Survey on anthelmintic resistance to gastrointestinal nematodes in unorganized goat farms of Tamil Nadu

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Abstract One of the major problems in small ruminant farms is emergence of anthelmintic resistance (AR) to commonly used dewormers. This study investigated AR to gastrointestinal nematodes affecting goats in 27 unorganized farms in three different agro-climatic zones (Cauvery delta zone, high altitude zone and high rainfall zone) of Tamil Nadu, India. Two anthelmintics viz., albendazole (AZ) and levamisole (LEV) were used in this study as per the dose recommended by the manufacturer. Status of AR was detected by using the faecal egg count reduction test. Results revealed the presence of high level of resistance to both AZ and LEV. In the high rainfall and high altitude zones, all the farm flocks were found to be resistant to LEV. In the Cauvery delta zone, 13 farm flocks were resistant and four farm flocks showed suspect resistance to AZ. Fifteen farm flocks showed resistance and two showed suspect resistance to LEV. Further, morphological characterization of the infective larvae derived from faecal cultures indicated that by far the most predominant gastrointestinal nematode species found in goats was *Haemonchus contortus*.

Keywords Anthelmintic resistance · Albendazole · Levamisole · Goat · Gastrointestinal nematode · Faecal egg count reduction test · *Haemonchus contortus*

Introduction

Goat farming is one of the most significant and upcoming livestock enterprises in India and it is considered as the

backbone of rural economy. The goat farming plays a major role in making the resource poor farmers self-sufficient in Tamil Nadu. The surging goat population during the last two decades in spite of restriction by few government agencies has made to realise its growth. With a highly fragmented goat population reared along with sheep not much of attention had been paid for deworming of goats. Gastro-intestinal parasitism in goats severely affects the economy of goat farming. Benzimidazoles and levamisole (LEV) have been regularly and widely used in India for controlling parasitic gastroenteritis in goats for the last 2–3 decades. There have been complaints on the failure of these anthelmintics to provide the expected degree of control with regard to parasitic gastroenteritis. The reason for inadequate efficacy of these anthelmintics is frequent and indiscriminate usage that has led to the development of resistance which hampers the effective control of GI nematodes (Yadav et al. 1993). The development of anthelmintic resistance (AR) in gastrointestinal nematodes of small ruminants is of major concern in developing countries of the world like India. The rate at which resistance to additional anthelmintics is being reported in India is alarming, as it narrows the choice of alternative anthelmintics (Yadav 1990; Uppal et al. 1992; Yadav and Uppal 1992). Knowledge about the status of AR and its monitoring becomes a vital component of worm management strategy in order to maintain efficacy of available anthelmintics with simultaneous reduction in the selection pressure in worm population (Várady et al. 2007). Studies on multiple AR status have been mostly done in sheep farm flocks and very less is known about the prevalence of multiple AR in goats in India. Hence, the present study was undertaken to detect the status of AR to commonly used anthelmintics such as Albendazole (AZ) and LEV in 27 unorganized goat farms of three different agro-climatic zones of Tamil Nadu.

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Materials and methods

Animals and management

The study was carried out in 27 unorganized goat farm flocks from three different agro-climatic zones of Tamil Nadu namely Cauvery delta zone, high altitude zone and high rain fall zone. Each farm flock consisted of a minimum of 45 goats. The samples were collected from farm flocks maintained in semi intensive system of management with 6–8 h of grazing during the day time and housing overnight in raised floor pens. The animals were offered with limited concentrate feed supplements and ad libitum water.

Faecal egg count reduction test (FECRT)

FECRT was carried out as per the guidelines of World Association for Advancement of Veterinary Parasitology (Coles et al. 1992). The study was carried out in two groups of animals ($n = 15$) in farm flocks that were treated with the two class of commonly used anthelmintics namely benzimidazole and tetra hydropyrimidines as per the manufacturer recommended dose rates. About 5 g of fresh faecal sample was collected *per rectum* from each animal on day 0 and 10–14 days post-treatment was placed in pre-labelled zip lock polythene covers and were shipped to the laboratory. Egg counting was done as per modified McMaster technique (MAFF 1989; Coles et al. 1992). Resistance to a particular class of anthelmintic was considered to be present if the percentage reduction in egg count was less than 95 % and also the 95 % confidence level was less than 90 %. If only one of the two criteria was met out, the resistance was classed as suspected. Pre- and post-treatment faecal samples were pooled and subjected to jar method of faecal culture and larvae were identified based on the keys provided by MAFF (1986).

Results

The percentage faecal egg count reduction results are shown in Table 1. The study indicated the presence of high level of resistance to both the anthelmintics viz. AZ and LEV. Out of 27 flocks screened, resistance to AZ was observed in 22 farm flocks (81 %), while LEV resistance was observed in 25 farm flocks (92 %). In addition to this, AZ showed suspect resistance in five farm flocks and LEV showed suspect resistance in two farm flocks. High level of resistance to AZ and LEV was observed in high rain fall zone. All the four farm flocks studied in the high altitude zone were resistant to LEV (100 %) whereas three

farm flocks (75 %) were resistant to AZ and one farm flock (25 %) showed suspect resistance to AZ. In Cauvery delta zone, 13 farm flocks (76 %) were resistant to AZ and four (24 %) showed suspect resistance to AZ, while fifteen farm flocks showed resistance (88 %) and two showed suspect resistance (11 %) to LEV. Faecal culture results indicated that *Haemonchus contortus* was the most predominant species of GI nematode identified in the farm flocks followed by *Trichostrongylus* spp. Hence, the present study indicated that *H. contortus* is resistant to both AZ and LEV in the screened goat farm flocks of Tamil Nadu.

Discussion

Multiple AR in GI nematodes has been well documented from all over the world. The incidence of multiple AR in naturally grazing goats was reported in USA (Anne and Terry 2000). The prevalence of resistance to benzimidazole group and LEV in goat farms in Malaysia has also been well documented (Chandrawathani et al. 1999). In India several studies have indicated the presence of multiple AR in sheep (Varshney and Singh 1976; Yadav et al. 1993; Gill 1996; Swarnkar et al. 1999; Dhanalakshmi et al. 2003). Resistance to the commonly used anthelmintics like AZ and LEV in organised farms is well documented in sheep farms of Southern India also. (Jeyathilakan et al. 2003; Arunachalam et al. 2005; Easwaran et al. 2009). Ram et al. (2007) and Laha et al. (1999) reported the less therapeutic efficacy of AZ against GI nematodes of goats. The results of the present study were found to be in accordance with these findings. The GI nematodes of both sheep and goats were resistant to ivermectin and fenbendazole, whereas LEV was still effective in sheep, but not in goats in Kenya as observed by Mwamachi et al. (1995). Resistance to AZ, Ivermectin and morantel in goats has been investigated by Deepa and Devada (2007). The level and type of AR in the gastrointestinal parasites in different farms appeared to be associated with the type and frequency of anthelmintic used and the management practices followed in the farms. The role of management practices and frequent use of anthelmintics in the development of resistance has been well studied (Martin et al. 1982; Prichard 1994). Hence, there is an urgent need to educate the farmers about the problems of development of AR and the ways to control it. Appropriate use of anthelmintics and good management will lead to delay in onset of AR in gastrointestinal nematodes affecting small ruminants.

In conclusion, this study documented the presence of multiple AR in gastrointestinal nematodes of goats of Tamil Nadu.

Table 1 Prevalence of AR in goat farms of three different agro-climatic zones of Tamil Nadu

Zone	Farms	Drugs	Faecal egg count reduction (%FECR)	95 % confidence limits		Status
				Upper	Lower	
Cauvery delta	1	Albendazole	87.38	94.35	71.79	Resistance
		Levamisole	89.94	95.98	74.85	Resistance
	2	Albendazole	88.50	92.69	81.88	Resistance
		Levamisole	88.85	93.54	80.75	Resistance
	3	Albendazole	87.54	91.75	81.17	Resistance
		Levamisole	86.39	92.12	76.78	Resistance
	4	Albendazole	89.72	94.54	80.64	Resistance
		Levamisole	84.12	91.14	71.49	Resistance
	5	Albendazole	69.23	83.04	44.18	Resistance
		Levamisole	77.97	88.87	56.39	Resistance
	6	Albendazole	89.38	94.31	80.16	Resistance
		Levamisole	88.64	93.63	79.74	Resistance
	7	Albendazole	64.71	78.63	41.71	Resistance
		Levamisole	83.45	91.11	69.23	Resistance
	8	Albendazole	72.50	82.72	56.24	Resistance
		Levamisole	88.07	94.35	74.79	Resistance
	9	Albendazole	75.00	83.98	60.98	Resistance
		Levamisole	87.50	93.48	76.03	Resistance
	10	Albendazole	95.00	97.50	89.99	Suspect resistance
		Levamisole	50.85	50.85	66.37	Resistance
	11	Albendazole	95.77	98.60	87.25	Suspect resistance
		Levamisole	95.95	98.65	87.79	Suspect resistance
	12	Albendazole	56.25	68.59	39.05	Resistance
		Levamisole	57.45	65.83	47.01	Resistance
	13	Albendazole	95.60	98.51	86.96	Suspect resistance
		Levamisole	95.18	98.16	87.37	Suspect resistance
	14	Albendazole	95.55	98.24	88.79	Suspect resistance
		Levamisole	79.45	87.94	64.98	Resistance
High altitude	15	Albendazole	39.58	59.32	10.25	Resistance
		Levamisole	50.00	63.51	31.47	Resistance
	16	Albendazole	49.05	63.13	29.60	Resistance
		Levamisole	12.12	36.04	−20.74	Resistance
	17	Albendazole	28.78	46.94	4.41	Resistance
		Levamisole	43.39	64.57	9.56	Resistance
	18	Albendazole	72.55	91.08	15.50	Resistance
		Levamisole	71.86	85.98	43.49	Resistance
	19	Albendazole	92.76	96.52	84.91	Suspect resistance
		Levamisole	78.10	90.15	51.34	Resistance
	20	Albendazole	83.33	90.84	69.67	Resistance
		Levamisole	88.56	92.69	82.08	Resistance
High rain fall	21	Albendazole	84.64	91.27	72.96	Resistance
		Levamisole	88.47	93.01	81.03	Resistance
	22	Albendazole	74.74	90.71	31.29	Resistance
		Levamisole	86.95	92.15	78.32	Resistance
	23	Albendazole	75.68	93.55	8.20	Resistance
		Levamisole	65.67	79.47	42.59	Resistance
	24	Albendazole	58.06	86.57	−30.95	Resistance
		Levamisole	74.74	86.05	54.25	Resistance
	25	Albendazole	74.67	82.94	62.41	Resistance
		Levamisole	73.17	83.24	57.05	Resistance
	26	Albendazole	73.75	85.83	51.35	Resistance
		Levamisole	74.21	85.09	55.38	Resistance
	27	Albendazole	57.35	78.47	15.52	Resistance
		Levamisole	66.84	80.08	44.80	Resistance

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