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Prevalence of Gastrointestinal Parasites in Commercial Dairy Farms in Central Highlands of Oromia Regional State, Ethiopia

Yeshawork Begashaw Dessie, Worku Birhanu and Tigist Ashagre

Animal Health Institute (AHI), Sebeta, Ethiopia

Abstract: A cross-sectional study was conducted in a period from January to May 2021 to determine the prevalence of gastrointestinal parasites in commercial dairy cattle in Holeta and Sebeta towns, central highlands parts of Ethiopia. A total of 371 dairy cattle (30 pure Boran and 341 cross Friesian) were examined using standard qualitative and quantitative coprological examination techniques. Out of 371 cattle examined, 56.06% (n=208) were infected with one helminth at least. The prevalence of single and mixed infection was 70.7% and 29.3%, respectively. The prevalence of helminthes in single infection was *Eimeria* spp 24%, *Fasciola hepatica* 22.1%, *Toxocara vitulirum* 15.8% and *Strongyle* spp. 8%. GI parasites found in mixed infection were *T. vitulorum* and *F. hepatica* (6.7%) and *Eimeria* spp. and *F. hepatica* (6.7%) followed by *Eimeria* spp., Nematode spp and *Emeria* spp altogether had a 4.3% contribution. Age, breed, body condition and deworming history revealed a statistically significant disparity ($P<0.05$). High prevalence was recorded in adult animals and Holstein Friesian cross breeds while lactation and pregnancy status did not reveal any significant ($P>0.05$) relationship with occurrence of infection. This finding reveals that GI parasites seem to have an impact on the performances of commercial dairy farm settings and this necessitates that the stakeholders should consider strategic deworming additional to other health extension packages to improve production and productivity.

Key words: Dairy Cattle · Dairy Farm · Ethiopia · Gastrointestinal Parasites · Prevalence

INTRODUCTION

The growing demand for the meat and milk in developing world, changing function of livestock and consumers perspectives are the major future driving forces in the global livestock sector. Remarkable increase in human population and the movement of people from rural areas to urban centers will increase the demand for food of animal origin. Reviving animal agricultural research is essential to sustainably address the global challenge of food security. The demand for food from animal agriculture is anticipated to nearly double by 2050. Increased demand is due, in part, to a predicted increase in world population from 7.2 billion to between 9 and 10 billion people in 2050. The increase in population puts additional pressure on the availability of land, water and energy needed for animal and crop agriculture [1].

Ethiopia is an agricultural country with over 80% of its population engaged in agricultural activity. It has diverse agro-ecological zones which contributes to the evolution of different agricultural production systems. Animal production forms an integral part of agricultural system in almost all agro-ecological zones of the country [2]. The animal production systems are extensive, semi-intensive and intensive in Ethiopia and have 65 million heads of cattle [3]. They serve as source of food, hides and important draught power for crop production. However, the productivity of these animals is severely reduced by malnutrition, low management system, low genetic potential and health problems. Among the livestock health problem, diseases caused by helminthes parasite is highly prevalent and economically important [4].

Gastrointestinal and protozoan parasites infections are the major causes of wastage and decreased productivity exerting their effect through mortality, morbidity, decreased growth rate, weight loss in young growing calves and late maturity of slaughter stock, reduced milk and meat production and working capacity of the animal mainly in developing countries [5]. These effects largely relate to specific damage caused by the parasites including villous atrophy at the site of

Corresponding Author: Yeshawork Begashaw Dessie, Animal Health Institute (AHI), Sebeta, P.O. Box: 04, Ethiopia. Cell: +251911065353.

gastrointestinal nematode attachment and liver trauma resulting from the presence of migratory liver fluke [6]. Indirect effects have also been described, including altered feed intake, digest flow rate, nutrient absorption and liver metabolic activity, endocrine status and immunological response [7].

In addition, the diverse agro-climatic conditions, animal husbandry practice and pasture management largely determine the incidence and severity of various parasitic diseases in certain area. Furthermore, the prevalence of gastrointestinal parasites, the genera of helminthes parasites involved, species and the severity of infection also vary considerably depending on local environmental conditions such as humidity, temperature, rainfall, vegetation and management practices [8, 9]. The prevalence of helminth parasites in dairy cows in many African countries including Ethiopia is found to be high. For instance, Keyyu *et al.* [10] recorded prevalence of 44.4% and 37% for large and small scale dairy cattle, respectively in Tanzania. Furthermore, Charlotte and Madsen [11] and Chatikobo *et al.* [12] reported that gastrointestinal parasites are among the constraints in dairy farms of Zimbabwe, Eastern Rwanda and Kenya, respectively.

In Ethiopia, different researchers have reported some varying prevalence data regarding cattle GI nematode infections. For example, Etsehiwot [13] reported 82.2% and Telila *et al.* [4] reported 61% in central Ethiopia while Degefu *et al.* [14] reported a prevalence of 77.6% in Jimma zone and Keno *et al.* [15] reported 48.4% in Eastern Oromia. However, studies have been undertaken to provide information on the prevalence of GI infections in cattle general but limited attempt has been made to study prevalence of GI parasitic infections in commercial dairy farms particularly in exotic and cross breed animals. Regarding to occurrence of protozoan parasites in dairy cattle in Ethiopia, Ayele *et al.* [16] reported 18.6% in Northwest Ethiopia and Ebiyo and Haile [17] reported 13.8% in East Wollega. Therefore, an attempt that has been made to investigate the status of gastrointestinal and protozoan parasite infections in exotic and cross breed dairy farms of central Ethiopia seems to be limited.

Thus, the objectives of this study were:

- To estimate the prevalence and assess the contributory factors for the occurrence of gastrointestinal parasite infections in commercial dairy farms of Sebeta and Holeta in central highlands of Ethiopia.
- To identify gastrointestinal parasites and protozoans infecting cattle in commercial dairy farms in central highlands of Ethiopia.

MATERIALS AND METHODS

Study Area: The study sites were selected purposely on the basis of major milk shied area and transport access. The study was carried out in selected private and government dairy farms at Sebeta and Holeta towns in central highlands of Oromia region. Both sites are far away 25 and 29 Km Southwest from Addis Ababa at a latitude and longitude of 9°15' N and longitude of 8°54'40", 38°25 and E 38°37'17", 38°45, respectively. It has an elevation 2356 and 3380 m.a.s.l and has annual rain fall range from 834-1300mm. The mean annual minimum and maximum are temperature 8°C-19°C and 11°C-22°C respectively [3]. Rainy season occurs with bimodal distribution 80% of which occurs during the main rainy season mid June to September and 20% during the small rainy season (February to April) and the mean annual relative humidity of 50.4%.

Study Farms and Animals: The Study animals were Holstein Friesian crosses and pure Boran cattle which were kept under semi-intensive management system in both sites. Dairy farms were selected randomly from the list of farms in both study sites using the lottery system, those farms which hold >10 animals. Individual animals also were selected based on the following selection criteria farms which keep 10-20, 21-40 and >41 animals 5, 10 and 15 samples were selected randomly from each farm. A total of 371 cattle of different age groups were included in this study. Individual animal data (age, breed and deworming history) were collected from the records of each farm.

Study Design: A cross sectional study type was carried out from January to May 2017 to determine the prevalence of gastrointestinal helminthes of cattle in dairy farms of Sebeta and Holeta. The study cattle were selected by simple random sampling method using the previously collected sampling frame and fecal sample was collected from the selected animals. Each selected animals for study was identified by their code.

Sample Collection Procedure: The fecal samples were collected directly from rectum of the selected animals or from the top layers of fresh voided feces placed into the universal sampling bottle and preserved at 5 %

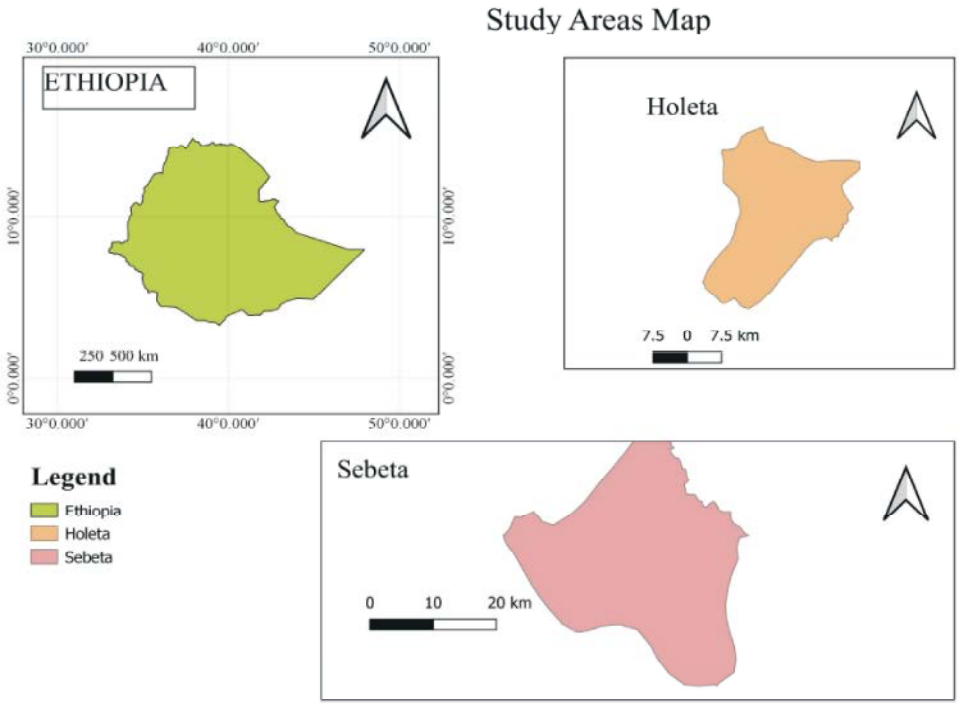

Fig. 1: Study area map

potassium dichromate. The sample was properly labeled with the following information Date, place, Ear tag (Animal identification). Samples were transported and processed at Animal Health Institute (AHI) helminthology laboratory. During sample collection additional data including date, sex, age, breed, body conditions and production system, for each sampled individual animal was recorded. Body condition scoring was determined as described by Morgan *et al.* [18] and further classified into poor, medium and good. Most of the farms were established as small scale commercial dairy farm which have <30 milking cows FAO [19] and few of them established as government breed improvement program.

Sample Size Determination: The sample size was calculated according to Thrusfield [20] by considering 50% expected prevalence (P), 95% confidence interval (CI) (Z=1.96) with 5% desired absolute precision (d), using the formula N= (Z) 2 P (1-P)/d2. The calculated required sample size (N) was 384. However, in this study the total numbers of sampled animals were 371, out of this 186 and 185 animals were sampled from Sebeta and Holeta towns, respectively and this can be attributed due to resource availability and animal management during the study period. Simple random sampling was considered to select the animals from the two farms of the study area where there was small herd size of animals existed in the farms.

Laboratory Analysis: All collected fecal samples were stored in refrigerator at 4°C for some delayed samples. Nematode eggs were identified by floatation technique in saturated NaCl solution and trematodes were examined by sedimentation methods. Fasciola species eggs were distinguished by their morphological and color differences. Helminthes positive fecal samples were subjected to modified McMaster Egg counting technique used as rule for fecal samples that were positive to the parasite eggs and the degree of infection was identified based on Soulsby [21], Smith *et al.* [22], Urquhart *et al.* [23] and MAFF [24]. Positive cattle were categorized as their GI parasitic burden low, moderate and severe infected according to their egg per gram (EPG) of faces counts. Where their fecal egg counts were between100-250, 251-500 and >500 EPG of feces were considered as low, moderate and severe infection, respectively [21, 23, 24].

Data Analysis: The data collected from the study area was coded and recorded in Microsoft excel spread sheet 2010 and then analyzed by using SPSS software package version 25. And descriptive statistics was used to determine the GIT prevalence, while Chi-square (χ^2) analysis was used to measure association between prevalence of the helminthes and age, sex, breed, body condition, lactation status, pregnancy status and

de-worming status of animals in the study. Confidence interval was held at 95% and P < 0.05 was set for significance. In all the analyses, confidence level was held at 95% confidence level and P<0.05 were set for significance value.

RESULTS

In the present study, from the total 371 fecal samples examined by sedimentation, floatation and McMaster methods, the overall prevalence of GI helminthes were found to be 56.06 (%) (n=208). Examined Animals were found to be harboring for single or mixed protozoan and nematodes and trematodes parasite eggs in their feces. The number of cows harbouring single GI parasites was 50 (24%) Incorporate p-value *Eimeria spp* eggs, followed by 44 (22.1%) *Fasciola hepatica*, 32 (15.4%) *Toxocara vitulirum,* 16 (8.0%) for *Strongyle* type eggs. The higher proportion of mixed infection prevalence 14 (6.7%) *Toxocara vitulirum* and F*asciola hepatica*, 14 (6.7%) *Eimeria spp* and *Toxocara vitulorum*, followed by 9 (4.3%) *Eimeria spp* and Nematodes spp and 9 (4.3%) Eimeria spp, Nematodes spp and *Toxocara vitulorum* Table 1.

The quantitative examination shows that majority of animals positive for helminths 102 (49%) were infested severely (>500 EPG), while 69 (33%) animals were moderately (500 to 1000 EPG) infested and few animals were infested lower (<500 EPG). The eggs of protozoan and helminths identified with respective genera were *Eimeria* spp. (50/24%) *Fasciola* (46/22.1%), *T. vitolurum* (33/15.9%), *Strongyle* (16/7.7%) *Trichuris* (1/0.5%), *Oesophagostomum* (1/0.5%).

The prevalence study in the different age categories were also conducted and it was observed to be 6.2%, 22.9% and 70.9% in age groups of <1year, 2-3 years, >than 3 years calves, Heifers and dairy cows respectively. The prevalence of GIT parasite by age group was 51/24.5%, 11/5.3% and 146/70.2%, respectively. There was statistically significant difference among the age groups (χ^2=53.926, P=0.028) as shown in Table 2. Higher prevalence rate was shown in adult than young animals.

There were a significant difference in prevalence of GI parasites with body condition of the animals observed (χ^2=64.228[a], p=0.003). A higher prevalence rate was occurred in animals with good body condition 62.5%, followed by 22.9% and 14.6% were in animals with poor and moderate body condition respectively (Table 2). The statistical analysis in between breeds of animals showed that there was significance difference (χ^2=39.633[a], P=0.002) with the prevalence of helminthes parasites (Table 1).

Risk factors sex, lactation status and Pregnancy status of the animals did not revealed any significant (*P*>0.05) relation with occurrence of protozoan, nematodes and trematodes helminthes.

Similarly, animals with de-worming history the prevalence of GI parasites with un-dewormed animals were high (74.5%) than de-wormed cattle 25.5% did not statistically significant among de-worming and un-dewormed cattle (28.321, P=0.057) (Table 2).

Table 1: Prevalence of helminthes parasites among dairy cattle

GI parasites species single infection	Frequency	Percent (%)
Emeria spp.	50	24.0
Strongyle spp.	16	8.0
T. vitolurum	33	15.8
F. hepatica	46	22.1
Tricuris	1	0.4
Oesophagostomum	1	0.4
Sub total	147	70.7
GI parasites species mixed infection	**Frequency**	**Percent (%)**
Emeria spp. *Strongyle* spp. & *T. vitulirum*	9	4.3
Emeria & *Fasciola hepatica*	2	1.0
T. vitolurum & *F. hepatica*	14	6.7
Strongyle spp. & *T. vitolurum*	1	0.4
Emeria spp & *Tricuris*	4	2.0
Emeria spp. & *T. vitolurum*	14	6.7
Emeria spp. & *Strongyle* spp.	9	4.3
Emeria spp. *Strongyle* spp. & *F. hepatica*	1	0.4
Strongyle spp. & *F. hepatica*	4	2.0
Strongyle spp., *T. vitolurum* & *F. hepatica*	2	1.0
Emeria spp. *T. vitolurum* & *F. hepatica*	1	0.4
Sub total	61	29.3
Grand total	208	99.9

Table 2: Risk factors involved in the prevalence of gastrointestinal parasites

Risk Factors	No of examined animals	No positive (%)	χ^2	P-Value
Age				
≤ 1 Year	85	51(24.5)	53.926	0.028
2-3 Years	23	11(5.3)		
> 3 Years	263	146(70.2)		
Breed				
Boran	30	24(11.5)	39.633	0.002
Friesian cross	341	184(88.5)		
Body condition				
Poor	85	48(23.1)	64.228	0.003
Moderate	54	33(15.9)		
Good	232	127(61.1)		
Deworming history				
Undewormed	262	155(74.5)	28.321	0.057
De-wormed	109	53(25.5)		
EPG				
Low	37	37(17.8)	41.404	0.179
Moderate	69	69(33)		
Severe	102	102(49)		

DISCUSSION

The present study has revealed that the presence of gastrointestinal helminthes parasites of dairy cattle in Holeta and Sebeta towns. The overall prevalence of 208 (56.6 %) of the cattle were infected with single or mixed GI parasite species, the present study revealed that the cattle herd in the study area suffers from a wide variety of GI helminthes infection. The present study finding was very close with the previous result reported by Jelalu *et al.* [25] gastrointestinal parasites infections in dairy cattle are well-known as a major limitation to farm animal production. The lower prevalence was reported by Bacha, A and Haftu [26] and Yimer *et al.* [27] at west Arsi zone and Dire Dawa Administration 49% and 41.15%, respectively. The high prevalence was also reported by Bedasa [28] at Holleta Agricultural Research institute dairy farm 68.2% and 87.90%, respectively. Helminthes infections are subclinical with considerable economic losses due to morbidity, mortality and reduced productivity of farm animals [29, 30]. Heavy parasitic burden dominated by *Emeria* spp. High prevalence of helminthes infections may be caused by frequent exposure to pasture contamination under semi intensive and extensive production system in the study areas.

In the present study, the most prevalent GIT parasite in dairy cattle was *Emeria* spp (13.5%). This was lower than previous report by Regasa *et al.* [31] with (26.04%) and higher than the report of Bacha and Haftu [26] with prevalence of (2.9%). The second most prevalent GIT trematode parasite in this study were *F. hepatica* (12.4%) Similarly, the higher prevalence was reported by Bacha and Haftu [26], Babagana *et al.* [32]. With (36.5%) and (21.74%), respectively. Followed by *T. vitolurum* (8.6%) the higher prevalence was reported by Keno *et al.* [15] with (14.29%) nematode [4] reported higher prevalence of *Strongyles* 41%. While Bacha and Haftu [26] reported lower prevalence of *Strongyles (*2.6%) when it was compared to the present study finding (4.3%).

This might be attributed to several accumulated evidence shows that changes of these environmental factors can exert influence on the occurrence, transmission and distribution of endo-parasites [33, 34]. Extreme environmental conditions may affect pathogens directly when they include free-living stages in their life-cycles and indirectly through reduced resource availability for hosts and thus reduced ability to produce efficient anti-parasite defenses, or by effects on host density affecting transmission dynamics of diseases or the frequency of specific contact [35].

CONCLUSION AND RECOMMENDATION

GI parasites are important health problems of dairy cattle in the study areas with an overall prevalence of 56.06%. The current finding confirmed that Eimeria spp was the predominant GI parasite followed by *F. hepatica* and *T. vitolurum* and *Strongyles* were the most abundant nematodes and trematodes. Mixed infection was composed by different helminthes genera in the study areas. Managements, particularly history of de-worming and body condition of the animals were found to be related to the occurrence of nematode infection in dairy cattle farms. Therefore, suitable control and preventive measures using regular de-worming would have very important.

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