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Study on *Eimeria* and *Cryptosporidium* infections in sheep and goats at ELFORA export abattoir, Debre-zeit, Ethiopia

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Abstract: A cross sectional study on *Eimeria* and *Cryptosporidium* infections in small ruminants at ELFORA export abattoir was conducted from October 2005 to February 2006. In this study, attempts were made to determine the prevalence and intensity of *Eimeria* and *Cryptosporidium* infections in sheep and goats. Moreover, potential risk factors associated with the infections and the species of *Eimeria* and *Cryptosporidium* incriminated in the infections were identified. A total of 384 fecal samples were collected and examined by flotation technique using Sheather's sugar solution to detect the oocysts of *Eimeria* and *Cryptosporidium* species. For *Cryptosporidium* infection, fecal samples were also examined under a microscope using modified Kinyoun acid-fast staining technique. Measurement of oocysts to identify the species involved in the infections and determination of oocysts per gram of faeces (OPG) was also conducted. Out of the 384 fecal samples examined, 59.6% of *Eimeria* infection was recorded. Statistically significant variation ($P < 0.001$) in the prevalence rate of *Eimeria* infection between animal hosts and different age groups was observed. There was no significant variation ($P > 0.05$) observed in the mean OPG values of *Eimeria* between the 2 age groups of the study animals.

Key words: *Eimeria*, *Cryptosporidium*, small ruminants, ELFORA export abattoir

Introduction

Ethiopia, with its great variation in climate and topography, possesses one of the largest livestock populations in the world. Of the total 12.2 million sheep population in Ethiopia, 75% are raised in the highlands with altitude of above 1500 m a.s.l. sustaining 92% of the human population. The rest 25% are reared in the low lands. Goats, with a population of 9.5 million, are widely distributed in all agro-climatic zones but with a higher concentration in dry areas (1).

In spite of this huge small ruminant population in Ethiopia under developed infrastructure coupled with

poor management practices, low nutritional status, poor genetic makeup, and diseases considerably affect the productivity of this sector. The share of parasitic diseases in this regard has been of paramount importance. Among parasitic diseases, coccidiosis and cryptosporidiosis are important protozoan parasites responsible for low productivity and mortality in small ruminants.

Cryptosporidiosis, caused by the genus *Cryptosporidium*, is an important protozoan disease of young animals and humans with a cosmopolitan distribution. Contrary to coccidiosis, the disease is not host-specific and affects several species of animals (2).

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Information with respect to the prevalence of these infections and the distribution of *Eimeria* and *Cryptosporidium* species in small ruminants in Ethiopia is nil. Therefore, the objectives of this study were to determine the prevalence and intensity of *Eimeria* and *Cryptosporidium* infections in sheep and goats, to identify the species of *Eimeria* and *Cryptosporidium* incriminated in the infections, and to identify factors influencing these infections.

Materials and methods

Study area, study animals, sampling method and sample size determination

The study was conducted at ELFORA export abattoir. This abattoir is a private firm located in Debre-zeit and is involved in slaughtering of cattle and small ruminants for export to the Middle East. A systematic random sampling technique was employed to select the sampling units in such a way that every third animal in the carriage was sampled. The sample size was calculated based on the formula given previously (3) with a 95% confidence interval and is described as follows:

$$n = \frac{1.96^2 \times P_{exp} (1-P_{exp})}{d^2}$$

where:

n = the required sample size

P_{exp} = expected prevalence

d = desired absolute precision

Since there was no previous study reporting the prevalence rate of coccidiosis and cryptosporidiosis in sheep and goats in Ethiopia, the expected prevalence was taken as 50%. Thus, using the above formula, the sample size was calculated to be 384.

Study methodology

The study involved a combination of qualitative and quantitative fecal examinations.

Fecal samples were taken directly from the rectum of the selected animals and examined microscopically by fecal flotation using concentrated sugar solution (Sheather’s sugar solution) to detect the oocysts of *Eimeria* and *Cryptosporidium*. It also involved a microscopic examination of fecal smears suspected of

Cryptosporidium using modified Kinyoun acid fast staining to differentiate it from yeasts (4,5). Fecal culture for sporulation of oocysts using 2.5% potassium dichromate solution was used to measure the size of different oocysts identified during the study. Oocyst per gram of faeces (OPG) was also determined to assess the intensity of infection of these parasites.

Data analysis

The collected data was analyzed using SPSS and Stata (6,7). The Pearson’s chi-square (χ^2) was used as a screening test to see the association between the influencing factors (variables), i.e. the animal host and age, and the infections. T-test was used to test the association between OPG values and the age category studied. A statistically significant association between the variables and the infections was considered to exist if the P-value was <0.05.

Results

Assessment of the prevalence of *Eimeria* and *Cryptosporidium* infections

Out of the 384 fecal samples collected during the study period, an over all prevalence rate of 59.6% *Eimeria* infection was obtained. All the fecal samples were found to be negative for *Cryptosporidium* infection.

Host difference in the prevalence rates of *Eimeria* infection

There was a statistically significant difference (P < 0.001) in the prevalence rate of *Eimeria* infection between ovine and caprine; with more infection rate (66.8%) in ovine and relatively less in caprine (44.3%) (Table 1).

Table 1. The overall prevalence of *Eimeria* infections.

Animal host	No examined	No (%) positive
		<i>Eimeria</i>
Ovine	262	175 (66.8)
Caprine	122	54 (44.3)
Total	384	229 (59.6)

$\chi^2 = 14.4518$ (P = 0.000) P < 0.001

The interaction between the age of study animals and prevalence rates of *Eimeria* infection

In this study, there was a significant difference observed in the prevalence of *Eimeria* infection between the 2 age categories i.e. young animals with the age of less than or equal to 12 months were found to be more infected with *Eimeria* species (66.2%) than the adult ones (33.8%) (Table 2).

Table 2. Prevalence of *Eimeria* infection by age.

Age category (month)	No examined	No % positive
< 12	305	202(66.2%)
>12 - ≤ 24	79	27(33.8%)
Total	384	229(59.6%)

$$\chi^2 = 150.8008 \text{ (P= 0.000) } P < 0.001$$

Parasite species identification

Twelve and 10 different *Eimeria* species were identified respectively in sheep and goats based on the morphological characteristics of oocysts (size, shape, presence or absence of micropyle and the polar cap). The most prevailing species in sheep was *E. parva* (30.8%), *E. crandallis* (30%), and *E. pallida* (13.8%); whereas *E. arloingi* (31%), *E. ninakohlyakimovae* (18.5%), and *E. faurei* (10.8%) were the most frequently observed species in goats.

Quantitative fecal examination

The oocyst count per gram of feces (OPG) was conducted using the Mac Master technique, which revealed a minimum and maximum OPG values of 0 and 2,000,0000, respectively, with a mean of 3955.642. Majority of the samples (58.5%) had an OPG value ranging from 0 to 100, and only few samples (0.2%) had OPG value above 200,000 implying a low infection intensity of this parasite. Statistically there

was no significant difference in the mean OPG values of *Eimeria* between the 2 age categories ($t = 1.3663$, $P > 0.05$) (Table 3).

Discussion

In this study, out of the 262 sheep and 122 goats examined, 175 (66.8%) sheep and 54 (44.3%) goats were found to be infected with different *Eimeria* species. This finding is the first documented report regarding the prevalence of *Eimeria* infection in small ruminants of Ethiopia.

Various prevalence rates of *Eimeria* infection in sheep and goats have been reported in various parts of the world. Kamarage et al. (8) reported a 97.5% prevalence in sheep, and 97.3% in goats in Tanzania; Kusiluka et al. (9) recorded 91% and 93% prevalence rates in sheep and goats, respectively, in Tanzania; Arslan et al. (10) obtained a prevalence rate of 93.9% in sheep of Turkey; Değer et al. (11) reported a prevalence rate of 73.6% in goats in Turkey; Kaya (12) recorded 100% prevalence in sheep in Turkey; Balicka-Ramisiz (13) reported 90.5% in goats in Poland; while Waruru et al. (14) recorded 28% prevalence in goats in Kenya; Hassum and Menezes (15) reported 81.95% in goats in Brazil; Divanoic et al. (16) recorded 16.6% prevalence in goats in Croatia; Woji et al. (17) recorded a prevalence of 87% in goats in Nigeria; Sisodia et al. (18) reported 12.7% prevalence in sheep in India, and Harper and Penzhorn (19) reported 88.7% prevalence of *Eimeria* infection in goats in South Africa. The present finding in the prevalence of *Eimeria* species infection in sheep (66.8%) is lower as compared to that reported by Kamarage et al. (8) (97.5%), Kusiluka et al. (9) (93%), Arslan et al. (10) (93.9%), Kaya (12) (100%) but greater than that reported by Sisodia et al. (18) (12.74%). As far as goats are concerned, the present

Table 3. T-test analysis of the association between age and OPG.

Age (Month)	Mean	Standard Error of mean	Standard Deviation	[95% Conf. Interval]	t	df	P
≤ 12	5781.226	2869.805	80303.27	147.7932 11414.66	1.3663	1150	0.1721
> 12-≤ 24	68.02168	11.33363	217.712	45.73487 90.30849			
Total	3951.215	1951.757	66244.82	121.8157 7780.615			

finding, 44.3%, is lower as compared to that reported by Kamarage et al. (8) (97.3%), Kusiluka et al. (9) (91%), Değer et al. (11) (73.6%), Balicka-Ramisz (13) (90.5%), Hassum and Menezes (15) (81.95%), Woji et al. (17) (87%), and Harper and Penzhorn (19) (88.7%) but greater than that reported by Divanoic et al. (16) (16.62%).

There was a significant difference ($P < 0.001$) in the prevalence of *Eimeria* infection between the 2 species of the study animals; the prevalence rate being higher in sheep (66.8%) than goats (44.3%). This disparity could emanate from the differences in the natural immunity of the hosts and from the feeding habits of these animals. Goats are usually browsers in nature and they tend to graze in very rare cases where they do not find shrubs and bushes; thereby reducing the risk of being infected with sporulated oocysts of *Eimeria* species and other internal parasites. A similar finding was obtained by Waruru et al. (14) in which higher prevalence of *Eimeria* infection was observed in sheep than goats.

Young animals were found to be more infected by *Eimeria* infection than adults ($P < 0.001$). Similar results were also reported by Waruru et al. (14) and Balicka-Ramisz (13) (100% in young and 81% in adult goats). This is perhaps associated with the immunity of the animals where adult animals have a better immunity due to previous exposure to *Eimeria* infection compared to young animals, which are usually susceptible to initial infections as has been reported by Radostits et al. (20).

In the present study, a total of 12 *Eimeria* species in sheep and 10 species in goats have been identified based on the characteristics of the oocysts as described by Soulsby (21) and Levine (22) suggesting the abundance of this parasite in different parts of the country where the study animals have originated.

Mixed infections in a single host were common findings in this study suggesting the prevailing condition of polyparasitism. The maximum number of *Eimeria* species per sample was 4 as indicated in the Figure. Several works have been conducted to identify *Eimeria* species by several researchers worldwide. For instance, Kaya (12) identified 10 different *Eimeria* species from lambs in Antakya province of Turkey where *Eimeria crandallis* (64.91%),

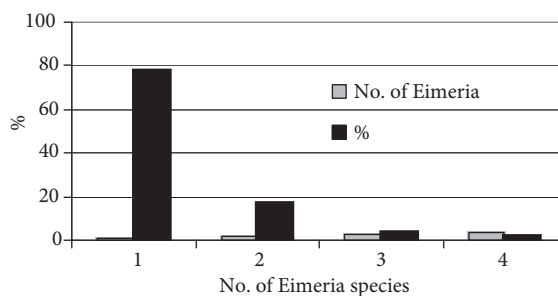


Figure. The frequency of occurrence of *Eimeria* species per fecal sample.

E. ovinoidalis (55.24%), and *E. bakuensis* (38.7%) were the most prevailing species. Gül and Değer (23) reported nine different species in sheep in Turkey; *E. parva* (46.7%), *E. ovinoidalis* (43.14%), *E. ahsata* (39.42%), and *E. ovina* (39.14%) being the most prevalent species.

In this study, *E. parva* (25.7%) was found to be the most frequently encountered species in sheep, which is consistent with the finding of Gül and Değer (23).

Among the 10 different *Eimeria* species identified in goats, the most pathogenic species, *E. arloingi* (40.7%) and *E. ninakohlyakimovae* (22.2%) were the most frequently encountered species. This shows that there will be a considerable threat of goat coccidiosis in this country if intensification programmes in the livestock sector particularly in the areas of small ruminants are implemented. Several species of *Eimeria* were reported to exist in goats. Waruru et al. (14) reported 7 species in goats in Kenya; where *E. ninakohlyakimovae* (45.9%) and *E. arloingi* (26.1%) were found to be the most prevailing species. Değer et al. (11) identified 9 different *Eimeria* species in goats in Turkey. In both sheep and goats, clinical coccidiosis was not observed in this study.

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