it through a tea strainer or piece of cheesecloth into another chamber.
5. Add flotation medium to form a convex meniscus above the chamber. Place a 22 mm^2 coverslip on top of the solution.
6. Flotation period: allow to stand 15-20 min. (While Ovassay Plus® instructions say 5 min, we have had much better results with 15 min.)
7. Lift coverslip straight up so that a drop adheres to it; place the coverslip on a slide, examine with a compound microscope starting with the 10X objective.

Quantitative Fecal Examination

Interpretation of small ruminant fecal exams requires quantitative techniques, as healthy sheep and goats are expected to have some parasites and trying to eradicate them with dewormers will increase the risk of development of parasite resistance. A threshold for treatment should be 500 to 1000 strongyle eggs per gram. The lower threshold would be appropriate early in the grazing season, when it is important to limit pasture contamination. Fecal egg count reduction tests are used to check that a dewormer is still effective in the herd. Do fecal egg counts on animals before deworming and repeat on the same animals 10 days later. If the counts do not decrease by at least 90% (some say 95%), resistance is present. Owners will see a clinical response to treatment of parasitized animals with as little as 30% efficacy, so do not trust "response to therapy" as an indication that resistance is not present. The problem of

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anthelmintic resistance in small ruminant strongyles in the United States is very serious and increasing in prevalence.[3]

Quantitative methods vary in the flotation solution, mixing chamber, dilution and counting chamber used. The method below, using a McMasters[c] counting slide, is useful for all species. The volume under each grid for this chamber is 0.15 ml. Counting chambers with etched grids are about $15; those with higher contrast green grids are about $20 each. The dilution can be increased as necessary, e.g., to obtain a more accurate count of large numbers of coccidia in small ruminants. Make sure to modify the multiplication factor accordingly.

Procedure:
1. Place beaker on balance and tare it.
2. Using tongue depressor, weigh out 4 gm of feces into beaker.
3. Add approximately 20 ml flotation solution.
4. Mix well with tongue depressor to break up lumps.
5. Bring up to 60 ml with flotation solution.
6. Add stir bar, and stir at medium speed for five min.
7. While mixture is still stirring, draw about 0.6 to 1 ml fecal suspension into a 1 ml syringe.
8. Load one side of counting chamber carefully to avoid producing bubbles.
9. Repeat sampling and loading procedure for second side of chamber.
10. Let preparation stand five minutes but no longer than 20 min.
11. Place chamber on microscope and examine with 10X objective.
12. Count eggs in both sides of chamber, counting those eggs located under the grid.
13. Calculate eggs per gram: for 60 ml final volume, eggs per gram (epg) = (side 1 + side 2) x 50
    To clean the chamber, rinse under a stream of cold water.

Baermann Test

The sensitivity of this test for actively wiggling nematodes is directly proportional to the volume of feces used. The Baermann technique is used to collect and concentrate lungworm larvae from feces, nematode larvae from tissue or soil samples, or larvae that have been grown in a larval culture. When exposed to warm water the larvae wiggle out of the macerated sample but are unable to swim, so they sink to the bottom of the tube.

Procedure:
1. Macerate the feces or fecal pellets with a tongue depressor.
2. Place the fecal sample on an 8" cheesecloth square.
3. Wrap the cloth once around the fecal mass, tie corners so no material falls out.
4. Snip off any loose cloth from corners.
5. With hemostat, clamp tube below the funnel closed.
6. Fill funnel 2/3 full with lukewarm water.
7. Squeeze tubing, expelling bubbles from tubing and funnel stem.
8. Check that the apparatus does not leak!
9. Add tied feces, checking that it is immersed and that no cloth is outside the funnel.
10. Allow apparatus to stand for 45 minutes to overnight.
11. Briefly release hemostat to withdraw 10-15 ml sample into centrifuge tube.
12. Centrifuge this sample two minutes at maximum speed and decant.
13. With pipette, mix and withdraw a drop of sediment.
14. Place on slide; put coverslip on top.
15. Examine with a compound microscope using 4X objective for scanning.

An alternate method is available. In step 11, drain fluid into a petri dish and examine with a dissecting scope.

Culture of Nematode Larvae

Because development of larvae is enhanced with some aeration and moisture, mixing dense feces with an inert substance such as activated charcoal or vermiculite may increase the culture yield. As eggs of most strongyles and trichostrongyles look similar, it may be useful to determine what proportion of eggs shed by ruminants represent pathogenic trichostrongyles. This is especially important when some but not all species have developed resistance to one or more anthelmintics.

Procedure:
1. In a sandwich bag, mix about 25 g feces approximately 1:1 with vermiculite.
2. Add sodium carbonate solution until slightly moist but not dripping.
3. Place mixture into bottom of jar.
4. Pack mixture into bottom of jar: it should be about 1/4 or less of jar volume.
5. Wipe sides of jar clean of any debris.
6. Place the cap loosely on jar.
7. Let stand about a week at room temperature; moisture droplets will form on inside of jar.
8. Using magnification check for larvae in droplets.
9. If there are larvae, invert jar and rinse its sides down into a petri dish with distilled water.
10. To obtain more larvae, replace the cap loosely and repeat the rinsing in a day.
11. Transfer larvae to a slide with transfer pipette, in a drop of water.

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12. Rub a small amount of petroleum jelly onto your palm, then by dragging a coverslip on edge through this, form a tiny bead of jelly on all edges of the coverslip.
13. Place the coverlip, jelly down, over the drop.
14. Examine and measure larvae, using information from a parasitology text to determine identity of larvae. The larvae are "relaxed" (killed) by briefly heating the slide with a burning match. This allows them to straighten out so that the total length, tail of sheath (anus to tip of sheath) and extension of sheath (tip of larva to tip of sheath) can be measured. *Strongyloides* larvae do not have a sheath.

Coccidiosis and Coccidiostats

The most common cause of diarrhea in lambs and kids over three weeks of age is coccidiosis. Weaning, crowding, poor nutrition (including vitamin E/selenium deficiencies), wet environment, feet and feces in feeders all predispose to coccidiosis. The fecal may be negative early in the disease or have 100,000 oocysts/gram in animals in balance with the parasites. No treatments are available to kill the coccidia, rather treatment just slows parasite multiplication to allow the animal to develop immunity and to decrease environmental contamination to protect others. There is a rebound of fecal oocyst counts after treatment and it is common to have higher counts 10 days after than before treatment. Once clinical signs appear, treatments have little effect on weight gain but do limit shedding. Treat all animals in the group prophylactically. Group the lambs or kids by age (no more than two weeks difference) to avoid deaths in late-born animals (Table 1).

Routinely medicate starter/creep ration. Shedding from adults can be limited by mixing one of the first three drugs with salt, but only do this to protect neonates, and not in dairy animals.

Intestinal Strongyles and Anthelmintics

Intestinal strongyles commonly infest small ruminants on pasture, especially if the pasture is small and damp. Goats are more susceptible to strongyles than are sheep, and goats that are forced to graze will have heavier parasite loads than browsing goats. They do not develop a strong immune response to the parasites with age and exposure. Haemonchosis may cause death from anemia without diarrhea. Other strongyles more typically cause diarrhea.

The veterinary technician needs to be familiar with dewormers available in the US and with drug dosages, as the label often will not tell the proper dose for the species of host or parasite to be treated. In general, use double the sheep dosage to treat goats (except levamisole, 1.5X sheep dose). Dose according to the correct body weight, and dose for the heaviest animals in a group, not the average weight. Use fewer strategic dewormings. Treat all animals at parturition to control the periparturient rise, and before release to pasture in the spring. During the rest of the year, treat only those animals that need treatment and cull animals that require frequent dosing. Leave unselected parasites *in refugia*, on pasture or in untreated animals, to delay resistance problems by permitting crossbreeding of susceptible and resistant parasites.

Determine which dewormers work with a fecal egg count reduction test. Withholding feed for 12 to 24 hours before treatment increases the efficacy of benzimidazoles and avermectins. Use drugs of two classes simultaneously if resistance is suspected. Furthermore, anthelmintics should be given orally (not topically of subcutaneously) to decrease selection pressure for resistant parasites. A long metal dosing tip with a smooth ball on the end that reaches over the back of the tongue is preferred in order to deliver the drug into the rumen (Table 2).

Conclusions

Veterinary technicians have a very important role in providing parasite control programs for small ruminant clients. Identification of parasitism, whether it be by evaluating the animal for anemia or body condition or the fecal sample for presence and number of parasite eggs and larvae is the first step in the program. Treatment thresholds need to be set, as the goal of the program is control, not eradication of parasites. The

Table 1.

Drug	Approval*	Dose range	Duration	Comments
Decoquinate	G, S	0.5 mg/kg BW	daily in feed or MR	safest – no LD50
Monensin	G	20 g/ton feed	daily in feed	
Lasalocid	S	20-30 g/ton feed	daily in feed	
Amprolium	no	25-50 mg/kg	5 days	1 ml of 9.6%/8#
Sulfonamide	no	1.25 g/100 lb	5 days	double dose on day 1

* G = goat, S = sheep

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Table 2.

Drug for strongyles	Drug class	Dose for goats*	Dose for sheep	Comments
Fenbendazole	benzimidazole	10 mg/kg**	5 mg/kg	
Albendazole	benzimidazole	15 mg/kg	7.5 mg/kg	approved for sheep
Levamisole	levamisole	12 mg/kg	8 mg/kg	approved for sheep
Morantel	levamisole	10 mg/kg	10 mg/kg	approved for goats, no milk WD
Ivermectin	avermectin	300-400 ug/kg	200 ug/kg	not for dairy goats
Eprinomectin	avermectin	0.5 mg/kg	0.5 mg/kg	

*all are extralabel for goats except morantel
**approved but less effective for goats at 5 mg/kg

technician is in a good position to educate owners on the choice of drugs and the appropriate dose to use in sheep and in goats. The veterinary technician can also evaluate the efficacy of treatment and monitor the herd for the development of resistant parasites, using the fecal egg count reduction test.

Footnotes

[a] Fecalyzer®, EVSCO Pharmaceutics, PO Box 685, Harding Hwy, Buena, NJ 08310
[b] Ovassay Plus®, Synbiotics, 4444 N. Belleview, Kansas City, MO 64116
[c] Available from Chalex Corporation (was Advanced Equine), 5004 228th Avenue SE, Issaquah, WA 98029

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