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Abomasal nematodes of sheep and goats slaughtered in Awassa (Ethiopia): species composition, prevalence and vulvar morphology

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Summary

A study was carried out to determine the prevalence of abomasal nematodes of sheep and goats slaughtered in Awassa town from January 2006 through June 2006 with special emphasis given to *Haemonchus* spp. and to characterize vulvar morphs of female *Haemonchus* worms. During the study period 180 abomasa of sheep and 132 abomasa of goats were examined. Three genera of nematodes were identified in both sheep and goats abomasa with overall prevalence of 91.1 % and 87.1 % respectively. The specific prevalence rates observed were 81.1 % for *Haemonchus* spp., 47.2 % for *Trichostrongylus axei,* and 19.4 % for *Teladorsagia* spp. in sheep and 76.5 % for *Haemonchus* spp., 39.4 % for *T. axei* and 20.5 % for *Teladorsagia* spp. in goats. Out of 653 female *Haemonchus* recovered from sheep, 37.8 % had a linguiform vulvar flap, 30 % knobbed and 35.4 % smooth vulvar morphs. Out of 448 female *Haemonchus* recovered from goats, 43.8 % had linguiform vulvar flaps, 27.2 % knobbed and 29 % smooth morph type. A total of 239 linguiform female *Haemonchus* from sheep were further classified in to 15.1 % linguiform A (LA), 17.5 % linguiform B (LB), 39.7 % linguiform C (LC) and 27.6 % linguiform I (LI) and similarly from goats 196 linguiform female *Haemonchus* were further classified into 11.2 % LA, 12.2 % LB, 44.9 % LC and 31.6 % LI. Similar findings were observed in both host species regarding the worm burden, prevalence of infection and morphological pattern of *Haemonchus* species. Generally a high infection rate with abomasal nematodes was observed in both sheep and goats of the study area.

Key words: abomasal nematodes; Awassa; *Haemonchus*; *Teladorsagia*; *Trichostrongylus axei*; prevalence; vulvar flap

Introduction

Ethiopia, with its great variation in climate and topography, possesses one of the largest small ruminant populations in Africa. The latest estimate of small ruminant population gives 23.6 million sheep and 23.3 million goats (CSA, 2004). Small ruminants play a significant role in maintaining household stability by providing meat, milk, skin and wool, generate cash income and play traditional social and religious roles (Devendera & Mclery, 1982; El-Azazy, 1995). Studies have revealed that ruminants contribute 80 % of the total food production from livestock in tropical Africa, of which small ruminants account for about 22 %.

However, in spite of the presence of huge numbers of small ruminant populations, Ethiopia fails optimally to exploit these resources. This is due to a multitude of constraining factors like ill health (Bekele *et al.*, 1982; Teklye *et al.*, 1987). Health disorders in all classes of small ruminants represent the major problems and greatly affect the economics of sheep and goat production. Gastrointestinal helminthosis is among the main constraints to small ruminant productions in Ethiopia. These parasites pose subtle economic losses and are the major factors responsible for lowered levels of production in many parts of the country. Abomasal nematodes and liver flukes are believed to be the most prevalent and widely distributed helminths (Barger, 1982).

Even though the losses incurred by these parasites are believed to be significant, accurate and up-to-date estimates of the economic impacts are lacking in Ethiopia. Available information revealed that infection due to abomasal nematodes especially *H. contortus* is responsible for important morbidities and mortalities in sheep and goats in different parts of the country (Bekele *et al.*, 1982; Teklye *et al.*, 1987). Mulugeta *et al.* (1989) reported yearly losses amounting to USD 82 million due to endoparasites in Ethiopia. Krecek and Waller (2006) reported that *H. contortus* alone is responsible for annual loss ranging from

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USD 26 million to 45 million in Kenya and South Africa. Studies conducted on gastrointestinal helminthosis of small ruminants (Abebe & Esayas, 2001; Bekele *et al.*, 1982; Donald, 1999) indicated the importance of nematodes as a cause of impaired productivity. However, nationwide studies have never been carried out to determine the distribution of abomasal nematodes. Most previous studies in Ethiopia were based on coprological examinations, which are less sensitive in identifying the nematode species. We conducted this study to identify the species and determine the prevalence of abomasal nematodes of sheep and goats in and around Awassa town.

Materials and Methods

Study area

The study was conducted in Awassa town, the capital of Sidama zone, which is located in the northern part of Southern Nations, Nationalities and People's Region (SNN PR) 275 km south of Addis Ababa, capital of Ethiopia. Geographically the area lies between 4° 27' and 80° 30' N latitude and 34° 21' and 39° 11' E longitude (Fig. 1). During the study period, Awassa received an annual average rainfall ranging from 801 to 1000 mm and with a mean temperature of the area of 20.1 – 25°C with an average altitude of 1790 m above sea level. The area is mainly covered by dry savanna and bush types of vegetation.

Study animals and design

The study was conducted on sheep and goats slaughtered in different restaurants in Awassa town. Most of the study animals were originated from Awassa and different areas of Sidama zone. As most of these animals were obtained from different markets it is difficult to trace the exact locality of their origin. Regular visits to restaurants in Awassa town allowed collections of abomasa of sheep and goats for the study. As soon as possible, after removal of the alimentary tract from the body cavity, the abomasa ligated at both ends were cut and transported to the parasitology laboratory of Animal Science Department of Awassa College of Agriculture for microscopic examination.

Worm recovery, identification and count

Worm recovery, species identification and determination of worm burden were carried out according to standard procedures described by Hansen and Perry (1994) and MAFF (1977). The abomasa were ligated at both ends and removed from omasum and duodenum. Then they were opened along the greater curvature and their contents were thoroughly washed in to a graduated bucket under a slow jet of water (the approximate volume of the abomasal content was 0.75 l). The mucus membrane was carefully rubbed with fingers to remove any worms adhering to it. The contents and washings were made to a total volume of two liters. Then it was vigorously stirred until all the abomasal contents, mucous and water were thoroughly mixed. A total of 200 ml of the contents was then transferred to measuring cylinder in five steps of 40 ml per step while stirring the mixture. A sub-sample of 20 ml was transferred to a small graduated beaker to which 2 – 3 ml iodine was added to stain the worm and 2 – 3 ml sodium thiosulfate solution was also added to decolorize debris. Finally about 3 – 4 ml of the sample was placed in a Petri dish having parallel lines marked at 5 mm apart, diluted with water and examined under a stereomicroscope. Samples were examined for the presence of nematodes, which were identified and counted as male or female. The total number of worms counted in the 20 ml sub-sample was then multiplied by 100 to get the total number of worms present in the abomasum.

Vulvar morphology of Haemonchus species

A representative number of female worms collected from each host species were classified according to their vulvar morphology under a stereomicroscope as follows: Linguiform females (with a supra vulvar flap), knobbed females (with knob like vulvar process) and smooth females (with out any vulval process). Identification was performed according to the criteria set by Rose (1966) and Jacquiest *et al.* (1995).

Each linguiform female *Haemonchus* worms were further classified in to sub linguiform types (A, B, C & I) as has been described by Le Jamber and WhitLock (1968). Linguiform A has one cuticular inflation, Linguiform B has no cuticular inflations, Linguiform C has two cuticular inflations while in Linguiform I, the cuticular inflation arises from the linguiform process.

Statistical analysis

Descriptive statistics were used to summarize the data. In addition, Microsoft Excel software was used to store the

* – study area

Fig. 1. Map of Ethiopia showing the location of the study area

data of abomasal nematodes. The software program, Stata, (intercooled Stata 7.5) and SPSS 11.5 were employed for data analysis.

Results

Prevalence and worm burden of abomasal nematodes

Examination of 180 abomasa of sheep revealed the presence of three different genera of nematodes with overall prevalence rates of 91.1 % (n = 164). The different genera identified were: *Haemonchus* 81.1 %, *T. axei* 47.2 % and *Teladorsagia* 19.4 % (Table 1). Likewise, of the total 132 abomasa of goats examined three genera of nematodes with overall prevalence rate of 87.1 % (n = 115) were recorded. The three genera of nematodes identified were: *Haemonchus* 76.5 %, *T. axei* 39.4 % and *Teladorsagia* 20.5 % (Table 2).

The overall monthly average worm burden ranged from 1690.1 in January to 2344.3 in March for sheep whereas it varied from 1601.1 in May to 2165.2 in January for goats. In sheep the highest *Haemonchus* count was recoded in April (726.9) and the lowest in February (578.3) and falls between these values for other months as shown in Table 1. The highest *T. axei* burden was recorded in March (942.1) and the lowest in January (500), while for *Teladorsagia* the highest worm burden was found in March (742.8) while the lowest was observed in February (400). In goats the average worm count for *Haemonchus* spp. was highest in January (670) and lowest in April (514.3), for *T. axei* the highest count was recorded in January (920) and lowest in May (453.3), where as the highest count for *Teladorsagia* was observed in January (575.2) and the lowest in June (500) as shown in Table 2. Generally sheep with 1903.1 overall mean worm count were found to be more heavily infested than goats with 1832.5 overall mean worm count during the study period. However, there was no statistically significant (P > 0.05) difference between months and host species in prevalence and worm burden of abomasal nematodes.

Vulvar morphology of Haemonchus species

Out of the total 653 female *Haemonchus* worms from sheep abomasa subjected to the vulvar morphology study, 37.8 % linguiform, 35.4 % smooth and 30 % knobbed vulval morphs were identified (Table 4). Similarly from the abomasa of goats, 448 female *Haemonchus* were categoryzed into 43.8 % linguiform, 29 % smooth and 27.2 % knobbed vulvar morphs. There was no significant (P > 0.05) difference in the proportion of the different vulvar morphs between sheep and goats. In both sheep and goat hosts, the linguiform type was encountered as the most predominant type of vulvar morphology. The study also showed that there was insignificant (P > 0.05) variation in the proportion of the major vulvar morph types in different months in both sheep and goats.

A total of 239 linguiform female *Haemonchus* worms from

Table 1. Monthly prevalence and mean count of abomasal nematodes in sheep

Month	No. examined	*Haemonchus* spp. (%)	*T. axei* *(%)*	*Teladorsagia* spp. (%)	Total
January	20	85 (623.5)	55 (500)	15 (566.6)	1690.1
February	30	76.6 (578.3)	46.6 (792.8)	16.6 (400)	1771.1
March	40	77.5 (659.4)	47.5 (942.1)	17.5 (742.8)	2344.3
April	32	81.3 (726.9)	34.4 (818.1)	12.5 (625)	2170
May	30	83.3 (632)	46.6 (733.3)	26.6 (587.5)	1952.8
June	28	85.5 (617.4)	53.5 (820)	28.5 (562.5)	1999.9
Total	180	81.1 (639.6)	47.2 (767.8)	19.4 (495.7)	1903.1

P > 0.05 for monthly prevalence and total worm burden; Values in bracket are the mean worm burden

Table 2. Monthly prevalence and mean count of abomasal nematodes in goats

Month	No. examined	*Haemonchus* spp. (%)	*T. axei* (%)	*Teladorsagia* spp. (%)	Total
January	14	71.4 (670)	42.9 (920)	23.7 (510.5)	2165.2
February	38	76.3 (640)	44.7 (706.)	16.6 (400)	1846.7
March	ND	ND	ND	ND	ND
April	20	70 (514.3)	40 (612.5)	20 (575)	1701.8
May	40	77.5 (580.6)	32.5 (453.8)	15 (566.7)	1601.1
June	20	85 (658.8)	45 (688.8)	20 (500)	1847.6
Total	132	76.5 (612.7)	39.4 (673.3)	20.5 (543.5)	1832.5

P > 0.05 for monthly prevalence and total worm burden; Values in bracket are mean worm burden; ND – Not Done

Table 3. Monthly percentage of vulvar morph types of *Haemonchus* spp. in sheep and goats.

Host spp and worm no	Vulvar morphology	Jan.	Feb.	Mar.	Apr.	May	June	Average
Sheep	Linguiform (%)	38.3	24.2	41.2	40.1	35.9	41.3	37.8
(N = 653)	Knobbed (%)	26	40.6	18.1	25.9	42.7	27.9	30
	Smooth (%)	35.6	34.9	35.5	33.8	21.4	28.2	35.4
Goats	Linguiform (%)	44.2	44.3	ND	44.6	42.6	43.56	43.8
(n = 448)	Knobbed (%)	23.3	29.1	ND	29.8	26.2	25.1	27.2
	Smooth (%)	32.5	26.5	ND	25.5	31.1	25.6	29

ND – Not Done

Table 4. Monthly percentage of the different linguiform morphotypes of *Haemonchus* spp. in sheep and goats

Month	Sheep (n = 239)				Goat (n = 196)			
	LA (%)	LB (%)	LC (%)	LI (%)	LA (%)	LB (%)	LC (%)	LI (%)
Jan.	14.3	21.4	35.7	28.6	10.5	10.5	47.4	31.6
Feb	7.1	15.4	46.2	30.8	8.6	14.3	42.9	34.3
Mar.	11.1	14.8	44.4	29.6	ND	ND	ND	ND
Apr.	15.2	13.7	43.1	27.4	9.5	19.1	47.6	23.8
May	23.8	21.4	30.9	23.8	11.5	7.6	46.2	34.6
June	15.8	21.1	36.8	26.3	17.6	11.8	44.1	26.5
Average	15.1	17.5	39.7	27.6	11.2	12.2	44.9	31.6

ND – Not Done

sheep were further categorized into 15.1 % (n = 36) type A, 17.5 % (n = 42) type B, 39.7 % (n = 95) type C and 27.6 % (n = 66) type I. Likewise from goats, a total of 196 linguiform morphotypes were further classified as: 11.2 % (n = 22) type A, 12.2 % (n = 24) type B, 44.9 % (n = 88) type C, and 31.6 % (n = 62) type I as shown in table 5. In both host species, the C type linguiform vulvar flap appeared as the most common subgroup.

Discussion

Prevalence and worm burden of abomasal nematodes

The high overall prevalence and worm load of abomasal nematodes encountered in the current study is in agreement with the results of previous studies. For example, the report of Gebrekiros (1990) supports the results of the current study and further confirms the rampant nature of abomasal nematodes. Donald (1999), Abebe and Esayas (2001), and Bersissa (2004) reported more than 90 % prevalence of abomasal nematodes from the eastern part of the country. Other studies carried out on gastrointestinal nematodes of small ruminants revealed prevalence rates of 52.2 % in Bale (Tesfalem, 1989), 90.2 % in Illubabor (Bayou, 1992), 91 % in Wollayita Sodo (Dereje, 1992), 91.4 % in Kombolcha (Genene, 1994) for these nematodes. However, our result is not in agreement with that of El-Azazy (1995) and Wang *et al.* (2006). El-Azazy (1995) carried out his study in Saudi Arabia, which is a desert where hot dry climatic conditions prevail, whereas the present study was conducted in relatively wet and humid climate with variable amount of rain occurring during all months of the study period in Awassa and its surrounding in southern Ethiopia. The results of worm counts presented herein showed slightly different patterns in sheep and goats. In sheep both the overall worm count and the specific counts for the three genera of nematodes showed similar trends. Even though the variation was insignificant, higher worm loads were recorded during March and April than January and February months of the study period. These higher worm counts during March and April coincide with the short rainy season in March to May in the area. This suggests that humidity and temperature during wet months favourably supports larval development and survival of nematodes in the pasture of the study area. This finding is in line the work of Amenu (2005), El-Azazy (1995) and Fritsche *et al.* (1993) all of which indicated high prevalence and worm burden during months of rainy seasons. In goats, the burden decreased from January onwards and then gradually started to rise in June. This difference between sheep and goats is most probably attributed to the difference in grazing habits and physiology of the two hosts.

In both sheep and goats *Haemonchus* spp. with respective prevalence of 81.1 % and 76.5 % was identified as the most predominant abomasal nematode of the area. This suggests the widespread occurrence of *Haemonchus* spp. in the area and, owing to its known high pathogenic significance, it can undoubtedly contribute to subtle

production losses, unthriftness, morbidity and mortality of small ruminants of the study area. In support of our results earlier investigators reported that *Haemonchus* constitutes the largest proportion of abomasal nematodes. Similar high prevalence rates of *Haemonchus* was observed by Bersissa (2004, 2006) in Ogaden (90.1 %), Dereje (1992) in Wollayita Sodo (80 %), Gennene (1994) in Kombolcha (83.9 %), Getachew (1998) in Mekele (95.4 %), Githigia *et al.* (2001), Wang *et al.* (2006) and El-Azazy (1995). The result of this study revealed that there was no significant ($P > 0.05$) difference in monthly infection rates of small ruminants by abomasal nematodes. This suggests the presence of infection during all months of the study period, which is in line with the observations of Bersissa (2006) and Tekelye (1987) who reported the occurrence of infection by abomasal nematodes throughout all seasons of the year.

In this study, moderate prevalence rates of *T. axei* (47.2 % and 39.4 %) and *Teladorsagia* spp., (19.4% and 20.5%) in sheep and goats, respectively were recorded. Very few previous studies in Ethiopia have revealed the existence and prevalence of *Teladorsagia* infections in small ruminants (Amenu, 2005; Graber, 1975). The result of this study is in support of the reports made by the previous workers. Even though its prevalence was lower than that of *Haemonchus* and *T. axei*, the importance of these parasites on the health and productivity of small ruminants should not be overlooked as the immature stages of these parasites are highly pathogenic to their host (Dunn, 1978). Moreover, this nematode has developed resistance to the most commonly used anthelmintics (Scott *et al.*, 2006) and it has become a challenge to small ruminant production.

Vulvar morphology

The study on vulvar morphology of female *Haemonchus* worms collected from sheep and goats revealed that the linguiform types prevailed and appeared as the most predominant morphotype in both sheep and goats. The study also showed very similar morph distribution and absence of fluctuations of the major vulvar morphs in different months of the study period both in sheep and goat hosts. This observation is inline with many other findings of Jacquiet (1995), Abebe and Esayas (2001) and Bersissa (2004).

In the current study within the linguiform morph types, the C type was encountered as the most predominant subtype of the study area. This finding is in contrast to the previous work of Bersissa (2004) who reported the dominance of type A in small ruminants of Ogaden region. This could be due to the difference in agro-ecological conditions or environmental factors between the two study areas. Vulvar polymorphism in *Haemonchus* spp. of sheep and goats is observed to be common in the study area.

Rose (1966) and Le Jambre and Whitlock (1968) indicated vulvar morphology helps to understand and know more about the biology of *Haemonchus* spp. and determine the type of population that occurs in sheep and goats of an area. Tod (1965) also considered that vulvar morphology is a manifestation of some genetic factors important to establish and develop in hosts. Vulvar morphology is also considered as markers of ecological adaptation to an area (Rose, 1966; Le Jambre & Whitlock, 1968; Jacquiet, 1995). These investigators described that, based on vulvar morphology, it is possible to arrange *Haemonchus* spp. populations from different hosts as: the linguiform females predominate in *H. contortus* of sheep and goats, the prominently knobbed females predominate in *H. placei* of cattle whereas the small knobbed and smooth females occur in equal proportions in *H. longistipes* of camels. Hence determination of the vulvar morphology of female *Haemonchus* spp. population of an area gives an indication as to which species is occurring.

Conclusion

This study showed that small ruminants of the study area were found to suffer from high overall and monthly prevalence of abomasal nematodes infection. In both host species abomasal nematodes (especially *Haemonchus* spp.) are important impediments to small ruminant production of the area. The result of the present study revealed that sheep and goats in the study area are affected by similar prevalence and pattern of abomasal nematodes and also harbor female *Haemonchus* worms of similar proportion of vulvar morph types. In the current study the investigation on vulvar morphology of female *Haemonchus* spp. in its turn disclosed the predominance of linguiform vulvar morph types in both sheep and goats. Further investigation on biology and significance of vulvar morphology of *Haemonchus* spp. and epidemiological studies to determine the associated losses in domestic ruminants in all seasons in different agroecology and managements need to be pursued.

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