Coping with anthelmintic resistance in ruminants

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Summary

- Infections with gastrointestinal nematodes (gut worms) are a major threat to the health, welfare and productivity of grazing ruminants in Ireland and good gut worm control is dependent on effective wormer products.
- A direct and unavoidable consequence of the use of wormers is the development of anthelmintic resistant worm populations.
- Anthelmintic resistance is defined as the ability of worms to survive a dose of a wormer that would normally kill them.
- Anthelmintic resistance is the single most important worm control problem facing beef farmers today.
- The current method used to detect anthelmintic resistance is the Faecal Egg Count Reduction Test, but this method can only detect resistance when it is already well established (i.e. when a large proportion of the worms are already resistant).
- Thus, new and more sensitive methods are required for the early detection of anthelmintic resistance. These are currently being developed at Grange.

Introduction

Irish beef production is predominantly grass-based and 90% of all beef produced is exported. The Food Harvest 2020 report targets a 20% increase in Irish beef output value by 2020. The technical efficiencies required to meet this target will include improvements in animal health and reducing losses due to animal diseases. Gut worms can cause ill-thrift and disease, and good worm control is highly dependent on effective worming products. However, a direct and unavoidable result of continuous use of wormers is the development of drug resistant worms. These are worms that can survive a dose of the wormer that would normally kill them.

The gut worm lifecycle

Adult worms in the gastrointestinal tract of animals lay eggs which are passed out with the faeces. The eggs hatch within approximately two weeks and the larvae migrate onto pasture and are ingested by grazing animals. Ingested larvae undergo further development in the gastrointestinal tract before maturing to adult worms approximately three weeks later. Occasionally, larval development can be arrested (hypobiosis). The main gut worm species which infect cattle in Ireland are *Ostertagia* and *Cooperia*. *Ostertagia* is the main species associated with disease while the less pathogenic *Cooperia* species is the main contributor to faecal egg counts. Ostertagiosis is primarily a disease of first season grazing cattle and is generally a bigger problem in dairy calf-to-beef than in suckler beef systems. Disease is more common in the second half of the grazing season due to the build-up of larvae on pasture over time.

The development of anthelmintic resistance

There are currently three classes of anthelmintics available for the treatment of gut worms in cattle, benzimidazoles (white drenches), levamisoles (yellow drenches) and macrocyclic

lactones (clear drenches). In species such as sheep and horses the widespread use of wormers has resulted in the emergence of anthelmintic resistant worms. Anthelmintic resistance has been a problem in sheep production for some time and has recently been detected in cattle. Effective detection and prevention methods need to be put in place to ensure that anthelmintic resistance does not become a problem for cattle producers. As in sheep, anthelmintic resistance in cattle is usually measured using a faecal egg count reduction test. A fully effective anthelmintic dose reduces egg count to zero after administration. If the egg count reduction is less than 95%, then anthelmintic resistance is present. A major limitation of the egg count reduction test is its expense and its relatively low sensitivity. Additionally, very few beef farmers are carrying out faecal egg counts. Therefore, anthelmintic resistance is only detected when there are production losses from the failure of anthelmintic treatment. By this stage the treatment has failed and that particular anthelmintic product is no longer effective on that farm. New anthelmintic drugs take many years and are costly to develop. Thus, early methods of anthelmintic resistance detection are required so that its occurrence can be prevented and the lifespan of the existing anthelmintic drugs can be prolonged.

Molecular tests for anthelmintic resistance detection

At Teagasc Grange and Athenry we are working with other European researchers on strategies to mitigate the risk of anthelmintic resistance. This work includes the development of molecular markers of anthelmintic resistance. Currently, we are using sheep worms as models of cattle worms due to the similarity of sheep and cattle worms and the ease and lower cost of working with sheep than cattle. Worms resistant to the white drenches (benzimidazole) have been isolated from four sheep farms in Ireland. Resistant worms of the *Teladorsagia* (*Ostertagia*), *Cooperia* and *Trichostrongylus* species were identified. The DNA sequence of the beta-tubulin gene from these worms has been determined and a mutation has been found which is responsible for their resistance to the white drenches. Additionally, worms that are resistant to ivermectin (macrocyclic lactone) have also been isolated from a farm in Ireland. These worms are of the *Teladorsagia* (*Ostertagia*) species. The genome of these ivermectin-resistant worms is currently being analysed by next-generation sequencing technology in order to identify potential molecular markers associated with the ivermectin resistance. The detection of molecular markers will allow the development of rapid and inexpensive tests for anthelmintic resistance in worms.

Conclusions and implications

Good gut worm control is currently dependent on the availability of efficacious wormers. However, worms that are resistant to the available wormers are emerging. Sensitive, inexpensive tests are required in order to detect resistant worms and implement strategies that prolong the life of the current anthelmintics. A molecular marker of white drench resistance has been identified. Work to identify a marker of clear drench resistance is on-going.