DISCONTOOLS

Nematodes
Summary

Introduction

1. This note summarises the Disease and Product analysis prepared by a DISCONTOOLS group of experts on Nematodes. They reviewed the current knowledge of the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details are available on the website at http://www.discontools.eu/

Disease profile

2. There are a large number of genera and species but only nematodes of the gastrointestinal (GI) tract of ruminants, pigs and poultry are considered. Some GI nematode species are more pathogenic than others but within nematode species, no documented differences in pathogenicity have been identified between strains or regional isolates.
3. GI nematode infections are an important constraint to efficient livestock production worldwide and also negatively affect livestock welfare. The effect of ruminant nematodes is mainly in growing animals where subclinical infections can reduce weight gain up to 30%, whereas clinical disease can be associated with mortalities. In adult animals, infections can result in milk yield losses of 5 to 10% in cattle and up to 40% in small ruminants, but this is strongly influenced by nutrition. Other losses include lower conception rates, poor carcass quality, and reduced wool yields. Pig nematodes can cause reduced reproductive performance and weight gain. Liver condemnations (due to “white spots”) may be up to 20 % in certain countries. In laying hens, apart from the welfare aspect, egg production is reduced, and infection may favour secondary infections.

Risk

4. In ruminants, parasitic gastroenteritis mainly occurs during the grazing period and will vary according to latitude. Management conditions (e.g. access to pastures, turn-out and housing periods) will determine infection levels. Selective grazing strategies may limit the problem. Selective control agents may suppress certain nematode species and allow others to flourish. Changing climate is likely to affect parasite transmission by changing the level and duration of pasture infectivity. In pigs and especially poultry, GI nematode infections are on the rise due to new husbandry methods with outdoor access, ban of non-enriched battery cases.
5. Drug-resistant nematodes not responding to treatment are a well-known problem in sheep and are emerging in cattle, pigs and poultry. Anthelmintic resistance (AR) is one of the main threats to sustainable parasite control in the future. There is also a need to assess the impact of ascarid infections on humans (zoonosis).

Diagnostics

6. In ruminants, coprological (microscopical) methods are used for all GI nematodes and all hosts to identify and quantify parasite eggs. The methods can be combined with coproculture to identify L3-stage larvae or molecular assays. Serological methods involve measuring serum pepsinogen levels to assess the degree of damage/extent of exposure to abomasal nematode infections in young stock. Antibody levels against the crude extract of *Ostertagia ostertagi* in bulk-tank milk are used to assess nematode exposure in adult cows. Morbidity markers, like anaemia scoring (FAMACHA©), have been described in sheep. Pig nematodes are mainly diagnosed by faecal examination for eggs and occasional reports from the abattoir of milk spots in the liver, only indicative of recent *A. suum* exposure. A serological test to detect *A. suum* infection in finishing pigs is available, which has higher sensitivity and specificity compared to faecal examination. Similarly, the detection of poultry ascarids can be based on coproscopy, although alternative non-invasive methods such as those based on serology of yolk, copro-antigen detection, and molecular markers have been described.
7. The conventional diagnosis of nematode infections can be insensitive and expensive and does not always provide sufficient information on whether animals should be treated or not and with which substance. A key problem is to streamline drug use by identifying those animals or herds/flocks requiring treatment to avoid unnecessary use of anthelmintics. Non-invasive and automated sampling methods and assays (e.g. milk, meat-juice, body condition scoring) are required. Several initiatives to

make existing tests suitable for high-throughput platforms and to develop pen-side tests are in the pipeline. Sampling strategies used in parasite surveillance in combination with different diagnostic approaches need further evaluation in field settings. Novel assays for the early detection of AR are needed as well as genetic markers for host resistance/resilience for breeding purposes. New digital tools have several applications for parasite detection and need to be explored.

Vaccines

8. A commercial vaccine against *Haemonchus contortus* is available in Australia, South-Africa and the UK and reduces worm numbers and worm egg output by > 90% after repeated administrations. Prototype vaccines against *Ostertagia ostertagi* reduce worm egg output by 60% during a two-month artificial challenge period. A prototype vaccine against *Cooperia oncophora* reduced worm egg output by >90% after artificial challenge infections and by 60% in a field trial, resulting in a >80% reduction in worm counts at housing. The main shortcomings include a lack of efficacy of recombinant vaccines, lack of cross-protection against other important nematodes and need for repeated administrations. The required efficacy has been defined for some species by experimental infection and/or by modelling but there is a requirement to define efficacy in the field, probably at the level required to reduce or eliminate the economic impact of the disease. Vaccines for all the important GI nematodes – in some cases (*Haemonchus, Ostertagia*) might have a marketplace as mono-valent vaccines but the ambition should be polyvalent vaccines. Effective recombinant vaccines to allow mass production is required.
9. No vaccines are available for nematodes of pigs or poultry. Regarding laying hens, vaccination is not considered a realistic option due to the short production cycles.

Pharmaceuticals

10. Control of GI nematodes in Europe relies largely on anthelmintics. When released all anthelmintics used in livestock are very effective at reducing susceptible worm burdens. Possible drawbacks to the use of anthelmintics may include the increasing incidence of AR and concerns regarding drug residues in food products and the environment. Therefore, treatment strategies need to be developed and implemented based on selective treatment of only those animals or herds/flocks requiring treatment based on practical diagnostics.
11. The dependence on anthelmintics is not without risk as AR is now a widespread problem. The prevalence of AR varies geographically, depending on the livestock species involved and the drugs used. Benzimidazole-resistant and macrocyclic lactones-resistant nematodes are widely reported in sheep/goats globally. Resistance to levamisole and monepantel is present in sheep and goat parasites, though at a lower level. In cattle AR has been reported, however, until now it is mainly limited to macrocyclic lactone resistance in *Cooperia* spp. and, to a lesser extent, *O. ostertagi*. In pigs, AR has been demonstrated for *Oesophagostomum* spp. in Denmark and Germany (pyrantel, levamisole, benzimidazoles) in single case studies. In poultry, resistance to ascarids have been described in the USA.

Knowledge

12. There are many significant areas of uncertainty in understanding and knowledge about nematode infections, especially in parasite genetics, pathogenesis, immunology, vaccinology, epidemiology and control. Research is needed to fill these gaps in knowledge as many of these are closely linked to the research requirements to develop more effective tools for the control of the disease. Full details of the gaps are shown in the Disease and Product Analysis for Nematodes on the DISCONTOOLS website.

Conclusions

13. The demand for animal based food is expected to continue to grow as a result both of population growth and rising incomes. Monitoring and managing nematode infections is indispensable to increasing production efficiency, promoting animal welfare, and the secure provision of safe animal based food.
14. Improved communication and implementation of holistic control strategies using improved diagnostics and surveillance, host genetics, nutrition and pasture management are needed to reduce the reliance upon anthelmintics to stop the ongoing spread of AR. These can be complemented on the medium to long term with novel control measures such as vaccines, bio-active forages (nutraceuticals), and ovicidals.