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Research Article

REVERSION OF SUSCEPTIBILITY TO ANTHELMINTIC (MORANTEL) OF A PARTIALLY RESISTANT HAEMONCHUS CONTORTUS STRAIN IN GOATS

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ABSTRACT

Forty one goats at an organized farm with faecal egg count of more than 150 eggs per gram were divided into three groups (Groups I, II and III) of 11, 15 and 15 goats,respectively. Goats of groups I and II were treated with morantel @ 20 mg/kg orally and ivermectin @ 0.4 mg/kg subcutaneously, respectively while group III served as control. Faecal samples were collected on 14th day after treatment from animals of all groups and individual faecal egg counts were determined by modified Mc Master technique. The reduction in faecal egg counts of goats treated with morantel and ivermectin was 100% and 73.68%, respectively. Only *Haemonchus contortus* larvae were found on copro-culture in ivermectin treated group. In 1994-95, faecal egg count reduction for morantel on this farm was 53.7% which increased to 100% indicating complete reversion to susceptibility of *H. contortus* to this anthelmintic. Further, anthelmintic resistance by *H. contortus* against ivermectin was detected for the first time on the farm. The history revealed that after withdrawl of morantel, the farm has switched on to closantel and ivermectin since 1995.

Key words: Goat, *Haemonchus contortus*, ivermectin, morantel, resistance, reversion

Gastrointestinal parasitism is one of the major factor limiting goat production because they cause heavy economic losses in meat and milk production (Gordon, 1974). Anthelmintic resistance by gastrointestinal nematodes which cause parasitic gastroenteritis in goats is now a problem impairing their effective control throughout the world including India. The rate at which resistance to anthelmintics is being reported in India, is alarming as it narrows the choice of anthelmintics (Uppal *et al.*, 1992; Singh and Yadav, 1997; Ram *et al.*, 2007). One of the most valuable weapons in the battle to conserve susceptibility in nematode population is the ability to detect resistance even at low level. Accurate diagnosis and measurement of the extent of anthelmintic resistance in parasitic population are important components in the development of control measures (Donald, 1983). Anthelmintic resistance against morantel was detected in an organized farm during a survey in July 1994 (Singh and Yadav, 1997). Therefore, the use of this anthelmintic was discontinued in the farm and use of ivermectin was started. The present study was undertaken to assess the level of resistance in *Haemonchus contortus* to these anthelmintics on the farm.

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MATERIALS AND METHODS

The study was conducted between February and March 2011 on naturally infected goats with gastrointestinal nematodes on a Goat Breeding Farm, LLRUVAS, Hisar to assess the efficacy of morantel and ivermectin against gastrointestinal nematodes using faecal egg count reduction (FECR) test. This farm had a history of *H. contortus* resistance to morantel (Singh and Yadav, 1997). The animals were being maintained on permanent pastures for the last several years and had received regular anthelmintic treatment. After detection of anthelmintic resistance against morantel in 1994 (Singh and Yadav, 1997), this anthelmintic was withdrawn from the farm in 1995 and the farm switched on to closantel and ivermectin. Goats on the farm received on an average three treatments of ivermectin @ 0.2 mg/kg b.wt/year at an interval of four months i.e. in April, August and December during the previous ten years. Before that closantel (10 mg/kg b. wt.) was being used. Forty one goats with faecal egg count (FEC) of more than 150 eggs per gram (EPG) were selected in the farm. They were divided in three groups viz. Groups I, II and III with 11, 15 and 15 goats, respectively. Animals of group I were treated with morantel citrate (Banminth, Pfizer, Ltd. Mumbai) @ 20 mg/kg orally and group II with ivermectin (Dosmec, Dosch Animal Health Ltd., Mumbai) @ 0.4 mg/kg subcutaneously as described in Table 1. Group III served as untreated control.

Faecal samples were collected per rectal from each animal to estimate the FEC by modified Mc Master technique before treatment and 14 days after treatment. Pooled faecal cultures were made from each group to ascertain the larval composition of third stage larvae (L3) by standard technique (Anon., 1977). Percent reduction in FEC and 95% confidence limit were determined by the method of the World Association for the Advancement of Veterinary Parasitology (Coles *et al.*, 1992) using arithmetic mean egg counts. Resistance was considered to be present if the FECR following treatment was less than 95% and the 95% confidence interval value was less than 90%. These results were compared with the earlier report of Singh and Yadav (1997) to judge the effect of removing anthelmintic selection pressure on resistance status of *H. contortus.*

RESULTS AND DISCUSSION

Mean FEC and percent reduction in FECR are shown in Table 1. On the farm, morantel and ivermectin reduced the FEC by 100% and 73.68%, respectively and the 95% confidence limit for ivermectin was less than 90%. The nematode larvae recovered from faecal culture in ivermectin treated group comprised only of *H. contortus* (Table 2).

It was interesting to note that anthelmintic resistance against morantel was not present on the farm. However, Singh and Yadav (1997) reported lower reduction in FEC after treatment with morantel citrate (53.7%) on this farm during survey in July, 1994 and suggested that *H. contortus* was severely resistant to this anthelmintic. Therefore, the use of morantel citrate was discontinued in this farm since 1995 and the use of closantel and ivermectin were started. Higher efficacy of morantel citrate (100%) in this study compared to earlier report (Singh and Yadav, 1997) may indicate complete reversion to susceptibility of *H. contortus* to this drug. Withdrawl of the drug when the population comprised mainly of heterozygotes will allow a measure of reversion to susceptibility (Jackson and Coop, 2000). Singh and Rayulu (2007) reported partial reversion of susceptibility to morantel resistant strain of *H. contortus* in an organized sheep farm after withdrawl of drug for 10 years. Singh and Gupta (2009) reported partial reversion of susceptibility to fenbendazole and levamisole resistant strain of *H. contortus* in an organized sheep farm after switching over to ivermectin and closantel for 12 years. However, Rowan *et al.* (1996) and Zajac and Gipson (2000) have shown complete reversion to susceptibility to levamisole after withdrawl of drug for 3 years and 1 year in sheep and goats, respectively. In developed countries, where free range grazing system and animal husbandry practices like rotational grazing are followed, reversion may take place earlier. This finding has a great economic significance as development and release of a new anthelmintic may take 6 to 8 years and costs around US$30 million (Hotson, 1985). The complete reversion of susceptibility to morantel resistant *H. contortus* in goats is reported for the first time in India.

Table 1
Efficacy of morantel and ivermectin against gastrointestinal nematodes in goats at the organized farm

Group	No. of goats	Faecal egg counts (Mean+S.E.) 49		FECR on day 14^{th} Post-treatment		UCL	LCL
		0 days (Pre-treatment)	14^{th} day (Post-treatment)	Per cent	Variance reduction		
I	11	305±33	0	100	0.004	100	100
II	15	387±36	67±22	73.68	0.11	87	48
III	15	337±39	253±17	-	-	-	-

Group I=Treated with morantel @ 20mg/kg b.wt. orally; Group II=Treated with ivermectin @ 0.4 mg/kg b. wt. subcutaneously; Group III=Untreated control; FECR=Faecal egg count reduction; UCL=Upper confidence limit at 95%; LCL=Lower confidence limit at 95%

Table 2

Efficacy of morantel and ivermectin on different genera of gastrointestinal nematodes (copro-culture)

Group	Type of L3 identified (%) on coproculture 0 day (Pre-treatment)	14^{th} day (Post-treatment)
I	*Haemonchus contortus* (89)	-
	Trichostrongylus sp. (2)	
	Oesophagostomum sp. (1)	
	Bunostomum sp. (1)	
	Strongyloides papillosus (7)	
II	*Haemonchus contortus* (89)	*Haemonchus contortus* (100)
	Trichostrongylus sp. (2)	
	Oesophagostomum sp. (1)	
	Bunostomum sp. (1)	
	Strongyloides papillosus (7)	
III	*Haemonchus contortus* (90)	*Haemonchus contortus* (91)
	Trichostrongylus sp. (1)	*Trichostrongylus* sp. (1)
	Oesophagostomum sp. (2)	*Oesophagostomum* sp. (1)
	Bunostomum sp. (1)	*Bunostomum* sp. (1)
	Strongyloides papillosus (6)	*Strongyloides* papillosus (6)

Group I=Treated with morantel @ 20mg/kg b.wt. orally; Group II=Treated with ivermectin @ 0.4 mg/kg b. wt. subcutaneously; Group III=Untreated control

The history of use of anthelmintics on the farm revealed that after the withdrawl of morantel, the farm switched on to closantel and ivermectin since 1995. In 1994 (Singh and Yadav, 1997), FECR for ivermectin was 100% which has now decreased to 73.68% indicating moderate resistance of *H. contortus* to this anthelmintic. The anthelmintic resistance by *H. contortus* against ivermectin has been detected for the first time on this farm. The role of management and frequent use of anthelmintics in the development of resistance has been reported previously (Prichard, 1994; Singh and Yadav 1997; Artho *et al.*, 2007). Moreover, goats have different anthelmintic metabolism than sheep (Conder and Campbell, 1995) and they manifest the lower availability of anthelmintic. In the present study, history of deworming revealed that ivermectin was being used @ 0.2 mg/kg b. wt. i.e. at the recommended dose rate for sheep. It has been repeatedly suggested that underdosing can lead to ineffective therapeutic levels and therefore increase the chances of selection of resistant parasites. The selection pressure exereted by regular use of anthelmintic and underdosing are responsible for the development of anthelmintic resistance. No resistance was detected in *Trichostrongylus* sp., *Oesophagostomum* sp., *Bunostomum* sp. and *Strongyloides papillosus*.

Complete reversion to susceptibility of partially resistant *H. contortus* strain in goats is reported for the first time in India. The anthelmintic resistance by *H. contortus* against ivermectin has been detected for the first time on this farm.

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