

Antiparasitic Resistance in Cattle and Small Ruminants in the United States: How to Detect It and What to Do About It

Introduction

Internal parasite infections and external parasite infestations harm animal health and can result in significant production losses in food-producing species, such as cattle, sheep, and goats.

Antiparasitic animal drugs are used to treat and control parasitic infections and infestations in animals. The parasites that a given drug is effective against are listed in the indication on the drug's label.

Antiparasitic resistance is the genetic ability of parasites to survive the effects of an antiparasitic drug to which they were previously susceptible. Antiparasitic resistance becomes a problem when an increasing percentage of a parasite population carries resistance genes, allowing the parasites to survive treatment with an antiparasitic drug that has been effective in the past.

Australia, New Zealand, South Africa, and South America have struggled with antiparasitic resistance in livestock species for the past few decades. Recent scientific data indicate antiparasitic resistance is now emerging in livestock species in the United States.

Refugia

After an animal is treated with an antiparasitic drug, the susceptible parasites die and the resistant parasites survive to pass on resistance genes to their offspring. If not enough susceptible parasites remain in the environment and in the animal, they cannot dilute the increase in resistant parasites that occurs after treatment. This scenario occurs when there is a lack of *refugia*.

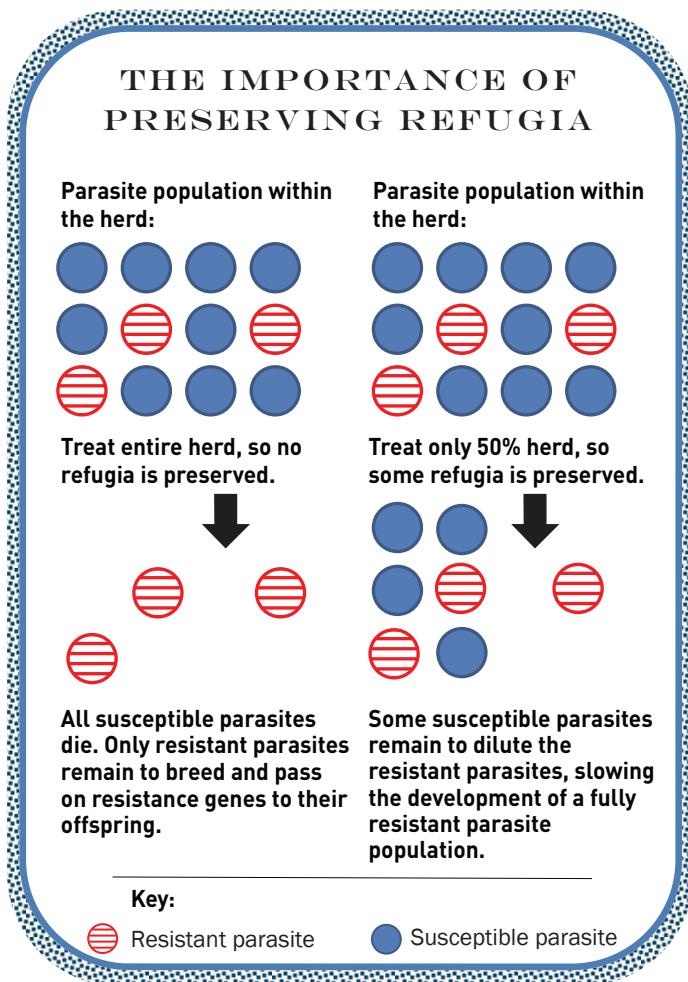
What is refugia?

Refugia is the proportion of the total parasite population that is not selected for antiparasitic drug treatment—essentially, those parasites that are in “refuge” from the drug. Therefore, there's no selection pressure on these parasites to develop resistance. Refugia maintains a proportion of susceptible parasites on the farm and includes:

- Parasites in untreated animals, called host-based refugia.
- Eggs and larvae already on the pasture when the animals are treated, called environmental refugia.
- Life stages of the parasite that are unaffected by drug treatment, such as some larval stages.

Why is preserving refugia important?

Preserving refugia maintains drug-sensitive (susceptible) parasites. The presence of some drug-sensitive parasites decreases (dilutes) the proportion of resistant parasites within the parasite population on a farm.



Factors Contributing to Antiparasitic Resistance

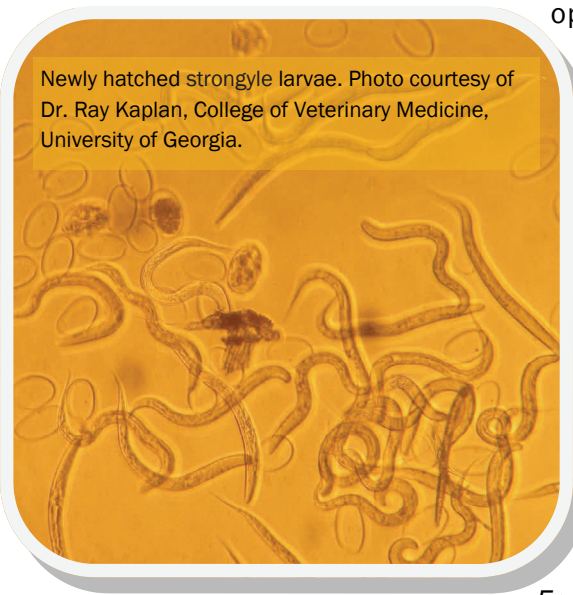
- Parasite biology, genetics, and pathogenicity.
- Immune status of the host animal.
- Treatment factors, such as dose and frequency of dosing.
- Drug factors, such as mechanism of action and half-life.
- Certain livestock management practices.

Livestock Management Practices Contributing to Antiparasitic Resistance

- *Treating every animal in the herd:* treating the entire herd eliminates susceptible parasites from all animals at once, increasing the proportion of resistant parasites in the population.
- *Frequent routine deworming without performing diagnostic tests or determining if treatment is necessary:* treating animals too often increases the opportunities to eliminate susceptible parasites, leaving only resistant parasites behind.
- *Deworming when environmental refugia is low:* treating animals when there are few eggs on the pasture, such as after a harsh winter or hot, dry summer, increases the proportion of resistant eggs in the environment.
- *Giving an antiparasitic drug without knowing if it will be effective on the farm:* treating with less effective drugs in the

presence of antiparasitic resistance may worsen the resistance.

- *Relying solely on antiparasitic drugs to control parasites, rather than changing management practices:* using only drugs instead of incorporating methods to preserve refugia and better manage the pasture can speed up antiparasitic resistance.
- *Using antiparasitic drugs for unapproved uses, such as to increase weight gain:* in the short-term, this may improve profitability; however, using antiparasitic drugs for unapproved uses increases the opportunities to eliminate susceptible parasites, leaving only resistant parasites behind. In the long-term, this may lead to significant economic losses due to the negative effects of antiparasitic resistance on herd health.



Newly hatched strongyle larvae. Photo courtesy of Dr. Ray Kaplan, College of Veterinary Medicine, University of Georgia.

Detecting Antiparasitic Resistance

Currently, the most common on-the-farm test to detect antiparasitic resistance is the *Fecal Egg Count Reduction Test (FECRT)*. **The FECRT is the only practical, widely available test to evaluate the effectiveness of antiparasitic drugs in the field.**

How the test works –

Fecal samples are collected from a proportion of animals in a herd just before treatment with an antiparasitic drug and again after treatment (usually 14 days, but varies depending on the drug). Parasite eggs are counted in both the pre- and post-treatment fecal samples. If the egg numbers in the post-treatment sample are not reduced by at least 90 percent, resistance may be present in the herd. Ninety percent has been the historical numerical value used to detect resistance based on FECRT results.

Because the level of antiparasitic resistance varies from farm to farm, not all farms will have

the same percentage reduction in post-treatment egg counts after treatment with the same antiparasitic drug. One farm may show a 98 percent reduction while a neighboring farm may have a 91 percent reduction. For this reason, percentage reductions in post-treatment egg counts should be compared over time *on the same farm*.

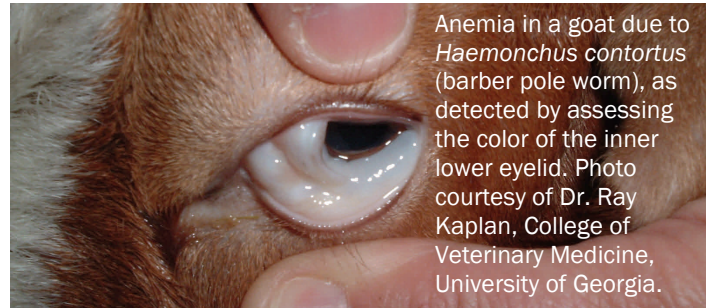
If repeated FECRTs on the same farm show a consistent decrease in percentage reduction (for example, 98 percent reduction→96 percent reduction→91 percent reduction), resistance may be developing, even if the values are over 90 percent.

The FECRT is most accurate in sheep and goats. Several biological factors in cattle affect the sensitivity of the FECRT, including:

- Cattle shed fewer parasite eggs as they age.
- Cattle-specific parasites generally reproduce less frequently and produce less offspring than small ruminant-specific parasites.
- Cattle manure has a higher water content than small ruminant manure. The water dilutes the concentration of parasite eggs, resulting in fewer eggs per fecal sample.

Other tests to detect antiparasitic resistance are available only through select laboratories:

- **Polymerase Chain Reaction (PCR) Test**
 - ◇ Genetically identifies resistant parasites.
- **Egg Hatch Test**
 - ◇ Evaluates resistance to benzimidazoles.
- **Larval Development Assay (LDA)**
 - ◇ Evaluates *in vitro* resistance to benzimidazoles, levamisole, and some macrocyclic lactones.



Currently, these tests have some limitations, mainly high cost. Also, the Egg Hatch Test and LDA are only available for specific antiparasitic drugs.

Other ancillary tests used to determine if treatment with an antiparasitic drug is necessary and to identify which parasites are present:

- **FAMACHA® Eye Color Chart Scores**
 - ◇ On-the-farm test only for sheep and goats that evaluates an animal's load of *Haemonchus contortus* (barber pole worm). Worm load is associated with the color of the inner lower eyelid which correlates to the degree of anemia.
- **Coproculture**
 - ◇ Identifies the parasites that are present in a herd.
 - ◇ *How the test works –*

Fecal samples are collected and cultured from select animals in a herd. The parasite eggs hatch and the larvae are identified to the species level.

Managing Antiparasitic Resistance

To slow the development of antiparasitic resistance on a farm, encourage producers to use antiparasitic drugs as just one part of an overall parasite control program that fits the needs of their herd.

Tips for managing antiparasitic resistance:

- Use clinical signs and diagnostic test results to determine which parasites are present on the farm, as well as to determine the level of infection and level of resistance. Base management and treatment decisions on this information.
- Use only antiparasitic drugs that are effective based on recent diagnostic test results and approved for the particular parasites present on the farm. Always follow the directions on the drug's label.
- Don't use antiparasitic drugs for unapproved uses.
- Ideally, identify and cull the animals that are the highest fecal egg shedders.
- If identifying the heavy shedders is impractical, target treatment toward animals at greatest risk of illness from parasitic infections (young or stressed animals and those showing clinical signs of parasitism). Small ruminants with high FAMACHA® scores should be treated.
- Treat animals with antiparasitic drugs when infective larvae are at the highest number on the pasture. This maximizes environmental refugia and usually occurs when:
 - ◊ The environmental temperature and humidity are high. Warmth and moisture are required for parasite eggs to develop into infective larvae.
 - ◊ Females in the herd are periparturient. Animals shed more parasite eggs around the time of parturition.
- When practical, weigh animals to avoid under-dosing antiparasitic drugs.
- Maintain adequate treatment records and document FECRT results, FAMACHA® scores, antiparasitic drug use, etc. This will help you make appropriate treatment and culling decisions.
- Use management practices along with antiparasitic drugs to treat and control parasites. Some good management practices include:
 - ◊ Preserving refugia within the herd.
 - ◊ Quarantining new livestock.
 - ◊ Rotating pastures with other livestock species or horses.
 - ◊ Dragging or harrowing pastures to break up manure piles.
 - ◊ Keeping pasture grass sufficiently tall. Because most parasite larvae stay within 1 inch from the ground, grass that is too short exposes animals to more infective larvae.
 - ◊ Reducing stocking density, especially so animals are not forced to graze near manure piles.

Good management practices will slow the development of antiparasitic resistance in livestock species and will also help approved antiparasitic drugs remain effective for longer.



Remember the 80/20 rule!

80 percent of parasite eggs are shed by 20 percent of the animals in a flock or herd. These animals are the “heavy shedders.”

LEARN TO LIVE WITH WORMS!

The goal of a well-managed and sustainable antiparasitic strategy for cattle and small ruminants should not be to make them 100 percent parasite free. Animals can have some parasites and still be healthy and thrive.

Learn to live with a low burden of gastrointestinal parasites in the herd. Be sure this low worm burden has a corresponding low level of pathogenicity and does not compromise animal health.

Keeping some parasites in the herd maintains a population of parasites sensitive to antiparasitic drugs and prolongs the drugs' effectiveness.

Resources for You



FDA's Center for Veterinary Medicine

<http://www.fda.gov/AnimalVeterinary/default.htm>

AskCVM@fda.hhs.gov

240-402-7002

FDA's Public Meeting on Antiparasitic Drug Use and Resistance in Ruminants and Equines

[http://www.fda.gov/AnimalVeterinary/ResourcesforYou/
ucm318015.htm](http://www.fda.gov/AnimalVeterinary/ResourcesforYou/ucm318015.htm)

[http://www.fda.gov/downloads/AnimalVeterinary/
ResourcesforYou/UCM344299.pdf](http://www.fda.gov/downloads/AnimalVeterinary/ResourcesforYou/UCM344299.pdf)

