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Parasite control practices and anthelmintic efficacy field study on gastrointestinal nematode infections of Horro sheep in Western Oromiya, Ethiopia

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Gastrointestinal nematodes are one of the rampant parasitic diseases constraining sheep farming in western Oromiya. A study aimed at assessing parasite control practices in use and to determine the efficacy of three brands of anthelmintics commonly used on the farms was conducted. Questionnaire survey and faecal egg count reduction tests (FECRT) were used to collect data. Majority of respondents (95.3%) indicated that anthelmintic treatment was the only method used to manage nematode infections in sheep. Many farmers (60.0%) followed prescription orders to determine dosage while others (40.0%) were reliant on visual appraisals. In most responses (38.7%) two treatments were given per year and more deworming can be done directed to animals exhibiting general syndromes such as emaciation, diarrhea and loss of production. Most of the treatments (49.3%) were performed on the farms by the owners. Efficacy tests showed a suspected resistance against albendazole by *Haemonchus contortus* and *Trichostrongylus* spp. whereas tetraclozan and ivermectin demonstrated high efficacy against all nematode genera isolated on the farms. Some worm control practices which are thought to enhance selection of resistant strains have been evident. These involved mainly risk of underdosing and continued use of one class of anthelmintics, irrespective of its efficacy status, which may accelerate selection dynamics. To preserve the efficacy of anthelmintics, targeted selective treatments traditionally practiced by farmers should be encouraged and supported by laboratory tests to identify animals in need of treatments. Anthelmintic efficacy evaluations should be part of the control strategies to monitor treatment failures in the study areas.

Key words: Gastrointestinal nematode, parasite control, anthelmintic efficacy, questionnaire, horro sheep, Ethiopia.

INTRODUCTION

In Western Oromiya region of Ethiopia, agriculture is the mainstay of the smallholder farmers. Mixed crop-livestock production system is largely practiced in this part of the country (Gizaw et al., 2013). Sheep production is an important component and they are kept under traditional management within this farming system. The animals depend mostly on grazing natural pastures for feed sources with scanty supplements and minimum health care interventions (Edea et al., 2012). Livestock diseases are one of the major production constraints frequently

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observed in the region among which helminth parasites are the biggest causes of production losses. In general, gastrointestinal (GI) nematode parasites remain one of the most prevalent and important diseases affecting small ruminants worldwide. They are responsible for both direct and indirect major losses (Hoste et al., 2008). Losses occur through mortalities, reduced production due to subclinical parasitism and direct costs associated with control (Miller and Horohov, 2006).

For the foreseeable future, anthelmintic chemotherapy will remain the basis of helminth control programs (Taylor et al., 2002). However, resistance to the drugs has become a global problem in the small ruminant industry during the last three decades (Waller, 1994). The extensive and indiscriminate use of the drugs has resulted in the development of resistances. In Western Oromiya, the existing method to control endoparasites has increased its dependence on the treatment with anthelmintics. Meanwhile, the risk of underdosing and a continued use of one class of anthelmintics, irrespective of efficacy status are frequently encountered on many farms. On the other hand, no systematic surveys have been carried out to evaluate anthelmintic resistance situation in Horro sheep. The incidences of anthelmintic resistance in small ruminant nematodes have been reported from studies conducted in different parts of the country (Sissay et al., 2006; Desalegn, 2009; Kumsa and Girma, 2009). This is perhaps an alarming signal for the incoming challenges with worm management in small ruminants in Ethiopia.

It is unlikely that development of new anthelmintics will rescue livestock producers from the inevitable losses in productivity and problems of animal welfare that result from a failure to control multiple drug resistant (MDR) worms adequately. Now and in the future, anthelmintics must be considered as highly valuable and limited resources to be preserved (Kaplan, 2004). For this reason, monitoring of the status of anthelmintic resistance in sheep nematodes is a relevant action to be instituted in all production systems. This study was therefore aimed at assessing worm control practices in use and to determine the efficacy of three brands of anthelmintics commonly available and used in the region to control sheep nematodes on selected farms in Horro district, Western Oromiya, Ethiopia.

MATERIALS AND METHODS

Study site

The study was carried out in a selected peasant association (PA) namely Abe Dullacha located at about 328 km West of Addis Ababa in Horro district of Horro Guduru Wollega Zone in Western Oromiya at an altitude of 2,500 m above sea level. The selection of the farms was based on the presence of large number of sheep population with the history of frequent use of anthelmintics for nematode control and willingness of the farmers to participate. The climate is characterized by a long rainy season from May to September and an extended dry season from October to February. The average annual rainfall was above 1,500 mm with heavy falls occurring in July and August. The mean minimum temperature of 10 to 15°C and the mean maximum annual temperature ranges from 15 to 25°C were recorded (NMA, 2011). The vegetation in the area is dominated by *Andropogon* grasses with variable proportions of *Trifolium* species.

Study animals and management

The study animals comprised indigenous Horro sheep kept on 9 small farms each with an average flock size of 12 animals and one large farm with a flock of about 100 animals all located in neighborhood which were owned by smallholder farmers. Altogether 208 animals were shepherded together for the most part and grazed on permanent communal pastures. The communal natural pasture lands were of an average size of 4 to 5 hectares and not divided into paddocks where hundreds of sheep were herded from day to day until after harvesting season. The animals also shared the same watering point during day time and housed in pens during night on their respective farms. The production system was based on traditional practices and no controlled mating (Edea et al., 2012), breeding occurring year round with two lambing cycles a year for many ewes.

Feed supplements were not known except crop residues which were available after harvesting season and a rare supply of common mineral salts (NaCl) for selected animals. The history of the farms indicated that all animals received regular treatments with anthelmintics twice a year at the beginning and end of the long rainy season in June and November, respectively. The program was operated in collaboration with Bako Agricultural Research Centre based on mutual agreements reached with farmers. Additionally, farmers also experienced to treat with anthelmintics based on individual animal exhibiting clinical parasitism. However, this treatment regimen could lack precision in determining the appropriate dosages. The records available indicated that the types and sources of anthelmintics used on the farms included mainly albendazole 300 mg for sheep and goats as well as tetraclozan 900 mg (tetramisole 450 mg and oxyclozanide 450 mg) for sheep and goats were all available on the local markets. No previous report was documented pertaining to anthelmintic resistance in sheep nematode from these farms or in the areas as a whole.

Study design and faecal nematode egg counts

In September, 2012 prior to conducting anthelmintic efficacy tests, 208 individual faecal samples were collected from the rectum of sheep kept on the target farms to determine egg per gram of faeces (EPG) using the modified McMaster method according to MAFF (1979). The purpose of the pre-treatment examination was to screen animals with high EPG for drug efficacy test according to Coles et al. (1992). Subsequently, 60 sheep which had EPG counts above 150 and did not receive anthelmintic treatments within the last 12 weeks were identified. They included 57 female and 3 male animals aged 6 to 18 months were used in this experiment. The animals already had ear tags with identification numbers which were used for record keeping in this study. They were distributed by

Table 1. Description of the anthelmintic drugs used in the FECRT for efficacy evaluation.

Trade name	Generic name/composition	Manufacturer	Dosage/kg BW	Route of administration	Batch/lot number	Manufacturing date	Expiry date
Ashialben 300 mg	Albendazole	Ashish Life Science Pvt. Ltd. India	7.5 mg	Oral	ALT-3548	Mar. 2012	Feb. 2016
Tetraclozan-QK sheep 900 mg	Tetramisole HCl + Oxyclozanide	Chengdu Qiankun Vet. Pharmaceuticals Co. Ltd. China	30 mg	Oral	20131	31/01/2012	30/01/2015
SG Ivermectin	Ivermectin (1%)	Shanghai Gongyi Vet. Medicine Plant. China	0.2 mg	SC injection	1206096-4	06/2012	06/2015

FECRT: faecal egg count reduction test, SC: subcutaneous, BW: Body weight.

faecal egg counts and blocked into four treatment groups of 15 animals each. Each group was then randomly assigned to four treatment groups of control (untreated), albendazole (BZ), tetraclozan (TC) and ivermectin (IV). Experimental animals were allowed to graze freely on permanent communal pasture under the same condition with other animals on the farms and were believed to harbour the same worm populations.

Each sheep was weighed with a scale and treatments were given based on registered label dose rate recommended by the manufacturers. Albendazole 300 mg was given at the rate of 7.5 mg/kg of body weight and tetraclozan 900 mg at 30.0 mg/kg body weight all being administered orally using a bolus applicator calibrated for this purpose. The ivermectin (1%) was administered based on 0.2 mg/kg (1.0 ml/50 kg) rate by subcutaneous route with hypodermic syringes and no treatment was administered to the control group in this round.

Individual animal faecal nematode egg counts and pooled faecal cultures for each treatment group were done based on 5 g of faeces collected from each animal in a group on day 0 (day of treatment) before treatment and again on day 12 to 14 after treatment. During the second visit to the farms, after completing sample collection, all animals in the control group were treated with ivermectin (1%) based on the recommended dose rate. The faecal egg counts were performed using the modified McMaster method as described by MAFF (1979) and Coles et al. (1992). Composite faecal materials were incubated at room temperature (approximately 20 to 25°C) for 14 to 20 days and then larvae were recovered by baermannization, quantified and identified as recommended by MAFF (1979) and van Wyk et al. (2004). When possible, 100 larvae were counted and identified per treatment group.

Anthelmintics

Majority of anthelmintic compounds widely available on the local markets were predominantly Chinese and Indian brands. They belong to three major classes namely the benzimidazole, imidazothiazole and the macrocyclic lactone groups. The anthelmintics used for these efficacy tests were imported and distributed by registered companies that are authorized to distribute except for tetraclozan which was not indicated in the packaging. All the drugs were used within their shelf life and stored as per the instruction of the manufacturers. The details of the drugs used in the tests are presented in Table 1.

Anthelmintic efficacy tests

The faecal egg count reduction tests (FECRT) were conducted in September, 2012. The efficacies of albendazole, tetraclozan (tetramisole HCl + oxyclozanide) and ivermectin were tested and interpreted according to the guideline provided by World Association for the Advancement of Veterinary Parasitology (WAAVP) recommendation (Coles et al., 1992). The faecal nematode egg count reduction percentage (FECR%) was determined by using a formula: $FECR\% = 100 \times (1 - M_t/M_c)$; Where M_t and M_c are the arithmetic mean EPG in the treated (t) and untreated control (c) groups at days 12 to 14 post treatment according to method described by Coles et al. (1992). The 95% confidence limits were calculated by using a software program RESO (Anonymous, 1990). Anthelmintic resistance was declared to exist when the FECR% was less than 95% and the lower 95% confidence limit for the reduction was less than 90%. If only one of the two criteria was met, resistance was suspected (Coles et al., 1992).

Questionnaire survey

A semi-structured questionnaire was prepared and administered to 150 sheep owners. The survey was conducted by way of personal interview of farmers in language they can communicate to complete the questionnaires (Toma et al., 1999). A second survey was also posed involving 45 farmers on selected farms willing to cooperate to run efficacy tests to examine the repeatability of responses obtained in the first survey. The questionnaire survey was used to collect information on parasite control practices, animal management and general demographic data (Bartley et al., 2003).

Statistical analysis

The efficacy of anthelmintics was evaluated based on the reduction in faecal nematode egg counts. Calculations of the arithmetic means, percentage of reduction between pre- and post-treatment faecal nematode egg outputs and 95% upper and lower confidence limits for the reduction were conducted according to the method described by Coles et al. (1992) and using a computer program, RESO (Anonymous, 1990). Descriptive statistics (percentages)

Table 2. Results of the questionnaire survey on anthelmintic utilization to control gastrointestinal nematodes in Horro sheep in the study area.

Description	No of respondents	Response rate (%)
Parasite control methods		
Anthelmintics	143	95.3
Traditional medicine	1	0.7
Both methods	3	2.0
None	3	2.0
Anthelmintic selection		
Color	38	25.3
Size	0	0.0
Familiarity	20	13.3
Prescription	32	21.3
Ease of administration	58	38.7
Low price	2	1.3
Dosage determination		
Weight of individual animal	0	0.0
Weight of heaviest animal in a group	0	0.0
Visual judgment	60	40.0
Prescription	90	60.0
Alternate use of anthelmintic classes		
Annual-based change	0	0.0
Change occasionally	70	46.7
No change	0	0.0
I do not know	80	53.3
Treatment frequency		
Single treatment a year	20	13.3
Twice per year	58	38.7
Three times per year	52	34.7
More than three treatments per year	17	11.3
None	3	2.0

were used to measure the responses of respondents from questionnaire survey using statistical package for social sciences (SPSS) Version 16.0 (2007).

RESULTS

Questionnaire survey

Information on education backgrounds showed that majority of the respondents (80.0%) were educated to the level of primary school and above (up to secondary schools) whereas fewer proportions (20.0%) were illiterate. The responses indicated that virtually on all farms anthelmintic treatments (95.3%) were the only method used to manage nematode infections in sheep. Frequency of treatments varied from nil to more than three treatments a year while the commonest treatment schedule was twice per year (38.7%) which was used relatively by more farmers (Table 2). According to respondents, selection of anthelmintics was largely based on ease of administration (oral formulations being more preferable), familiar color and prescription orders given by veterinarians or drug venders. Rotation of anthelmintic classes was not effected purposefully and rather it was done on random basis. Farmers showed a tendency to use the type of anthelmintics they are usually familiar

Table 3. Mean faecal egg counts and percentage reductions after treatment of sheep with different anthelmintics.

FECRT summary results	Treatment groups			
	Drench 1	Drench 2	Drench 3	Control
Number of animals (n)	15	15	15	15
Pre-treatment mean EPG	197	187	200	176
Post-treatment mean EPG	3	0	0	193
Reduction (%)	98	100	100	-
Upper 95% CI (%)	100	-	-	-
Lower 95% CI (%)	86	-	-	-
Interpretation	Suspected resistance	Susceptible	Susceptible	-

Drench 1 = Albendazole; Drench 2 = Tetraclozan (Tetramisole HCl + Oxyclozanide); Drench 3 = Ivermectin (1%); Mean EPG = arithmetic mean of faecal nematode egg counts; Control = Untreated group of animals

with. Moreover, they had no awareness of different classes of anthelmintics with different mode of actions in use.

Dosage determination was not precisely based on the body weight of individual animal. The responses indicated that 60.0% followed the prescription orders issued by veterinarians and 40.0% relied on visual appraisals. Scores of responses (49.3%) showed that treatment administrations were largely performed on the farms by the owners using oral formulations. Only 16.0% of the respondents indicated the involvement of veterinarians while 32.7% replied the operations were done by both veterinarians and farmers. However, very few farmers (2.0%) responded as non-users of anthelmintic compounds for nematode control.

Most of the responses (69.3%) showed that the outcomes of the treatments were good while fewer respondents (28.7%) indicated results were variable. Furthermore, majority of respondents (81.3%) replied the absence of treatment failures with anthelmintics whereas the minority (18.7%) complained the presence of failures. Replies obtained on the sources of the anthelmintics revealed that 54.0, 13.3 and 30.7% were supplied by public veterinary clinics, private pharmacies and both sources, respectively while the remaining 2.0% were non-users.

The repeatability of responses obtained in questionnaire survey was examined through a second questionnaire interview conducted involving 45 farmers on selected target farms. The replies obtained on grazing systems used were fairly repeatable being in the range of 57.8 to 61.3% in which open grazing method was mainly in practice. In the other option of alternate use of open versus tethered grazing, the reply was in the range of 33.3 to 40.0% which was nearly comparable. The responses recorded on the use of anthelmintics for the control of sheep nematode varied from 95.3 to 100.0% between the first and second rounds of interviews which had a fairly good repeatability. The replies to the absence of treatment failures with anthelmintics were recorded to be 81.3 and 75.6% in the first and second questionnaire survey, respectively. Similarly, the presence of anthelmintic failure to cure was responded to be 18.7% in the first interview and 24.4% of respondents complained the problem which did not show good repeatability. Obviously, the respondents participated in the second round interview were sheep owners presumed to use frequent deworming with anthelmintics on their farms to control endoparasites.

Anthelmintic efficacy

The results of faecal egg count reduction tests (FECRT) are shown in Table 3. The percentage reduction of faecal egg counts (FECR%) after treatment with albendazole was 98.0% while the lower confidence limit (CL) for the reduction was 86.0%. On the other hand, the percentage faecal egg count reductions for tetraclozan and ivermectin were 100.0%. In this study, a suspected resistance to albendazole was presumed present based on the lower 95% CL whereas no detectable level of anthelmintic resistance was recorded to tetraclozan and ivermectin. Treatments with tetraclozan and ivermectin were observed to be fully effective with 100.0% faecal nematode egg count reduction based on post-treatment faecal sample analysis.

Larval identification

Nematode infective larvae (L_3) recovered in pre- and

Table 4. Percentage larval composition (L_3) of faecal cultures from experimental animals before and after treatments with anthelmintics.

Nematode larval counts (%)	Treatment groups			
	Drench 1	**Drench 2**	**Drench 3**	**Control**
Pre-treatment coproculture				
Ostertagia/Teladorsagia spp	16	12	18	21
Nematodirus spp	22	28	20	26
Haemonchus contortus	23	21	14	19
Trichostrongylus spp	13	9	12	17
Oesophagostomum spp	11	5	17	7
Others	15	25	19	10
Post-treatment coproculture				
Ostertagia/Teladorsagia spp	0	0	0	15
Nematodirus spp	0	0	0	15
Haemonchus contortus	90.0	0	0	30
Trichostrongylus spp	10.0	0	0	11
Oesophagostomum spp	0	0	0	13
Others	0	0	0	16

Drench 1 = Albendazole; Drench 2 = Tetraclozan (Tetramisole HCL + Oxyclozanide); Drench 3 = Ivermectin. Values in pre-treatment and post-treatment percentage nematode larval composition are taken out of 100 larvae counts apart from few larvae counts observed in post-treatment coproculture from albendazole treated group.

post-treatment pooled faecal cultures of all treatment groups (during performing FECRT) are presented in Table 4. In pre-treatment coprocultures; *Nematodirus*, *Ostertagia/Teladorsagia*, *Haemonchus contortus and Trichostrongylus* were the dominant nematode genera isolated. Other genera including *Strongyloides*, *Bunostomum*, *Cooperia* and *Chabertia* occurred in low percentage. In post-treatment composite faecal cultures, similar genera occurred in untreated control group of sheep. From albendazole treated group a few nematode larvae (L_3) were isolated which comprised predominantly *H. contortus* (90.0%) and *Trichostrongylus* spp (10.0%).

DISCUSSION

In this study, the knowledge and perception of farming communities on the control of nematode parasites in grazing sheep were assessed. Control methods mainly relied upon the use of modern anthelmintic compounds as indicated by more than 95.3% of respondents. This appeared to be stimulated largely by the availability of the products on the local markets at immediate disposal to users. This result was in agreement with the observation reported by Kumsa et al. (2010) that due to the lack of other effective helminth control strategies for small ruminants in Ethiopia, anthelmintics are exclusively used for the management of adverse effects of nematodes in sheep. Frequency of treatments with anthelmintics varied. Most of the farmers treated their animals twice a year mainly at the beginning and end of the long rainy season which followed similar trend of treatment regimens reported from different regions of the country (Kumsa et al., 2010; Melaku et al., 2013). In majority of cases treatment frequencies were influenced by clinical conditions of animals. In most instances targeted selective treatments were directed to animals in poor conditions particularly emaciated, anaemic and diarrheic animals as well as those exhibiting loss of productions (only clinically suspicious animals) being the focus group. This was largely based on judgments of the farmers whether to seek treatments for their animals or not.

Even if the method was not employed in this study, given the widespread infections by *H. contortus* in sheep hosts and the tradition of selective treatment already practiced by farmers, perhaps the potential application of the FAMACHA© method may be useful to support selective treatment programs in Horro area. This program helps to make anthelmintic treatment decisions based on the color of a sheep's mucous membranes (an indicator of anemia induced by *Haemonchus*). The system is simple and low costing test that has been developed in South Africa for small resource-poor farmers (Malan et al., 2001; Van Wyk and Bath, 2002).

When needs aroused the routine treatment operations were largely performed by the farmers on their respective farms as indicated by greater preponderance of responses obtained in questionnaire-based survey. The underlying needs seemed to have greatly enforced sheep owners to select and buy anthelmintics formulated for oral route administration to easily manage the treatments on their farms. This practice could obviously introduce misuse of drugs which would possibly lead to treatment failures as a result of inappropriate dosing risk emanated from underestimation of the live weight. This is supported by a general observation that selection by treatment, not mutation, is the driving force in the establishment of anthelmintic resistance (Fleming et al., 2006).

As it can be judged from the findings of questionnaire survey, in the course of deworming process both opportunities and threats were parts and parcels of the control methods in practice. Firstly, the opportunities linked to the selective treatments experienced by farmers which were mainly directed to apparently parasitized animals to minimize treatment expenses. This procedure is often guided by farmer's indigenous knowledge based on the use of certain morbidity markers such as diarrhea, loss of condition and production to select suspicious animals for treatment. These practices may also simultaneously help to ensure the maintenance of adequate level of refugia and thus conserve susceptibility within parasite supra-populations (Abbott et al., 2004; Fleming et al., 2006; Pomroy, 2006; Jackson et al., 2009). Secondly, sharing of communal grazing pastures with many untreated flocks of sheep may open up the chance to dilute resistant strains through exploiting nematode subpopulations remained in refugia which would reduce or delay the selection pressure for resistance. This practice is also supported by research findings recorded (Sissay et al., 2006). Further evidences showed that targeted selective treatments based on parasitological and performance criteria, aiming to preserve worms in refugia and to administer anthelmintics solely to animals in need, were tested successfully in small ruminants (Gallidis et al., 2009).

On the other hand, continued threats existed to a judicious use of anthelmintic compounds due to problems of underdosing as well as failure to alternate different classes of anthelmintics on annual basis or to use drug combination (Jackson et al., 2009). Furthermore, sources of the drugs particularly in connection to local drug venders could not be truly dependable to get quality products. Similar findings were recorded in one way or another by other investigators from different parts of Ethiopia (Sheferaw and Asha, 2010; Melaku et al., 2013). Some of the drawbacks were reported to involve many forms of abuses. The efficacy of anthelmintic is affected by such factors as underdosage, exclusive use of drugs of the same mode of action, substandard quality drugs, and inappropriate use. Misuse and smuggling of anthelmintics in many forms, such as illegal sales on open markets and irrational administration is widespread (Kumsa et al., 2010).

The results obtained in the second questionnaire survey were fairly repeatable with regard to the use of anthelmintics for the control of sheep nematodes. In the second survey, the level of use of anthelmintics was raised to 100.0% because solely some selected farms supposed to use frequent deworming were involved. The presence of anthelmintic failure was complained by 18.7% of the respondents in the first interview compared to 24.4% recorded during the second survey which showed less repeatability. In the second interview, with the frequent use of anthelmintics, perhaps gastro-intestinal nematode population resistant to anthelmintics could be on the rise. This was also seen from results of efficacy tests conducted on the same farms in which suspected resistance was recorded on use of one anthelmintic brand, the albendazole, which was consistent with the result reported in southern Ethiopia (Kumsa and Girma, 2009).

Anthelmintic efficacy tests were conducted using 3 brands namely; albendazole, tetraclozan and ivermectin commonly available on the local markets. The tests were performed on animals coming from selected farms with a history of using anthelmintics indiscriminately, at least twice a year, according to predetermined deworming programs to control nematode infections in sheep. The results of the faecal egg count reduction tests (FECRT) showed the occurrence of a suspected resistance to treatments with albendazole based on the interpretation of the result according to guideline provide by World Association for the Advancement of Veterinary Parasitology (WAAVP). In contrast, treatments with tetraclozan and ivermectin revealed susceptibility with zero faecal nematode egg counts in the post-treatment faecal analysis. These results are fairly in agreement with the findings reported in anthelmintic efficacy tests of similar brands in sheep flocks from Eastern Ethiopia (Sissay et al., 2006). However, the results recorded in the present study were inconsistent with the findings reported in North Gondar (Melaku et al., 2013) in which susceptibility to albendazole and resistance against tetramisole were recorded. Yet, results are in concord with respect to treatment with ivermectin in which high efficacy was recorded. In other similar studies, low efficacy status to some brands of albendazole (Kumsa et al., 2010) and high efficacy in all tested brands of albendazole, tetramisole and ivermectin (Sheferaw and Asha, 2010) were reported against sheep nematodes at different localities in southern Ethiopia.

In general, it can be noted that similar brands of anthelmintics exhibiting quite divergent efficacy status at different localities which could be outcomes of various attributes. Occurrence of resistant nematode strains, dosing errors and perhaps low quality products may be some of the elements which could be blamed (Chartier et al., 2001; Kumsa et al., 2010).

Diversified nematode genera (L_3) were isolated in the pre-treatment composite faecal cultures performed for different treatment groups of sheep. Among others, the most prevalent genera isolated included *Nematodirus*, *H. contortus*, *Ostertagia/Teladorsagia*, *Trichostrongylus* and *Oesophagostomum*. In the post-treatment faecal cultures the same worm genera were identified from untreated control group of animals whereas *H. contortus* and *Trichostrongylus* were the only nematode parasites which survived albendazole treatments. In this study, the nematode genera detected in pooled faecal cultures were similarly reported from different sheep breeds in different parts of the country (Amenu, 2005; Sissay et al., 2007; Dereje, 2008). In the post-treatment coproculture larvae recovered (L_3), *H. contortus* was the most dominant parasite with very low proportion of *Trichostrongylus* survived treatments with albendazole which was consistent with findings reported from different regions of Ethiopia (Desalegn, 2009; Kumsa et al., 2010).

Conclusion

In this study, a suspected resistance against albendazole was observed in sheep nematodes, particularly *H. contortus* on farms where drugs were indiscriminately used for worm management. Some worm control practices which are thought to enhance the selection of nematodes resistant to anthelmintics have been evident. Among the major drawbacks, risks of underdosing and continued use of one class of anthelmintics, irrespective of its efficacy status, were widely practiced which may accelerate selection dynamics. To preserve the efficacy of anthelmintics, a targeted selective treatment traditionally practiced by farmers should be promoted and supported by coprological examination to identify animals in need of treatments. Anthelmintic efficacy tests should also be part of the worm management programs to monitor treatment failures on sheep farms in the study areas.

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