Play the game: discussing anthelmintic resistance and what's out there for treatment

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Abstract

Anthelmintic resistance is an ever-present problem for small ruminant practitioners and producers. Specifically, resistance to *Haemonchuscontortus* to all commercially available anthelmintic options has been a major complication with deadly consequences. Resistance development has been man-made with misuse of anthelmintics and inappropriate management practices. Alternatives to chemical anthelmintics do exist and are becoming more useful as continued anthelmintic resistance develops. This proceeding discusses anthelmintic resistance in gastrointestinal nematodes and some alternative options to traditional commercial anthelmintics.

Keywords

Anthelmintic Resistance, Small Ruminants, Alternative Therapies

Anthelmintic resistance development

Unfortunately, resistance of gastrointestinal nematodes (especially*Haemonchuscontortus*) has developed to every anthelmintic on the market today. Resistance development in the United States has been proven by several studies including studies by Crook et. al. in 2016 looking at the Mid-Atlantic United States and Howell et al. in 2008 looking at states in the South. This resistance has been created by overuse of anthelmintics, a concept influenced by the fact that most anthelmintics are older products, available over the counter, and marketed for multiple species making accessibility simple and veterinary oversight non-existent. The biology of *Haemonchuscontortus* also aids in the development of resistance. Resistance is created when the parasite survives therapeutic (or subtherapeutic) dosing of the anthelmintic. The generation of "survivors" can then develop a resistance gene that can be specific to an anthelmintic. For example, *H. contortus* may

develop beta tubulin that is resistant to the effects of the benzimidazole class. Nematodes are specifically adept at resistance development due to their short life cycles, high reproductive rates, large population size, and rapid rate of evolution. These qualities allow for a high degree of genetic diversity and more incidence of gene mutation.

Resistance development can be slowed. First, it is imperative that strategic anthelmintic use is exercised. This means that "blanket deworming", or deworming an entire herd or flock, is being eliminated as a practice. Instead, animal and fecal assessment should be performed before choosing to use an anthelmintic. Animal assessment includes FAMACHA© scoring and utilizing The Five Point Check©, a system that includes assessment of the lower eyelids, nose, jaw, topline, and tail to identify clinical signs of parasitism. Animal assessment must be paired with fecal assessment-performing fecal egg counts to identify severely affected animals. In most cases, 20% of the animals in a herd or flock harbor 80% of the parasites. Identification of these affected animals allows for proper treatment while maintaining a load of parasites that will not be exposed to, and subsequently develop resistance to, anthelmintics. This population of parasites is referred to as refugia. If an animal is found to have both clinical signs of parasitism and an elevated fecal egg count, that animal should be treated with anthelmintics. Following treatment, a fecal egg count reduction test should be performed two weeks following anthelmintic administration. This is the only way to quantify how much parasite die-off is accomplished by the anthelmintic. Other management strategies that may be incorporated in conjunction with selective anthelmintic use include multi-species grazing (grazing sheep and goats with cattle and/or horses) and nutritional management (utilizing creep feeders for young stock and formulating diets based on stage of life and stage of production). Certain animals may also be classified as "naturally resistant" to parasites (hair sheep breeds, for example, are thought to be more naturally resistant than European wool sheep breeds) or "resilient", which means that they may carry a high worm load but show little to no clinical signs of disease. These "resistant" and "resilient" animals should be kept within a herd or flock while their more susceptible counterparts should be culled.

Anthelmintics should not be eliminated from a management plan. However, proper use of anthelmintics should always be a priority. Administration of anthelmintics at the correct dose is incredibly important for prevention of parasite resistance development. Ideally, animals should be weighed on a scale prior to dosing. This, however, may be complicated in a field setting. Utilizing a weight tape and a simple formula may help to better estimate weight on sheep and goats. Measuring in inches, measure the heart girth (around the chest from the withers to just behind the elbows) and the length of the body of the animal (from point of shoulder to caudal aspect of the ischium). The formula for weight estimation is as follows:

Heart Girth x Heart Girth x Body Length

300

This formulation will give the weight in pounds. Although this is just an estimation, it may aid in deciphering what an accurate weight may be for the animal. Medication should also be administered correctly using a drenching gun or drenching syringeto administer anthelmintic into the oropharynx and ensure the animal swallows. Proper administration of anthelmintics includes following labeled routes. For example, giving injectable ivermectin as an oral product is inappropriate. Administering products in an inappropriate fashion decreases their efficacy which drives resistance development.

Combination therapy has now become a staple for parasite control. This involves using anthelmintics from two or three different classes simultaneously. These anthelmintics have an additive effect on one another, enhancing efficacy. Anthelmintics should be administered in separate syringes (no mixing) and should be given at the full dose for each product. Blanket deworming with combination anthelmintics will only expedite resistance development to all anthelmintics, so a plan for selective use must be implemented. Finally, proper storage of anthelmintics (avoid direct sunlight and store between 59°F and 86°F) is a must.

Alternatives to anthelmintics

Several alternatives to anthelmintics are being incorporated into small ruminant management plans. These alternatives include copper oxide wire particles, use of plants high in phenolic tannins, and nematophagous fungi. Copper oxide wire particles may enhance die-off of *Haemonchuscontortus* but are a short-term solution and can be used to synergistically enhance an anthelmintic. Copper toxicity should be taken into consideration, especially with sheep. Plants such as chicory and *Sericea lespedeza* are high in condensed tannin phenolic compounds which enhance protein absorption by preventing degradation by the rumen. This helps to boost immune function and may have a direct effect on *Haemonchuscontortus.Duddingtoniaflagrans*, a nematophagous fungi, can be fed to sheep and goats. The fungal spores pass through the body and into the manure, creating a hypha on the pasture that traps and destroys larvae. A vaccination for *Haemonchuscontortus*has been in use in Australia but is unfortunately not available in the United States. A new anthelmintic, called monepantel, has also been developed in Australia but is not available in the United States.

Conclusion

The development of anthelmintic resistance in parasites is an important and evolving topic in small ruminant practice. Commercially available anthelmintics given at therapeutic doses are no longer working as a primary means to control parasitic infection in small ruminants. Management practices, proper use and storage of anthelmintics, and utilization of anthelmintic alternatives must be combined to combat the growing and deadly problem associated with parasitic resistance.

References

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