SCAP
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Aspects of epidemiology and control of gastrointestinal nematodes in sheep and cattle – Approaches for its sustainability

Aspectos de epidemiologia e controle de nematódeos gastrintestinais em ovinos e bovinos – Abordagens à sua sustentabilidade

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ABSTRACT

Gastrointestinal helminthosis in ruminants cause considerable economic losses, with marked impairment of productivity of these animals, especially in poor management systems and poor parasite control programs. Infections caused by these helminths represent an obstacle to the expansion of the sheep industry. Furthermore, high parasite burdens were associated with increased mortality in calves. The recommended methods for the control of gastrointestinal helminths not always have practical applicability. We discuss important epidemiological and control aspects concerning gastrointestinal nematodes in sheep and cattle. Thus, sustainable worm control practices are recommended. Each farm has a specific situation and a management system directed to a specific parasitic infection must be adopted.

Keywords: cattle, sheep, gastrointestinal helminths, epidemiology, control, sustainability.

RESUMO

Helmintíases gastrintestinais em ruminantes acarretam perdas econômicas relevantes, com marcante prejuízo da produção animal, especialmente em sistemas de maneio precários e em programas de controle parasitário deficientes. Infeções causadas por esses helmintos representam um obstáculo para a expansão do mercado ovino. Ademais, altas cargas parasitárias foram associadas à elevada mortalidade em bezerros. Os métodos recomendados para o controle de helmintos gastrintestinais nem sempre apresentam aplicação prática. Nós discutimos os aspectos importantes sobre nematodes gastrintestinais em ovinos e caprinos. Sendo assim, práticas de controle sustentáveis são recomendadas. Cada propriedade possui uma situação em particular e um sistema de maneio direcionado deve ser adotado para as infecções parasitárias específicas.

Palavras-chave: bovinos, ovinos, helmintos gastrintestinais, epidemiologia, controlo, sustentabilidade.

INTRODUCTION

Gastrointestinal helminthosis in ruminants are caused by trichostrongylid worms which are small, often have a capillary form, with copulatory bursa, and, excepting the lungworm *Dictyocaulus,* infect the digestive tract of animals and birds. The most important genera in ruminants are *Haemonchus, Trichostrongylus, Cooperia, Nematodirus* and *Ostertagia.*

These helminths represent a major obstacle to the expansion of the sheep industry (Amarante *et al*., 2004) and cause considerable economic losses, with marked impairment of these animals productivity, especially in poor management systems and poor parasite control programs (Santos *et al*., 2010). Gastrointestinal nematodes (GINs) are a major disease in beef cattle around the world, and its main consequence is a decrease in production (Charlier *et al*., 2014). In this review we discuss important epidemiological and control aspects about gastrointestinal nematodes in sheep and cattle, towards the sustainability of animal and parasites management.

EPIDEMIOLOGY AND BIOLOGY

Very common species in sheep, as *Haemonchus contortus, Cooperia curticei* and *Trichostrongylus colubriformis* can also infect cattle, and species that affect cattle, as *H. placei, T. axei* and *C. punctata,* can parasitize sheep. Heterologous infections are mild and over time the animals naturally eliminate them (Amarante *et al*., 1997).

Many publications discuss on parasitism in cattle under 24 months of age (Tongson and Balediata, 1972; Wymann *et al*., 2007; Jiménez *et al*., 2010). With the beginning of the development of the immune response to these helminths, from 18 to 24 months, the tendency would be to reduce the parasitic burden, with a decrease in the number of eggs excreted in faeces and diminished incidence of clinical cases of hookworm. However, it was observed the frequent occurrence of nematodes in adult animals (Waruiru *et al*., 1998; Chollet *et al*., 2000).

The resistance of sheep to infection by these worms is correlated to seasonal variations, the type of nutrition (Vagenas *et al*., 2007), proximity of parturition (Fthenakis *et al*., 2012), genetic factors (Mpetile *et al*., 2015) and certain racial patterns (Bowdridge *et al*., 2015). Some studies have reported a higher predominance of *H. contortus* in sheep, confirming the observations of this nematode, being more prevalent in extensive regimes of tropical and subtropical regions (Liu *et al*., 2003; Tariq *et al*., 2008; Yoshihara *et al*., 2015).

In general, the life cycle of gastrointestinal nematodes comprises the following steps: adult helminths in the digestive tract of the host eliminate eggs in the faeces; the larvae hatch, and after a period of development up to the third stage (L3), they become infective in the environment. The sheep or cattle ingest the contaminated vegetation, and once in the digestive tract, the larvae molt twice and give rise to adult specimens of both sexes, which will continue the life cycle of the parasite. Thus, there is a parasitic life phase (within the host) with a prepatent period of 14-44 days after infection, depending on the species, and a free-living phase (in the environment), which occurs under appropriate conditions of temperature and humidity in about a week (Yoshihara *et al*., 2013).

Trichostrongylids are responsible for symptoms such as diarrhoea, anaemia, weight loss, emaciation, and may cause death, especially in young animals. The subclinical symptoms related to parasitism may affect weight gain, reproductive rates and even the immune condition of ruminants (Santos *et al*., 2010; Tariq, 2015).

PARASITOLOGICAL DIAGNOSIS

The counting of eggs shed in faecal samples is used for the diagnosis of infection by gastrointestinal helminths, especially nematodes, and does not allow immediate identification of the corresponding genera. For this, faecal cultures are used, allowing the production of third stage larvae (L3), which can be morphologically identified. This method is laborious and requires at least a week to allow the isolation and identification of different genera of L3, and can be affected by a failure in the development from egg to infective larvae (Berrie *et al*., 1988).

Another technique being advocated is micromorphometry, being possible to classify the genus of 53% to 72% of eggs. This measurement method is very laborious and time-consuming (Georgi and McCulloch, 1989). Anyway, these techniques do not allow the identification of species, but only genera. In epidemiological studies in which species identification is essential, it is necessary the necropsy of deceased animals and euthanasia of infected animals in poor clinical condition for the collection of adult nematodes, which are then classified into species.

Due to the resistance of gastrointestinal helminths of ruminants to many used active ingredients, the awareness of veterinarians (the technicians responsible for the herd parasitological control) is of great importance in order to evaluate the anthelmintic efficacy of products to be used, with periodic monitoring by faecal examinations. Each farm features a special situation and a management system directed to the infections issues must be implemented.

KNOWN ANTHELMINTIC RESISTANCE IN RUMINANTS AND ITS DIAGNOSIS

The development of resistance to these products are likely to start as soon as they reach the market, due to the lack of effective options and the increasing pressure for the use of drug combinations against highly resistant isolates.

The administration of anthelmintics to animals is the primary control measure adopted to prevent damages caused by worms (Miller and Horohov, 2006). For many years, anthelmintics were effective in controlling intestinal parasites in ruminants. However, one consequence of the widespread use of these drugs has been the emergence of resistant nematodes, a problem that is widespread in the sheep farming systems worldwide (Lopes *et al*., 2009; Palcy *et al*., 2010; Soutielo *et al*., 2010; Almeida *et al*., 2013).

With the increasing problem of anthelmintic resistance, more emphasis has been placed on identifying herds or animals with helminth--induced production losses, and targeting anthelmintic treatment to these subgroups to preserve anthelmintic efficacy while preventing production losses (Charlier *et al*., 2014).

The broad-spectrum anthelmintics (the benzimidazoles group, the imidazothiazoles and the macrocyclic lactones) remove parasites in different stages of development. The narrow-spectrum compounds, like salicylanilides, substituted phenols and triclabendazole, have activity against fewer species of parasites (Tariq, 2015). Although the development of monepantel added another molecule to the antiparasitic compounds market, success in discovering new drugs has been limited (Kumarasingha *et al*., 2016).

SUSTAINABLE CONTROL

The recommended methods for the control of gastrointestinal helminths in organic production are balanced nutrition, pasture rotation, use of resistant breeds and alternate grazing of sheep and cattle (NCAT, 2004), but not always have practical applicability. The effectiveness of the latter in the decontamination of pastures is intrinsically dependent on the specificity of the parasites to the hosts (Rocha *et al*., 2008). The positive or negative effect of rotational grazing on the control of nematodes is directly dependent on the climatic conditions of each region. It was proved that nematodes with free-living stages can survive on pasture throughout the year (Amarante and Barbosa, 1995). Therefore, in most situations, more sustainable worm control practices are recommended (Amarante *et al*., 2014).

Thus, for an effective reduction of pasture contamination, it should be taken a rest for the pastures during an extended period of time, being economically unviable. To perform an integrated parasite management, knowledge of the ecology of the free living stages of sheep and cattle parasites is highly required. For example, in tropical areas, the average life of the larvae on the pasture is one to three months. In temperate climates the larvae can be viable for 180 to 540 days (O'Connor *et al*., 2006).

The use of different species of ruminants grazing in the same area can be a way to reduce the populations of nematode larvae, besides allowing the improvement of pasture management. This

treatment allows the larvae of parasites in sheep species to be ingested by the cattle or vice versa, which are destroyed in the host (Amarante *et al*., 2004). Based on the principle of host specificity of the parasites, the consortium of animals of different species consists of a management measure to be recommended in order to minimize pasture contamination (Amarante *et al*., 2014).

In general, animals have great susceptibility to parasitism until puberty. The resistance increases in adulthood, but there are certain times and physiological conditions in which the adult animal becomes more susceptible (Miller and Horohov, 2006). The intrinsic relationship between the intensity of parasitism and the age of affected cattle was mentioned as an essential element in a control program of gastrointestinal worms based in their epidemiology. With the adoption of strategic anthelmintic measures, it is possible to increase its efficacy, but also the cost-effectiveness of the activity.

The distribution of gastrointestinal helminths populations in dairy cows and calves in this organic production system does not constitute a health risk for the animals. Measures such as rotational grazing, pasture rest periods and use of genetically resistant animals are approaches that match with the principles of organic livestock production and play an important role in controlling gastrointestinal nematodes (Barbosa da Silva *et al*., 2012).

Several strategies have been suggested for the control of parasites, including adequate food to supply the nutritional requirements of the animal, which favours its body condition to confront disease threats, especially worm infections (Bricarello *et al*., 2005). Finally, supplementary feeding and breeding strategies to improve resistance to nematodes can reduce the use of anthelmintic drugs to control worm infections (Amarante *et al*., 2014).

Forages with high condensed tannin content when provided to sheep and cattle, improve protein digestion and absorption of amino acids. Animals that have higher protein absorption produce more wool, meat and milk, as well as, it improves the ovulation rate in females (Yoshihara *et al*., 2013).

Therefore, plant-based products can be considered as a viable alternative (Tariq, 2015). *Carica papaya, Terminalia arjuna* (Tannin and ellagic acid), *Fumaria parviflora* (alkaloids and tannins) and *Zingiber officinale* (ginger) showed efficacy against gastrointestinal nematodes of ruminants. The possibility of resistance to plant-based drugs is lower than chemical anthelmintics (Bauri *et al*., 2015).

These plant extracts could be introduced into the drinking water of livestock, especially cattle. This method of parasite control is indeed cheap and easy to practice and could be adopted to complement the already in-use method of application of commercially available chemical anthelmintics (Ngozi *et al*., 2015).

The sustainable use of certain fungi and earthworms may reduce parasitism in pastures, but needs to be further investigated against different gastrointestinal nematode parasite species all over the world (Tariq, 2015). The coadministration of *Duddingtonia flagrans* and *Monacrosporium thaumasium* has been effective in controlling gastrointestinal helminths of adults and young sheep (Vilela *et al*., 2016).

Many epidemiological aspects related to gastrointestinal helminths of ruminants need to be better elucidated by research, which will allow a current updated overview of these helminth infections.

CONCLUSION

In this review were discussed important epidemiological and control aspects about gastrointestinal nematodes in sheep and cattle. The pasture rotation system has been used to control parasite populations in the pasture, although alternate grazing systems using different host species seem to be also a good option on this sense. Plant-based products can be considered a viable alternative and showed efficacy against gastrointestinal nematodes of ruminants. Sustainable use of certain fungi and earthworms may reduce parasitism, but each farm has a special situation and a management system directed to the specific parasitic infection must be adopted accordingly.

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