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Review Article

Difficulties with nematodiasis control in small ruminants: a review

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ABSTRACT

Among the many illnesses that afflict sheep, parasite gastroenteritis, which is mostly brought about by the intestinal worm *Haemonchus contortus*, is a major concern for sheep in India and is accountable for a high rate of morbidity and death (Yadav, 1997). Sheep's gastrointestinal nematodes include *Trichostrongylus axei*, *Nematodirus* spp., *Telodorsagia circumcinta* and *H. contortus*. Depending on the region, sheep populations have different ratios of each of these nematodes. The majority of parasite loads seen in sheep are caused by *T. circumcincta* and *H. contortus*, with *H. contortus* having the greatest frequency. All of these parasites have anthelmintic resistance, but *H. contortus* has the greatest frequency, making it the most significant gastrointestinal nematode in sheep terms of economic impact.

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Introduction

For rural populations whose primary source of income is livestock production, small ruminants play a significant role (Biffa et al., 2006). In India, sheep are a significant species of livestock. With 78 millions of sheep, or 8 % of the global sheep population, India is major source of ovine germplasm with varied (FAOSTAT, 2010). They had major role in the agricultural economy, particularly in areas where growing dairy or crops is not profitable. They are crucial to the livelihoods of a sizable portion of landless laborers who raise sheep as well as small and marginal farmers. However, a number of issues, such as poor husbandry practices, insufficient nutrition, and animal health limitations, make it difficult to produce sheep (Sissay et al., 2006). In grazing animals, intestinal nematodes result in significant productivity losses and are a global issue for animal welfare. Since anthelmintics are the sole workable way to lessen the negative consequences of these nematode parasites, their usage has been a mainstay of parasite control programs for decades. For the treatment and management of nematodes, only three broad anthelmintic categories are available: imidathiazole, benzimidazole and macrocyclic lactones. Since the research and distribution of novel anthelmintics may take six to eight years, no new class with a different mechanism of action is anticipated in the near future. According to Fleming et al. (2006), *Haemonchus contortus* often developed resistance to the various anthelmintics any other nematode did.

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Anthelmintics used to prevent gastrointestinal nematodiasis:

Strong evidence suggests that if a parasite develops resistance to one anthelmintic in a class, it often develops resistance to other products in the same class as well. Additionally, there is evidence that deliberate treatments have aided in the development of resistance, especially during periods when the proportion of free-living parasites in the population has been low. Reducing the selection pressure caused by medications and timing their use to maximize effectiveness continue to be the most effective ways to prevent the rise of anthelmintic resistance (Silvestre et al., 2002).

About 31.2 million US doller (Hoston, 1985). According to estimates, these expenses would rise to USD 229 million in only 9 years (McKellar, 1994). Anthelmintic resistance against gastro-intestinal nematodes has developed as a result of broad usage, suppressive dosage, and abuse (Singh and Yadav, 1997; Waller, 1986). This poses a major constraint on the use of anthelmintics, and our alternatives are running out. Additionally, there is a growing demand from consumers for environmentally friendly goods, and these concerns have prompted research into sustainable alternative control methods that need less anthelmintic input (Saddiqi et al., 2011). The "heritable ability of the parasite to tolerate a normally effective dose of the anthelmintic" is the definition of anthelmintic resistance (Abbott et al., 2009).

Many nations have developed resistance to one or more of the commonly used anthelmintics as a consequence of the widespread usage of these drugs to control gastro-intestinal worms. Sheep's intestinal nematodes are known as resistant to anthelmintics, a condition that had shown to have an impact on sheep production and health worldwide (Geurden et al., 2014 and Maroto et al., 2011). Anthelmintic resistance is expected to be more common in some breeding locations because to a high drench frequency and a lack of anthelmintic class rotation, either alone or in combination (Yadav, 1997).

Moreover, mixed-goat grazing has been suggested as a potential risk factor for the formation and dissemination of anthelmintic resistance. Many nations have recorded many reports of anthelmintic resistance (Domke et al., 2011). The earliest report of sheep developing benimidazole resistance dates back to 1964 (Drudge et al., 1964). Furthermore, it has been noted that several nations have various resistances to the majority of anthelmintics against intestinal nematodes (Barbara et al., 2012 and Acosta et al., 2012), which is a significant worry for the sheep sector (Sargison, 2012). There have been reports of resistance to all kinds of current broad-spectrum anthelmintics, including benzimidazoles, imidothiazoles-tetrahydropyrines, and macrocyclic lactones (Ihler, 2010).

Summary of reports on anthelmintic resistance in india and around the world available:

At the State Sheep and Wool Research Station at Rishikesh, Pashulok, Uttar Pradesh, *H. contortus* was shown to be resistant to phenothiazene in the first recorded case of anthelmintic resistance in India (Varshney, singh, 1976). Since then, reports of benzimidazole resistance in sheep populations across India, including several agroclimatic zones in the country's north, have been frequent (Kumar and Yadav, 1994; Garg and Yadav, 2009). Nevertheless, no comprehensive research has been done to find out how resistant sheep and goats in the Himalyan area of northern India are to intestinal nematodes to benzimidazole. There are surprisingly few reports on the same in South India (Rajagopal et al., 2013; Harikrishnan, 2012; Buttar et al., 2012 and Meenakshi Sundaram et al., 2014). Furthermore, no prior research has been conducted in this region of India on the appropriateness of several in vitro assays for identifying benzimidazole resistance (Rialch et al., 2013).

For the first time since the early 1980s, the discovery of new classes of anthelmintic compounds has raised the possibility that a new class of anthelmintic may soon be made available for use in ruminants on the New Zealand market. Examples of these compounds are tribendimidine (Shu Hua et al., 2005), cyclodepsipeptides, paraherquamides (Altreuther et al., 2005) and amino-acetonitrile derivatives (Kaminsky et al., 2008a). In fact, monepantel (Kaminsky et al., 2008), an amino-acetonitrile derivative, is one of these substances that was only recently registered for use in sheep.

Resistance to anthelmin:

Maintaining the effectiveness of current anthelmintics is crucial to the wellbeing and production of animals. Furthermore, Singh and Yadav (1997) conducted the most recent study on the frequency of anthelmintic resistance in the Government breeding farm for sheep at Hisar. Finding out the present state of anthelmintic resistance in sheep farms was thus necessary since knowing the resistance status of the parasites on the property makes it simpler to choose the best medication to manage gastro-intestinal nematodes. Consequently

Regularly monitoring for anthelmintic resistance is a crucial part of any worm management program (Varadharajan and Vijayalakshmi, 2015 and Rialch et al., 2013). Additionally, removing an anthelmintic from a farm where a low level of resistance is detected may cause a reversion to susceptibility by diluting the resistant population with susceptible or hybrid phenotype (Le Jambre et al., 1982 and Qadri et al., 2015). This is why early resistance detection may be very helpful in extending the useful life of anthelmintics.

Furthermore, most parasitologists concur that utilizing a combination of two or more potent broad-spectrum drenches is preferable than administering these drenches alone if postponing resistance is the main goal (Dobson et al., 2001). Since it is widely acknowledged that there is no, or very little, cross resistance between the benzimidazole, imidathiazole, and macrocyclic lactone classes of anthelmintics and that their mechanisms of resistance are distinct, combinations are likely to slow the development of resistance (Coles and Roush, 1992).

The researchers found that individuals who had developed resistance to both benzimidazole and levamisole may often be successfully treated with concurrent administration of levamisole and fenbendazole. In a later study (Waller et al., 1990) and a follow-up report (McKenna et al., 1996), this was confirmed for *Trichostrongylus colubriformis* with the disclaimer that the results would depend on the level of resistance to each therapy that was present. Uruguay, New Zealand, Australia, and other nations sell formulations that permit the simultaneous use of two or three molecules from the three main categories of anthelmintics that are already on the market.

Conclusions

History demonstrates that resistance to a new medication class will unavoidably arise over time if it is only used to replace older drug classes to which resistance is already common. This is true even if nematodes resistant to presently available compounds should not represent an immediate danger to production with the introduction of a new class of anthelmintic. However, when a new class of drugs is introduced, it presents an opportunity to modify parasite management protocols such that resistance to it either never arises or develops much more slowly than it did with the prior drug classes.

References

1. Abbott KA, Taylor MA and Stubbings LA (2012). Sustainable worm control strategies for sheep. A technical manual for veterinary surgeons and advisers, SCOPS. *In*: Sustainable Control of Parasites in Sheep 4th ed. (SCOPS), UK (KA Abbott, MA Taylor and LA Stubbings Eds.), Malvern, pp. 51.

2. Acosta TJF, Mendoza-de-Gives P, Aguilar Caballero AJ and Cuellar Ordaz JA (2012). Anthelmintic resistance in sheep farms: Update of the situation in the American continent. *Vet. Parasitol*., **189**(1): 89–96.

3. Altreuther G, Buch J, Chales SD, Davis WL, Krieger KJ and Radeloff I (2005). Field evaluation of the efficacy and safety of emodepside/praziquantel spot-on solution against naturally acquired nematode and cestode infections in domestic cats. *Parasitol. Res.*, **97**: 58–64.

4. Barbara G, Hanrahan JP, de Waal DT, Patten T, Kinsella and Lynch CO (2012). Anthelmintic-resistant nematodes in Irish commercial sheep flocks – the state of play. *Ir. Vet. J*., **65**(1): 21–25.

5. Besier RB (2007). New anthelmintics for livestock: the time is right. *Trends Parasitol*., **23**: 21–24.

6. Biffa D, Jobre Y and Chaka H (2006). Ovine helminthosis, a major health constraint to productivity of sheep in Ethiopia. *Anim. Health Res. Rev.*, **7:** 107–118.

7. Buttar BS, Hari HS, Singh NK, Haque JM and Rath SS (2012). Emergence of anthelmintic resistance in an organized sheep farm in Punjab. *J. Vet. Parasitol*., **26**(1): 69–71.

8. Coles GC and Roush RT (1992). Slowing the spread of anthelmintic resistant nematodes of sheep and goats in the United Kingdom. *Vet. Rec*., **130**: 505– 510.

9. Dobson RJ, Besier RB, Barnes EH, Love SCJ, Vizard A, Bell K and Le Jambre L (2001). Principles for the use of macrocyclic lactones to minimize selection for resistance. *Aust. Vet. J.*, **79**: 759–761.

10. Domke AV, Chartier C, Gjerde B, Leine N, Vatn S, Osterås O and Stuen S (2011). Worm control practice against gastro-intestinal parasites in Norwegian sheep and goat flocks. *Acta Vet. Scand*., **13**: 53– 29.

11. Drudge JH, Szanto J, Wyant ZN and Elam G (1964). Field studies on parasitic control in sheep: Comparison of thiabendazole, ruelene and phenothiazine. *Am. J. Vet. Res*., **25**: 1512–1518.

12. FAOSTAT (2010). FAOSTAT Agriculture Data. Food and Agriculture Organization Statistics, Rome, Italy.

13. Fleming SA, Craig T, Kaplan RM, Miller JE, Navarre C and Rings M (2006). Anthelmintic resistance of gastrointestinal parasites in small ruminants. *J. Vet. Intern. Med.*, **20**: 435–444.

14. Garg R and Yadav CL (2009). Genotyping of benzimidazole susceptible and resistant alleles in different populations of *Haemonchus contortus* from Himalayan and sub-Himalayan regions of North-West India. *Trop. Anim. Health Prod*., **41**(7): 1127– 1131.

15. Geurden T, Hoste H, Traversa PJD, Strake S, *et al.* (2014). Anthelmintic resistance and multidrug resistance in sheep gastro-intestinal nematodes in France, Greece and Italy. *Vet. Parasitol*., **201**(1– 2): 59–66.

16. Harikrishnan TJ (2012). Management of anthelmintic resistance in GI helminthes of sheep and goats in Tamil Nadu – the way forward. Proceeding, International Conference on Holistic Approaches for Combating Anthelmintic Resistance – an update in parasitology. *Vet. Parasitol*., **189**(1): 46–53.

17. Hoston IK (1985). New developments in nematode control. The role of animal health products Industry. *In*: Resistance in Nematodes to Anthelmintic Drugs (N Anderson and PJ Waller Eds.), pp. 117–125. CSIRO, Melbourne.

18. Ihler CF (2010). Anthelmintic resistance. An overview of the situation in the Nordic countries. *Acta Vet. Scand.*, 52(1): 1–24.

19. Kaminsky R, Ducray P, Jung M, Clover R and Rufener L (2008a). A new class of anthelmintics effective against drug-resistant nematodes. *Nature*, **452**: 176–180.

20. Kaminsky R, Gauvry N, Schorderet Weber S, Skripsky T and Bouvier J (2008b). Identification of the amino-acetonitrile derivative monepantel (AAD 1566) as a new anthelmintic drug development candidate. *Parasitol. Res*., **103**: 931–939.

21. Kumar R and Yadav CL (1994). Prevalence of fenbendazole resistance in ovine nematodes in North West India. *Trop. Anim. Health Prod*., **26**(4): 230–234.

22. Le Jambre LF, Martin PJ and Jarrett RG (1982). Comparison of changes in resistance in *Haemonchus contortus* egg following withdrawal of thiabendazole selection. *Res. Vet. Sci*., **32**: 38– 43.

23. Maroto R, Jimenez AE, Romero JJ, Alvarez V, De Oliveira JB and Hern´andez J (2011). First report of anthelmintic resistance in gastro-intestinal nematodes of sheep from Costa Rica. *Vet. Med. Int.*, **145**: 3–12.

24. McKellar QA (1994). Chemotherapy and delivery, systems helminths. *Vet. Parasitol*., **54**: 249–258.

25. McKenna PB, Allan CM and Taylor MJ (1996). The effectiveness of benzimidazole-levamisole combination drenches in the presence of resistance to both benzimidazole and levamisole anthelmintics in New Zealand sheep. *N.Z. Vet. J*., **44**(3): 116–118.

26. Meenakshisundaram A, Anna T and Harikrishnan J (2014). Prevalence of drug-resistant gastrointestinal nematodes in an organized sheep farm. *Vet. World*, **7**(12): 1113–1116.

27. Qadri K, Ganguly S, Wakchaure R, Sharma S, Kumar A and Kumar P (2015). Resistance to anthelmintic medications in animals: A review. *Ann. Pharma Res*., **3**(09): 144–147.

28. Rajagopal A, Radhika R, Shameem H and Devada K (2013). Detection of anthelmintic resistance in small scale goat rearing units in Thrissur. *J. Vet. Anim. Sci*., **44**: 51–53.

29. Rialch A, Vatsya S and Kumar RR (2013). Detection of benzimidazole resistance in gastrointestinal nematodes of sheep and goats of sub-Himalayan region of northern India using different tests. *Vet. Parasitol*., **198**(3–4): 312–318.

30. Saddiqi HA, Jabbar A, Sarwar M, Iqbal Z, Muhammad G, Nisa M and Shahzad A (2011). Small Ruminant inherited resistance against G.I. nematodes: A case of *Haemonchus contortus* in Faisalabad, Pakistan. *Parasitol. Res.*, **109**: 1483–1500.

31. Sargison ND *(*2012*)*. Pharmaceutical treatments of gastrointestinal nematode infections of sheep– future of anthelmintic drugs. *Vet. Parasitol.*, **189**: 79–84.

32. Shu Hua X, Hui-Ming W, Tanner M, Utzinger J and Chong W (2005). Tribendimidine: a promising, safe and broad-spectrum anthelmintic agent from China. *Acta. Trop.*, **94**: 1–14.

33. Silvestre A, Leignel V, Berrag B, Gasnier N, Humbert JF, Chartiere C and Cabaret J (2002). Sheep and goat nematode resistance to anthelmintics: Pros and cons among breeding management factors. *Vet. Res*., **33**(5): 465–480.

34. Singh S and Yadav CL (1997). A survey of anthelmintic resistance by nematodes on three sheep and goat farm in Hisar (India). *Vet. Res. Commun*., **21**: 447– 451.

35. Sissay MM, Aset A, Uggla A and Waller PJ (2006). Anthelmintic resistance of nematode parasite of small ruminants in eastern Ethiopia, exploitation of refugia to restore anthelmintic efficacy. *Vet. Parasitol*., **135:**337–346.

36. Varadharajan, A and R. Vijayalakshmi (2015). Prevalence and seasonal occurrence of gastrointestinal parasites in small ruminants of coastal areas of Tamil Nadu. Int. J. Adv. Res. Biol.Sci. 2(2): 21–25.

37. Varadharajan, A and R. Vijayalakshmi (2015). Emergence of anthelmintic resistance in naturally infected goats of Cuddalore district, Tamil nadu. G.J.B.A.H.S. 4(1):101-104.

38. Varshney TR and Singh YP (1976). A note on development of resistance of *Haemonchus contortus* worms against phenothiazine and thiabendazole in sheep. *Indian J. Anim. Sci*., **46**: 666–668.

39. Waller PJ (1986). Anthelmintic resistance in sheep nematodes. *Agric. Zool. Re*v., **1**: 333–373.

40. Waller PJ, Dobson RJ and Haughey KG (1990). The effect of combinations of anthelmintics on parasite populations in sheep. *Aust. Vet. J*., **67**(4): 138–140.

41. Yadav CL (1997). Premature ovine births caused by *Haemonchus contortus. Indian Vet. J*., **74**: 983–984.