Prevalence of gastrointestinal helminthes of donkeys and mules in and around Bahir Dar, Ethiopia

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Abstract

This study was conducted from October, 2010 to April, 2011 in and around Bahir Dar to identify the major gastrointestinal helminthes of donkeys and mules, to estimate prevalence of these parasites and their burden on equines. A total of 384 faecal samples (212 donkeys and 172 mules) were collected randomly for qualitative and quantitative faecal analyses. The overall prevalence of different parasites was found to be 88.21% in donkeys and 77.91% in mules. In the study area, 94.1% of donkeys and 84.33% of mules harbored two or more types of parasites (mixed infection). The parasites encountered in both donkeys and mules in the study period were strongyles species (65.09% and 66.28%), *Trichostrongylus axei* (42.45% and 31.97%), *Triodontophorus* spp. (36.32% and 33.72%), *Trichonema* spp.(34.91% and 37.79%), *Parascaris equorum* (13.68% and 10.46%), *Dictyocaulus arnfieldi* (22.17% and 8.14%), *Anoplocephala* (23.12% and 16.86%) and *Fasciola* spp.(17.92% and 13.95%), respectively. The prevalence of all identified parasites were statistically significant ($p<0.05$) between female and male donkeys. The prevalence of strongyles, *T. axei, Triodontophorus, Trichonema*, and *P. equorum* was statistically significant ($p<0.05$) among age groups of donkeys, but *Anoplocephala* and *Fasciola* was not. In mules, the prevalence of strongyles, *Triodontophorus* and *Trichonema* was statistically significant ($p<0.05$), but the prevalence of *T. axei, P. equorum, D. arnfieldi, Anoplocephala,* and *Fasciola* was not. The body condition score was negatively correlated ($r=-0.664$ for donkeys and $r=-0.637$ for mules, respectively) with total eggs per gram of faeces (EPG). The findings of the present study indicated a high prevalence of helminthic parasites compromising the health and welfare of equines. Sustainable prevention and control methods should be developed to prevent the burden of gastrointestinal helminthes of equines in and around Bahir Dar.

Key words: Bahir Dar, donkeys, Ethiopia, gastrointestinal helminthes, mules, prevalence

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Introduction

Ethiopia, located in Eastern Africa, is predominantly an agricultural nation. The country has diverse agro-ecological zones, which contributed to the evolution of different agricultural production systems. Animal production is practiced in all ecological zones of the country (Azage Tegegne and Crawford, 2000).

The equine population of the world is 98.3 million (40 million donkeys, 15 million mules, 43.3 million horses). In the distribution pattern, 98% of all donkeys, 97% of all mules, and 60% of all horses are found in developing countries (Wilson, 2002).The number of equines in Africa is in the range of 17.6 million, comprising 11.6 million donkeys, 2.3 million mules and 3.7 million horses (Fielding, 1991). The equine population in Ethiopia is estimated to be 8.4 million (2.75 million horses, 5.02 million donkeys, and 0.63 million mules) (Wilson, 1991). In Amhara region, the equine population is estimated to be 1.9 million (*www.esgpip.org/Amhara.htm).* Equids – donkeys, mules and horses- play an important role as working animals in many parts of the world, employed for packing, riding, carting and ploughing (Feseha Gebreab *et al.*, 1991). Equines power in both rural and urban transport system is cheap and viable, providing the best alternative in places where the road network is insufficiently developed, and the terrain is rugged and mountainous, and in the cities where narrow streets prevent easy delivery of merchandise (Feseha Gebreab *et al.*, 1991).

Although equines are often described as hardy and resistant animals, they do suffer from a number of health problems (Svendsen, 1986; Marquardt *et al.*, 2000). Parasitic diseases have an economic impact on donkeys and mules as they cause loss through lowered fertility, reduced work capacity and increased treatment cost (Krecek *et al.,* 1989). These diseases are also serious to the welfare of donkeys and mules, causing pain in affected animals (Fikru Regassa *et al.,* 2005). Infections of equines with gastrointestinal parasites are recorded from most countries of Africa and few parts of Ethiopia. In Ethiopia, few studies were done in central and eastern parts of the country (Feseha Gebreab, 1998; Ayele Gizachew *et al.*, 2006). Previous studies and observations conducted have pinpointed helminthic parasites as being a major health hazard, limiting the overall performance of equines. Among the helminthes, strongyles (large and small strongyles), *Trichostrongylus axei*, *Triodontophorus* species, *Trichonema* species, *Parascaris equorum*, *Anoplocephala* species, *Dictyocaulus arnfieldi*, and *Fasciola* species are the most known devastating parasites of equines (Pandit *et al.,* 2008).

To our knowledge, a previous report on helminthosis of equines (mule and donkeys) in and around Bahir Dar has not been available. The present study was therefore undertaken with primary objective of estimating the prevalence of helminthosis in equines of Bahir Dar and its surroundings.

Materials and Methods

The study area

Bahir Dar is located at the geographic co-ordinates of 11°38'North latitudes and 37°15'East longitudes. In relative terms, Bahir Dar city is located at the distance of 567 km north of Addis Ababa. The area is known for its water resources, Lake Tana and Blue Nile River. The core city has an estimated area of 16000 hectares (http://campus.Iss.nl).

Study animals and protocol

Fresh faecal samples were taken from 384 equines. Among 384 equines; 172 were mules (80 males and 92 females) and 212 were donkeys (112 males and 100 females). Equines were selected by simple random method in and around Bahir Dar and faecal specimens were taken and subjected to quantitative and qualitative coprological examination to identify the major gastrointestinal helminthes involved. The cart-men and farmers were informed on the importance of the study. The age of the selected donkeys and mules was determined from birth records of owners and by dentition (Crane and Svendsen, 1997). Body condition score (BCS) was subjectively estimated based on the guides published by Svendsen (1997). Accordingly, donkeys were grouped into three age categories: donkeys from 1-2 years of age were classified as young (n=33); 3-10 years were considered as adult (n=74); and those beyond 10 years were classified as old (n=105) whereas mules from 2-10 years were considered as adult (n=67) and above 10 years were considered as old (n=105). These age classes were based on age of first work, productive age and the life span of Ethiopian donkeys (Svendsen, 1997; Yosef Shiferaw *et al*., 2001). Regarding BCS, the studied animals were grouped as poor, medium, and good.

Sampling technique

Faecal samples were taken directly from the rectum or from the ground with strict sanitation when the animals were seen defecating and placed in universal bottles.

Each sample was labeled with animal identification (sex, age, BCS and owner's name) and then brought to Bahir Dar Regional veterinary laboratory. Samples were kept in refrigerator at 4°C to be examined for coproscopic examination. Sodium chloride solution was used as flotation fluid for this study. Modified McMaster, sedimentation and flotation methods were used to identify and count eggs of helminthic parasites (Soulsby, 1982; Urquhart *et al*., 1996). Severity of infection as obtained from the number of eggs per gram of faeces was determined according to Soulsby (1982) as follows: less than or equal to 500 eggs/gram of faeces regarded as mild infection; 800-1000 eggs /gram of faeces as moderate infection; and 1500-2000 eggs/ gram of faeces as severe infection.

Sample size determination

The study design was cross-sectional and an expected prevalence of 50% for gastrointestinal helminthes was taken into consideration for sample size determination as there was no previous report on the prevalence of the parasites in the study area. With 95% confidence level and 5% absolute precision, the required sample size was calculated by the following formula (Thrusfield, 1995) and as per the calculation, 384 equines (172 mules and 212 donkeys) were included in study.

$n = Z^2 \times P (1-P) / d^2$,

Where n = the required sample size, Z =Confidence level (regular value=1.96), P = expected prevalence (50%) and, d=desired absolute precision (0.05)

Preparation of faeces for microscopic examination

Sedimentation technique

A simple gravitational sedimentation technique and centrifugation were used to concentrate the helminth eggs as described by Hendrix (1998). Using a tongue depressor, about 2 gram of faeces was mixed with distilled water in a 250 ml conical plastic beaker. The mixture was allowed to sit undisturbed for one hour on a table. The supernatant in the top of the beaker was poured-off without disturbing the sediment at the bottom. Using pasture pipette, small amount of the middle layer of sediment was transferred to a microscope slide. A cover slip was applied to the drop. The slide was examined microscopically as described by Hendrix (1998).

Flotation technique

The procedure of flotation methods was as described by Hendrix (1998).

Approximately 3g of faeces was put in a beaker or a plastic container. Fifty milliliters of flotation fluid was poured to the beaker or a plastic container containing 3 g of faeces. The flotation fluid (sodium chloride) was mixed with faeces thoroughly with stirring device (tongue blade, fork). The resulting faecal suspension was poured through a tea strainer or double layer of cheesecloth into another beaker or plastic container. The faecal suspension was poured into a test tube from the second container, then placed in a test tube rack, leaving a convex meniscus at the top of the tube and a cover slip was carefully placed on top of test tube. The tube was left to stand for 15-20 minutes. The cover slip was lifted off from the tube vertically together with the drop of fluid adhering to it and immediately placed on microscope slide and examined under the microscope.

Microscopic examination of faeces for helminth eggs

This was done as described by Hendrix (1998). Compound microscope with the objective lens with a magnification power of 10X was first used to examine the prepared faecal smears. Mechanical microscopic stages were used for smooth and uniform movement of the slides. All the area under the cover slip was thoroughly and uniformly searched for the presence of parasitic eggs. When a parasite egg was observed at low magnification power (10X), high power object (40X) was used to examine it more closely and for the identified eggs. Bearman apparatus technique was used to identify the larvae of the helminthes, specially for *D. arnfieldi*.

Determination of eggs per gram of faeces (EPG)

A quantitative faecal examination was conducted using a modified McMaster egg counting technique to count helminth parasite eggs selectively on those samples positive for parasitic eggs upon qualitative procedure. A flotation fluid (sodium chloride) was used to separate eggs from faecal material in a counting chamber with two compartments. The procedures were done as described by Hansen and Perry (1994). Three grams of faeces were taken from the collected sample and 42 ml of water was added to it and emulsified using mortar and pestle. The solution was strained through a plastic tea strainer and the strained material was poured into 15 ml centrifuge tube and centrifuged at 2000 rpm for 2 minutes. Supernatant was poured off, sediment was agitated and the tube was filled to the previous level with flotation fluid (sodium chloride). Both sides of the McMaster counting chamber were filled with the subsample. The counting chamber was allowed to stand for 5

minutes and the subsample in the counting chamber was examined under a compound microscope at 10X magnification power. All parasitic eggs within the engraved area of both chambers were counted and the number of eggs per gram of faeces (EPG) was calculated by adding the egg counts of the two chambers together and then multiplied the total by 50.

Data analysis

Data collected from the study animals were coded and entered in a Microsoft Excel sheet. All statistical analyses were performed using SPSS version 16 for windows. The association between prevalence of each studied parasite and the study variables (season, age, sex, and BCS) was analyzed by Chi-square test of independence. Associations of total EPG with BCS were determined by Spearman test. One way ANOVA was used to observe the variations of total mean EPG of parasite species with age, season, and sex groups. In all the analyses, confidence level was held at 95% and P-values <0. 05 were considered as significantly different.

Results

Prevalence of gastrointestinal helminthes in donkeys and mules

During the study period, faecal specimens taken from a total of 384 equines (212 donkeys and 172 mules) were thoroughly observed for the presence of different helminthic parasites. From the observed animals, 187 donkeys and 134 mules were positive for different helminthic parasites. In the study area, 5.88% of donkeys and 15.67% of mules harbored only one type of parasite (single infection) whereas 94.1% of donkeys and 84.33% of mules harbored two or more types of parasites (mixed infection). The overall prevalence of parasites in equines in the study area was found to be 83.59% (Table 1).

Table 1. Overall prevalence of gastrointestinal helminthes during the study period (October, 2010 to April, 2011) in equines (mules and donkeys)

Species studied	№ of animals examined	№ of positive animals	Percentage	$\chi 2$ (p-value)
Donkeys	212	187	88.21	7.346 (0.007)*
Mules	172	134	77.91	
Total	384	321	83	

*Statistically significant (p=0.007) between mules and donkeys

The parasites encountered in both donkeys and mules in the study period were strongyles (65.09% in donkeys and 66.28% in mules), *Trichostrongylus axei* (42.45% and 31.97%), *Triodontophorus* (36.32% and 33.72%), *Trichonema* (34.91% and 37.79%), *Parascaris equorum* (13.68% and 10.46%), *Dictyocaulus arnfieldi* (22.17% and 8.14%), *Anoplocephala* (23.12% and 16.86%) and Fasciola species (17.92% and 13.95%), respectively (Figure 1).

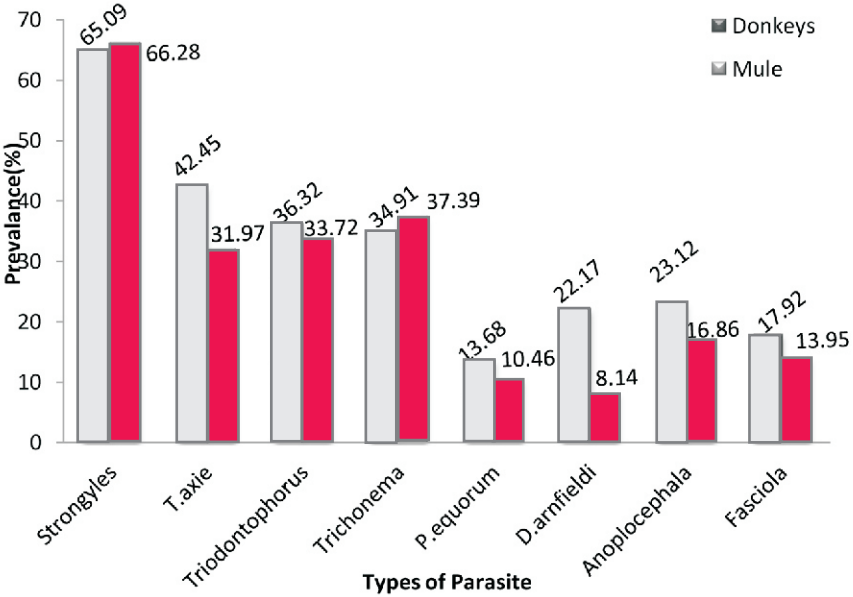

Figure 1. Types of gastrointestinal helminthes and their prevalence in donkeys and mules in the study period.

Age-wise comparison of studied animals for hosting one or more types of parasites showed varied prevalence. The prevalence of parasites was higher in old donkeys and mules than their young counterparts (Table 2).

Table 2. Age-wise prevalence of different gastrointestinal helminthes in mules and donkeys

Parasites identified	Donkeys				Mules		
	Young (%)	Adult (%)	Old (%)	χ2 (P-value)	Adult (%)	Old (%)	χ2 (P-value)
Strongyles	42.42	55.41	79.05	19.519(0.000)*	56.72	72.38	4.490 (0.034)*
T. axei	24.24	31.08	56.19	16.508 (0.000)*	26.86	35.24	1.318 (0.251)
Triodontophorus	15.15	32.43	45.71	10.884 (0.004)*	23.88	40.00	4.755 (0.0290)*
Trichonema	18.18	31.08	42.85	7.460 (0.024)*	25.37	45.71	7.199 (0.007)*
P. equorum	45.45	10.81	5.71	34.374 (0.000)*	17.91	6.66	5.263 (0.022)*
D. arnfieldi	12.12	16.22	26.70	4.654 (0.098)	5.97	5.71	0.005 (0.944)
Anoplocephala	12.12	20.27	28.57	4.340 (0.114)	11.94	20.00	1.895 (0.169)
Fasciola	12.12	16.22	21.90	1.961 (0.378)	8.95	17.14	2.284 (0.131)

*Statistically significant ($p<0.05$) among age groups of donkeys and mules

Comparison of the prevalence using sex of animals revealed the percentage prevalence of gastrointestinal helminthes to be higher in females than in males both in donkeys and mules. In donkeys, the prevalence of all identified parasites except *Triodontophorus* were statistically significant between the two sex groups ($P<0.05$). In contrast, all studied parasites were not statistically significant ($p>0.05$) between male and female mules (Table 3).

Table 3. Sex-wise prevalence of different gastrointestinal helminthes in mules and donkeys

Parasite identified	Donkeys			Mules		
	Male (%)	Female (%)	$\chi 2$ (P value)	Male (%)	Female (%)	$\chi 2$ (P value)
Strongyles	55.35	76	9.908 (0.002)*	65.00	67.39	0.109 (0.741)
T. axei	35.71	50	4.413 (0.036)*	31.25	32.61	0.036 (0.849)
Triodontophorus	48.21	43	3.651 (0.056)	32.50	34.78	0.100 (0.752)
Trichonema	27.68	43	5.458 (0.019)*	33.75	41.30	1.039 (0.308)
P. equorum	8.92	19	4.538 (0.033*	10.00	10.87	0.035 (0.853)
D. arnfieldi	15.18	30.00	6.726 (0.010)*	7.50	8.70	0.082 (0.775)
Anoplocephala	16.07	31	6.625 (0.010)*	15.00	18.48	0.369 (0.543)
Fasciola	12.5	24.00	4.749 (0.029)*	11.25	16.30	0.910 (0.340)

*Statistically significant ($p<0.05$) between sexes of donkeys and that of mules

In relation to BCS, the percentage prevalence of helminthic parasites was higher in animals with poor BCS and medium than animals with good BCS (Table 4).

Table 4. Percentage prevalence of gastrointestinal helminthes based on BCS in mules and donkeys

Parasites identified	Donkeys				Mules			
	Poor (%)	Medium (%)	Good (%)	χ2 (P value)	Poor (%)	Medium (%)	Good (%)	χ (P value)
Strongyles	80.00	64.81	54.23	7.465 (0.024)*	85.71	67.36	47.62	12.509 (0.002)*
T. axei	75.60	41.70	18.64	33.901 (0.000)*	57.14	31.57	11.90	17.977 (0.000)*
Triodontophorus	73.33	33.33	13.56	40.286 (0.000)*	51.42	29.47	28.57	6.175 (0.046)*
Trichonema	62.22	31.48	20.33	20.845 (0.000)*	74.28	34.73	14.28	30.076 (0.000)*
P. equorum	35.56	9.25	6.77	21.737 (0.000)*	22.87	10.52	0.00	10.646 (0.005)*
D. arnfieldi	51.11	17.59	10.17	27.635 (0.000)*	28.57	3.15	3.80	24.557 (0.000)*
Anoplocephala	55.56	17.59	8.47	35.618 (0.000)*	40.00	9.47	9.52	19.611 (0.000)*
Fasciola	40.00	15.74	5.08	21.868 (0.000)*	37.14	11.57	0.00	22.933 (0.000)*

*Statistically significant ($p<0.05$) among BCS groups of donkeys and mules

Intensity of infection in donkeys and mules

Based on the results of EPG counts in the study area, 46.82% donkeys were severely infected, 86.31% moderately, and 69.47% mildly whereas 39.42% mules were infected severely, 93.43% moderately, and 80.29% mildly (Figure 2).

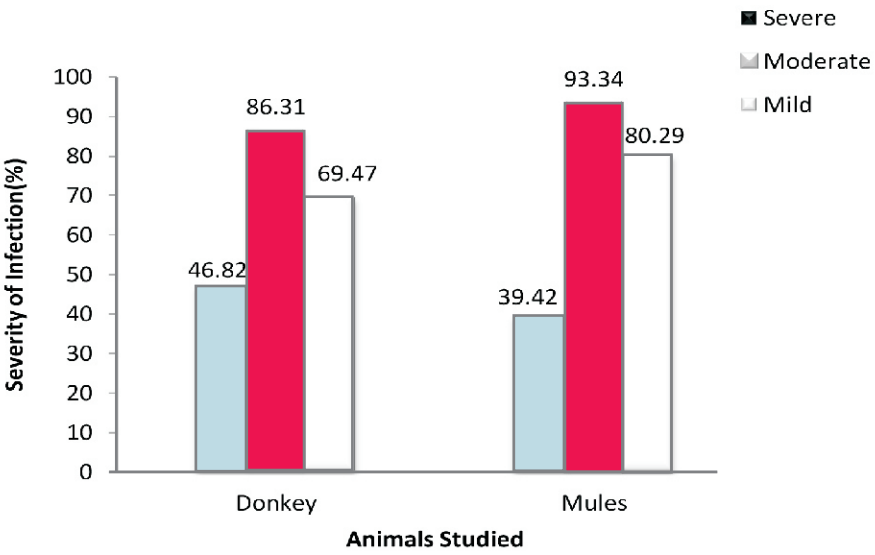

Figure 2. Overall severity of infection by nematode helminthes in donkeys and mules

Total mean EPG counts of major nematode parasites in relation with sex and age groups were analyzed and shown in tables (5-8) for both donkeys and mules. Body condition score was negatively correlated (r=-0.664 for donkeys and r=-0.637 for mules) with total EPG counts.

Table 5. Mean value ± SD of EPG in different sexes of donkeys for different parasites

Parasites identified	Donkeys		
	Male	Female	P-value
Strongyles	644.35 ± 496.31	1051.30 ± 506.81	0.000*
T. axei	626.25 ± 573.78	1006.00 ± 507.76	0.001*
Triodontophorus	614.71 ± 552.34	1014.00 ± 552.08	0.002*
Trichonema	827.42 ± 611.26	881.40 ± 454.08	0.664

*Statistically significant ($p<0.05$) between the two sexes

Table 6. Mean value ± SD of EPG in different sexes of mules for different parasites

Parasites identified	Mules		
	Male	Female	p-value
Strongyles	464.42 ± 99.06	940.32±527.04	0.000*
T. axei	550.00 ± 484.98	1033.00 ± 538.90	0.001*
Triodontophorus	465.38 ± 488.62	673.44 ± 538.06	0.133
Trichonema	509. 26± 536.02	976.32 ± 506.27	0.001*

*Statistically significant ($p<0.05$) between male and female mules

Table 7. Mean value ± SD of EPG in different age groups for different parasites in donkeys

Parasites Identified	Age groups			
	Young	Adult	Old	P-value
Strongyles	910.71 ± 689.53	600.00 ±461.52	995.18 ± 506.94	0.000*
T. axei	293.75 ± 232.13	539.13 ± 465.63	1028.1 ± 542.46	0.000*
Triodontophorus	390.00 ± 108.39	481.25 ± 529.52	1069.80 ±529.22	0.00*
Trichonema	475.00 ± 434.45	634.78 ± 622.57	1026.70 ± 400.35	0.002*

*Statistically significant ($p<0.05$) among age groups

Table 8. Mean value ± SD of EPG in different age groups for different parasites in mules

Parasites identified	Age groups		
	Adult	Old	P-value
Strongyles	388.16 ± 301.89	913.82 ± 543.05	0.000*
T. strongylus	488.89 ± 382.93	971.62 ± 577.61	0.002*
T. dontophorus	243.75 ± 218.99	729.76 ± 541.91	0.001*
Trichonema	405.88 ± 286.62	942.71 ± 573.53	0.000*

Discussion

The prevalence of gastrointestinal helminthes may vary temporally and spatially. The results of the present study demonstrated the presence of 8 different types of helminthic parasites in donkeys and mules in and around Bahir Bar. The overall prevalence of different helminthic parasites was found to be 88.21% and 77.91% in donkeys and mules, respectively. The prevalence was significantly higher in donkeys ($p<0.05$) than in mules. This might be associated with negligence; donkeys were given less attention by their owners and were kept under poor management conditions than their counterparts, mules (personal communication with the owners of equines) and mules may have higher resistance than donkeys. The occurrence of 8 types of helminthic parasites in different percentage in the study area might also be associated with (1) suitable humidity and moisture provided by warm and wet conditions throughout the year for the eggs to develop to larval stage (L_3) (Andrews, 1999); (2) temperature that was favorable for the development and maturation of the larvae of the most helminthic species (Lima *et al*., 1990), and (3) ample provision of water that facilitated the migration of larvae from manure to the herbage (Lima, 1998) and development and multiplication of snails in case of the transmission of *Fasciola* species; as well as poor management system, for example lack of antihelmenthic treatment, over working time and allowing the equines for open grazing after work which facilitates ingestion of the eggs of helminthes in the study area (personal communication).

The finding of the current study was in line with the previous reports in other countries. Mattioli *et al*. (1994), Paudel (2007) and Umur and Acici (2009) have reported 84.4%, 80.48% and 93.5% prevalence of parasites in equines of Gambia, Nepal and Turkey, respectively. The current finding, however, was lower than other findings reported by other workers in Ethiopia. Yosef Shiferaw *et al*. (2001), Fikru Regassa *et al*. (2005), Mulate (2005), and Ayele Gizachew *et al*. (2006) have reported the prevalence of helminthic parasites to be 100%, 100%, 98.2% and 100% in donkeys of Wonchi, Highlands of Wollo provine, Western highlands of Oromia, and Dugda Bora district, respectively. The relative low occurrence of helminthic parasites in Bahir Dar might be associated with the agro-ecological differences, veterinary services provided by Bahir Dar Regional Veterinary clinic for equines and the diagnostic capacity of the parasitological technique used.

Varied prevalences, which ranged from 8.14 % to 66.28%, were observed in equines during the study period. Among the eight different types of helminthic parasites identified in the current study, strongyles (65.09% in donkeys and 66.28% in mules) were found to be dominant in the study area. This was in agreement with the finding of Ayele Gizachew *et al*. (2006) who reported 100% prevalence of strongyles in donkeys of Dugda Bora. In our study, the second most prevalent helminth in donkeys next to strongyles was *T. axei* (42.45%) followed by *Triodontophorus* (36.32%), *Trichonema* (34.91%), *Anoplocephala* (23.12%), *D. arnfieldi* (22.17%), *Fasciola* (17.92%), and, *P. equorum* (13.86%) whereas the second most prevalent helminth in mules was *Trichonema* (37.79%) followed by *Triodontophorus* (33.72%), *T. axei* (31.97%), *Anoplocephala* (16.86%), *Fasciola* (13.95%), *P. equorum* (10.46%), and *D. arnfieldi* (8.14%). The prevalence of the top three gastrointestinal parasites, *strongyles*, *T. axei*, and *Triodontophorus* of donkeys, for instance, are in agreement, respectively, with the prevalence of 92%, 12%, and 29.7% in donkeys of central Shoa, Ethiopia (Ayele Gizachew and Dinka Ayana, 2010), and in donkeys of Hawassa and its surrounding (Nuraddis Ibrahim *et al*., 2011).

Female donkeys were found to have significantly higher infestation of strongyles than their counterpart males as they might have lower immunity due to gestation, lactation and stresses occurred during this period (Sapkota, 2009). However, no significant difference was observed between the two sexes of mules. This might be due to the absence of gestation and lactation in the female mules. Generally, it is assumed that sex is a determinant factor that influences the prevalence of parasitism (Pal and Qayyum, 1992).

The highest prevalence of strongyles infestation was seen in animals of old age in both donkeys and mules than in their young. This finding disagrees with the work of Niredin *et al*. (2011), Ayele Gizachew and Dinka Ayana (2010) in Hawassa and its surrounding and central Shoa, Ethiopia, respectively. But, it was in agreement with the work of Sapkota, 2009. The probable reason may be due to waning body conditions and immunity. Compared to the young equines, the immunity of the old equines is low as they are frequently exposed to different parasites, extensive work overload, and undernourished conditions (Sapkota, 2009).

The body condition score was negatively correlated (r=-0.664 for donkeys and r=-0.637 for mules) with the total EPG counts, implying equines with poor BCS are good indicators of parasitic burden which can be used by the resources limited communities to identify donkeys and mules with immediate requirements of anthelmintic remedies. This finding was in agreement with the findings of Ayele Gizachew *et al*. (2006) who reported the value of r as -0.67 in donkeys of Dugda Bora district and the relation was significantly higher. For instance, the prevalence of strongyles was higher in animals of poor BCS than good BCS in both donkeys and mules. The reason might be associated with the fact that animals with poor BCS have waning immunity and as a result they could not resist the parasites burden when compared with animals of good BCS (Sapkota, 2009).

In the current study the mean EPG count of nematode helminthes was found to be 838.09 and 710.05 in donkeys and mules, respectively. The finding was lower than the previous studies conducted by Seri *et al.* (2004) in Sudan and Ayele Gizachew and Dinka Ayana (2010) in Ethiopia who reported mean EPG count of 1016.6 and 2893, respectively. The difference might be associated with geographical variation and climatic factors. A high seasonal variation in the eggs per gram of faeces (EPG) of donkeys and mules was observed, the highest being in the wet season (896.48) and the lowest in the dry season (779.7) in donkeys and 815.72 and 605.9 in mules in wet and dry seasons, respectively. This might be associated with suitable weather conditions for development of parasitic larvae.

Conclusion

Equines have crucial importance in the livelihood of developing countries especially in Africa, particularly for transportation. In this study, 8 types of helminthic parasites (strongyles, *T. axei*, *Triodontophorus*, *Trichonema*, *P. equorum*, *D. arnfieldi*, *Anoplocephala*, *Fasciola*) were found both in donkeys and mules with an overall prevalence of 83.59%. This prevalence was relatively high;

46.82% of donkeys and 39.42% of mules were severely affected. Owners of equines should be educated about proper management of equines such as providing sufficient food and shelter, minimizing overworking and extensive open grazing.

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