



Status of Fenbendazole, Closantel and Ivermectin Resistance in Goats

Hardeep Kalkal*

Krishi Vigyan Kendra, Sirsa, CCS Haryana Agricultural University, Hisar-125004, Haryana, India

ABSTRACT

Two unorganized goat farms from the dry sub-humid zone of Sirsa, Haryana were surveyed to assess the efficacy of fenbendazole, closantel, and ivermectin against gastrointestinal nematodes using the faecal egg count reduction test (FECRT). A total of 120 goats, 60 each from Sahuwala (SV) and Rupana (RV) villages, with a minimum of 150 eggs per gram (EPG) of faeces, were selected. Animals were divided into four groups of 15 goats each per farm. Groups S1 and R1 received fenbendazole (@ 10 mg/kg b.wt. orally), groups S2 and R2 received closantel (@ 20 mg/kg b.wt. orally), groups S3 and R3 received ivermectin (0.4 mg/kg b.wt., subcutaneous), while groups S4 and R4 served as untreated controls. Faecal samples were collected on day 0 and day 14 post-treatment, and egg counts were determined using the Modified McMaster technique. Percent reduction in faecal egg counts in SV was 89.11, 67.12, and 55.23 for fenbendazole, closantel, and ivermectin, respectively, while in RV it was 51.22, 89.0, and 91.02, respectively. Post-treatment coproculture revealed predominance of *Haemonchus contortus* larvae in both farms, with minor genera disappearing after treatment. The findings confirmed the presence of multiple anthelmintic resistance, with fenbendazole showing variable efficacy ranging from moderate to severe resistance, closantel exhibiting moderate resistance, and ivermectin showing reduced effectiveness. These results highlighted the urgent need for regular monitoring, strategic drug rotation, and judicious use of anthelmintics to sustain effective parasite control in goat farms of Sirsa, Haryana.

Keywords: Anthelmintic resistance, Closantel, Fenbendazole, Goat, Haryana and Ivermectin Goat.

INTRODUCTION

Goat farming is an important source of livelihood in India, particularly for landless and smallholder farmers, because of its low input requirements, adaptability to diverse agro-climatic conditions, and quick economic returns (Thakur *et al*, 2025). In Haryana, the goat population is estimated at 0.335 million (DAHD, 2020). Despite its economic significance, productivity is often constrained by parasitic gastroenteritis caused by gastrointestinal nematodes (GINs) such as *Haemonchus contortus*, *Trichostrongylus axei*, *Nematodirus spp.*, and *Strongyloides papillosus*. Among these, *H. contortus* is recognized as the most pathogenic and widely prevalent species, responsible for high morbidity, mortality, and production losses in goats (Yadav, 1997; Sani *et al*, 2004; Kumar and Gill, 2025).

Chemical control using anthelmintics remains the primary strategy for managing GINs. Drugs such as fenbendazole, closantel, and ivermectin are widely used in India and globally. However, frequent and

indiscriminate use, coupled with underdosing, has led to the emergence of anthelmintic resistance (Rialch *et al*, 2013; Chandra *et al*, 2015). Reports of resistance in goats have been documented from different parts of India (Godara *et al*, 2011; Dixit *et al*, 2017; Sharma *et al*, 2015; Kumar and Singh, 2016; Kalkal *et al*, 2019; Bihaqi *et al*, 2020) and abroad (Zajac and Gipson, 2000; Chartier *et al*, 2001; Pena-Espinoza *et al*, 2014; Arsenopoulos *et al*, 2020; Macedo *et al*, 2023).

Fenbendazole resistance has been particularly widespread, with studies confirming reduced efficacy in India (Rialch *et al*, 2013; Chandra *et al*, 2015; Bhagat *et al*, 2024) and other countries (Silvestre and Humbert, 2000; von Samson-Himmelstjerna *et al*, 2009; Dolinska *et al*, 2023). Closantel, though long considered reliable, has also shown declining efficacy in goats (Basripuzi *et al*, 2012; Chandrawathani *et al*, 2013; Bihaqi *et al*, 2020). Similarly, ivermectin resistance has been reported in India and globally, reflecting the impact of continuous use of macrocyclic lactones (Kumsa and Abebe, 2009; Rialch *et al*, 2013; Pena-Espinoza *et al*, 2014; Kaur *et al*, 2025).

Table 1: Response to various anthelmintics in goats naturally infected with gastrointestinal nematodes in Village Sahuwala.

Group	Anthelmintic	Dose (mg/kg)	No. of goats treated	Route of administration	Faecal egg counts on days (Mean $\pm$ S.E.)		Faecal egg counts reduction on day 14 post-treatment		Confidence limits at 95%	
					0	14	%	Variance	Upper	Lower
I	Fenbendazole	10	15	Oral	662 ^a $\pm$ 111.45	180 ^b $\pm$ 39.22	89.11	0.02	32.21	33.39
II	Closantel	20	15	Oral	666 ^a $\pm$ 212.67	77.22 ^b $\pm$ 52.00	67.12	0.12	92.02	62.33
III	Ivermectin	0.4	15	S/C	689.2 ^a $\pm$ 134.44	222.34 ^b $\pm$ 33.34	55.23	0.71	44.66	43.21
IV	Control	---	15	---	676 ^a $\pm$ 34.33	333.74 ^a $\pm$ 55.04	0	---	---	---

Means with same superscripts in column are not significantly different ($p < 0.05$)

Table 2: Response to various anthelmintics in goats naturally infected with gastrointestinal nematodes in village Rupana.

Group	Anthelmintic	Dose (mg/kg)	No. of goats treated	Route of administration	Faecal egg counts on days (Mean $\pm$ S.E.)		Faecal egg counts reduction on day 14 post-treatment		Confidence limits at 95%	
					0	14	%	Variance	Upper	Lower
I	Fenbendazole	10	15	Oral	700.77 ^a $\pm$ 70.6	222.22 ^b $\pm$ 34.11	51.22	0.14	71.87	65.12
II	Closantel	20	15	Oral	604.33 ^a $\pm$ 11.22	106.77 ^b $\pm$ 33.34	89.0	0.23	99.19	22.13
III	Ivermectin	0.4	15	S/C	722.22 ^a $\pm$ 29.52	133 ^b $\pm$ 57	91.02	0.33	94.28	73.22
IV	Control	---	15	---	771 ^a $\pm$ 92.58	776.63 ^a $\pm$ 99.58	0	---	---	---

Means with same superscripts in column are not significantly different ($p < 0.05$)

Table 3: Effect of anthelmintics on different genera of gastrointestinal nematodes of goats in village Sahuwala and Rupana

Group	Species	Sahuwala		Rupana	
		Per cent larval composition on day		Per cent larval composition on day	
		0	14	0	14
I	<i>Haemonchus</i> spp.	89	100	91	100
	<i>Trichostrongylus</i> spp.	3	0	7	0
	<i>Oesophagostomum</i> spp.	1	0	1	0
	<i>Strongyloides</i> sp.	7	0	1	0
II	<i>Haemonchus</i> spp.	77	100	83	100
	<i>Trichostrongylus</i> spp.	3	0	5	0
	<i>Oesophagostomum</i> spp.	6	0	7	0
	<i>Strongyloides</i> sp.	4	0	5	0
III	<i>Haemonchus</i> spp.	93	100	88	100
	<i>Trichostrongylus</i> spp.	3	0	2	0
	<i>Oesophagostomum</i> spp.	2	0	6	0
	<i>Strongyloides</i> sp.	2	0	4	0
IV	<i>Haemonchus</i> spp.	93	87	89	97
	<i>Trichostrongylus</i> spp.	3	3	1	1
	<i>Oesophagostomum</i> spp.	2	9	5	1
	<i>Strongyloides</i> sp.	2	1	5	1

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The persistence of resistant nematode populations even in the absence of drug pressure (Webb *et al*, 1979; McKenna, 1990) underscores the importance of regular monitoring. Updated WAAVP guidelines recommend faecal egg count reduction tests (FECRT) as the standard method for assessing drug efficacy (Coles *et al*, 2006; Ray *et al*, 2023). Given the climatic vulnerability of Haryana, particularly the dry sub-humid zone of Sirsa and the dependence of farmers on chemical control, it was essential to evaluate the current status of anthelmintic efficacy. Therefore, the present study was undertaken to investigate resistance against fenbendazole, closantel, and ivermectin in unorganized goat farms of Sahuwala and Rupana villages in Sirsa, Haryana.

MATERIALS AND METHODS

The present study was conducted on goats reared under unorganized farming systems in the dry sub-humid zone of Sirsa, Haryana. Two villages, Sahuwala (SV) and Rupana (RV), were selected to evaluate the efficacy of fenbendazole, closantel, and ivermectin against gastrointestinal nematodes using the faecal egg count reduction test (FECRT) as recommended by the World Association for the Advancement of Veterinary Parasitology (Coles *et al*, 1992; Coles *et al*, 2006).

A total of 120 goats, 60 from each village, naturally infected with gastrointestinal nematodes and having faecal egg counts (EPG) greater than 150 were included in the study. None of the animals had received anthelmintic treatment during the preceding two months. Each goat was identified, weighed, and its baseline faecal egg count was determined using the Modified McMaster technique, with one egg representing 50 EPG.

The animals from each farm were randomly divided into four groups of 15 goats each. In Sahuwala, groups S1, S2, and S3 were treated with fenbendazole (@ 10 mg/kg body weight orally, Panacur®, MSD), closantel (@ 20 mg/kg body weight orally, Zycloz®, Zydus), and ivermectin (@ 0.4 mg/kg body weight subcutaneously, Zenvet®, INTAS), respectively, while group S4 served as untreated control. Similarly, in Rupana, groups R1, R2, and R3 received fenbendazole, closantel, and ivermectin at the same dosages, while group R4 served as untreated control. Faecal samples were collected from all animals on day 0 and day 14 post-treatment, and egg counts were determined to assess drug efficacy.

Pooled faecal cultures from each group were incubated at 27 ± 2 °C for seven days to recover infective third-stage larvae (L3). The larvae were identified morphologically according to the criteria described by Keith (1953). The percentage reduction in faecal egg counts and 95% confidence intervals were calculated following WAAVP guidelines. Anthelmintics were considered fully effective when the reduction exceeded 95% with lower confidence limits above 90%, moderately resistant when reduction ranged between 60–95% with lower confidence limits below 90%, and severely resistant when reduction was below 60% with lower confidence limits under 90%. All recorded data were statistically analyzed using one-way ANOVA with SPSS software version 27.0.

RESULTS AND DISCUSSION

The faecal egg counts (Mean $\pm$ S.E.) on day 0 and day 14 post-treatment, percent reduction in faecal egg counts (FECRT%), variance, and confidence limits (95%) for fenbendazole, closantel, and ivermectin in goats naturally infected with gastrointestinal nematodes at SV and RV of Sirsa are presented in Tables 1 and 2. In SV, fenbendazole reduced faecal egg counts by 89.11%, closantel by 67.12%, and ivermectin by 55.23%. In RV, the corresponding reductions were 51.22%, 89.0%, and 91.02%, respectively. These results indicated variable resistance patterns: fenbendazole showed moderate to severe resistance across both farms, closantel exhibited moderate resistance in SV but higher efficacy in RV, while ivermectin demonstrated reduced effectiveness in SV but comparatively better efficacy in RV.

The pooled faecal cultures revealed predominance of *Haemonchus contortus* larvae in both villages before and after treatment (Table 3). Minor proportions of *Trichostrongylus spp.*, *Oesophagostomum spp.*, and *Strongyloides spp.* were present on day 0 but disappeared after treatment, leaving only *H. contortus*. This finding was consistent with earlier reports from India and abroad, where *H. contortus* has been identified as the most pathogenic and resistant nematode species in small ruminants (Rialch *et al*, 2013; Bihagi *et al*, 2020; Chartier *et al*, 2001).

The resistance observed against fenbendazole may be attributed to its frequent and prolonged use, often without accurate body weight estimation, leading to underdosing. Similar persistence of resistant populations has been reported previously, even in the

absence of drug pressure (McKenna, 1990). Closantel resistance, particularly evident in SV, may be linked to its prolonged activity and indiscriminate usage, as reported in Malaysia and Kashmir Valley (Basripuzi *et al*, 2012; Chandrawathani *et al*, 2013; Bihaqi *et al*, 2020). Ivermectin resistance in Sahuwala aligns with earlier findings from Ethiopia, Denmark, and India, where moderate resistance was observed due to continuous use of macrocyclic lactones (Kumsa and Abebe, 2009; Pena-Espinoza *et al*, 2014; Sharma *et al*, 2015). Overall, the study demonstrated that fenbendazole has lost substantial efficacy, while closantel and ivermectin are showing moderate resistance in goat farms of Sirsa. The predominance of *H. contortus* after treatment underscores its role in the development of multiple anthelmintic resistance. These findings highlighted the urgent need for regular monitoring, strategic drug rotation, and integrated parasite management practices to sustain effective gastrointestinal nematode control in goats of Haryana.

CONCLUSION

The present study clearly demonstrated the occurrence of multiple anthelmintic resistance in goats reared under unorganized farming systems in SV and RV of Sirsa, Haryana. Fenbendazole showed variable efficacy, ranging from moderate resistance in SV to severe resistance in RV. Closantel exhibited moderate resistance in SV but comparatively higher efficacy in RV, while ivermectin displayed reduced effectiveness in SV and moderate resistance in RV. Post-treatment coproculture confirmed *Haemonchus contortus* as the predominant nematode species, with minor genera disappearing after treatment. These findings highlighted the persistence and pathogenicity of *H. contortus* as the major driver of resistance in small ruminants. The results emphasized the urgent need for regular monitoring of drug efficacy, strict adherence to WAAVP guidelines for FECRT, and judicious use of anthelmintics. Strategic drug rotation, accurate dosing based on body weight, and integration of non-chemical parasite control measures should be prioritized to delay further resistance development. This study provided important evidence of multiple anthelmintic resistance in goat farms of Sirsa, underscoring the necessity of vigilance and adaptive parasite management strategies in the dry sub-humid zone of Haryana.

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