CHALLENGES IN THE CONTROL OF NEMATODIASIS IN SMALL RUMINANTS: A REVIEW

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ABSTRACT

Out of various diseases affecting sheep, parasitic gastroenteritis caused by gastro-intestinal nematodes, mainly *Haemonchus contortus*, is very important for the sheep in India and is responsible for high mortality and morbidity (Yadav, 1997). The gastrointestinal nematodes of sheep include *H. contortus*, *Teladorsagia circumcinta*, *Trichostrongylus axei*, *Nematodirus* spp. and *Cooperia* spp. The proportions of each of these nematodes in sheep populations vary according to geographic location. *H. contortus* and *T. circumcincta* represent most of the parasite burdens seen in sheep, with *H. contortus* being present in highest numbers. Anthelmintic resistance is present in all of these parasites, but the prevalence is highest for *H. contortus*, making it the most economically important gastrointestinal nematodes of sheep (Fleming *et al.*, 2006).

Keywords: Animal health, Anthelmintic resistance, Gastrointestinal nematodes, Small ruminants, Livestock productivity

INTRODUCTION

Small ruminants are important source of income for rural communities whose livelihood is largely based on livestock production (Biffa *et al.*, 2006). Sheep is an important livestock species in India. India is a rich source of diverse ovine germplasm with 74 million sheep which is 6.8% of the world’s sheep population (FAOSTAT, 2010). They contribute greatly to the agrarian economy especially where crop and/dairy farming are not economical. They play an important role in the livelihood of a large percentage of small and marginal farmers and landless labours engaged in sheep rearing. However, sheep production is hindered by many factors including animal health constraints, inadequate nutrition and poor husbandry system (Sissay *et al.*, 2006).

USE OF ANTHELMINTICS AGAINST GASTROINTESTINAL NEMATODIASIS

In most cases, *Haemonchus contortus* was the first nematode to develop resistance against the different anthelmintics (Fleming *et al.*, 2006). There is substantial evidence that when a parasite has developed resistance to one anthelmintic from a certain class, it will usually also be resistant to other products from the same class. There is also evidence that strategic treatments have contributed to resistance development, particularly at times when the free-living component of the parasite population has been small. The most efficient way to limit the increase of anthelmintic resistance remains the reduction of the selection pressure by drugs and optimal timing to maximise their efficacy (Silvestre *et al.*, 2002).

Gastrointestinal nematodes in grazing animals cause major production losses and represent an animal welfare problem worldwide. For decades, use of anthelmintics has been central in the control programmes of these parasites, as this is the only practical method to reduce the adverse effects of these nematode parasites. There are only three broad-spectrum anthelmintic classes available for treatment and control of nematodes, namely benzimidazole, imidathiazole and macrocyclic lactones. No new class with different mode of action is expected in the market in near future, as development and release of new anthelmintic may take 6–8 years and
cost around US$ 30 million (Hoston, 1985). These costs have been estimated to be increased to US$ 230 million just after 9 years (McKellar, 1994). The widespread use, suppressive dosing and misuse have led to development of anthelmintic resistance (Waller, 1986) against gastro-intestinal nematodes (Singh and Yadav, 1997) posing serious limitation on use of anthelmintics, and our options are decreasing. Moreover, there is an increased consumer demand for environment-friendly products and these issues have stimulated investigations to find alternative sustainable control strategies, which are less reliant on anthelmintic input (Saddiqi et al., 2011). Anthelmintic resistance is defined as the ‘heritable ability of the parasite to tolerate a normally effective dose of the anthelmintic’ (Abbott et al., 2009).

The extensive use of anthelmintics for control of gastro-intestinal nematodes has resulted in the development of resistance to one or more of the widely used anthelmintics in many countries. Resistance to anthelmintics by gastro-intestinal nematodes of sheep is a widespread problem (Maroto et al., 2011) and has been reported to affect the health and productivity of sheep globally (Geurden et al., 2014). A lack of anthelmintic class rotation and, in some breeding areas, a high drench frequency, which alone or in combination, are likely to increase the risk for anthelmintic resistance (Yadav, 1997). Further, mixed grazing of sheep and goats has been evoked as a possible risk factor for the spread and emergence of anthelmintic resistance. A number of reports on anthelmintic resistance have been documented in many countries (Domke et al., 2011). Benzimidazole resistance in sheep was first described in 1964 (Drudge et al., 1964). In addition, multiple resistances to most of the anthelmintics against gastro-intestinal nematodes have also been detected in many countries (Acosta et al., 2012; Barbara et al., 2012), and these are a major concern in sheep industry (Sargison, 2012). Resistance to all classes of broad-spectrum anthelmintics available namely benzimidazoles, imidothiazoles-tetrahydropyrines and macrocyclic lactones has been reported (Ihler, 2010).

AN UPDATE ON REPORTS AVAILABLE ON ANTHELMINTIC RESISTANCE IN INDIA AND ABROAD

In India, the first report of anthelmintic resistance was documented against phenothiazene in *H. contortus* at State Sheep and Wool Research Station, Pashulok, Rishikesh, Uttar Pradesh (Varshney and Singh, 1976). Since then, benzimidazole resistance has been commonly reported in sheep population of India (Kumar and Yadav, 1994; Garg and Yadav, 2009) including different agro-climatic zones of northern India. However, no systematic studies have been undertaken to determine the status of benzimidazole resistance against gastro-intestinal nematodes in sheep and goats of sub-Himalyan region of northern India. The reports about the same in South India are very limited (Buttar et al., 2012; Harikrishnan, 2012; Rajagopal et al., 2013; Meenakshisundaram et al., 2014). Moreover, the suitability of different in vitro tests in detecting benzimidazole resistance has also not been studied earlier in this part of India (Rialch et al., 2013).

The discovery of new classes of anthelmintic compounds such as the paraherquamides, the cyclodepsipeptides (Altreuther et al., 2005), tribendimidine (Shu Hua et al., 2005) and the amino-acetonitrile derivatives (Kaminsky et al., 2008a) has, for the first time since the early 1980s, raised the possibility that a new class of anthelmintic could soon be released onto the New Zealand market for use in ruminants. Indeed, one of these compounds, an amino-acetonitrile derivative, monepantel (Kaminsky et al., 2008b), has very recently been registered here for use in sheep.

ANTHELMINTIC RESISTANCE

Maintenance of efficacy of existing anthelmintics is essential for continuing animal productivity and welfare. Moreover, an investigation on the prevalence of anthelmintic resistance in Government Sheep Breeding Farm, Hisar was last carried out by Singh and Yadav (1997). Therefore, there was a need to find out the current status of anthelmintic resistance in sheep farm because the task of selecting the drug of choice to control gastro-intestinal nematodes becomes easier if resistance status of parasite on property is known. Thus
regular monitoring of status of anthelmintic resistance is required as an integral part of worm control programme (Rialch et al., 2013; Varadharajan and Vijayalakshmi, 2015). Further, to prolong the useful life of anthelmintics, early detection of resistance maybe greatly beneficial, as withdrawal of an anthelmintic from a farm where a low level of resistance is detected could lead to reversion to susceptibility by diluting the resistant population with susceptible or hybrid phenotype (Le Jambre et al., 1982; Qadri et al., 2015).

Further, parasitologists generally agree that if delaying resistance is the prime objective, it is better to use a mixture of two or more effective broad-spectrum drenches than using these drenches alone (Dobson et al., 2001). Combinations are likely to slow the development of resistance, as it is generally accepted that the mechanisms of resistance to the benzimidazole, imidathiazole and macrocyclic lactones classes of anthelmintics are different, and that, there is no, or virtually no, cross resistance between them (Coles and Roush, 1992).

The investigators found that where resistance to benzimidazole and levamisole was present to each individual drug, mixtures of fenbendazole and levamisole given simultaneously were effective in many cases. This was confirmed in a later study (Waller et al., 1990) for Trichostrongylus colubriformis and in a further report with the caution that the result would depend on the degree of resistance to each drug that was present (McKenna et al., 1996). Formulations permitting the simultaneous use of two or three molecules from the existing three main groups of anthelmintics are available in countries such as Australia (Q-drench® etc.), New Zealand, Uruguay and others.

CONCLUSION

Although the release of a new class of anthelmintic should remove any immediate threat to production posed by nematodes resistant to compounds currently available, history indicates that if a new drug class is simply used as a replacement for older drug classes to which resistance is already widespread, then it is inevitable that, in due course, resistance will develop to the new drug class as well. Conversely, the release of a new class of drug presents the opportunity to make changes to parasite management practices to ensure that resistance either never develops to it or takes substantially longer time to develop than the older drug classes (Varadharajan and Vijayalakshmi, 2015).

REFERENCES


