Survey of gastrointestinal nematodes and anthelmintic resistance in sheep and goats in communal grazing pastoral area, Yabello District, southern Ethiopia

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Abstract

A cross-sectional study was carried out from November 2013 to April 2014 in pastoral area, Yabello districts, to estimate the prevalence and to identify risk factors associated with gastrointestinal strongyle infection in sheep and goats. Moreover, to assess the anthelmintic resistance in goats gastrointestinal nematodes a total of 1040 faecal samples were collected (sheep, n=; 400 goats, n=640) of which 656 animals (63.1%) were positive for strongyle eggs. Three-hundred three (75.8%) of sheep and 353 (55.2%) goats were positive for strongyle eggs.. Animal species and body condition influenced the prevalence of gastrointestinal parasite in sheep and goats in the study area. The mean EPG was significantly higher in female animals (χ^2 =4.02, P < 0.05) and in local breed (χ^2 =3.89, P < 0.05). The proportion of light level infection was higher followed by medium and heavy level of infection for species, sex, age, body condition and breeds of the study animals. The FEC reduction percentage for Ivermectin, Albendazole and Tetramisole were 91.8%, 95.9% and 96.8%, respectively. Since the 95% confidence level lower limit for Albendazole and Ivermectin were less than 90%, the gastrointestinal nematodes circulating in the area could be suspected to develop resistance for Albendazole and Ivermectin. Hence, after further epidemiological study, strategic deworming and also animal health extension to create awareness of the sheep and goats owners regarding the impact of gastrointestinal parasites will play key role to reduce the higher prevalence of gastrointestinal parasites of sheep and goats in the study area.

Keywords: EPG, Gastrointestinal, Sheep, Goat, Yabello, Ethiopia

http://dx.doi.org/10.4314/evj.v19i1.5

Introduction

Sheep and goats are among the major economically important livestock in Ethiopia. There are about 24.2 million sheep and 22.6 million goats (CSA, 2012) that are playing an important role in the livelihood of resource poor farmers, representing an important component of the farming system. They require

smaller investment; have shorter generation cycle and high reproductive rate, faster growth rate and greater environmental adaptability than cattle (Adane Hirpa and Girma Abebe, 2008; Lebbie, 2004). Sheep and goat have ability to utilize wide variety of plant species. Hence, they form an important economic and ecological niche in all agricultural systems throughout the country (Adane Hirpa and Girma Abebe, 2008; Lebbie, 2004).

Sheep and goat are a major source of income, cash, and food protein for rural farmers in most part of tropics including Ethiopia (Ibrahim, 1998), and skin, fiber, manure and as an investment (Rege, 1994). However, the full exploitation of these resources is hindered in the tropical environment, and particularly in Africa due to a combination of factors such as drought, poor genetic potential of the animals, traditional system of husbandry and the presence of numerous prevalent diseases (Rege, 1994; Ibrahim, 1998). Parasitic infections pose a serious health threat and limit productivity of sheep and goat due to the associated morbidity and mortality (Markos Tibbo *et al*., 2008; Nwosu *et al*., 2007). It can affect feed ingestion and digestion, reduced live-weight gain, reduced yield and altered feed conversion efficiency. These in turn can have effects on animal productivity and on community development (Perry and Randolph, 1999).

The control of parasitic helminths in domestic animals relies largely on the use of anthelmintic drugs (Taylor *et al*., 2002). But the parasitic populations that developed anthelmintic resistance severely threaten the exploitation of this control strategy (Waller, 2006). Parasitic resistance of anthelmintic drugs is a seriously increasing problem in various parts of the world (Wolstenholme *et al*., 2004). In Ethiopia, there are some reports indicating the development of anthelmintic drugs resistance in sheep and goats gastrointestinal nematodes (Bersissa Kumsa and Girma Abebe, 2009; Abebayehu Tadesse *et al*., 2009; Bersissa Kumssa and Ajebu Nurfeta, 2008), and some suspection for resistance development against albendazole (Desie Sheferaw *et al*., 2013). There is no information on the prevalence of sheep and goat gastrointestinal nematodes and status of anthelmintic drugs resistance of sheep and goats nematodes so far in extended grazing system particularly in pastoral areas. Therefore, the objective of this study was to estimate the coproscopic prevalence of sheep and goats gastrointestinal strongyle, and to identify the associated risk factors that influence the occurrence of gastrointestinal strongyle infection and to investigate the existence of gastrointestinal nematodes resistance for the commonly used anthelmintic drugs in Yabello district, Borana.

Material and methods

Study area and animals

The study was conducted from November 2013 to April 2014 in Yabello districts, Borana, Southern Oromia Region. It is a pastoral area, where the society rear and derive most of their income from livestock. The area is characterized by semi-arid climatic condition, and mean annual rain fall ranging from 300 mm to 700 mm. There is a bimodal pattern of rain fall: main rainy season locally known as "Ganna" that extends from March to May and short rainy season "Haggaya" that extends from mid-September to mid-November (Coppock, 1994).

According to previous report (CSA, 2012), there are 365,520 sheep and 849,261 goats in Borana region that are managed under traditional (smallholders) and semi-intensive (Yabello Pastoral and Dry Land Agricultural Research Center) management systems. The study animals were selected by systematic random sampling technique during which those that had not been treated with anthelmintics within 6 months were considered. Age of sheep and goats were determined based on dental eruption as described by Gatenby (2002), Steele (1996), respectively. Body condition of the study animals was recorded as poor, medium and good based on the appearance of the animal and manual palpation of the spinus and transverse processes of the lumbar vertebrae. Local breeds of sheep and goats as well as crosses between local and Droper and Boer were included in the study.

Study design and methodology

Coproscopic examination

A cross sectional study design was employed to estimate the prevalence and to identify the risk factor associated with the occurrence of gastrointestinal nematodes in sheep and goats managed under pastoral management system in Yabello district of Borana zone. Faecal samples were collected directly from the rectum of each animal and placed in a screw capped bottle and transported to Yabello Regional Veterinary Laboratory. The faecal samples were subjected to qualitative and quantitative techniques. The quantitative examination was done using a McMaster technique as described by Hansen and Perry (1994) and Coles *et al.* (1992). Based on the egg count per gram of

faeces, the level of infection both in sheep and goats was classified according to Soulsby (1982).

Anthelmintic resistance test

Goats (n=80) aged from 6 to 18 months were selected for the investigation of resistance of gastrointestinal nematodes against the commonly used anthelmintic drugs. All selected goats were with more than 150 eggs per gram of faeces, and kept in traditional pastoral management system. The goats were classified into four treatment groups: Albendazole, Tetramisole, Ivermectin and control groups, each containing 20 goats. On day 0, faecal samples were collected from each animal enrolled in the study, and then the animals were either treated with an anthelmintic or left untreated. The dosage and route of application is based on manufacturers' recommendation as described in Table 1. Faecal samples were collected again 10 to 14 days post-treatment from all animals included in the study.

Table 1: Animals and treatment group

Group	Treatment	Manufacturer	Dose and route
G-I	Albendazole	Ashish Life Science PVT. Ltd, India	7.5mg/Kg (Oral)
G-II	Tetramisole	Ashish Life Science PVT. Ltd, India	15mg/Kg (Oral)
G-III	Ivermectin 1%	Laboratorios Microsules Uruguay, SA	300µg/Kg (Oral)
G-IV	Control	-	-

Data analysis

Data was analyzed using STATA software, version 11.0 (STATA corp., College Station, TX). Descriptive statistics were used to calculate the prevalence and proportions. Chi-square test and logistic regression analysis were used to assess the association between the prevalence of gastrointestinal helminthes and the considered risk factors. The count of strongyle eggs per gram of faeces was transformed in to logarithmic form [Log10(X+1)] in order to have normal distribution. Then ANOVA was used to compare the mean EPG within each risk factors group.

The effectiveness of different anthelmintic drugs 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 con-

fidence limits; and the findings were interpreted as described by Coles *et al.* (1992).

Results

Coproscopic examination

From a total of 1040 animals (400 sheep and 640 goats) examined, 656 (63.1%), 15 (1.4%) and 1 (0.1%) were positive for Strongyles, Strongyloides and Trichuris, respectively. The result of coprological prevalence of strongyle for the considered risk factors is shown in Table 2.

Table 2: Prevalence of small ruminant gastrointestinal strongyles vs. risk factors

Risk factor	No examined	No positive (%)	χ^2	P-value
Species				
Sheep	400	303 (75.8%)		
Goat	640	353 (55.2%)	44.82	0.000
Age				
≤ 1yr	312	202 (64.7%)		
>1yr	728	454 (62.4%)	0.53	0.466
Sex				
Male	402	244 (60.7%)	1.59	0.207
Female	638	412 (64,6%)		
Body score				
Good	269	148 (55.0%)*	12.00	0.002
Medium	493	316 (64.1%)		
Poor	278	192 (69.1%)*		
Breed				
Local	876	563 (64.3%)		
Cross	164	93 (56.7%)	3.39	0.066

Sheep in Yabello district are 2.5 times more likely to get infected by gastrointestinal Strongyles than goats ($\chi^2 = 46.21$, $p < 0.05$). Sheep and goats with poor body conditions are 1.5 and 1.8 times more likely to be positive to gastrointestinal Strongyles than those with medium and good body conditions ($\chi^2 = 11.93$,

p <0.05), respectively. The result for mean eggs count and the considered risk factors shown in Table 3.

Table 3: Mean EPG for sheep and goats infected by gastrointestinal strongyles vs. considered risk factors.

Risk factor	No Positive	Mean EPG ± SE	t or F	P-value
Species				
Sheep	303	702.3 ± 40.3	0.54	0.587
Goat	353	758.8 ± 42.2		
Age				
≤ 1yr	202	809.4 ± 54.9		
>1yr	454	698.7 ± 34.6	1.07	0.285
Sex				
Male	244	651.0 ± 28.5	4.02	0.0001
Female	412	870.9 ± 61.7		
Body condition				
Good	148	725.7 ± 37.3		
Medium	316	767.4 ± 51.8		
Poor	192	681.3 ± 44.5	1.06	0.346
Breed				
Local	563	769.6 ± 33.5		
Cross	93	509.7 ± 32.6	3.89	0.0001

NB. Log10(X+1) transformed eggs count data used to compute t, F and P values.

The mean eggs count is computed only for positive animals. The proportion of infection levels (light, medium and heavy) indicated in table 4.

Table 4: Proportion of the level of infection by gastrointestinal strongyles in the various considered risk factors

Risk factor	Level	Level of infection (% ± SE)		
		Light	Medium	Heavy
Species	Sheep	62.4 ± 0.03	29.4 ± 0 .03	8.3 ± 0.02
	Goat	63.7 ± 0.03	24.1 ± 0.02	12.2 ± 0.02
Age	≤ 1yr	56.4± 0.03	28.7± 0.03	14.9 ± 0.02
	>1yr	66.1 ± 0.02	25.6± 0.02	8.4 ± 0.01
Sex	Male	56.6 ± 0.03	28.7 ± 0.03	14.8 ± 0.02
	Female	67.0 ± 0.02	25.2 ± 0.02	7.8 ± 0.01
BCS	Good	54.1 ± 0.04	35.1 ± 0.04	10.8 ± 0.03
	Medium	64.6 ± 0.03	25.9 ± 0.02	9.5 ± 0.02
	Poor	67.7 ± 0.03	20.8 ± 0.03	11.5 ± 0.02
Breed	Local	60.6 ± 0.02	27.7 ± 0.02	11.7 ± 0.01
	Cross	78.5 ± 0.04	19.4 ± 0.04	2.1 ± 0.02

Field anthelmintic resistance test

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 5. The percentage reduction of faecal egg count for Ivermectin, Albendazole and Tetramisole were 91.8%, 95.9% and 96.8%, respectively. Tetramisole and Albendazole had faecal egg count reduction percentage above 95%. Only for Tetramisole, the faecal egg count reduction percentage and the lower limit of 95% confidence level were greater than 95% and 90%, respectively. Hence, result indicated that Albendazole and Ivermectin are suspected for development of resistance against gastro-intestinal nematodes, while Tetramisole was found to be effective.

Table 5. Pre-treatment and post-treatment faecal egg count and reduction percentage in goats at Yabello district

Treatment Group	EPG		Reduction %	95% CL (LCL – UCL)
	Pre-treatment	Post-treatment		
Albendazole	785 ± 163.9	75 ± 21.1	95.9%	89.3 – 98.4
Tetramisole	600 ± 115.8	10 ± 7.2	96.8%	90.7 – 98.9
Ivermectin	775 ± 154.4	225 ± 25.0	91.8%	83.3 – 96.0
Control	655 ± 137.7	1095 ± 237.5	-	-

Discussion

The coprological examination showed an overall 63.1% of studied animals (75.8% in sheep and 55.2% in goats) were found infected with gastrointestinal strongyles in Yabello district, Borana. This finding is comparable with some reports from Ethiopia (Bersissa Kumsa *et al.*, 2011; Tesfaheywet Zeryehun, 2012; Getachew Terefe *et al.*, 2013). Significantly higher ($\chi^2 = 44.82$, $P < 0.05$) prevalence was recorded in sheep compared to goats. This finding is in agreement with the reports from Ethiopia (Teklye Bekele, 1991; Rahmeto Abebe *et al.*, 2010; Welemehret Negasi *et al.*, 2012) and other areas (Waruiru *et al.*, 2005). This is due to the grazing and browsing habit of sheep and goats, respectively. Goats prefer browsing when plant leaves are available; and Yabello area has sufficient browsing plants. Thus, comparatively goats are less challenged by the infective stage larvae than that of sheep. The prevalence of gastrointestinal strongyles was significantly ($\chi^2 = 12.00$, $P < 0.05$) higher in small ruminants with poor body condition than in good and medium animals. This result is in a general agreement with the report on small ruminants (Rahmeto Abebe *et al.*, 2010; Welemehret Negasi *et al.*. 2012; Gonfa Shankute *et al.*, 2013) and also report on sheep (Diriba Lemma and Berhanu Abera, 2013; Takele Sori *et al.*, 2013).

Female animals ($\chi^2 = 4.02$, $P < 0.05$) and local breeds ($\chi^2 = 3.89$, $P < 0.05$) showed higher mean EPG count in the current study. Previous authors also reported higher mean EPG in female animals (Abebe Wossene and Esayas Gelaye, 2001; Takele Sori *et al.* 2013) and local breed animals (Assefa Deressa and Sissay Lemma, 1998; Biu *et al.*, 2009). The higher EPG in female animals could be associated with physiological factors like pregnancy, parturition and lactation, and/or their overall health (Soulsby, 1982). The higher mean EPG in

local breeds might be due to absence of any supplementary feed in this group compared to the local breeds in the study area. The proportion for the level of infection was dominated by light infection, and followed by medium and then heavy level of infection in all considered risk factors: species, sex, age, body condition and breeds of study animals. This finding is in support of the earlier report (Amenu Asha and Abebe Wossene, 2007). Light infection is a common report from various parts of the Ethiopia (Regassa *et al.*, 2006; Asha and Wossene, 2007; Takele Sori *et al.*, 2013) and other areas (Maichomo *et al.*, 2004; Almalaik *et al.*, 2008). In fact, it is documented that the level of infection (or EPG) epidemiologically affected by season of the year (Etana Debela, 2002; Kumba *et al.*, 2003; Sissay Menkir *et al.*, 2007; Almalaik *et al.*, 2008). The major determinants for this variation are temperature and moisture (Radostits *et al.*, 2007).

The field experimental anthelmintic resistance test result for goat gastrointestinal nematodes is interpreted as described by Coles et al. (1992). The FEC reduction percentage for Ivermectin, Albendazole and Tetramisole were 91.8%, 95.9% and 96.8%, respectively. The lower limit of the 95% confidence level for Albendazole and Ivermectin were less than 90%. Hence, it is suspected that the gastrointestinal nematodes circulating in the areas have develop resistance to Albendazole and Ivermectin. This finding is in a general agreement with the report on sheep and goats in Dale district, Southern Region (Desie Sheferaw *et al.*, 2013). Albendazole and Ivermectin are the most commonly available and widely used in Yabello (Borana Zone Department of Agriculture and Rural Development, 2014, Personal communication), and hence, there is high risk for the development of resistance.

Conclusion

It can be concluded that the prevalence of sheep and goats gastrointestinal strongyles was very high in Yabello area. Host species and body condition are the prominent risk factors influencing the prevalence of gastrointestinal strongyles in the area. Light infection was the dominant type of infection. There was no development of anthelmintic resistance, but there was suspection for the development of resistance against Albendazole. Based on this finding to slow resistance development for these drugs avoidance of frequent dosing and under dosing, and also alternating with other anthelmintic drugs could be helpful. The higher prevalence of sheep and goats gastrointestinal strongyles can be controlled by means of strategic deworming. Moreover, animal health

extension work to create awareness of the owners about the impact of gastrointestinal parasites, and how to control them also play key role to reduce the prevalence and distribution. Further study through coproculture and/or post mortem to identify the parasitic fauna should be done.

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