Sudan University of Science and Technology

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Prevalence and Risk Factors of Bovine Coccidiosis in Alselait Agricultural Scheme-Khartoum State

معدل إنتشار و عوامل الخطر لمرض الكوكسيديا في الأبقار في مشروع السليت الزراعي بولاية الخرطوم

By

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Dedication

To my beloved parents, Sisters and Brothers.

Acknowledgements

Firstly, I would like to express my deepest sense to the Almighty Allah, for all the blessings and wonderful opportunities that has been given to me and for letting me accomplish all the goals to complete the research work.

I am really grateful to my supervisor Prof. Siham Eliasfor her valuable supervision and guidance. I really deemed it and I realized it was an opportunity for me to work under her creative guidance.

Last but not least, I express my deepest sense of gratitude to my friends for their sacrifice, blessings and encouragement.

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Abstract

A cross-sectional study was carried out to estimate the prevalence of Coccidiosis in cattle and to investigate the potential risk factors associated with the disease during February 2018 in Alselait Agricultural Scheme, Khartoum State, Sudan.

A total of 100 cattle were examined randomly for the presence of *Eimeria*spp.oocysts using fecal floatation technique. The overall prevalence rate was 25%. The infection rate in the local breeds was 0% , whilst 25% in the cross breeds. The infection rate according to the age from a day up to 2 years old was 23.4%, 30%,50% and 6.66% ,respectively. The infection rate in males was 25.5% whereas in females was 24.5%. The infection rate in poorly managed farms was 20.9% , while 50% in well managed farms. The infection rate was 17.1%, 23.2% and 40.9% in poor, medium and good body condition animals, respectively.

Univariate analysis using the Chi-square, with confidence intervals of 95% at a *p-value* ≤ 0.25 was used to identify the potential risk factors associated with bovine coccidiosis . Significant positive risk factors associated with bovine coccidiosis in the univariate analysis, there were found to be breed (X^2= 2.128 , P-value = 0.145) , age(X^2= 5.819, P-value= 0.121), body condition (X^2= 4.192, P-value= 0.123) and farm management (X^2=5.426 , P-value= 0.020). The multivariate analysis, using logistic regression CI = 95% ,*p value* ≤ 0.05 showed highly significant association between bovine coccidiosis and farm management Exp (B)=8.667. It was concluded that the potential risk factor (farm management) showed highly significant association with Coocidiosis infection.

ملخص البحث

أجريت دراسة مقطعية للتحقق من معدل انتشار مرض الكوكسيديا في الابقار و التحقق من عوامل الخطر المرتبطة بانتشار المرض في شهر فبراير 2018 في مشروع السليت الزراعي – ولاية الخرطوم , السودان.

تم اختيار 100 رأس من الابقار عشوائيا و فحصت لوجود اكياس البيض لانواع الإيميريا عن طريق اختبار طفو البراز. كان معدل انتشار المرض في كل الحيوانات التي تم فحصها بإختبار طفو البراز هو 25%. معدل انتشار المرض وفقا للسلالة هو 0% في السلالات المحلية و 25% في السلالات المهجنة , معدل انتشارالمرض وفقا لعمر الحيوان من عمر يوم إلى عمر عامين هو هو 23.4%, 30%,50% و 6.66% على التوالي. معدل انتشار المرض وفقا للجنس هو 25.5% في الذكور بينما 24.5 في الإناث.كان معدل انتشار المرض وفقا لإدارة المزرعة التي تتواجد بها الحيوانات هو 20.9% في المزارع التي ليست مهيئة بصورة جيدة بينما 50% في المزارع التي هيئت بصورة مناسبة. كان معدل انتشار المرض وفقا للبنية الجسدية هو 17.1, 23.2% و 40.9% في الحيوانات ضعيفة , متوسطة و جيدة البنية الجسدية على التوالي .

تم التحقق من العوامل الايجابية المرتبطة بانتشار المرض باستخدام مربع كاي للتحليل فيالتحليل وحيد وكانت عوامل الغرض $P\text{-value} \leq 0.25$, CI=95% الخطر التي تساهمبانتشارالمرض
هي سلالة الحيوان (X^2= 2.128 , P-value = 0.145),عمر الحيوان (X^2= 5.819, P-value= 0.121),
البنية الجسدية للحيوان (X^2= 4.192, P-value 0.123) و إدارة المزرعة (X^2=5.426 , P-value= 0.020). بإستخدام التحليل بالإنحدار اللوجستي CI= 95% , $P\text{-value} \leq 0.05$ لمعرفة درجة الإرتباط بين إنتشار المرض و عوامل الخطر اثبتت النتائج وجود ارتباط وثيق بين المرض وإدارة المزرعة (Exp (B)= 8.667) . في الختام اثبتت هذه الدراسة وجود إرتباط وثيق بين معدل انتشار مرض الكوكسيديا في الأبقار و إدارة المزرعة.

Introduction:

Protozoan diseases are major constraint in progress of dairy farming all over the world, specifically in developing countries (Om *et al*., 2010;Farooq*et al*., 2012).Coccidiosis which is caused by different species of *Eimeria* belonging to phylum-apicomplexa is one of the most pathogenic intestinal diseases (Almeida *et al.,* 2011) . More than 13 species of *Eimeria*and one species of *Isospora*infecting cattle have been described. *Eimeriabovis*and *Eimeriazuernii*are the most pathogenic species and associated with clinical coccidiosis under field conditions while other species have been documented to be mildly or moderately pathogenic (Das *et al*., 2015). It's responsible for huge economic losses to the livestock industry in terms of mortality and morbidity in young calves (Nalbantoglu*et al*., 2008; Nisar-Khan *et al.,* 2013).

The disease takes place in acute, subacute and chronic Forms (Bastianetto*et al.,* 2007). In cattle, the disease is characterised by diarrhoea, fever, anorexia, weight loss, emaciation and sometimes death, particularly in young animals (Coetzer and Justin,2004).

Transmission takes place following ingestion of sporoblasts in the environment. These go through the first and second stages of schizogony in the small and large intestines, respectively, before gametogony in the colon. Oocysts are then passed in faeces to the environment where sporogony occurs and infection ofanother host can take place after ingestion of these oocysts with sporoblasts (Urquhart *et al.,*1996). Outbreaks of the disease have previously been linked to environmental stressors, including low
temperatures during cold seasons (Rodríguez *et al.*,1996). Environmental conditions in cattle sheds, which affect the survival andsporulation of infective oocysts, have been shown to influence risk of infection (Lassen *et al.*,2009). A number of studies have also looked at management-related factors such as housing system, feeding system, watering system, floor type and herd size affecting *Eimeria*spp. infection in cattle (Khan *et al.*,2013). Coccidiosis is particularly a problem of confined animals kept under intensive

husbandry practices and is more common in housed animals than in those on pastures (Radostits*et al*.,1994).

Diagnosis of coccidiosis is by detectingoocysts on fecal examination using direct smear, flotation or McMaster's techniques. The number of oocysts per one gram feces (OPG) is helpful in verifyingcoccidiosis as a cause of clinical disease (Almeida *et al*., 2011; Nisar-Khan *et al.,* 2013).

Objectives:

1- To estimate the prevalence of Bovine Coccidiosis in Alselait Agricultural Scheme.

2-To investigate the potential risk factors associated with the disease.

Chapter one

Literature Review:

1.1.Taxonomy:

The most abundant of all living things are unicellular organisms with a complex structure called *Protozoa*.They can be found in the lumen of the intestine, blood plasma, blood cells,other tissues and even in the nuclei of cells andmay result in diseases. *Protozoa* are a subkingdom of the Kingdom *Protista*. There are about 65,000 named species, roughly half of which are fossils. 'The Society of Protozoologists' in it's latest classification recognized seven phyla , two are very small and relatively unimportant (Levine,1985). The seven phyla are 1. *Labryinthomorpha*. 2. *Aceptospora*. 3. *Microspora* 4. *Myxozoa*.5.*Sarcomastigophora*6. *Ciliophora*. 7. *Apicomplexa*.The protozoa of the *Apicomplexa* contain an apical complex at some stage of development and a great number of these are parasitic. *Sporozoasida*and *Piroplasmasida* are the two classes of the phylum *Apicomplexa*. The class *Sporozoasida* is further divided into two subclasses which are *Gregarinasina* and *Coccidiasina.* They produce oocysts or spores. The members of the*Coccidiasina*are intestinal parasites of vertebrates , marine annelids and are further divided into four suborders. Out of the four suborders , three suborders (*Adeleorina, Haemospororina*, and *Piroplasmorina)* are haemoparasites of vertebrates,while the Suborder *Eimeriorina* contains primarily intestinal parasites and has 9 families,one is *Eimeriidae*. Among 24 genera in the family *Eimeriidae*, two genera;*Eimeria* and *Isospora*, are oftenly referredto as the "Coccidia".The Coccidia are generally extremely host specific (Levine, 1985 ; Andrews, 1980) and cattle are only infected by species of *Eimeria*.

1.2. Etiology:

All domestic animal species are vulnerable to coccidial infections. Although coccidian are host-specific, each host may be infected with many species of coccidia at the same time. In the United States at least 13 different coccidial species are known to infect cattle(Ernst and Benz, 1986), but not all are pathogenic. *Eimeriabovis*and *Eimeriazuernii* are the two most pathogenic species (Ernst and Benz, 1986). For *E.zuernii*and *E. bovis*incubation periods are usually 15 to 20 days (Georgi, 1985). Immunity to coccidiosis persists only 3 to 4 months and reinfection canoccur in the absence of continuous challenge (Fitzgerald, 1975).

1.3. Life Cycle:

The life cycle is initiated after the host has ingested sporulatedoocysts . In the host the sporozoites are released and invade appropriate host cells. In the host cell each sporozoite forms a meront, which undergoes merogony to form merozoites. When mature the merozoites escape from the meront, penetrate other host cells and begin another generation of merogony. Merogony continues for aspecific number of generations depending on the coccidial species. Finally gamogony occurs with microgametes and macrogametes being formed. Syngamy occurs within the cell hosting the macrogamete and a zygote is formed(Matjila,2000).

A membrane wall forms around the zygote to form an oocyst. Host cells containing the oocysts rupture and the oocysts are excreted together with faeces to the external environment. At the appropriate temperature and humidity, the oocyst cytoplasm divides to form four sporocysts, eachwith two sporozoites. The time required for sporulation depends on the species of coccidia and the temperature of the environment. Only sporulatedoocysts are infective to cattle(Matjila,2000).

1.4. Clinical Signs of Bovine Coccidiosis:

The clinical symptoms caused by various *Eimeria*species are similar in all animals. Mild fever can occur in the early stage, but in most clinical cases the temperature is normal or subnormal. The first sign of illness is commonly the sudden onset of severe diarrhoea with foul smelling fluid faeces containing mucus and blood. The blood can appear as a dark, tarry staining of the faeces or as streaks or charts of fresh red blood. Anaemia may be variable depending on the amount of blood loss. It can beextreme with ash-white pallor of the mucosa. There is weakness, staggering and dyspnoea. Severe dehydration, emaciation and complete anorexia occurs commonly(Oluwadare, 2004).The period of the disease is usually from five to six days and survivors undergo a convalescent period of some weeks and regain condition slowly. In mild cases, poor growth and anaemia are the only signs.Nervous signs like convulsions might be observed in calves and other cattle during outbreak.

1.5. Diagnosis

A combination of history, signs , gross lesions at necropsy and microscopic examination of scrapings of the intestinal mucosa and of faeces can aid in the diagnosis of bovine coccidiosis.Diarrhoea or dysentery accompanied byinappetence is indicative of coccidiosis in calves(Oluwadare, 2004).Other significant causes of diarrhoea in bovines in South Africa include acute and chronic salmonellosis, colibacillosis, chronic bovine viral diarrhoea, malnutrition, orgastrointestinal helminthosis. Coccidiosis may exist concurrently with any of these conditions (Oetjen, 1993).Secondary pneumonia isfrequently present (Oluwadare, 2004).Microscopic examination is essential to determine whether the lesions are due to coccidia or to some other agent. Nevertheless, diagnosis will be missed if one relies only on finding oocysts in the faeces. There can be none there at all in the acute stage of *E.zurnii*coccidiosis. Similarly,the mere presence of oocysts in the faeces is not evidence that coccidiosis is present. To be certain of a diagnosis scraping should be made from the affected intestinal mucosa and examined under the microscope.It

is not adequate to look for oocystsbut schizonts, merozoites and young gametes should be recognised (Oluwadare, 2004).Simple flotation and microscopicalinvestigation isoftenly sufficient to identify *Eimeria*oocysts, but species differentiation is needed if they are to be associated as a cause of diarrhoea(Daugschiesand Najdrowski, 2005). Morphological differentiation by light microscopy is still gold standard for *Eimeria*, although several new methods using enzymelinked immunoasorbent assay (ELISA) and Western blots have been developed. Nevertheless, their reliability suffer from species cross reactivity (Lassen, 2009).

1.6. Prevention and Treatment:

Metaphylactic treatments should be considered. Decoquinate, in the form of licks or included in the ration, are usually practised. However, clinical cases may still occur in certain circumstances. The most at risk of contracting the disease are calves between three weeks and six months of age . On “coccidia” farms it is necessary to recognise at what stage clinical signs “normally” occur; it may be change of housing, changes of feed or stress brought on by temperature variations. Once high numbers of oocysts are shed in faeces, the intestine has already been damaged. A single oral dose of either toltrazuril or diclazuril, seven days prior to the expected time of clinical signs or 14 days after a change in management, are often used successfully. However, this protocol should be reviewed frequently as the age at which the calves are affected may change. The challenge is to prevent disease and for the calves to build up immunity(Borsberry, 2014).

While numerous factors influence the reproductive efficiency of dairy cattle, there is little information about the effects that may be attributed to coccidiosis. Gut damage from coccidiosis can contribute to increased sensitivity to other pathogens, negatively influencing general fertility. The damage may also result in a long-term deficit in

nutrient absorption, contributing to endocrinal-metabolic changes which, in conjunction with changes caused by the onset of puberty, may increase overall stress on heifers (Veronesi*et al.*,2013).

1.7. Epidemiology Of*Eimeria* Infection:

A number of factors (environmental and host) affect the epidemiology of coccidiosis in cattle. These factors include, age of the animal, farm management, herd size and animal density. Management practices involve population density, stocking in pasture, aeration, farm hygiene and sanitation (Gaddam , 2005).All age groups are susceptible for infection whereas, calves under 1 months are mostly at risk . The majority of outbreaks occur following weaning (Gaddam , 2005).Studies speak both for and against high herd sizes as a factor for resulting in the increased occurrence of Eimeriosis (Matjila and Penzhorn, 2002). More animals together may put the animals at higher risk of infection in the presence of sick animals. There is however a larger consent regarding the source of calf infections being transmittable from older animals, especially if housed together (Bohrmann, 1991; Matjila and Penzhorn, 2002).Poor hygiene in the calf rearing area is a favorable condition for oocyst sporulation and longer survival in the environment. A low prevalence rate was observed with improved hygiene of calf pens (Chibunda*et al.*, 1996).Clinical disease relys on the magnitude of the oocysts ingested. Exposure to low oocysts number may not produce severe disease rather serves as immunity production for subsequent infection. Daugschiesand Najdrowski (2005) reported that when animals arecontinuously exposed to low levels of oocysts an endemic status-quo will establish itself under natural conditions. Thus the presence of *Eimeria* in a herd is not the same as the cause of outbreaks (Cornelissen*et al.*, 1995). Increased infection pressure increases the individual animals risk of Eimeriosis, but clinical outbreaks normally involve pathogenic species such as *E. bovis, E. zuernii*, and under certain conditions *E. alabamensis* (Marshall *et al.*, 1998). The rapid reproduction potential of

*Eimeria*ina closed environment with a few animals shedding millions of oocysts daily during patency and favourablecircumstances, does increase the spread of the parasite. Contaminated pastures may infect new first-grazers more than 3 years after being contaminated with oocysts (Svenssone*t al.,* 1994; Svensson, 2000).

Stress factors includingweaning, change in diet, climate condition, transportation, frequent regrouping, inadequate feeding or other infectious agents further contribute to infection (Gaddam , 2005).In the winter period outbreaks are also known to occur in the farms possibly due to numerous factors favourable for *Eimeria*such as feeding with contaminated hay and high humidity which accelerate sporulation of oocysts. Stress due to harsh cold conditions was considered as one of the factor for winter coccidiosis in Canada (Gaddam, 2005).Spring or pasture Eimeriosis may be observed at turn out or out-binding of calves where they consume overwintering oocysts from the pasture shed by animals infected the previous year(Larsson *et al.,* 2006; von Samson-Himmelstjerna*et al.,* 2006). Symptoms of disease may appear around 1-3 weeks after turn out, and often *E. alabamensis*can befound in high numbers (Svenssone*t al.*, 1994; von Samson-Himmelstjerna*et al.,* 2006). This species is known to cause problems in first year grazing calves in combination with *E. zuernii*- and *E. bovis*-infections in Sweden.

Chapter Two

Materials and Methods

2.1 Study Area:

This study was conducted in Alselait Agricultural Scheme, Khartoum State .The capital city of the Sudan, it lies between longitudes 31.5 to 34 °E and latitudes 15 to 16 °N. Population of the state was estimated at 5,274,321 in 2008 census of about 639,598 urban and 5,274,321 metro.The potential of Khartoum area for grazing is low.Grazing, therefore, is mostly dependent on the farms located in the forms of agricultural schemes.The ruminant populations are important resources in Sudan upon which depends the economy and livelihood of people significantly. AOAD (2000) showedthat Sudan,the most rich country of animal resources in the Arab world, holds about 35 million heads of cattle and the number of live cattle exports was 3350 thousands heads (AOAD , 1996) . This is the raw wealth of the country irrespective of the state of industry and the desirable grading standard .

2.2 The study design:

This study was a cross sectional study to provide snap shot information on occurrence of Coccidiosis in cattle in Alselait Agricultural Scheme in Khartoum State,Sudan. Fecal Samples were randomly collected from cattle of different breeds, age groups, sex, body condition and management practices during the period from February to March 2018.

2.3 Sample Size:

The expected prevalence of cattle Coccidiosis for calculation of sample size was taken from the previous study done in Sudan (where the prevalence of coccidiosisin calves was estimated to be 24.1% and 6.6% in adults in Khartoum State) (Gasmir*et al.,* 1998).

The sample size was calculated according to the formula done byThrusfield (2007):

$$n=1.96^2 Pexp(1-Pexp)/d^2$$

Where n=required sample size, d=desired absolute precision ,Pexp = Expected prevalence **.**

2.4. Sample Collection:

A total of 100 fecal samples were collected directly from the rectum of cattle into a clean plastic container. Each sample was clearly labeled with animal identification (age, breed ,sex, body condition) , farm management and date of collection .Transported to the laboratory and stored at 4°C until the test was performed within 48 hours.

2.5. Diagnostic Technique:

Animals were diagnosed using fecal floatation method .Approximately 3gm of faeces were placed in a beaker and 50 ml saturated salt solution was added to it. The faeces and flotation fluid werethoroughlymixed with a stirring device. The mixture was filtered through a fine tea strainer. The filtrate was poured into a test tubeand it was gently filled with the suspension until leaving a convex meniscus at the top of the tube. A coverslip was carefully placed on the top of the test tube and the test tube was left to stand for 20 minutes at room temperature after which the cover slip was removed and placed on a glass slide and examined under the microscope for the presence of *Eimeriaspp*. Oocysts(Hendrix,1998).

2.6. Data Analysis:

Results of the study were analyzed using Statistical Package of Social Science (SPSS). First, Descriptive statistical analysis was displayed in frequency distribution

and cross tabulation table. Univariate analysis using the chi-square for qualitative data. P-value ≤0.25 was considered as significant association and the risk factor was then selected to enter the multivariate analysis. Multivariate analysis: Forward or backward stepwise logistic regression was used to analyze the data and to investigate association between a potential risk factor and the prevalence of Coccidiosis. A p-value of ≤ 0.05 indicated significant association between Coccidiosisand the risk factor.

Chapter Three

Results

3.1. Overall prevalence rate of Bovine Coccidiosis:

A total of 100 fecal sample were collected and analysed, out of these 25 (25%) were found to be positive for Coccidiosis.The overall prevalence of cattle Coccidiosis examined by fecal floatation test inAlselait Agricultural Schemewas 25%(Table 3.1).

3.2.Risk factors contributed to Bovine Coccidiosis:

3.2.1. Breeds of Animals:

The distribution of Coccidiosis infection in Alselait Agricultural Scheme according to breeds is shown in table 3.2 and 3.3. Total number of local breed was 6 (6%) animals, all of which were found negative. The rate of infection was 0%. Total number of cross breeds examined was 94 (94%). Among these, there were 25 infections. The rate of infection was 26.5% (Table 3.1). The Chi-square test showed significant association between the infection and breed (p-value= 0.145), (Table3.4).

3.2.2. Age of Animals:

The animals were categorized into 4 groups according to their age. Forty seven (47%) were from one day old up to 6 months, 30 (30%) cattle were morethan 6 months up to one year, 8 animals (8%) were more than one year up to one and a half year and 15 (15%) animal were from more than one a half year up to 2 years.

Among the first group 11 animals were found infected. The rate of infection within this group was 23.4%. Nine animals were found infectedin the second group. The rate of infection within the second group was 30% (Table 3.3). Of the third group 4 animals were found infected . The rate of infection within this group was 50% .Only one animal of the forth group was found infected . The rate of infection within this group was 6.66%.

The Chi- square test showed significant association between *Eimeria*infection and the age of animal (p-value = 0.121), (Table 3.4).

3.2.3. Sex of Animals:

The results of this study as shown in table 3.2/3.3 the distribution of 100 cattle examined for Coccidiosis according to sex. Total number of males examined was 43 (43%) animals, while the total number of females examined was 57 (57%) (Table 3.2). Among males, 11 animals were found infected. Rate of infection within males was 25.5 %. While among females, 14 animals were found infected. The rate of infection within females was 24.5 % (Table 3.3).

The Chi- square test showed nosignificant association between *Eimeria*infection and sex of animal (p-value =0.907), (Table 3.4).

3.2.4. Body Condition of Animals:

Of the 100 cattle examined 35 (35%) of cattle were found to be in a poor condition, ,43 (43%) were in a medium condition, while 22 (22%) of cattle were found to be in a good condition (Table 3.1). Among poor condition animals 6 animals were found infected .

The rate of infection within poor animals was 17.1% (Table 3.3). Ten animals in a medium body codition were found positive. The rate of infection within medium body condition animals was 23.2%. Of the animals in a good body condition 9 animals were found infected. The rate of infection within good body condition animals was 40.9 %.

The Chi- square test showed a significant association between the infection and body condition of animals (p-value = 0.123), (Table 3.4).

3.2.5. Farm Management:

Eighty six (86%) animal were sampled from poorly managed farms while 14 (14%) were sampled from well managed farms. Of 86 animals 18 were found positive. The infection rate in poorly managed farms was 20.9%. While only 7 of the animals sampled from well managed farms were found infected . The infection rate in well managed farms was 50%.

The Chi-square test showed a significant association between the infection and management practices applied in the farms included in the study (p-value=0.020), (Table 3.4).

Table 3.1: Distribution of Coccidiosis among 100 cattle examined by fecal floatation method in Alselait Agricultural Scheme.

Valid	Frequency	Percent	Percent Valid%	Percent Cumulative%

+ve	**25**	**25**	**25**	**25**
-ve	**75**	**75**	**75**	**100**
Total	**100**	**100**	**100**	

Table 3.2: Summary of frequency distribution of 100 cattle examined for Coccidiosisby fecalfloatation test according to potential risk factors in Alselait Agricultural Scheme.

Risk Factors	Frequency	Relative Frequency%	Cumulative Frequency %

Breed			
Local	**6**	**6**	**6**
Cross	**94**	**94**	**100**
Total	**100**	**100**	
Age			
1 day-6 months	**47**	**47**	**47**
>6 months to 1 year	**30**	**30**	**77**
> 1 year-1 1/2 year	**8**	**8**	**85**
> 1 1/2 year-2years	**15**	**15**	**100**
Total	**100**	**100**	
Sex			
Males	**43**	**43**	**43**
Females	**57**	**57**	**100**
Total	**100**	**100**	
Body Condition			
Poor	**35**	**35**	**35**
Medium	**43**	**43**	**78**
Good	**22**	**22**	**100**
Total	**100**	**100**	
Farm Management			
Poorly managed	**86**	**86**	**86**
Well managed	**14**	**14**	**100**
Total	**100**	**100**	

Table 3.3: Summary of cross tabulation for the rate of Coccidiosis in each category of the potential risk factors in 100 cattle examined by fecal floatation test in Alselait Agricultural Scheme .

Risk Factors	No. Inspected	No. Affected (%)
Breed		
Local	**6**	**0**
Cross	**94**	**25(26.5%)**
Age		
1 day-6 months	**47**	**11 (23.4%)**
>6 months to 1 year	**30**	**9 (30%)**
> 1 year-1 1/2 year	**8**	**4 (50%)**
> 1 1/2 year-2years	**15**	**1 (6.66%)**
Sex		
Males	**43**	**11 (25.5%)**
Females	**57**	**14 (24.5%)**
Body Condition		
Poor	**35**	**6 (17.1%)**
Medium	**43**	**10 (23.2%)**
Good	**22**	**9 (40.9%)**
Farm Management		
Poorly managed	**86**	**18 (20.9%)**
Well managed	**14**	**7 (50%)**

Table 3.4: Summary univariate analysis for the association betweenCoccidiosis and potential risk factors in 100 cattle by fecal floatation test using the Chi-square test examined in Alselait Agricultural Scheme.

Risk Factors	No. Inspected	No. Affected %	df	X^2-value	P-value
Breed					
Local	**6**	**0**	**1**	**2.128**	**0.145***
Cross	**94**	**25 (26.5%)**			
Age					
1 day-6 months	**47**	**11(23.4%)**	**3**	**5.819**	**0.121***
>6 months-1 year	**30**	**9 (30%)**			
> 1 year-1 1/2 year	**8**	**4 (50%)**			
> 1 1/2 year-2years	**15**	**1(6.66%)**			
Sex					
Males	**43**	**11 (25.5%)**	**1**	**0.014**	**0.907**
Females	**57**	**14 (24.5%)**			
Body Condition	**35**	**6 (17.1%)**	**2**	**4.192**	**0.123***
Poor	**43**	**10 (23.2%)**			
Medium	**22**	**9 (40.9%)**			
Good					
Farm Management					
Poorly managed	**86**	**18 (20.9%)**	**1**	**5.426**	**0.020***
Well managed	**14**	**7 (50%)**			

*** Mean significant value**

Table 3.5: Multivariate analysis for the association between Coccidiosis and potential risk factors in 100 cattle examined by fecal floatation test inAlselait Agricultural Scheme.

Risk Factors	No. Inspected	No. Affected %	Exp (B)	P-value	95% CI for Exp (B)	
					Lower	Upper
Body Condition						
Poor	**35**	**6(17.1%)**	Ref			
Medium	**43**	**10(23.2%)**	0.558	0.440	0.127	2.459
Good	**22**	**9(40.9%)**	3.346	0.053	0.985	11.365
Farm Management						
Poorly managed	**86**	**18(20.9%)**	Ref			
Well managed	**14**	**7 (50%)**	8.667	0.008*	1.769	42.468

*** Mean significant value**

Significant positive risk factors associated with Bovine Coccidiosis in the univariate analysis, there were found to be**breed** (X^2= 2.128 , P-value = 0.145) , **age** (X^2= 5.819, P-value= 0.121), **body condition** (X^2= 4.192,P-value= 0.123) and **farm management** (X^2=5.426 , P-value= 0.020). There were also significant risk factors associated with fecal floatation positive in the multivariate analysis (Table 3.4).

The multivariate analysis showed highly significant associationbetween Bovine CoccidiosisandFarm management **Exp (B) =8.667** indicating that the risk of infection in well managed farms equals 8.667 times the risk in poorly managed farms (Table 3.5).

Chapter Four

Discussion

Results of the present study have increased knowledge on the epidemiology of Bovine Coccidiosis in Alselait Agricultural Scheme in Khartoum state of the Sudan, investigated by using fecal floatation method.Fecal floatation method showed that the prevalence rate of Bovine Coccidiosis was considerably high in the study area. A few studies have been conducted on Bovine Coccidiosis in the Sudan. Therefore, this study was conducted to estimate the prevalence rate of Bovine Coccidiosis and toinvestigate potential risk factors associated with the occurrence of BovineCoccidiosis in Khartoum state. In this study, the overall prevalence rate of Coccidiosisin cattle fecal samples collected from Alselait Agricultural Scheme inKhartoum state was 25% (25/100) by fecal floatation method.

The results obtained from fecal floatation method in the present study was higher than the prevalence (14.3%) reported byGasmir*etal.* (1998) who conducted a survey of Enteric Coccidia of cattle in Kharoum-Sudan, Heidari and Charekhani (2014) who reported a prevalence of 9.36 in Iran and Das e*t al.* (2015) who reported a prevalence of 11.97%in India.

However the prevalence reported in the present study was lower than that reported by Makau*et al. (*2017) in western Kenya who reported a prevalence of 32.8% ,Tomczuk*et al*. (2015) in Poland reported an overall prevalence of 52.8%.This could be due to the differences in the tested sample size (n). Many factors such as the number of ingested oocysts, the presence of a concurrent microbial infection, weather conditions (ambient temperatures and moisture), management in the farms and the functional level of protective immunity may be decisive in whether clinical disease isprecipitated or not (Parker and Jones, 1987; Waruiru*et al*., 2000).Additionally the

owners in the study area inject the animals suffering from diarrhea with sulpha containing drugs irrespective of the causative agent or other causes.

Knowledge of risk factors associated with Coccidiosis incattle is an important pre-requisite for the design andimplementation of effective control strategies and formanagement programs that can lead to the control anderadication of the disease. Knowledge of these risk factorsand their association and contributions to the occurrenceand spreading of Coccidiosis among cattle populationsalso is a good aid for clinical diagnosis and for determiningthe epidemiology and patterns of the disease. Very fewstudies in the Sudan have addressed risk factors associatedwith positivity to Coccidiosis in cattle.

The present study showed a strongly significantassociation (P-value < 0.05) between Farm management and risk of infection showing a higher prevalence in well managed farms compared to poorly managed ones. This finding is in contrast to the findings by Gasmir e*t al.* (1998) in Khartoum- Sudan ,Waruiru*et al*. (2000) in Central Kenya and Rehman*et al*.(2011) in Pakistan at Toba-Tek Singh districtwho reported a higher prevalence in poorly managed farms compared to well managed ones. This could be due to the fact thatthe presence of *Eimeria* in a herd is not the same as the cause of outbreaks (Cornelissen*et al.,* 1995).Coccidiosis is generally a self-limiting infection(Lassen, 2009)and animals are protected by immunity following a primary infection and thus subsequent infections are generally not related to clinical disease (Gaddam, 2005)with adult cattle acting as carriers of coccidia(Oluwadare, 2004).Additionally, according to Chapman (1999) immunity is measured in terms of reduced pathogenic effect, decrease in the number of parasitic

stages and improved body weight gain . Accordingly it's difficult to be diagnosed so as appropriate control measures (e.g. The use of a prophylactic treatment) usually adopted in well managed farms could be applied in order to reduce the risk of infection.

Conclusion and Recommendation:

Conclusion:

From the results of this study, it can be concluded that Bovine Coccidiosis is prevailing in Alselait Agricultural Scheme in Khartoum state with a high prevalence rate of 25% by using Fecal floatation method .Based on the results of this study, the risk factors associated with Coccidiosis in cattle were Breed, Age, Body Condition and Farm Management.

Recommendations:

- Reducing shedding of oocysts in the enviromentis an effective control measure, successful immune response to coccidia depends on limiting the infection and keeping the calves well fed and healthy
- Immunity to coccidia comes from successful response of calves' immune system.
- Treating all calves with coccidiostatic drugs to limit infections is more cost effective than waiting to treat the clinically ill calves
- Determination of number of oocysts per gram of feces using McMaster technique to determine the rate of infection (intensity).

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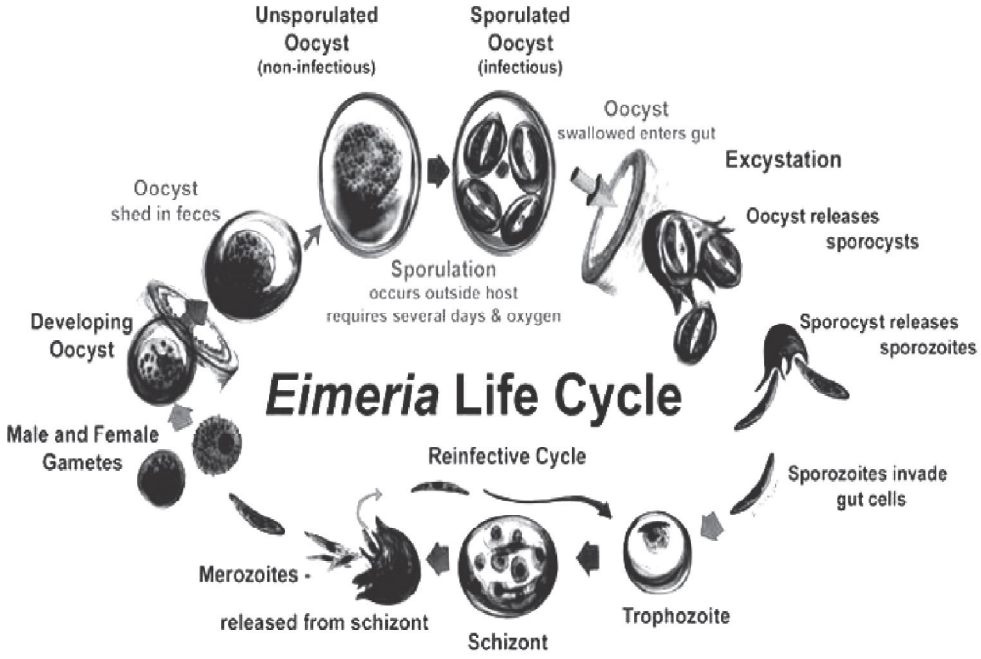
Appendices

Appendix I



*Eimeria*spp. life cycle.(Lassen, 2009).

Appendix II

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 3[a]	B.Cond			6.861	2	.032			
	B.Cond(1)	-.584-	.757	.595	1	.440	.558	.127	2.459
	B.Cond(2)	1.208	.624	3.748	1	.053	3.346	.985	11.365
	Manag(1)	2.159	.811	7.092	1	.008	8.667	1.769	42.468
	Constant	-1.576-	.448	12.341	1	.000	.207		

Forward stepwise logistic regression results.