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Research Article

Prevalence of Calves Coccidiosis and Its Associated Risk Factors in and Around Woldia Town of North Wollo Zone, Ethiopia

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Abstract

A cross sectional study was carried out from December 2024 to April 2025 in and around Woldia town to determine the prevalence of calves Coccidiosis and to identify its associated risk factors. Fecal samples were collected from a total of 384 randomly selected calves with the age of up to one year. Detailed information of the age, sex, breed, management system, body condition and origin of animals were taken in consideration. The Collected fecal samples were examined for the presence of Eimeria oocyst through floatation technique by using sodium chloride salt solution. The present study revealed that out of 384 calves, 99 (25.78 %) were found to be positive for Eimeria oocyst. Analysis of associated risk factors showed that there was statistically significant difference ($P<0.05$) in the prevalence of coccidia infection to the age groups of animals, body condition and management system. This means age, body condition and management system were the major risk factors for the prevalence of calves coccidiosis in and around Woldia town. However, the difference was not statistically significant ($P>0.05$) between coccidia infection within sex, breed, and origin of calves. In conclusion, calves coccidiosis required a serious attention for control and prevention programs as well as further epidemiological investigation in different season of the year should be carried out to observe the effect of season on prevalence of the disease and other risk/stress factors in the study area.

INTRODUCTION

Livestock contributes to the commercial production systems in most areas of the world. A survey conducted by Food and Agriculture Organization shows that livestock population in the world grow to about 1.43 billion cattle, 1.87 billion sheep and goats, 0.98 billion pigs, and 19.6 billion chicken [1]. Ethiopia has the largest livestock population in Africa, with 65 million cattle, 40 million sheep, 51 million goats, 8 million camels and 49 million chickens [2]. Despite the largest livestock population in Ethiopia, livestock diseases are the major constraints to productivity and production that causing economic losses to dairy producers in Ethiopia [3].

There are many protozoan parasitic diseases that affect the livestock productivity in the world as well as in Ethiopia. Coccidiosis is one of the protozoan diseases caused by one or more species of coccidia and is usually most common and important in calves younger than 1 year old [3-5]. All age groups of cattle are susceptible to infection, but clinical case is most common in young animals [6]. Infection is characterized by acute invasion and destruction of intestinal mucosa, blood containing diarrhea, weight loss, fever, anorexia, emaciation and sometimes death [7].

Bovine coccidiosis is an important protozoan disease of genus Eimeria affecting calves all over the world resulting in considerable economic losses each year to the beef and dairy industries [8]. More than twelve different species of Eimeria in cattle and buffalo have been documented until now. Most commonly prevalent species are E. *bovis*, E. *zuernii* and E. *auburnensis* [9]. However, E. *zuernii* and E. *bovis* are the two most common Eimeria species [3]. It is host specific which limits the infection transmission to come from other cattle and occasional passive transfer of oocysts [10]. In Ethiopia, Eimeria are among the most common diarrhea-causing protozoan entero-pathogens in calves and causes severe calf morbidity and mortality [11,12].

The lifecycle of coccidian is direct and transmission is faeco-oral from contaminated water and feed. Unsporulated oocysts are passed in the feces and become infective through a process called sporulation. Each zygote divides into four cells of sporocyst; each sporocyst develops to two

sporozoites within sporozoites are infective stage [13]. Infection is acquired by ingestion of sporulated oocysts; sporozoites are released and penetrate the intestinal wall; each species enters a specific type of host cell; reproduce asexually forming meront, growing meronts destroy host cells and release merozoites that penetrate new cells; each species undergoes a set number of meront generations (usually 2, can be 3 or 4); merozoites then penetrate new host cells and enter sexual phase. Microgametes leave cell to fertilize macrogametes then the fertilized macrogametes become oocysts. The oocysts break out of host cell to be passed in the feces [14].

The oocysts require sporulation time outside of the animal ranging from a few days to weeks depending on the species, humidity, temperature, and other environmental factors. The oocysts are very resistant and can survive minus degrees temperatures for long periods that can span the winter season [15]. Infection can rapidly spread from calf to calf when animals are communally housed and overcrowded or from cow to calf via the udder when they are contaminated with infected calf feces in the lying area of the dams [16]. In addition, stress factors like change of diet, harsh environment, poor nutrition and sanitation, can increase the level of infection and incidence of the disease due to stress-induced immune suppression [7].

The development of clinical coccidiosis in cattle mainly depends on factors like species of Eimeria, age of infected animal, number of oocysts ingested, presence of concurrent infections, and management practices. When Compared to clinical coccidiosis, subclinical coccidiosis is economically more important and may account for over 95 % of all the losses associated with coccidiosis [17,15]. It can also delay growth of calves by as much as 2 months [7].

Most anticoccidial drugs are only effective during early stages of a coccidian life cycle. These drugs have also been used for prophylaxis to reduce the prevalence of coccidia [18-20]. In an attempt of preventive actions, management is important tool in reducing infection pressure [21]. Cattle infected with Eimeria acquire some immunity to infection [15].

The prevalence, species composition, and importance of calves' coccidiosis have been documented in various parts of the world; however, there is scarcity of data or information on animal morbidity and mortality in Ethiopia due to calves' coccidiosis, particularly in and around Woldia town north Wollo zone. Only a few studies available on the coccidia of calves reported an outbreak of coccidiosis due to Eimeria species with an overall prevalence of 31.8% in Haramaya district Solomon et al. [22], 43.0% in Jimma Mengistu and Malke et al. [21], 53.6% in Honkolo Wabe District East Arsi Zone Mogos and Walkite et al. [7], 22.7% in selected dairy farms of Dire Dawa Dawid et al. [8], 31% in and around Jimma town [15]. While there is paucity/ shortage of information on the occurrence and losses associated with calves coccidiosis and very little attention has been given to the role of coccidiosis as the cause of disease and production losses in calves in and around Woldia town, North Wollo Zone.

Therefore, this study was initiated to fill the information gap regarding the prevalence and determinant factors in the study area with the following objectives:

- To estimate the prevalence of calves coccidiosis in and around Woldia town, north Wollo zone.
- To identify potential and associated risk factors of calves' coccidiosis.

MATERIALS AND METHODS

Study Area

The study was conducted from December 2024 to May 2025 in and around Woldia town, which is a capital city of North Wollo Zone, Amhara National Regional State of Ethiopia. The town Woldia is the center of the district, which is 521 km North-east of Addis Ababa. This town is built between two symmetrical hills: Gabriel hill on the northwest and Quaro hill on the southeast. It Located north of Dessie and south-east of Lalibela, which has a latitude and longitude of 11°50′N 39°36′E and an elevation of 2112 meters above sea level with annual rainfall of 800-1200mm and the maximum and minimum annual temperatures recorded are 15 and 250c, respectively. The town has a total of 10 kebeles among those 6 are town kebeles and 4 are rural kebeles [23]. According to Woldia town Livestock Resource Development Office statistical data (2024), the total population of cattle 17,426, goat 4573, sheep 10,075, camel 284, horse 23, poultry 57,620, 712 bee colony and no mule. The rural area is characterized by mixed crop-livestock farming system Figure 1.

Study Population

The study population were local, exotic and cross breeds, male and female calves that are managed under traditional (free ranging) and semi- intensive Management system. The study was conducted on 384 calves which are up to the age of one year and selected randomly from purposively selected study kebeles (Addis ketema, Yejugenet, mehal mechare, jenetober and gola mechare). According to Woldia town Livestock Resource Development Office statistical data (2024), the cattle

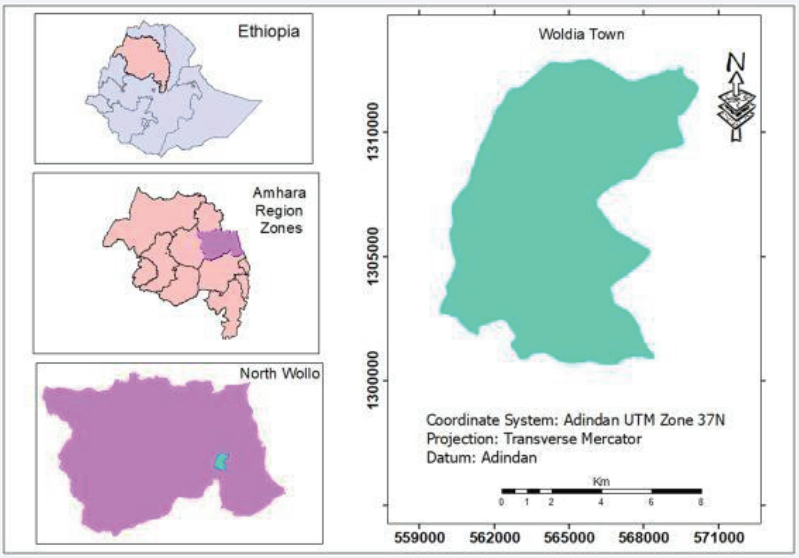


Figure 1 Map of study area. Source: Workineh et al., [24]

population of each selected study area were 2718, 2242, 539, 1241 and 955, respectively. Examined animals were categorized into two age groups as group one birth up to less than six months and group two six month up to twelve months which was determined by asking the owner of the animal orally [25].

Study Design

A cross-sectional study was conducted from December 2024 to May 2025 to assess the prevalence and associated risk factors of calves' coccidiosis in and around Woldia town, North Wollo zone. Active data was generated from randomly selected calves with regard to age, breed, sex, management system, origin and body condition was considered as risk factors to test for occurrence of calves' coccidiosis.

Sampling Methods and Sample Size Determination

For this study Woldia district was selected purposively due to time, transportation access, and number of animal's population. Simple random sampling technique was employed to select the study animal population and feces were collected from the individual calves. Since there was no previous work done on this study area, a 50% expected prevalence was used to calculate the required sample size. The desired sample size for the study was determined using the formula described by Thrusfield [26], as follows:

$$N = \frac{[1.96^2 P_{exp}(1 - p_{exp})]}{d^2}$$

Where, N = sample size required

1.96 = the value of Z at 95% confidence interval Pexp = expected prevalence

d = desired absolute precision

According to the above formula, the calculated sample size was 384 calves by using expected prevalence of 50% and 95% confidence interval at 5% desired level of precision.

Study Methodology

Fecal sample collection: Simple random samplings were followed in selecting the calves to study the prevalence of coccidiosis among calves in the selected study area. Three hundred eighty four fecal samples were collected during survey. About 10-25 gram fresh faecal sample were collected per rectum from each calf using sterile disposable plastic gloves. Each sample was placed in a clean plastic container and labeled. Sample was preserved with 10% formalin solution to avoid the eggs development and hatching. All collected samples were transported to Woldia university, biotechnology and biology laboratory using an ice box and stored at 4°C refrigeration until processing within 24 hours of arrival. At the time of sampling, the name of the owner, date of sampling, age, sex, breed, management system, body condition and origin were recorded for each calf on a recording sheet.

Laboratory (microscopic) examination: A 3 gm portion of each of the 384 fecal samples collected was weighed out using an electronic balance and put in a mortar. After grinding with pistil 50ml of sodium chloride

salt solution was added, mixed thoroughly and poured into a 100-ml glass beaker through a strainer. Then it was rinsed and the solution had been poured into 15-ml centrifuge tubes up to 3/4th of the tube but not filled. After centrifugation at 1,500 rpm for 3 minutes, more sodium chloride salt solution was added until a convex meniscus was formed on top of the tube. A glass cover slip was placed on top of each tube and was 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 binocular microscope at 4× then 10× magnification powers [27].

DATA ANALYSIS AND MANAGEMENT

Data collected from field during sample collection and laboratory identification were checked, coded, and entered into Microsoft Excel spreadsheet and then exported to STATA version 19 for analysis. Descriptive statistics were used to summarize the data with regard to frequencies and percentage. Tables were used to present the data. Analysis was done by comparing proportions (prevalence) distribution of positive and negative results. The prevalence was calculated for all data as the number of infected individuals divided by the number of sampled individual × 100. Pearson's chi square ($\chi 2$) was used to evaluate the association between the prevalence of coccidiosis and different risk factors. A 95% of confidence interval and a 5% desired level of precision were used to determine whether there was a significant difference between measured parameters. A value of P< 0.05 considered statistically significant.

RESULT

In the present study, out of total 384 samples tested, 99 (25.78%) were positive for the presence of Eimeria oocyts. Analysis of associated risk factors has revealed that there was statistically significant difference (P<0.05) in the prevalence of coccidia infection to age of the animals, body condition and management system. However, the difference was not statistically significant (P>0.05) between coccidia infection within sex, breed, and origin of calves as shown in Table 1 and 2.

DISCUSSION

Calves coccidiosis causes a significant economic loss throughout the world due to morbidity and mortality. The present study showed that the overall prevalence of calves' coccidiosis up to the age of one year was 25.78%, which is in line with the previous reported studies of Temesgen [28] [24.3%] in South Wollo Zone Amhara region, Kassa et al. [29], [24.9%], in Bahirdar, Zerihun et al. [30] [26.04%] in and around Holeta Town, Finfine Zuria Liyu Zone, Girma [31], [27.1%] in and around Deberebrhan town and Muhammed et al. [32] [30.7%] in and around Sekota town.

Table 1: Prevalence of calves' coccidiosis in relation to Sex, Age, Breeds and Body condition

Variables	Examined calves	Positive	Prevalence (%)	$\chi 2$	*P*-value
Sex				1.9498	0.163
Male	194	56	28.87		
Female	190	43	22.63		
Age < Six month 6-12 month	 158 226	 32 67	 20.25 29.65	4.2876	0.038
Breeds				1.3265	0.515
Local	198	55	27.78		
Cross Exotic	97 89	25 19	25.77 21.35		
Body condition				61.5456	0.000
Good Medium	82 163	4 28	4.88 17.18		
Poor	139	67	48.20		
Total	384	99	25.78		

Table 2: Prevalence of calves' coccidiosis in relation to management practices and its origin

Variables	Examined calves	Positive	Prevalence %	$\chi 2$	P-value
Management system				8.3932	0.004
Extensive	253	77	30.43		
Semi Intensive	131	22	16.79		
origin				2.6817	0.612
Addis ketema	135	41	30.37		
Yeju genet	112	27	24.11		
Mehal mechare	27	5	18.52		
Jenetober	62	15	24.19		
Gola mechare	48	11	22.91		
Total	384	99	25.78		

However, the prevalence result of the present study is much lower than many of the previous reports in Ethiopia, such as, 68.1% in Addis Ababa and Debre Zeit Dairy Farms Abebe et al., [25], 68% in the central high land of Ethiopia Rahmeto [33], 51.42% in Jimma Yadessa et al. [34], 62.5% in Asella Ibrahim et al. [35], and 38.9% in and around Asella town dairy farms [36]. On the other hand the result of the present finding was higher than the reports of Kebadu, [37], (20%) in Debre Zeit, Tamrat et al. [3], (20.1%) in Bahir Dar and Dawid et al. [8], (22.7%) infection rate in selected dairy farm of Dire dawa. This variation is most likely attributed to the differences in agro-ecology, management system, and management practices of the study animals in different areas [38]. Moreover, this could also be due to the fact that the study has been conducted mainly in dry season; hence, higher prevalence may be recorded if the study was carried out in the rainy and humid season.

There was no statistically significant difference in prevalence of coccidian infection between male and female animals (P =0.163), which is in agreement with the reports of [25,28]. Absence of statistically significant difference between the sexes of the study animals might suggest that both sexes of the animals have almost equal probability of accessing the oocysts and the fact that different sex groups kept in parallel management system might have equal chance of being infected with coccidiosis [39]. However slightly higher prevalence in male calves could be due to less care given to the male calves as compared to the female calves that are deemed to be future cows.

There was a strongly significant association between the age of the calves with the risk of infection (P=0.038), in which the prevalence of coccidia appeared to follow an age pattern. Higher infection rate was observed in calves 6 up to 12 months of age than calves of less than 6 months of age due to the fact that there was good nursing/protection of the colostrum feeding for younger calves while 6 up to 12 months of age calves were highly infected due to stress factors like weaning and change of diet can increase level of infection and incidence of the disease due to stress-induced immune suppression [20].

Additionally less care were given and have easy contact with adult animals. This has given more chance for the animals to lick each other and ingest large number of oocytes, which is in agreement with previous reports [38,25,15]. On the other hand this is in contrast to the previous studies of Rahmeto et al. [33]; Dawid et al. [8]; Alemayehu et al. [10], who noted that young animal less than 6 months were more susceptible than adults. This showed that younger ages (less than 6 months) were strongly associated with infection of coccidia.

The breed related prevalence of coccidian infection in the present study showed no statistical significant difference between breeds (P =0.515), which is in agreement with the findings of Abebe et al. [25]; Alemayehu et al. [10]. The absence of association between breed and coccidia infection may indicate either equal chance of accessing the oocytes or no difference on protective immunity for the disease between breeds. In contrast to the current findings, susceptibility differences were reported between local and cross breeds [35]. This breed susceptibility difference could be related to the dose of oocytes ingested and the species of Eimeria involved in the infection [40].

A strong significant association of coccidiosis prevalence was recorded between body conditions in the current finding which is similarly with, Dawid et al. [8]; Zerihun et al. [30], reported a higher infection rate in calves with poor body condition than in calves with good and medium body condition. This might be due to the weak immune status of the calves with poor body condition. This intimately related to animal's health, quality and has been widely claimed to be an important determinant of fitness [41]. As a result, higher prevalence of calf coccidiosis in poor body condition calves; might be all calves assess the oocytes, calves having good body condition can withstand the infection due to high level of immunity compared to calves having poor body condition. However, Poor body condition could be also due to lack of feed or nutritional management, might lead to lack of resistance to infection, decrease immune status of the calves and contribute to increase prevalence rate in poorly condition animals [20]. Beyond this the present finding disagrees with the report of Abebe et al. [25], and Alemayehu et al. [10].

The influence of management system on prevalence of coccidia has revealed that there was statistically significant association between them (P=0.004). This might be attributed to the fact that nutritional status and contamination of the feed or overcrowding of the animals was different in both management systems. In the present finding the prevalence of calves coccidiosis was higher in extensive than in semi-intensive management system. The reason for higher prevalence of Eimeria in extensive management system compared to semi intensive; it may be due to mal-nourishment, more contamination of water in ponds and overcrowding around a limited water source, which concentrates the hosts and parasites within a restricted area. The result of the present study is in agreement with the findings of previous studies Kennedy and Kralka [42]; Dawid et al. [8], that concluded husbandry systems to significantly influence prevalence of disease such as coccidiosis. However the current finding disagrees with the previous study of Abebe et al. [25]; Alemayehu et al. [10]; Mohammed et al. [15], and Temesgen [28].

Generally, poor calf nutrition, droughts, group pens, heavy stocking, presence of cows with calves and soiled bedding were regarded as risk factors for coccidiosis infection [38,20]. The variation in prevalence of infection between locations may be due to differences in management systems.

CONCLUSIONS AND RECOMMENDATIONS

The current finding showed that out of the total 384 samples tested, 99 (25.78%) were positive for Eimeria oocyts. The prevalence of coccidiosis has significant association (P<0.05) with age, body condition and management system. This means age, body condition and management system were the major risk factors for the

prevalence of calves coccidiosis in and around Woldia town. However the current finding has no significant association with sex, breed and origin of calves examined during the study period. The result indicates that the prevalence of calves' infections due to Eimeria species was high and it was more important in calves from the age of six months up to the age of one year. The maximum infection rate was observed in calves with poor body condition and in extensive management system. It has a great significance for the livestock producer in and around Woldia town and it needs a serious attention for control and prevention programs as well as further epidemiological investigation in different season of the year should be carried out to observe the effect of season on prevalence of the disease and other risk factors in the study area.

Based on the above conclusion, the following recommendations were forwarded:

- Immune status of the calves could be improved by get colostrum in the first 24 hrs of their life and by providing adequate nutrition.
- There should be Standard treatment regimen for infected calves and isolation of sick animals to prevent further transmission of the disease.
- All measures that minimize the amount of fecal contamination of hair coats should be practiced regularly.
- It should be avoid Stressful conditions such as mal-nourishment transportation, contamination of water in ponds and overcrowding around a limited water source, which concentrates the hosts and parasites within a restricted area.
- Regularly hygiene of animal and premises should be properly practiced.

ANNEXES

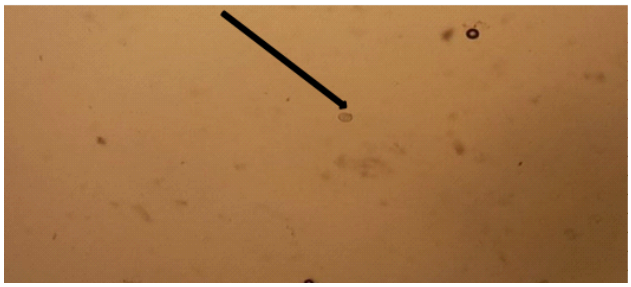
Annex I: Data collection sheet

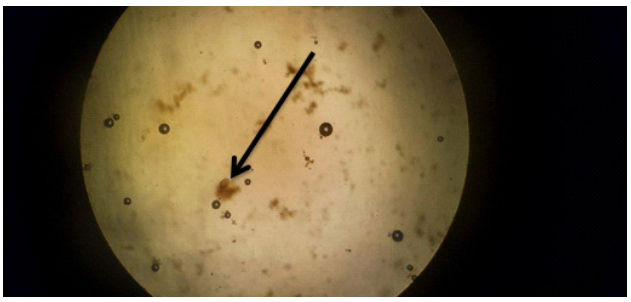
No.	sex	age	breed	origin	Management system	Body condition score	Lab result

Annex II: Laboratory procedures

- 3gm of well-mixed fecal specimen was taken.
- The specimen was mixed with the floatation fluid (saturated salt solution) of 50ml
- Coarsen specimen, was strained through a sieve to remove the large faecal particles filled in to centrifuge test tube.
- The mixture was centrifuged to sediment at 1500 revolution per minutes for 3 minutes.
- Floatation fluid was added into the test tube until a convex meniscus is formed to the top.
- A microscope cover slip was Placed on the meniscus and waited for 10min.
- The cover slip was remove and placed on the slide and examined under the microscope starting with lower magnification power (4x and 10x)

Annex III: Unsporulated eimeria oocyst observed during laboratory work





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