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Assessment of anthelmintic resistance in gastrointestinal nematodes of small ruminants, Dale district, Southern Ethiopia

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The anthelmintic resistance status of gastrointestinal nematodes of small ruminants owned by smallholder farmers in the Dale district, Southern Ethiopia, was investigated. A faecal egg count reduction test (FECRT) was conducted in traditionally managed and naturally infected goats and sheep. For this study, 60 sheep and 60 goats of both sexes, aged from 6 to 18 months, and with a faecal egg count (FEC) of more than 150 eggs/g of faeces were selected for the test from 5 neighboring kebeles. Both sheep and goats were grouped into four treatment groups: albendazole, tetramisole, ivermectin and control groups. In sheep, the percentage reduction in FECs (95% confidence intervals) for albendazole, tetramisole and ivermectin were 95.0% (86.5 to 98.2%), 97.5% (93.2 to 99.1%) and 96.7% (91.0 to 99.1%), respectively. In goats, the percentage reduction in FECs (95% confidence intervals) for albendazole, tetramisole and ivermectin were 96.6% (88.3 to 99.0%), 97.7% (90.6 to 99.4%) and 97.1% (91.0 to 99.1%), respectively. All the anthelmintics were found to be effective, but resistance to albendazole was suspected. Based on the findings, it was concluded that development of anthelmintic resistance could be prevented by avoiding frequent dosing and under dosing, while strategic deworming should be practiced by both animal health workers and animal owners.

Key words: Anthelmintics, resistance, faecal egg count reduction, small ruminants, Dale, Ethiopia.

INTRODUCTION

Sidama Zone contributes to approximately 7% of the total small ruminant population of the Southern Regions of Ethiopia, and these small ruminants are mainly kept by resource poor smallholder farmers. There are about 432,947 and 253,447 sheep and goats, respectively, in the Sidama Zone (CSA, 2012). However, the productivity of this huge small ruminant population remains marginal due to prevailing diseases, poor nutrition and husbandry systems, and lack of effective veterinary services (Gizaw et al., 2010; Assefa, 2007). Gastrointestinal nematodes (GINs) constitute one of the greatest disease threats for grazing livestock worldwide. Infection with helminth parasites results in both clinical and sub-clinical diseases causing low productivity due to stunted growth, insufficient weight gain, delay of puberty, anemia, poor feed utilization and mortality (FAO, 2002; Nahed et al., 2003) hindering optimization of the economical benefits from small ruminants (Tembely et al., 1997).

The control of parasitic helminths in domestic animals relies largely on the use of anthelmintic drugs (Taylor et al., 2002). However, increasing reports of parasitic populations that have developed anthelmintic resistance (AR) have become increasingly common, and this phenomenon severely threatens the beneficial

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exploitations of this control strategy (Waller, 1997). In fact, AR in gastrointestinal nematodes of sheep and goats has been reported in different parts of the world (Waller, 2007), making it a seriously increasing problem (Wolstenholme et al., 2004).

In Ethiopia, various anthelmintics have been used in different parts of the country for the treatment of sheep and goats helminth parasites (Biffa et al., 2006; Asmare et al., 2005). The use of anthelmintics has been practiced for a long time, and constitutes a considerable share of the costs spent by the country in the control of helminthosis (Biffa et al., 2006). Also, smuggling and misuse of veterinary drugs involving anthelmintics is a wide spread practice in the country (Maingi et al., 1997). Some of these drugs, particularly albendazole and tetramisole, have been continuously imported and distributed to every corner of the country under different trade names and by different manufacturers (Kumsa and Wossene, 2006). There was a complaint by the Regional Animal Health Officers and some animal owners with regard to the effectiveness of available anthelmintics, especially albendazole. Moreover, some researcher reported existence (Kumsa and Abebe, 2008; Kumsa and Abebe, 2008) and some others absence of anthelmintic resistance (Sheferaw and Asha, 2010; Asmare et al., 2005) in the region.

Therefore, the objective of this study was to investigate the existence of GIN resistance for albendazole, tetramisole and ivermectin, in naturally infected sheep under field conditions.

MATERIALS AND METHODS

Study area

The study was conducted in the midland area of Dale district, Sidama Zone in Southern Ethiopia, from November 2011 to May 2012. The area is characterized by a bimodal rainfall, and receives a total annual mean rainfall of 1314 mm (Improving Productivity and Market Success of Ethiopian Farmers, 2005). It is located at 6.45N and 38.23E (Gonfa, 1996). The annual mean maximum and minimum temperature are 25.4 and 14.5°C, respectively. The main livestock species in the district are cattle, goats, sheep and equines with estimated population of 2056994, 31443, 30152 and 19233, respectively (CSA, 2012).

Study animals and study design

The study population was sheep and goats in the Dale district, especially Awada and its surroundings, which were kept by smallholder farmers under backyard management system. Before the actual experiment, screening was done to identify sheep and goats naturally infected with GINs. During the screening examination, fecal samples for 135 and 111 sheep and goats were collected, respectively and the result was recorded using the owner's code of identification, for ease of identification. Sheep and goats with more than 150 eggs per gram (EPG) of feces and aged 6 to 18 months were eligible for inclusion in the field experiment on anthelmintic efficacy, following guidelines by Coles et al. (1992).

Accordingly, 60 animals of each species were selected, and for each species were grouped into four treatment groups (n=15): albendazole, tetramisole, ivermectin and control (i.e. left untreated). On day 0, fecal samples were collected from each animal enrolled in the study, and then the animals were either treated with an anthelmintic or left untreated. The manufacturer of the anthelmintics used and dose rate are described in Table 1. The expiration date of albendazole and tetramisole is august 2015, and that of ivermectin is January 2014. Fecal samples were collected again 10 to 14 days post-treatment from all animals included in the study, and the changes in the EPG were determined. All fecal samples were analyzed using a modified McMaster technique as described by Ministry of Agriculture, Fisheries and Food (1984) and Coles et al. (1992), with a minimum detection limit of 50 EPG (Cole et al., 2006).

Data analysis

The effectiveness of different anthelmintics was evaluated by computing the mean faecal egg counts reduction for each treatment group. Computation of the arithmetic mean, percentage of reduction and 95% upper and lower confidence limits; and the findings were interpreted as described by Coles et al. (1992).

RESULTS

The fecal samples collected during the screening indicated that 91 and 92.6% of the sheep and goats sampled, respectively were shedding GIN eggs in their feces (Table 2). The mean fecal egg count (per gram of faeces) was 546.4±64.5 and 619.9±43 for sheep and goats, respectively (Table 3).

The mean pre and post treatment faecal egg counts (EPG) and the percentage of faecal egg count reduction (FECR) and the lower and upper 95% confidence limit for each groups of anthelmintic drugs tested was summarized in Table 4. The percentage reduction of faecal egg count (95% confidence intervals) for albendazole, tetramisole and ivermectin were, 95.0% (86.5 to 98.2), 97.5% (93.1 to 99.1) and 96.7% (91.0 to 100.0), respectively in sheep. The percentage reduction of faecal egg count (95% confidence intervals) for albendazole, tetramisole and ivermectin were, 96.6% (88.3 to 99.0), 97.7% (93.2 to 99.4) and 97.1% (91.0 to 99.1), respectively in goats.

DISCUSSION

The coprological screening of the studied goats and sheep confirmed the common occurrence of GINs in goats and sheep of Dale district (92.6 and 91.0% of the goats and sheep sampled were infected, respectively). This result is comparable to the previous report by Kumsa and Abebe (2008) conducted on an agricultural farm in Hawassa College.

In this study, anthelmintic resistance was considered to be present if the percentage reduction in faecal egg

Table 1. The study animals included the four treatment groups, and the name of the manufacturer, dose and route of the anthelmintics used in a field study to determine anthelmintic efficacy in small ruminants in the Dale district, Southern Ethiopia (2011-2012).

Animal	Group	Treatment	Manufacturer	Dose and route
Sheep	S-I	Albendazole 300 mg	Ashish Life Science PVT, Ltd. India	7.5 mg/kg (Oral)
	S-II	Tetramisole 600 mg	Ashish Life Science PVT, Ltd. India	15 mg/kg (Oral)
	S-III	Ivermectin 1% (W/V)	Laboratorios Microsules Uruguay, SA	300 mcg/kg (S/C)
	S-IV	Control	-	-
Goats	G-I	Albendazole	Ashish Life Science PVT, Ltd. India	7.5 mg/kg (Oral)
	G-II	Tetramisole	Ashish Life Science PVT, Ltd. India	15 mg/kg (Oral)
	G-III	Ivermectin	Laboratorios Microsules Uruguay, SA	300 mcg/kg (Oral)
	G-IV	Control	-	-

Table 2. The number of animals included, and number of animals that had positive fecal egg counts, in a field study to determine anthelmintic efficacy in sheep and goats in the Dale district, Southern Ethiopia (2011-2012).

Species	Category	No. of animals examined	No. of positive animals (proportion, %)	Standard error	95% CI
Sheep	Male	34	30 (88.2)	0.06	77.1 - 99.4
	Female	77	71 (92.2)	0.03	86.1 - 98.3
	Total	111	101 (91.0)	0.03	85.6 - 96.4
Goat	Male	62	56 (90.3)	0.04	82.8 - 97.8
	Female	73	69 (94.5)	0.03	89.2 - 99.8
	Total	135	125 (92.6)	0.02	88.1 - 97.0

Table 3. The mean gastrointestinal nematode egg count (per gram of faeces) in sheep and goats in the Dale district, Ethiopia (2011-2012).

Species	Category	No. of animals examined	Mean egg count ± Standard error	95% CI
Sheep	Male	34	555.9 ± 164.5	229.8 - 881.9
	Female	77	542.2 ± 59.0	429.2 - 659.2
	Total	111	546.4 ± 64.5	419.4 - 673.4
Goat	Male	62	584.0 ± 64.0	457.3 - 710.6
	Female	73	650.4 ± 58.3	535.2 - 765.7
	Total	135	619.9 ± 43.0	535.1 - 704.7

counts was less than 95% and the lower limit of the 95% confidence interval was less than 90% (Coles et al., 1992). If only one of these criteria is met, anthelmintic resistance is suspected. Based on this criterion, the FECR percentage and the lower confidence limit obtained from Dale district smallholder sheep and goat production system revealed the absence of a significant level of GIN resistance to tetramisole and ivermectin. This finding is in line with other studies conducted in various parts of Ethiopia, on the efficacy of the most commonly used anthelmintics in small ruminants (Asmare et al., 2005; Kumsa and Abebe, 2008; Kumsa and Nurfeta, 2008; Kumsa and Wossene, 2006; Sheferaw and Asha, 2010; Tadesse et al., 2009). These studies also reported the absence of anthelmintic resistance to albendazole, tetramisole and ivermectin in small ruminants in Ogaden. However, the lower and upper 95% confidence limits of the FECR percentage following albendazole treatment were 86.5 to 98.2% and 88.3 to 99.0% for sheep and goat, respectively. This finding revealed that albendazole was suspected for resistance in this region of Ethiopia.

Table 4. The faecal egg count reduction percentage following treatment with albendazole, tetramisole and ivermectin, in sheep and goats in the Dale district, Ethiopia (2011-2012).

Treatment group	Animal species	EPG		Reduction (%)	95% CL (UCL – LCL)
		Pre-treatment	Post-treatment		
Albendazole	Sheep	756.7 ±171.5	20.0 ± 9.5	95.04	98.2 - 86.5
	Goat	550.0 ± 42.5	20.0 ± 11.8	96.6	99.0 - 88.3
Tetramisole	Sheep	723.3 ± 89.0	10.0 ± 7.2	97.5	99.1 - 93.2
	Goat	1063 ± 187.9	13.3 ± 9.1	97.7	99.4 - 90.6
Ivermectin	Sheep	743.3 ± 197.8	13.3 ± 9.1	96.7	100.0 - 91.0
	Goat	976 ± 323.4	16.7 ± 7.0	97.1	99.1 - 91.0
Control	Sheep	436.3 ±44.6	403.3 ±45.4	-	-
	Goat	623.3 ±75.3	583.3 ±72.6	-	-

UCL: Upper confidence limit; LCL: lower confidence limit.

CONCLUSION AND RECOMMENDATION

Most worm control strategies rely heavily on the use of anthelmintics. However, the regular and indiscriminate use of anthelmintics increases the risk of development of resistant parasite populations. The current findings indicated that albendazole was suspected for development of resistance, while ivermectin and tetramisole were found to be effective. To prevent further development of anthelmintic resistance in this area, the following practices are recommended: i) avoid frequent and unnecessary treatments anthelmintics, opting instead for strategic deworming and, ii) avoid under dosing of animals (Cole et al., 1992). Further studies, are needed to determine the anthelmintic resistance status of the different species of GINs in other neighboring areas of Ethiopia. Moreover, studies are needed to be conducted based on a comparative efficacy on drugs from reliable source and drugs used by the owners from unreliable sources such as imported drugs or smuggled drugs to arrive at a proper conclusions and further advice.

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