



**UNIVERSITI PUTRA MALAYSIA**

**PREVALENCE OF COCCIDIOSIS IN GOATS FROM FIVE SELECTED  
FOSTER FARMS OF FACULTY OF VETERINARY MEDICINE,  
UNIVERSITI PUTRA MALAYSIA**

**SITI KHADIJAH BINTI AZMAN**

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FPV 2020 32**

**PREVALENCE OF COCCIDIOSIS IN GOATS FROM FIVE SELECTED  
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UNIVERSITI PUTRA MALAYSIA**

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**SITI KHADIJAH BINTI AZMAN**

**A Project Submitted To The  
Faculty Of Veterinary Medicine, Universiti Putra Malaysia  
In Partially Fulfilment Of Requirement Of The  
Degree Of Doctor Of Veterinary Medicine  
Universiti Putra Malaysia  
Serdang, Selangor**

**2020/2021**

**CERTIFICATION**

It is hereby certified that we have read this project paper entitled “Prevalence Of Coccidiosis In Goats from Five Selected Foster Farms Of Faculty Of Veterinary Medicine, Universiti Putra Malaysia”, by Siti Khadijah Binti Azman and in our opinion it is satisfactory in term of scope, quality and presentations as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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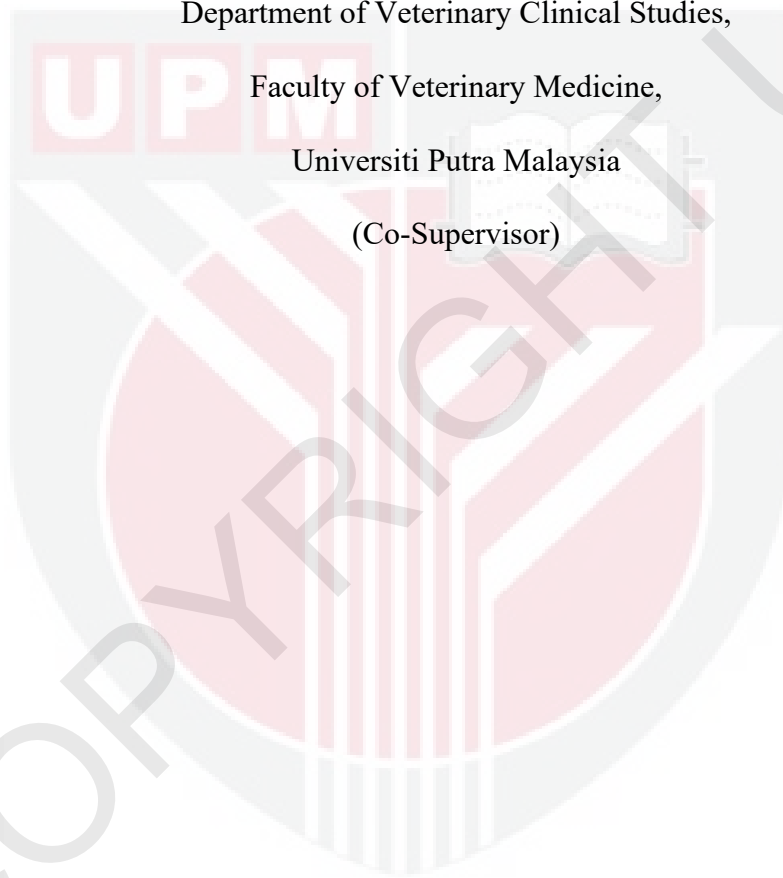
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## **DEDICATIONS**

This project paper is dedicated to my parents, my family members and my friends who have supported me throughout my DVM years in UPM.

### **My late father and my mother**

Azman bin Marzuki and Khasiah binti Haji Mislan

Whose affection, love, encouragement, non-stopping prays of days and night make me able to reach at this stage

### **My siblings**

Siti Nadiah Azman, Muhammad 'Arif Firdaus Azman and Siti Aisyah Azman

For giving encouragement and space by not disturbing me in finishing this project

### **My best friends**

For your understanding and overwhelming support that never end

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For being extraordinary batch mates ever

### **My supervisor**

For your non-stopping guidance and help

### **Farmers, UVH and FPV staffs**

For giving me chance to conduct my project without any problem

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**LIST OF ABBREVIATIONS**

OPG	Oocysts per gram
FOC	Faecal oocysts count
%	Percentages
Spp.	Species
GDP	Gross Domestic Product
FPV	Faculty of Veterinary Medicine
UPM	Universiti Putra Malaysia
°C	Degree Celcius
v/v	Volume/volume
mg	Milligram
kg	Kilogram
ml	mililiter
mm	Milimeter
10X	10 times magnification
40X	40 times magnification

**ABSTRAK**

Abstrak daripada kertas yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Ilmiah Tahun Akhir

**PREVALEN KOKSIDIOSIS DI LIMA LADANG ANGKAT TERPILIH  
FAKULTI PERUBATAN VETERINAR (FPV), UNIVERSITI PUTRA  
MALAYSIA**

**Oleh: Siti Khadijah Binti Azman**

**Penyelia: Dr. Nor Azlina Binti Abdul Aziz**

**Penyelia bersama: Dr. Sharifah Salmah Binti Syed Hussain**

Koksidiosis usus adalah salah satu penyakit parasit yang paling penting pada ruminan kecil seluruh dunia. Ianya disebabkan oleh spesis *Eimeria* dan telah dilaporkan sebagai penyebab jangkitan dan kematian yang teruk pada ruminan kecil di Malaysia. Kajian ini dijalankan untuk mengkaji prevalen koksidiosis dan menilai hubungannya di antara beberapa amalan pengurusan ladang pada kambing di lima buah ladang angkat terpilih FPV. Sejumlah 60 sampel najis telah diambil melalui rektum. Sampel najis tersebut digunakan untuk pengiraan koksidia melalui teknik kiraan telur McMaster. Oosista tersebut kemudian melalui proses sporulasi menggunakan 2% kalium dikromat selama seminggu pada suhu bilik.

Pengenalpastian spesies *Eimeria* adalah berdasarkan kriteria morfologi koksidia yang dikesan dibawah mikroskop. Tiada prevalen koksidiosis di dalam semua ladang yang dikaji. Namun, terdapat kehadiran koksidia di dalam semua ladang yang dikaji dan OPG koksidia berkisar dari 50 hingga 8350 dalam semua sampel kambing. Spesies *Eimeria* yang dikenal pasti adalah seperti berikut: *E. arloingi* (9%), *E. ninakohlyakimovae* (9%), *E. christenseni* (30), *E. alijevi* (14%) *E. hirci* (9%), *E. jolchijevi* (7%), *E. caprovina* (15%) and *E. caprina* (7%). Faktor yang menyebabkan prevalen koksidia yang tinggi berdasarkan OPG adalah disebabkan tiada aplikasi pemberian ubat cacing dan garam jilat dan pemberian makanan tambahan. Kesimpulannya, kajian menunjukkan terdapat kehadiran koksidia yang penting pada semua ladang yang dikaji dan amalan pengurusan ladang yang berkaitan seperti pemberian ubat cacing dan garam jilat boleh membantu mengurangkan kadar kehadiran koksidia.

**Kata Kunci:** Prevalen, koksidiosis, kambing, *Eimeria*, McMaster, OPG

**ABSTRACT**

Abstract of the project paper presented to the Faculty of Veterinary Medicine in partial requirement for the course VPD 4999 - Project

**Prevalence Of Coccidiosis In Goats from Five Selected Foster Farms Of  
Faculty Of Veterinary Medicine, Universiti Putra Malaysia**

**By: Siti Khadijah Binti Azman**

**Supervisor: Dr. Nor Azlina Binti Abdul Aziz**

**Co-Supervisor: Dr. Sharifah Salmah Binti Syed Hussain**

Intestinal coccidiosis is one of the most important parasitic diseases of small ruminants worldwide. It is mainly caused by *Eimeria spp.* and have been reported to cause severe morbidity and mortality in small ruminants in Malaysia. This study was conducted to determine the prevalence of coccidiosis and its association with selected management practices in goats from five selected foster farms of the Faculty of Veterinary Medicine. A total of 60 faecal specimen were collected per rectum. Faecal samples were subjected to oocysts counts via McMaster Faecal egg count technique. The oocysts were subjected to sporulation using 2% Potassium dichromate for about a week in room temperature. Identification of *Eimeria spp.* was based on morphology criteria observed under the light microscope. There is no or zero prevalence of coccidiosis was found in all studied farms. However,

there is the presence of coccidia in all studied farms and the oocysts per gram (OPG) ranged from 50 to 8350 among the sampled goats. *Eimeria spp.* identified was as followed: *E. arloingi* (9%), *E. ninakohlyakimovae* (9%), *E. christenseni* (30), *E. alijevi* (14%) *E. hirci* (9%), *E. jolchijevi* (7%), *E. caprovina* (15%) and *E. caprina* (7%). Factors associated with a higher prevalence of coccidia based on oocysts per gram (OPG) were due to the absence of deworming, lack of mineral block application and administration of additional feed. In conclusion, the study suggests there is a significant presence of coccidia in the studied farms and the management practices such as deworming, provision of the mineral block may assist in controlling the number.

**Keywords:** Prevalence, coccidiosis, goat, *Eimeria*, Mc Master, Oocysts per gram.

## 1.0 INTRODUCTION

The livestock industries is one of the subsectors of the agriculture industries contributing to 11.8 % for Malaysia Gross Domestic Product (GDP). Recently, goats (*Capra hircus*) are known as the third-largest population in Malaysia farming following cattle and swine population (Perangkaan Ternakan 2018/2019, Jabatan Perkhidmatan Veterinar, Kementerian Pertanian Dan Industri Asas Tani). As a result of development and modernization, the growth rate of the goats' population in Malaysia has also consistently increased from 2018 to 2020 nationwide. Gradual increase of this goat population has created a lot of small scales farmers to meet with the demand by Malaysian for small goat meat and milk production.

Coccidiosis is a protozoal infection of genera *Eimeria spp.* causing acute invasion and destruction of intestinal mucosa; by invading and destroying the intestinal cells, resulting in blood loss and poor nutrient absorption (Fazly Ann Zainalabidin *et al.*, 2015). Foreyt (1990) reported that coccidiosis is one of the most ubiquitous and economically important diseases of goats. The disease spreads from one animal to another by ingestion of infective oocysts (David and Kenneth, 1993). It can infect animals of all ages and usually cause no clinical signs (Chekol Demis, 2015). According to Jalila *et al.* (1994), nine species of *Eimeria* identified in Malaysia are *Eimeria arloingi*, *Eimeria ninakohlyakimovae*, *Eimeria christenseni*, *Eimeria alijevei*, *Eimeria hirci*, *Eimeria jolchijevi*, *Eimeria caprovina*, *Eimeria caprina* and *Eimeria pallida*. Different species of *Eimeria* have different pathogenicity, where *E. ninakohlyakimovae* is considered to be the most pathogenic

species (Pellerdy, 1974) with severe diarrhoea, depression and death. In the study by Yvone and Esnault (1987), they agreed that *E. ninakohlyakimovae* was the most pathogenic.

Coccidiosis could be very devastating in goats, as it is known to cause mortality and morbidity in larger herds every year (Mukherjee *et al*, 1991). A study from (Soulsby, 1982; Zamri, 1987) has shown that coccidiosis was reported to be one of the important infections related to intestine second to worm infection. *Coccidia* would invade and destroy intestinal cells of the hosts thus causing blood loss, electrolyte imbalance and poor absorption of nutrient content. Coccidiosis presented with common clinical signs of diarrhoea with bloodstain if severe, poor weight gain, rough hair coat and inappetence. Coccidiosis burden is always associated with age, where it contributes to a parasitic infection that is more vulnerable to young animals compared to adults due to different levels of immune system and association with poor management, high animal density, poor sanitation, low immunity and poor nutrition. The disease severity based on the species of *coccidia* involved, age, resistance of the host, number of host cells destroyed, number of oocysts that initiated the infection and the degree of reinfection (Cheng, 1986).

Since there is limited knowledge, information or literature available in Malaysia regarding the coccidiosis in goat despite the importance of coccidiosis in the livestock industry, this study was conducted with the following objectives:

1. to determine the prevalence of coccidiosis in goats from five selected foster farms of the Faculty of Veterinary Medicine.
2. to study the associations of selected management practices namely mineral block supplementation, type of drug used, breed, age, sex, source of the animal, farm system, additional feed with coccidiosis.

## **2.0 LITERATURE REVIEW**

### **2.1 Taxonomical classification**

Taxonomically, coccidia belongs to the kingdom of Protozoa, phylum of Apicomplexa, subphylum of Sporozoa, class of Conoidasida, order Eucoccidiorida, and family of Eimeridae (Soulsby,1982). The family Eimeridae include the genera of *Eimeria* and *Isospora* which consist of four sporocysts and two sporocysts respectively. Members of the Eimeridae are usually monoxenous, microscopic, spore-forming and single-cell protozoa (Frenkel and Dubey, 1972; Susan, 2011). Protozoa are unicellular organisms in which the various activities of metabolism, locomotion are carried out by organelles of the cell (Soulsby,1982).

### **2.2 Species of Eimeria**

There are seventeen species of *Eimeria* known to infect goats throughout the world, of which nine species have been recorded in Malaysia. *E. arloingi*, *E. christenseni* and *E. ninakohylakimovae* are considered to be the most pathogenic species of *Eimeria* in goats (Kusiluka and Kambarage,1996).

### **2.3 Life Cycle of Eimeria spp.**

The life cycle of coccidia can be divided into two phases which are an exogenous phase and an endogenous phase. The exogenous phase takes place outside of the body in the environment and is called sporulation of oocysts. While in the endogenous phase, which occurs internally where the parasite undergoes numerous

divisions in the intestinal cells. The life cycle takes between two to four weeks, depending on the species of *Eimeria*. (Samuel et. al, 2015)

In exogenous phase, the unsporulated oocysts are passed out in faecal material of the goat into the environment. Under optimal environments, unsporulated oocysts of most species sporulate in two to five days. Oocysts can be killed at a temperature over 40°C and below -30°C. However, in between it, unsporulated oocysts can remain viable for more than a year (Foreyt and W.J.,1986). Unsporulated oocysts are more susceptible to extreme temperature conditions than sporulated oocysts (Smyth and Horten,1954). Under suitable environmental conditions, temperature, and oxygen density, the formation of four sporocysts occurred, thus forming infective sporulated oocysts.

The endogenous phase, started once sporulated oocysts ingested by the susceptible goats. Oocysts encystation happened within the intestinal lumen under the influence of mechanical and biochemical action of an enzyme in the digestive tract of the goat escaping the infective sporozoite (Fitzgerald and p.p.,1980). In the schizogony phase, eight sporozoites are released through the action of bile and trypsin and are actively penetrated epithelial cells and transform into a feeding stage called trophozoites in one to two days. The trophozoites started to enlarged as nucleus division occurs by asexual multiplication forming merozoites within the schizonts. Rupture of mature schizont will release merozoites that will penetrate epithelial cells producing secondary schizonts thus creating second-generation merozoites by the asexual multiplication for three to four more cycles.

In the gametogenic phase, second-generation merozoites penetrate the epithelial cells of the large intestine and initiate the sexual development of microgamonts (male) or macrogamonts (female). Both micro and macro gamonts will rupture and mature into micro and macrogametocytes. Fertilization of macrogamete by microgamete results in the formation of zygotes further undergoes zygotelays forming a wall around itself to form unsporulated oocysts. The oocysts again exit from the cell into the intestinal lumen and excreted or shed into the faeces (Lefevre & B., 2010). The entire life cycle in the host need two to three weeks and might extend for several months depending on the species of Eimeria.

#### **2.4 Disease Transmission**

Coccidia is transmitted from one animal to another by ingestion of infective oocysts (David and Kenneth, 1993). Oocysts can be killed at temperatures over 40°C and below -30°C. However, in between it, unsporulated oocysts can remain viable for more than a year (Foreyt and W.J.,1986). Studies by Musa et al., (2010) reported that oocysts have been shown to survive outside the host for up to two years and resisted low temperatures, dry conditions and many forms of disinfectant. The spread of coccidiosis has been aided by contaminated equipment, feed containers, personnel, rodents, insects and wild birds.

## **2.5 Coccidiasis and coccidiosis**

Coccidia can be found everywhere in the environment and can be detected microscopically by examining the faecal sample of the animal herd (Soulsby, 1982). The presence of coccidia does not necessarily imply that it has the disease. There are 2 types of coccidial infection which are clinical infection and subclinical infection. Studies by Jolley and Bardsley, (2006) state that counts of 5000 oocysts per gram or higher in combination with a typical clinical picture such as bloody dropping are highly suggestive of coccidiosis or clinical coccidial infection. Meanwhile subclinical infection or coccidiasis, affected goat do not have visible symptoms of the disease but the gross lesion and coccidia are present (Cervantes, 2015).

## **2.6 Coccidiosis risk factor**

Management systems and age factors are the common predisposing factors that are known to influence the coccidia oocysts burden in livestock (Symoens et al, 1993). Young that are less than one year old are most susceptible to coccidia infection while adult goats develop coccidiosis if in immunocompromised status or when the animal lives in an environment that is heavily infested with coccidial oocysts. Older goats were able to resist infections of endoparasite more efficiently than in young (Gibsons *et al*,1973). Symoens et al, (1993) suggest that kids usually exhibit high faecal oocysts count in the first few weeks after birth.

Management such as semi-intensive and intensive systems also contribute as a risk factor of coccidial infection. Small ruminants grazing in a semi-intensive system for three to four days in an area which was emptied for five to six weeks has

reduced worm burdens (Sani et al., 2004). Other than that, poor hygiene status could increase levels of infection and incidence of the disease due to feed and water contamination (A. Khodakaram-Tafti & M. Hashemnia, 2017).

The control of worms in small ruminants in Malaysia, like elsewhere, relies heavily on chemical dewormers or anthelmintic drugs. Anthelmintics being easily available and affordable, together with the government-subsidized ruminant health programme implemented in Malaysia, have led to the emergence of widespread anthelmintic resistance (Nor-Azlina *et al.*, 2011). The deworming status could be a risk factor for coccidial infection as no implementation of deworming programmes with poor health conditions if animals result in coccidiosis. According to Radovan and Jana (2014), anthelmintic treatment results in reducing helminth infection thus causing the shedding rate of *Eimeria spp.* oocysts to be reduced.

Apart from that, the absence of mineral block application also contributes to the presence of coccidia. When the mineral block was used as a supplement, the worm burden was reduced compared to unsupplemented goats. By supplementation with mineral blocks, the animals were able to minimize the incidence of new infections and reducing the parasites burden in goats (Nor-Azlina *et al.*, 2011).

## 2.7 Diagnosis of coccidiosis

The diagnosis of coccidiosis depends on the clinical findings (diarrhoea, dehydration, lethargic and weight loss), the presence of large numbers of oocysts in the faeces, appropriate signalment and intestinal lesions at necropsy and history. Diagnosis is difficult because clinically normal goats often shed coccidial oocyst. Furthermore, there may be considerable intestinal damage even before oocysts appear in the faeces. The developmental stages of *Eimeria spp.* in the intestinal cells can be demonstrated in Giemsa-stained intestinal smears and haematoxylin eosin-stained histological sections. The demonstration of various developmental stages of *Eimeria spp.* and the denudation of the intestinal epithelium is considered to be a positive diagnosis for coccidiosis. Post mortem examination is the best means of confirming the diagnosis. The intestines may be slightly reddened and full of fluid, but the most characteristic feature of coccidial infection is the presence of multiple small pale nodules one to two mm in diameter in the intestinal wall.

Microscopic analysis of faecal samples makes it possible to quantify the rate of infestation by counting the number of oocytes excreted per gram of faeces (OPG). Although this method can support the diagnosis, it is usually not very reliable because most animals will excrete the oocysts in the absence of the disease and acute coccidiosis may occur before the oocysts are demonstrable in faeces. Furthermore, *Eimeria spp.* vary in their pathogenicity. However, the presence of very high numbers of oocysts in faeces together with clinical signs may be highly suggestive of the disease. Faecal oocyst counts on randomly selected goats are needed to obtain a correct estimation of the average excretion of a group of animals.

Identification of *Eimeria* species has to be made based on the morphological criteria of the oocysts, most often after sporulation (faecal material at room temperature for two or three days, or after dilution in 2% potassium dichromate and incubation at 25°C). According to the species, there are variations in the size of the oocyst, its wall, the presence or absence of a membrane surrounding the wall, the appearance of the sporocysts (four per oocyst) and the sporozoites (two per sporocyst, comma-shaped), polar cap, micropyle and the cytoplasm colour. The traditional methods are not only very subjective and time-consuming but are also unreliable since the different species have overlapping properties. Furthermore, morphological observations combined with the faecal examination are very labour intensive and require skilful technique. It is essential to develop a more rapid, convenient, and accurate diagnostic method.

Coccidiosis can be differentiated by an experienced examiner by the morphology of the unsporulated oocysts. However, sporulation is done to make a clear vision of the oocysts to make the identification of species more accurate. Following recovery from coccidia infection, an animal is relatively immune to reinfection with the same species. But immunity is not solid and the infection will be of low grade and will not harm the host. Hence the presence of oocysts of even highly pathogenic species in the faeces does not necessarily mean that the animal has clinical coccidiosis. On the other hand, it may cause severe symptoms and even death before oocysts have been produced.

## 2.8 Coccidiosis treatment and control

Generally, the treatment of coccidiosis involved the use of coccidiostat and supportive treatment according to symptoms (Fitzgerald, 1980). Coccidiostats can be used to treat the coccidiosis and work as supportive treatment in goats according to the symptoms. The disease can be controlled and treated by improving the management with proper sanitation and reducing the stressor. It is also can be done by providing chemoprophylaxis treatment. It can be classified into Polyether antibiotics or ionophores, which are produced by the *Streptomyces* spp. fermentation. These drugs disrupt ion gradients across the cell membrane of the parasite. It is monovalent ionophores (monensin, salinomycin) and divalent ionophores (lasalocid). Studies by Noack, S., Chapman, H.D. & Selzer (2019) state that the other classification is synthetic compounds known as chemicals, with a specific mode of action that inhibit parasite mitochondrial respiration (decoquinate) or competitive inhibition of thiamine uptake (amprolium). Toltrazuril 20mg/kg was reported to prevent the establishment of coccidiosis by degeneration and disintegration of the first generation of schizont. Sulfonamides work by inhibiting dihydropteroate synthetase (McCullough and Maren,1974). It has broad-spectrum activity against gram-negative and gram-positive bacteria as well as protozoa. Its work as appetite is depressed in infected animals then inclusion in the drinking water is preferable for treatment (Shumard,1957).

### **3.0 METHODOLOGY**

#### **3.1 Farms**

A total of five selected Foster Farm of Faculty of Veterinary Medicine, UPM were included in the study and all farms have a coccidial count to allow for monitoring of their numbers in the faeces.

#### **3.2 Epidemiological survey**

A total of 60 faecal goats were collected from a total 144 goat population in the farms during the study period. The samples were transported to the lab in a cool box and processed on the same day. For each farm, management and feeding systems such as the number of animals, grazing time and type of feed and feed supplementation were recorded. Hygiene status was determined by assessing the following criteria such as ventilation, elevation above ground level and exposure to direct sunlight, frequency of cleaning, space for each animal and manure removal.

#### **3.3 Sampling**

Faecal samples were collected fresh per rectum of the goat and stored in the plastic bag. Each farm represented 20% of the sample size and was selected through random sampling. The samples were transported to the laboratory in a cool box and processed on the same day or up to two to three days after collection for oocysts count and identification. Faecal samples from the farm with the presence of coccidial oocysts were kept in 2% potassium dichromate for subsequent sporulation and measurement for species identification.

### **3.4 Parasitology Techniques**

#### **3.4.1 Eimeria Oocysts Count**

Modified McMaster techniques were used for oocysts counting. Two grams of faeces were weighed using an electronic balance and were mixed using a spatula. Then, faeces were suspended with 60 ml saturated Sodium Chloride (NaCl) solution in a graduated beaker and filtered through the sieve into another beaker. Faecal residue in the sieve was discarded. The filtrate was stirred with a spatula and pipetted to load both counting chambers of the McMaster slide.

Oocyst was counted in both chambers under the light microscope at 10x10 magnification and each oocyst counted 50 represent oocysts per gram faeces (OPG). When the faecal sample was less than two grams, the volume of saturated NaCl was adjusted to 15 ml of solution per gram of faeces.

#### **3.4.2 Sporulation of Oocysts**

The method of oocysts sporulation used in this study was based on MAFF (1986) as cited by references. Firstly, faecal samples were suspended in 2% of potassium dichromate solution (1:1 v/v) for storage at room temperature. Then, the suspension was filtered through a tea sieve to remove coarse debris and then spread thinly in 60 mm Petri dishes, covered and kept at room temperature (25-30°C) to allow for sporulation. After one week, the samples were stored in 100 ml containers at 4°C until examined.

### 3.4.3 Morphological examination

Oocysts were examined under the digital microscope (Nikon eclipse 80i Research Microscope) at 40 x 40 magnification and oocysts length measurement was taken using software equipped with the digital microscope. The morphological characteristics of the various oocysts based on the measurement of the oocysts found in 1 ml of supernatant.

*Eimeria* spp. identification was based on the measurement of sporulated oocysts length and width, the shape and presence or absence of micropyle and polar granule (Levine *et al.*,1962). The micropyle is a refractive area in the wall of oocysts situated usually at the more pointed extremity. Fully sporulated oocysts can have up to three refractile granules (also known as polar bodies and polar granulated), usually near the pointed end.

### 3.5 Analysis of Data

The differences in oocysts count across farm management practices were compared using the Kruskal - Wallis test. The difference in oocysts counts across farm management practices evaluated using Mann-Whitney U test. The association between each management practice and oocysts count were evaluated using Spearman correlation. A value of significant level below 0.05 ( $P < 0.05$ ) was considered significant. Prevalence percentages of coccidia infestation in all sample collected were also calculated. Data analysis will be conducted in MS Excel and SPSS Version 22.0 (IBM Corp).

#### 4.0 RESULTS

A total of 60 goats of two different breeds were successfully examined; 60 faeces samples were obtained for faecal examination by McMaster technique.

The results are shown in Table 1. The analysis of the faecal samples showed that 100% (n = 60) of the samples were positive for coccidia. The oocysts count ranged from 50 to 8350 oocysts per gram (OPG). From all the sample examined, only 10% (n = 6/60) of the animal to have counts showed a high oocyst counts exceeding 5000 opg ranged between 5000 to 8350. While 90% (n = 54/60) of animal have count showed a lower oocysts number ranged from 50 to 4999 opg.

Table 1: Prevalence of coccidia in all farms

Farm	Total sample	Positive sample	Prevalence (%)	Oocysts count per gram (opg)	Oocysts > 5000 opg
A	11	11		50 – 3650	2
B	20	20		250 – 6150	3
C	19	19	100	450 – 8350	1
D	4	4		550 – 3250	0
E	6	6		50 – 1550	0

Eight coccidia species were identified in the study. Examination of 1 ml supernatant from each farm was done and based on identification from all studied farm, 57 oocysts was found. The results are shown in Table 2 where *Eimeria* spp. was identified as followed: *E. christenseni* (30%; n = 17/57), *E. caprovina* (15%; n = 9/57), *E. alijevi* (14%; n = 8/57), *E. ninakohlyakimovae* (9%; n = 5/57), *E. arloingi* (9%; n = 5/57), *E. hirci* (9%; n = 5/7), *E. jochijevi* (7%; n = 4/57) and *E. caprina* (7%; n = 4/5)

Table 2: *Eimeria* spp. presence in studied farms

<b><i>Eimeria</i> spp. detected in 1 ml</b>	A	B	C	D	E	ALL
<b>Supernatant</b>	%	%	%	%	%	%
<i>Eimeria arloingi</i>	5.5	0	25	33	6	9
<i>Eimeria ninakohlyakimovae</i>	22	8	0	0	0	9
<i>Eimeria christensenii</i>	22	42	38	0	31	30
<i>Eimeria alijevei</i>	11	0	25	67	13	14
<i>Eimeria hirci</i>	17	0	12	0	6	9
<i>Eimeria jolchijevi</i>	5.5	8	0	0	13	7
<i>Eimeria caprovina</i>	0	8	0	0	18	15
<i>Eimeria caprina</i>	17	34	0	0	13	7
<i>Eimeria pallida</i>	0	0	0	0	0	0

The number of oocysts counts is influenced by the management practices in all studied farms. The management practices applied are semi-intensive and intensive system, sex, age, breed, source, diet, additional feed, deworming status and mineral block supplementation. The number of oocysts in presence of deworming and mineral block supplementation ( $p < 0.05$ ) while additional feed results in higher counts of oocysts in the farm ( $p < 0.05$ ). Other management practices result in an insignificant effect on coccidia number in farm as shown in Table 3.

Table 3: Management practices effect on faecal oocysts count

Management	N (goats)	Mean FOC (opg)	Standard error	Sig. (Independent t test)
System				0.283
Semi intensive	11	1900.00	715.891	
Intensive	49	2009.18	235.785	
Sex				0.053
Male	20	2180.00	527.250	
Female	40	1893.75	227.177	
Age				0.596
> 1 year	33	1865.15	343.462	
< 1 year	27	2140.74	296.081	
Breed				0.258
Mix breed	50	2149.00	263.010	
Boer x	10	1190.00	334.979	
Diet (Pasture)				0.158
Given	54	2136.11	246.043	
Not Given	6	666.67	278.288	
Add Feed				0.039
Given	31	2225.81	354.934	
Not Given	29	1736.21	286.153	
Deworming				0.039
Yes	29	1736.21	286.153	
No	31	2225.81	354.934	
Mineral block				0.039
Given	29	1736.21	286.153	
Not Given	31	2225.81	354.934	

## 5.0 DISCUSSION

Based on the present study, there was high prevalence of coccidia in all studied farms with 100% (n = 60/60) of samples were positive for coccidial in agreement with observations of previous study in Malaysia where an infection rate of 89 to 93% (Afzan Mat Yusof *et al.*, 2016; Fazly Ann Zainalabidin *et al.*, 2015 and Jalila *et al.*, 1998;). Similar finding was also reported in other countries where infection rate is 80-98% (Reza Kheirandish *et al.*, 2014; Kahan *et al.*, 2013; Antonio *et al.*, 2012; M.S. Alyousif *et al.*, 1992 and O'Callaghan, 1989).

According to Chhabra and Pandey (1997), there were over 13 species of coccidia have been reported from goats from different part of the world. According to Jalila *et al.*, (1998), nine species of *Eimeria* were identified in smallholder farms in West Malaysia similarly in this study where nine species of *Eimeria* were identified. However, *E. pallida*, which was described in Malaysia by Jalila *et al.*, (1998) was not found in our study. *E. ninakohlyakimovae* is considered to be the most pathogenic species (Pellerdy, 1974). Although *E. ninakohlyakimovae* is present in our study, differential oocyst counts indicate that the high number of infections caused by *E. ninakohlyakimovae* was low and there were absent of clinical signs in all sampled animal thus correspond to this finding. The high prevalence are mainly caused by the species that in low pathogenicity.

The prevalence of coccidial infections in this study was highest in young animal which also showed significantly higher oocyst counts. According to Symoens *et al.*, (1993), young that are less than one year old are most susceptible to coccidia

infection while adult goats develop coccidiosis if in immunocompromised status or when the animal lives in an environment that is heavily infested with coccidial oocysts. The higher intensity of infections in kids may be explained by the lack of acquired immunity at the young age, but also by the current management of keeping young kids alongside their dams in and near the shed and thus exposing them to a higher infection level (Taylor, 1995). Older goats were able to resist infections of endoparasite more efficiently than in young (Gibsons *et al*,1973).

There was also higher prevalence of coccidial infection in intensive farming as poor hygiene status result in increased level and incidence of infection due to feed and water contamination (A. Khodakaram-Tafti & M. Hashemnia, 2017). In other hand, low prevalence of coccidial infection in semi-intensive are due to exposure of animal to low infection of coccidia and ability to gain effective immunity (Catchpole *et al.*, 1994). Based on study by Sani *et al.*, (2004), small ruminants grazing in a semi-intensive system for three to four days in an area which was emptied for five to six weeks has reduced parasites burdens.

In current study, the mineral block supplementation and deworming was found to be related with the intensity of infection. With supplementation of mineral block and deworming, it results in significantly affecting the coccidia number. When mineral block is supplemented, the parasite burden was reduced compared to non-supplemented goats. By supplementation with mineral blocks, the animals were able to minimize the incidence of new infections and reducing the parasites burden in goats (Nor-Azlina *et al.*, 2011). According to Radovan and Jana (2014), anthelmintic treatment results in reducing the helminth infection thus causing the shedding rate of

coccidia to be reduced. However, the control of worms in small ruminants in Malaysia, like elsewhere, relies heavily on chemical dewormers or anthelmintic drugs. Anthelmintics being easily available and affordable, together with the government subsidized ruminant health programme implemented in Malaysia, have led to the emergence of widespread anthelmintic resistance (Nor-Azlina *et al.*, 2011).

In relation of oocysts count with additional feed done in this study, it shows that the number of oocysts increase in presence of additional feed with significant value of ( $p < 0.05$ ). This is contradicted with the study done by Schulte *et al.*, (2006) reported that additional feed by using herbs shows positive result in lowering faecal oocyst counts. In this study, only 2 farm having additional feed in management practices such as ‘Daun Balik Angin’ (*Mallothus spp.*) and Oil Palm Fruit. The ‘Daun balik angin’ is one of the local plants in Malaysia other than Akasia, Puding and Macaranga that are widely being utilized in goat diets as source of roughage (Muhammad Azrolharith, 2015). From the screening of the medicinal properties, the leave extracts were shown to possess the antibacterial, antioxidant and anticancer properties (Bahaman *et al.*, 2020). In other hand, Oil palm fruit (*Elaeis guineensis*) showed that the feeding of Napier Grass-Oil Palm Fruit combination to goats could lead to a better growth rate in animals compared to feeding them with Oil Palm Fruit alone (Mohammad Mijanur *et al.*, 2014). Additional feed aid in increase the growth rate, as source of roughage and having medicinal properties thus improving overall health and immune system of the animal. Even with good properties effect of the additional feed on animal, the presence of high count of oocysts are likely due to low

frequency or amount of the additional feed provided to the animal to result in therapeutic doses in treating or reducing the parasite especially coccidial number.

TABLE 4: Management practices adopted by farms and their mean FOC

Farm	A	B	C	D	E
No./Management practices					
Farming system	Semi-intensive	Intensive	Intensive	Intensive	Intensive
Source of goats	Local	Local	Local	Local & Australia	Local
Diet	Pasture (cut & carry)	Pasture (fresh and cut & carry)	Pasture (fresh)	Pasture (cut & carry)	PKC
Mineral block supplementation	Not given	Not given	Given	Given	Given
Additional feed	Not given	Given	Not given	Not given	Not given
Drenching personnel	Veterinarian	Veterinarian	Veterinarian	Farmer	Veterinarian
Manure removal	2 times a day	Once in 2 days	2 times a day	Once a week	Once a day
Type of flooring	Slatted, wood	Slatted, wood	Slatted, wood	Slatted, wood	Slatted, wood & concrete
Breed	Mix breed	Mix breed	Mix breed	Boer cross	Boer cross
Deworming	No	No	No	Yes	Yes
Supplement	Not given	Not given	Not given	Given	Given
Pen cleaning	2 times a day	Once in 2 days	Once in 2 days	Once a day	Once a day
Vaccination	No	No	No	No	Yes
Mean FOC	1900	1905	1981	1975	666

Table 5: Spearman correlation coefficient among the management practices associated with faecal oocysts counts

	Mineral block	Supplement	Deworming	Add Feed	Diet	Source	Breed	Age	Sex	Management	Coccidiosis	
	0.069	0.209	0.069	-0.069	-0.337**	0.093	-0.209	0.151	0.051	0.137	1	Coccidiosis
	-0.458**	-0.212	-0.458**	0.458**	0.158	0.127	0.212	-0.091	0.305*	1	0.137	Management
	-0.189	0.063	-0.189	0.189	-0.236	0.189	-0.063	-0.142	1	0.305*	0.051	Sex
	0.272*	0.315*	0.272*	-0.272*	-0.190	-0.242	-0.315*	1	-0.142	-0.091	0.151	Age
	-0.462**	-1**	-0.462**	0.462**	0.745**	0.598**	1	-0.315*	-0.063	-0.212	-0.209	Breed
	-0.276*	-0.598**	-0.276*	0.276*	-0.089	1	0.598**	-0.242	0.189	0.127	0.093	Source
	-0.345**	-0.745**	-0.345**	0.345**	1	-0.089	0.745**	-0.190	-0.236	0.158	-0.337**	Diet
	-1**	-0.462**	-1**	1	0.345**	0.276*	0.462**	-0.272*	0.189	0.458**	-0.069	Add Feed
	1**	0.462**	1	-1**	-0.345**	-0.276*	-0.462**	0.272*	-0.189	-0.458**	0.069	Deworming
	0.462**	1	0.462**	-0.462*	-0.745*	-0.598*	-1**	0.315*	0.063	-0.212	0.209	Supplement
	1	0.462**	1**	-1**	-0.345*	-0.276*	-0.462**	0.272*	-0.189	-0.458**	0.069	Mineral block

## 6.0 CONCLUSION

In conclusion, this study suggests the significant presence of coccidial infection among the studied farms with 100% prevalence range from 50 to 8350 oocysts per gram. However, the management practices were not proven to be related with the presence of coccidial infection in the farm apart from deworming and supplementation of the mineral block. Eight *Eimeria* spp. were identified from this study, which are *E. christenseni*, *E. caprovina*, *E. alijevi*, *E. ninakohlyakimovae*, *E. arloingi*, *E. hirci*, *E. jochijevi* and *E. caprina*. *E. christenseni* and *E. alijevi*. Zero prevalence of coccidiosis was detected on all studied farms.

## 7.0 RECOMMENDATION

Based on the finding, further study should be conducted to investigate more on the prevalence of coccidial infection in goat farms in Malaysia. Besides, increase the sample size, involve high number of farms and good representative sample for each management practices also can be done for more robust data analysis. Coccidial infection are contributed by multiple factors, thus variance among farms should be controlled to get accurate result of evaluating coccidial infection level among different farm management practices. Other techniques of *Eimeria* species identification such as gastrointestinal macroscopic lesion and Polymerase Chain Reaction (PCR) technique should be used in complementary to morphology and size evaluation of the sporulated oocysts for better species identification.

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## APPENDICES

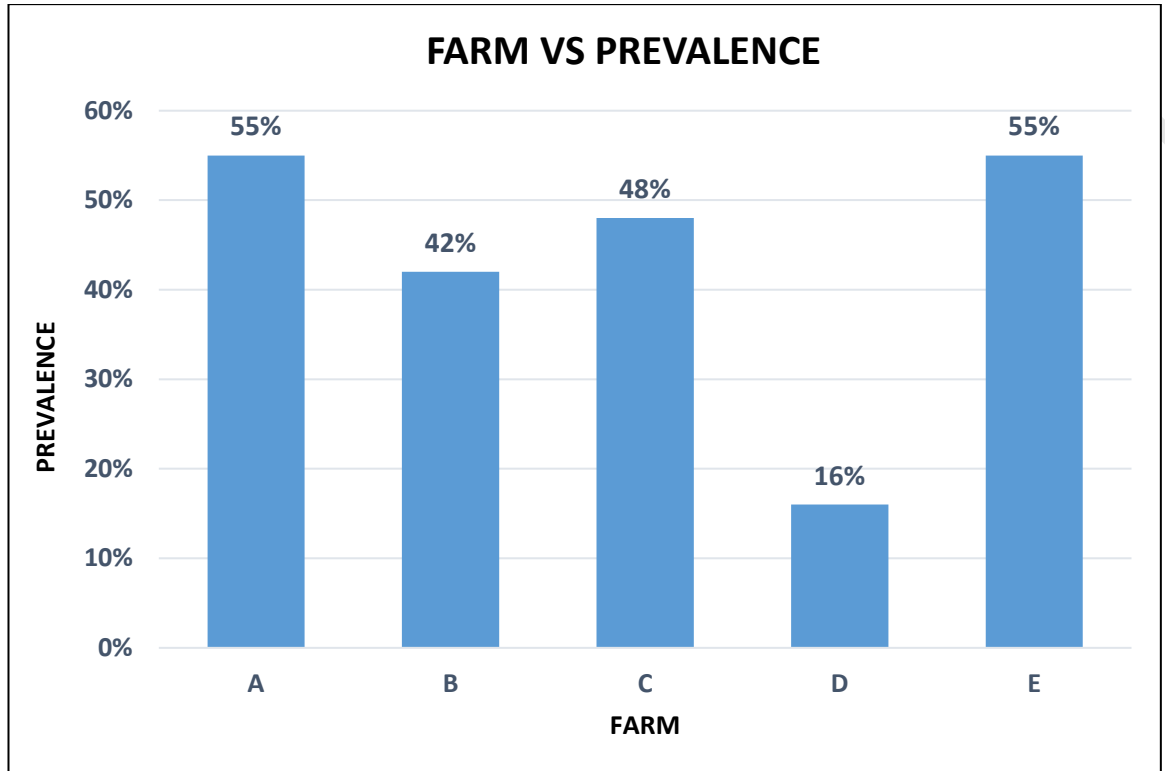


Figure 1: Prevalence of coccidial oocysts in studied farm

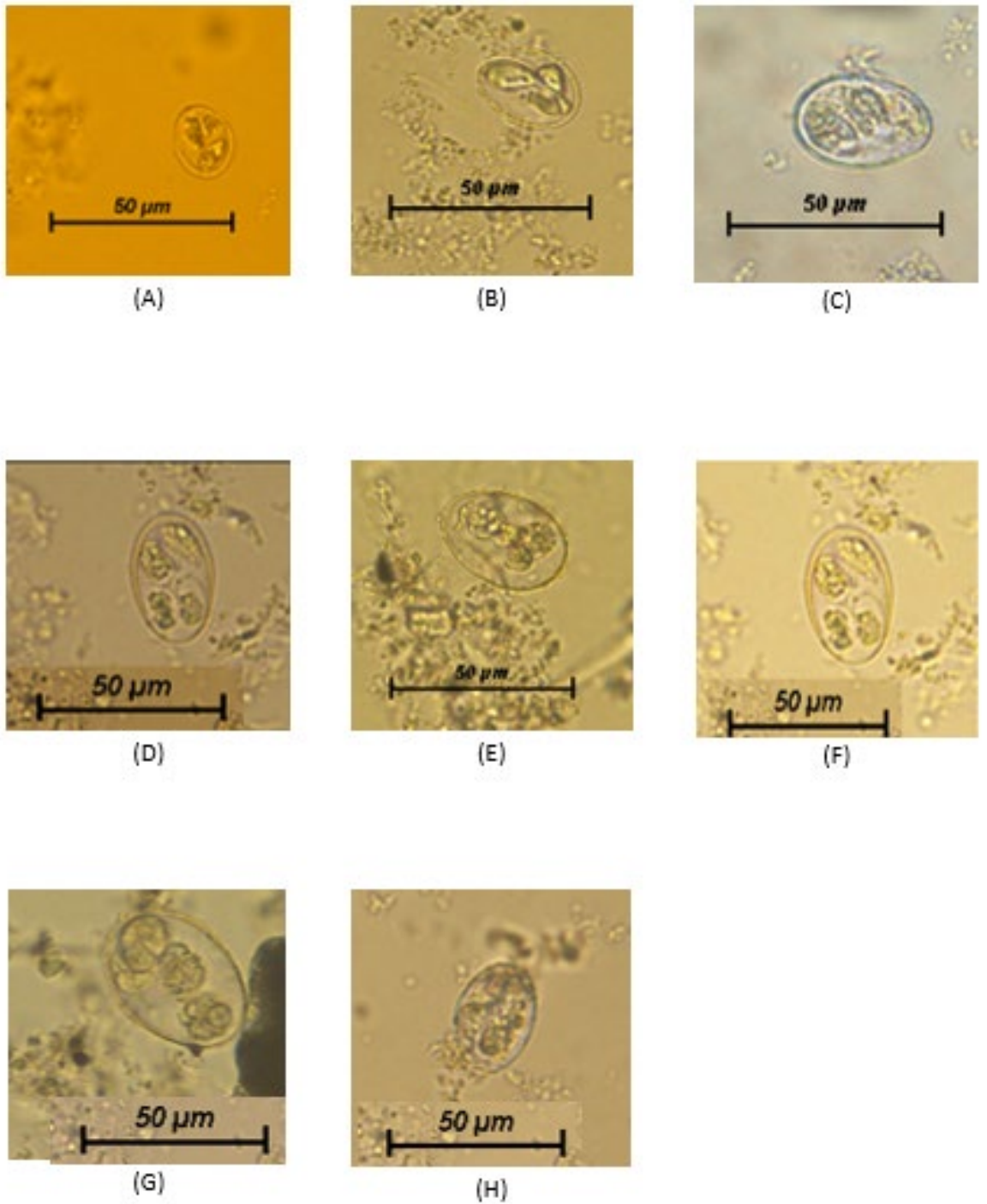


Figure 2: Species of *Eimeria* identified in the study

(A) *Eimeria alijeви* , (B) *Eimeria arloingi* , (C) *Eimeria caprina* , (D) *Eimeria caprovina* , (E) *Eimeria christensen* , (F) *Eimeria hirci* , (G) *Eimeria jolchijevi* , (H) *Eimeria ninakohlyakimovae*