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Eimeriosis of Calves in and Around Addis Ababa, Ethiopia

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Abstract: A cross-sectional study was conducted from November 2015 up to April 2016 to determine the prevalence of Eimeriosis in calves, identify the associated risk factors and to determine the intensity of infection in and around Addis Ababa. Three hundred thirty four fecal samples were collected from calves and were examined for the presence of the oocysts of *Eimeria* by floatation technique using concentrated sucrose solution. The study revealed that the overall prevalence of Eimeriosis was 24.3%. In this study age, breed, production system and hygiene status of the dairy farms were considered as risk factors. The prevalence of Eimeriosis was found to be higher within calves in poor hygiene dairy farms than caves from better hygiene. There was significant difference ($P<0.05$) in the prevalence of Eimeriosis between the different age groups with the highest prevalence in age category less than 6 months (31.5%). There was also significant variation ($P<0.05$) between calf breeds. The highest prevalence of the infection was recorded in calves with diarrheic feces (61.5%) than the other calves with soft and normal fecal consistency ($P<0.05$).

Key words: Addis Ababa · Calves · Eimeriosis · Prevalence · Risk Factors

INTRODUCTION

Ethiopia endowed with abundant livestock resources of varied and diversified genetic roles with specific adaption to its wide range of agro ecologies. The country has the largest livestock population in Africa accounting for about 53.99 million cattle. 98.95% of the cattle populations are local breeds. The remaining are hybrid and exotic breeds that accounted for about 0.94 percent and 0.11 percent, respectively. The remaining are hybrid and exotic breeds that accounted for about 0.94 percent and 0.11 percent, respectively [1].

The future of any dairy production depends, among other things on successful program of raising calves and heifers for replacement. On the other hand, the health and management of replacement animals are important components of total herd profitability. The productivity of the herd can be negatively impacted by impaired growth of calves, decreased milk production of animals that experienced chronic illness as baby calves, spread of infectious diseases from calves to adult cows, increased veterinary costs and the limited opportunity for genetic selection due to high mortality of replacement animals. Amongst all animals present on a dairy farm, the highest morbidity rates generally occur in baby calves prior to weaning [2].

Eventhough Ethiopia has a huge livestock resources, it could not exploit it as a result of the prevailing socio economic values and attitudes; poor management, prevailing live stock diseases and poor genetic potential [3].

The most important disease problems in the young calf are pneumonia and diarrhea. The important pathogens associated with calf diarrhea worldwide are rotavirus, corona virus, Salmonella species and protozoan parasites *Eimeria* and *Cryptosporidium* species. Eimeriosis is one of the most important parasitic diseases of neonatal calf both in dairy and beef farms and accounts approximately 75% of the mortality losses of dairy calves less than 3 weeks age [4]. This infection is caused by *Eimeria* species the most pathogenic species being *Eimeria bovis* and *Eimeria zurnii* [5].

In severe cases, these organisms damage the intestine by destroying epithelial cells and tissues, which interferes with the animal's ability to absorb nutrients [6]. All calves managed under conventional systems are exposed to coccidia and become infected early in life.

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Coccidiosis results a marked reduction in feed efficiency and weight gain which eventually leads to death of the animal. Fraser [7] reported that younger aged calves and poor hygienic status of the farms were strongly associated with infection of cocidiosis in dairy farms. Generally losses due to subclinical disease even exceed those resulting from clinical coccidiosis [8].

Although coccidiosis is an important cause of calf morbidity and mortality in Ethiopia in general and in the study area in particular, very little attention has been given to the disease and losses. Few reports on the occurrence of *Eimeria* in calves have been reported in Ethiopia by different researchers which include [9] 22.7% in Diredawa, Kassa *et al.* [10] 24.9% in Bahirdar, Abebe *et al.* [11] and Debre zeit and Yadessa *et al.* [12] 51.7% in Jimma.

Therefore, the current study was initiated with the following objectives:

- To determine the prevalence of calf Eimeriosis in and around Addis Ababa
- To identify the associated risk factors with the infection
- To determine the intensity of *Eimeria* infection

MATERIALS AND METHODS

Study Area: The study was conducted in and around Addis Ababa city including surrounding areas: Holeta, Sebeta, Sululta and Sendafa. Addis Ababa is the capital city of the government of Federal Democratic Republic of Ethiopia. Administratively, the city is a chartered city having three layers of government: city government, sub-city administration and district administration. It lies at an elevation of 2, 300 meters and is a grassland biome, located at 9°1'48?N 38°44'24?E. On the other hand Holeta, Sebeta, Sululta and Sendafa are towns surrounding Addis Ababa. Their altitude is 2391 m, 2356 m, 2500 m and 2514 m above sea level respectively. These areas have a complex mix of highland climate zones, with temperature differences of up to 10°C, depending on elevation and prevailing wind patterns. The high elevation moderates temperatures year-round and the city's position near the equator means that temperatures are very constant from month to month.

There are specialized dairy and poultry farms in the city. Apart from Government production under the Dairy Development Enterprise (DDE), there are 5, 167 dairy farms with 58, 568 dairy cows. Most of the farms (93%) have one to five cows while the rest have six or more cows. Annual milk production is about 44 million liters (An average of 2 liters per cow per day). The major constraints faced by dairy farmers include shortage and high costs of feeds, low price of milk, heavy taxation and marketing and management problems.

Selection of Study Farms and Animals: From study area, Addis Ababa and its surrounding, 4 Oromia special zones and 4 sub cities, 8 districts, 12 kebeles and 25 dairy farms were selected purposely. The farms were known for their potential of calve population and it is the hot spot for coccidiosis. Once dairy farms and extensively managed calves are identified and sampling frame was established all calves under one year age were sampled randomly

Sample Size Determination: Sample size was calculated with an expected prevalence of 68.1% from the previous research work on prevalence of calf coccidiasis in Addis Ababa *et al*. [11]. The desired sample size for the study was determined by using the formula described by Thrusfield [13]. As follows:

$$n=\frac{1.96^2 Pexp(1-Pexp)}{d^2}$$

where,

n = required sample size
d = desired absolute precision
P exp = expected prevalence
1.96^2 = z- value for 95% confidence interval

Accordingly the calculated sample size was 334 calves.

Study Design and Sampling Strategy: A cross sectional study design was employed from November 2015 to April 2016 to determine the prevalence of Eimeriosis both in dairy farms and extensively managed cattle and to determine the associated risk factors. Information on farm structure and calve management were collected from 25 farms using a standardized structured data collection table. The owner or manager of each farm was interviewed in the local language during sample collection. Sanitation status was judged as poor, medium (Satisfactory) or good based on aspects such as odor, waste drainage, cleanness of floor and animals, barn ventilation and light source and animal stocking based on the objective criteria developed by Curt and Gooch [14]. Body Condition, Age and sex were recorded during sampling.

Sample Collection and Examination

Faecal Sample Collection: Thirty gram of fresh fecal sample was collected from rectum from each calf using sterile disposable plastic gloves. The samples were placed in a labeled clean plastic container (Universal bottle) and were transported to College of Veterinary Medicine and Agriculture, AAU, parasitological laboratory on the same day of collection and were preserved at 4°C refrigerator until processing within 48 hours of arrival. At the time of sampling, the name of the farm (Owner), date of sampling, consistency of the feces (Diarrheic, soft or normal) and the age, sex, breed, address, body condition and management system were recorded for each calf on a data recording format.

Laboratory Examination of Fecal Samples: Flotation technique, was employed as follow, a 5 g portion of each of the 334 fecal samples collected from the total of 30 g was weighed out using a balance and put in a 50 ml beaker. Forty two ml of water was added, mixed thoroughly and poured into a 100 ml glass beaker through a strainer. The 50 ml glass beaker was rinsed with 8 ml of water and the total fluid was poured into four 15 ml conical tip centrifuge tubes. After centrifugation at 1, 500 rpm for 3 min, the supernatant was decanted and a sugar solution with specific gravity of 1.27 was added to the sediment, until the tube was about half full. The content of each test tube was thoroughly mixed with a wooden applicator stick. With the aid of a conical flux, more sugar solution was added until 13ml of the tube is filed with the solution. The mixture was again centrifuged in 1500 rpm for 3 minutes. After centrifugation the tube was filled to the top until a convex meniscus was formed and a glass cover slip was placed on top of the tube and left for 10 minutes. Then, each glass cover slip was briskly lifted up and placed on a clean glass slide, not allowing formation of air bubbles. The entire area under each cover slip was examined under a microscope at 10x magnification [15].

Quantitative Fecal Examination: Quantitative fecal analysis was conducted on positive samples to determine the number of oocysts of *Eimeria* per gram of feces (OPG) using the McMaster technique as described by Kaufman [16].

Data Analysis: The collected data was analyzed using SPSS, version 20 software package by employing the chi-square test. In the analysis, a difference was taken as statistically significant at a p-value less than 0.05.

RESULTS

Overall Prevalence of Calf Eimeriosis: Out of 334 fecal samples examined, from dairy calves 81 were found positive for *Eimeria* oocysts and hence the overall prevalence was found to be 24.3%.

Prevalence of Eimeriosis by Sex: From the examined 84 male calves 36 (42.9%) were found positive and from 250 female calves 45 (18%) were found positive. Accordingly, the prevalence of coccidiosis in male calves was higher than female calves (Table 1).

Prevalence of Calf Eimeriosis by Age: From the 223 examined calves with age category less than 6 months and from 111examined with age between 6 and 12 months age category calves, 68 (31.5%) and 13 (11.7%) were found positive, respectively. Accordingly, the highest prevalence was recorded in those calves with age less than 6 months old age (Table 2).

Prevalence of Calf Eimeriosis by Breed: Fecal analysis resulted in 26.5% and 10.6% prevalence for cross and local breed calves respectively (Table 3).

Prevalence of Calf Eimeriosis by Production System: The overall prevalence of Eimeriosis on the basis of production system was determined and it was more prevalent in intensive than in the calves that were reared under extensive one (Table 4).

Prevalence of Calf Eimeriosis by Fecal Consistency: Among samples collected, 78 were diarrheic of which 48 (61.5%) harbored Eimeria parasites (Table 5).

Prevalence of Calf Eimeriosis by Hygienic Status of Farms: From the total of 334 calves that were examined 15.7%, 27.1% and 30.0% prevalence were obtained from good, moderate and bad hygiene of the farm, respectively. Accordingly, calves belonging to the farms with bad hygiene showed higher prevalence (30.0%) than calves belonging to the farms with relatively better hygiene.

The Relation Between Occurrence of Eimeriosis and Different Risk Factors: The observed data result shows sex, age, breed, fecal consistency, production system and hygiene status of the farm were found to be potential risk factors for the occurrence of Emeriosis.

Table 1: Prevalence of calf Eimeriosis by sex

Sex	No examined	No Positives	Prevalence (%)
Female	250	45	18
Male	84	36	42.9
Total	334	81	24.3

Table 2: Prevalence of calf Eimeriosis by age

Age (Months)	No Calves examined	No Positive	Prevalence (%)
<6	223	68	31.5
6-12	111	13	11.7
Total	334	81	24.3

Table 3: Prevalence of calf Eimeriosis by breed

Bread	No examined	No Positives	Prevalence (%)
Cross	287	76	26.5
Local	47	5	10.6
Total	334	81	24.3

Table 4: Prevalence of calf Eimeriosis by production system

Production system	No examined	No Positives	Prevalence (%)
Extensive	69	12	17.4
Intensive	265	69	26
Total	334	81	24.3

Table 5: Prevalence of calf Eimeriosis by fecal consistency

Faecal consistency	No examined	No Positives	Prevalence (%)
Diarrheic	78	48	61.5
Soft	133	21	15.8
Normal	123	12	9.8
Total	334	81	24.3

Table 6: Prevalence of calf Eimeriosis by farm hygiene

Hygiene of housing	No examined	No Positives	Prevalence (%)
Good	102	16	15.7
Moderate	162	44	27.1
Bad	70	21	30.0
Total	334	81	24.3

Table 7: Logistic regression analysis of the prevalence of calf coccidiasis against the associated variables

Variable	No examined	No Positives	Prevalence (%)	χ^2	P-value
Sex					
Female	250	45	55.6	21.148	0.001
Male	84	36	44.4		
Age					
<6	223	68	84	17.889	0.001
6-12	111	13	16		
Breed					
Cross	287	76	93.8	5.18	0.019
Local	47	5	6.2		
Faces consistency					
Diarrheic	78	48	59.3	78.286	<0.001
Soft	133	21	25.9		
Normal	123	12	14.8		
Production system					
Extensive	69	12	14.8	2.228	0.136
Intensive	265	69	85.2		
Hygiene of house					
Good	102	16	19.8	6.154	0.045
Moderate	162	44	54.3		
Bad	70	21	25.9		

Table 8: Intensity of Eimeria infection in relation to risk factors

Variable		Less infected	Moderately infected	Severely infected	χ^2	P-value
Fecal consistency	Diarrheic	36.4	61.9	75	85.6	<0.001
	Soft	18.2	19.0	9.4		
	Normal	45.5	19.0	15.6		
Body condition	Good	9.1	31.3	9.4	23.259	0.001
	Medium	45.5	40.2	40.6		
	Poor	45.5	28.6	50.0		
Age	<6	77.3	85.7	87.5	16.918	0.01
	6-12	22.7	14.3	12.5		

Quantitative Fecal Examination: The McMaster technique employed to determine the OPG revealed that minimum, mean and maximum OPG value of 100, 479.5 and 3700 were observed, respectively. There was high correlation between fecal consistency and body condition with intensity of the infection (Table 8).

DISCUSSION

In the present study, the overall prevalence of calf Eimeriosis was 24.3%. The present result roughly agrees with the previous works reported by Dawid *et al.* [9] in Diredawa (22.7%), Kassa *et al.* [10] in Bahirdar (24.9%) and Nagwa *et al.* [17] in Egypt (24.2%). But in contrary it was lower than reported by Abebe *et al.* [11] (68.1%) in Addis Ababa and DebreZeit; 67.4% [18] in a neighboring Kenya and Yadessa *et al.* [12] (51.7%) in Jimma. The result is a bit higher than the previous prevalence reported by Heidari *et al.* [19] (8.25%) in Iran. This variation is most likely attributed to the differences in agro-ecologic and production system of the study areas [6]. The other possible reason might be associated with the season of the year in which the studies were performed. During rainy season the presence of relatively high humidity and moderate temperature, favors the survival and sporulation of the oocyst [20]. The present study was conducted during the dry season of the year which was unfavorable for the survival and sporulation of the oocyst.

There was statistically significant difference ($P<0.05$) in the prevalence of Eimeriosis between sex (Male 40% and female calves 19%). This finding disagrees with the report of Yadessa *et al.* [12] and Alemayehu *et al.* [21]. This finding could be explained in terms of the management given to male and female calves by the owners [9].

Age of the calves was significantly associated ($P<0.05$) with the risk of infection by Eimeriosis. Accordingly the highest prevalence was recorded in those calves with younger age categories (<6 months). This finding agrees with the report of Dawid *et al.* [9] and in contrast of Abebe *et al.* [11] who reported that risk of infection by *Eimeria* species appeared to increase with the age of the examined calves. However, it has been stated that Eimeriosis is commonly a disease of young cattle 1-2 months to 1 year [6]. Thus, stress factors like weaning, change of diet, harsh environment, poor nutrition and sanitation and overcrowding can increase level of infection and incidence of the disease due to stress-induced immunosuppression [22]. On the other hand, Eimeriosis is a self-limiting disease and spontaneous recovery without specific treatment is common when the multiplication stage of the coccidia has passed [23]. This could suggest that previous exposure might have a contribution to the development of certain level immunity of older calves as compared to younger that did not experienced previous exposure. Faber *et al*. [8] and Chibuanda *et al*. [24] also indicated the presence of immature immune system in younger calves resulting in more susceptibility to Eimeriosis than older calves with immunity from previous exposure, hence more resistant to subsequent reinfection.

There was a statistical significant difference in the prevalence of Eimeriosis between local (10.6%) and cross breeds (26.5%) ($p\leq0.05$). This finding agrees with the result of Asfaw *et al*. [25]. However, this result disagrees with the report by Alemayehu *et al*. [21].

There is highly statistically significant difference ($p<0.05$) in the prevalence of Eimeriosis between diarrheic calves (61.5%) and calves that defecate semisolid feces (15.8%) and dry feces (9.8%). This finding agrees with Yadessa *et al*. [12]. Coccidiosis is a common health problem particularly in neonatal calves being responsible for considerable economic losses in both dairy and beef calves. It is the cause of acute diarrhea accounting for approximately 75 % of cases related to mortality in the young age group of dairy calves [4].

There was no significant difference ($p>0.05$) in the prevalence of Eimeriosis and production system. This result agrees with the report by Alemayehu *et al*. [21] but disagrees with Asfaw *et al*. [25] which revealed that there was statistically significant association between them ($P<0.05$). However, as the result shows it's more prevalent in intensive production system (26%) than the extensive ones (17.4%); this was justified by Radostitis *et al*. [26] thatEimeriosis in cattle is particularly a problem of confined animals kept under intensive husbandry practices.

Statistically significant difference ($p<0.05$) has been observed in the occurrence of Eimeriosis in the different hygienic status of farms. Indicating that, calves belonging to the farms with poor hygiene showed higher prevalence than calves belonging to the farms with relatively better hygiene. This could imply that poor sanitation in the calving and calf housing areas as well as poor management of housing favors infection with Eimeriosis. Obviously, poor ventilation, draughts, poor calf nutrition, group pens, heavy stocking, cows present with calves, soiled bedding were regarded as risk factors for Eimeriosis [6]. This finding is in agreement with the results of Dawid *et al*. [9] and Asfaw *et al*. [25].

Quantification of Eimeriaoocysts in fecal samples by the MC Master technique revealed minimum and maximum OPG of 100 and 3750 respectively. This finding is in line with Yadessa *et al*. [12] who reported the minimum value of 100 and a maximum value of 2400. The result is in the middle when compared with those reported from different countries [11] mean value of 5109 and maximum 267000 Oocyst excretion levels OPG in Addis Ababa and DebreZeit, Munyua and Ngotho [18] reported a maximum of 30, 600 OPG in Kenya. The maximum OPG belongs to a fecal sample with a diarrheic consistency from a calf younger than 6 months.

The highest intensity of oocyst output was detected in calves with age category less than 6 months. This might be due to immature immunity. In addition highest intensity of oocyst also observed in calves with poor body condition revealed that the intensity of oocyst has direct effect on the body condition. There was a high significant association between the intensity of infection and fecal consistencies. This result is same as Abebe *et al.* [11] who reported that a highly significant ($P<0.001$) association was observed between fecal consistency and the intensity of infection. Not only that significant association was observed both on body condition and age category with that of intensity of infection.

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