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Prevalence and Pathology of Caprine Coccidiosis in South Darfur State, Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MAAK and AMS designed the study. Authors MAAK, AMS and YA performed the experiments. Author MH analyzed the data. All authors were involved in writing.

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ABSTRACT

This study was carried out to investigate the prevalence and pathology of coccidiosis in local breeds of goats in South Darfur State and the factors affecting it. One hundred faecal samples were directly collected from the rectum during September – December 2017, from goats, kept in an open system. The animals were grouped according to sex (34 males and 66 females), and according to age group (85 goats in the age one year or more, 15 less than one year). Oocysts were detected using the floatation method; the McMaster method was used for oocysts count. Length, width and size were measured by calibrated microscope attached to computer for the parasite identification. On the other hand, 100 samples of intestine sections were collected for gross and microscopic examination, from Nyala North slaughterhouse. The gross intestinal lesions were reported and sections for

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histopathology were made according to standard method. The overall prevalence of coccidiosis in goats was 65% in South Darfur State. Eimeria species identified were: *E. alijevi* (15.7%), *E. hirci* (26.3%), *E. ninakohlyakimovae* (36.8%), and *E. caprovina* (21%). The infection was higher in goat kids compared to adults. The gross lesions were characterized by scattered white nodules in the intestinal wall particularly in the jejunum and ileum as well as hemorrhages. Microscopically there were hemorrhages in the mucosa; hyperplasia of the mucosal epithelium with infiltration of inflammatory cells mainly lymphocytes, plasma cells, and eosinophils in the lamina propria, and presence of different developmental stages of the parasite in the intestinal epithelium and mucosal glands. Coccidiosis in goats resulting from complex interactions between parasites and host with many factors contributing to the severity of the disease, kids are more susceptible to infection with the clinical coccidiosis.

Keywords: Coccidiosis; goats; South Darfur State; pathological lesions; prevalence rate.

1. INTRODUCTION

Caprine coccidiosis caused by *Eimeria species* is an economically important disease and has been reported in different parts of the world including Europe, Africa, America and Asia [1, 2].

The disease infects different age groups, but it is more serious in young growing kids. It is a common cause of diarrhea and anemia in addition to poor growth rate, suppressed resistance, high morbidity and mortality [3]. Poor management can influence the incidence of the disease. Stress conditions like poor nutrients containing diet, weaning and transportation are very likely to have a role in clinical coccidiosis in goats [4].

Sudan is one of the tropical countries that suffer more from tropical diseases, because of poor quality pasture, hot and dry temperature [5]. Caprine coccidiosis was reported from different parts in the Sudan [6]. But little information is available on infection rate of Caprine coccidiosis in South Darfur States. Therefore, the present study was designed to assess the prevalence of the disease in South Darfur States and to study the different species of Eimeria and pathological lesions in slaughterhouses in addition to associated risk factors for possible prevention and control measures of the disease.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Nyala town, South Darfur State. It is located in western parts of the Sudan and lies between latitudes 8°30' to 13°'N and longitudes 23°15'to 28°E.

2.2 Sampling

One hundred Fecal samples were collected aseptically from rectum (about 5gm), of goats of both sexes and different age groups and kept in open system during September – December 2017. 100 fresh samples of goat's intestinal sections were collected randomly from Nyala North slaughterhouse for gross and microscopic examination. The gross intestinal lesions were reported and sectioning for histopathology.

2.3 Floatation Method

The floatation method was used for the detection of the oocysts. Faeces were placed in a test tube containing saturated sodium chloride solution and covered with a coverslip for 10 minutes (simple floatation technique). Then examined under 10X objective of the microscope for the presence of oocysts [7].

2.4 Oocyst Counts

The Modified McMaster technique was used for counting [8]: A 1.5 gm of faeces was mixed with 21 ml of water using a pestle and mortar to form a suspension, 15ml of suspension was centrifuged at 1500 rpm for 3 minutes and the remaining of the filtrate was cultured for identification of oocysts, the supernatant was discarded. Saturated sodium chloride solution was added to the sediment until the volume becomes equal to the initial volume of the filtrate. The centrifuge tube was inverted several times until the sediment was evenly suspended. The two chambers of McMaster slide were filled using a Pasteure pipette. The slide was then left some minutes to allow the oocyst to float and examined under the low power (10X) of the microscope. The calculation was made with the average

numbers of oocysts present in the two chambers multiplied by 50 which is the dilution factor to get the number of oocysts present in gram of faeces (OPG).

2.5 Culture and Sporulation of Oocysts

The remaining sample of the faeces was placed in container of 2.5 % potassium dichromate (K2Cr2O7) solution. The container was partially covered to allow the passage of oxygen, incubated at 37°C for 48 hours [9]. The content of the container were stirred off and on to ensure the oxygenation of the oocyst. During sporulation 60-80 percent humidity was maintained by placing water in 2 petri dishes in the incubator. The sporulation of the oocyst was confirmed by taking a drop of the mixture to be examined for the sporocysts/sporozoites presence.

2.6 Oocyst Identification

After sporulation of the oocysts, five slides were made from each culture containing sporulated oocysts and the oocysts present in these slides were described on the basis of their morphology using the method of Levine, et al. [10]. The measurement of length and width of the oocysts using a calibrated microscope were made and the average values of dimensions were used for the identification of the species of Eimeria present.

2.7 Pathology

One hundred samples of intestines were collected from the slaughtered goats, from Nyala slaughterhouse in South Darfur State. Macroscopic lesions were described and representative samples were fixed in 10% buffered formalin, then dehydrated in ascending concentration of alcohol and the clearance was made by xylene, embedded in paraffin wax, sectioned using rotary microtome and stained with Haematoxylin and Eosin (H&E) as described by Bancroft and Steven [11].

2.8 Statistical Analysis

The prevalence of infections and the oocysts load was compared on the basis of age and sex differences as faecal samples containing coccidial oocysts. Data were analyzed statistically using SPSS 19.0 for Windows. Experimental data were presented as mean ± SD. independent sample t-test was used to test the statistical significance. P-values <0.05 were considered statistically significant.

3. RESULTS

3.1 The Overall Prevalence Rate of Eimeria infection in South Darfur State

The infection rate in goats in South Darfur State was 65% (65 Fecal samples were positive out of 100).

3.2 The Eimeria Species Identified from Goats

Four species of Eimeria were identified morphologically based on the length, width, shape, and presence or absence of micropyle in the sporulated oocysts (Fig. 1). These were: *E. alijevi* (15.7%), *E. hirci* (26.3%), *E. ninakohlyakimovae* (36.8%), *E. caprovina* (21%).

3.3 Factors Affecting the Prevalence of the Disease

3.3.1 The effect of age on the prevalence of infection

The prevalence of the disease with Eimeria species in goats less than one year old in the age 12months or less was 72.9%, and in the age group more than 12months was 20%. There was a significant increase in the rate of infection (P = 0.000) in the kids compared to the adults (Table 1).

3.3.2 Effect of sex on the prevalence of infection

The prevalence of the disease was 71.2 %, and 52.9% in females and males respectively. There was no significant difference in the prevalence rate between different sexes (Table 2).

3.4 Factors Affecting the Oocysts Load

The mean of oocysts count in South Darfur State was 245.38, ± 316.81.

3.4.1 Effect of age in the oocysts load

The mean of oocysts count in the age group less than one year was 217±226, whereas in the age group more than one year the mean was 570,

±832.6 (Table 3). There was a significant differences in the oocysts load between the two age groups (*P* = 0.015).

3.4.2 Effect of sex in the oocysts load

The mean of oocysts count in males was 214±146, whereas in females the mean was 257± 326(Table 3). There was no significant differences in the oocysts load between the two sexes (*P* = 0.284).

3.5 Pathological Examination

3.5.1 Macroscopic lesions

The gross lesions were found more obviously in the distal part of the jejunum and ileum. They comprised thickening of the intestinal mucosa with scattered white nodules (about 5mm to 1 cm in advanced cases) and haemorrhages. These nodules were observed from the external surface of the affected areas. When groups of the villi are thickened and enlarged they become visible to the naked eye like polyps or small nodules.

3.5.2 Microscopic lesions

The microscopic lesions were characterized by sloughing, destruction and denudation of the villi and haemorrhages. In other fields there was thickening of the villi with infiltration of inflammatory cells mainly lymphocytes, plasma cells and eosinophils (Fig. 2).

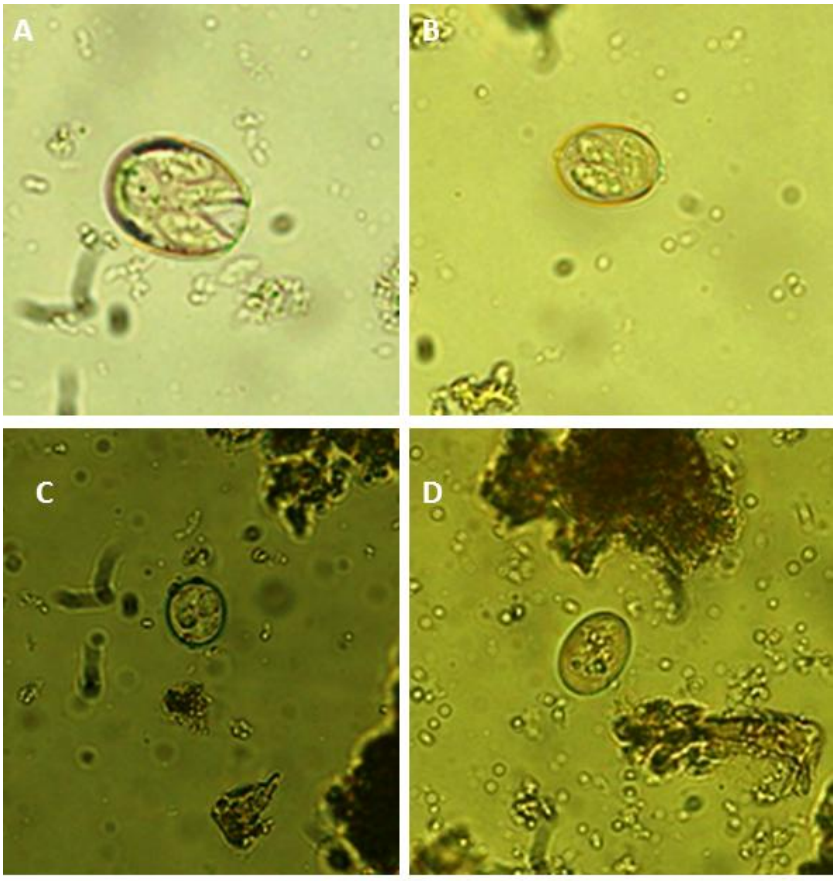

Fig. 1. Depict the photomicrograph of Eimeria species and their morphological features. (A) Sporulated oocysts of *E. caprovina*: broadly ellipsoidal, micropyle is present and no cap, (B) Sporulated oocyst of *E .ninakohlyakimovae*: ellipsoidal, thin-walled colorless or pale yellow, micropyle barely perceptible, (C) Sporulated oocyst of *E. alijevi*: subspherical, elipsoidal or ovoid, colourless or pale yellow, micropyles sometimes discernible, and (D) Sporulated oocyst of *E. hirci* : ellipsoidal to subspherical. colourless to light yellow with or without a shallow micropyler

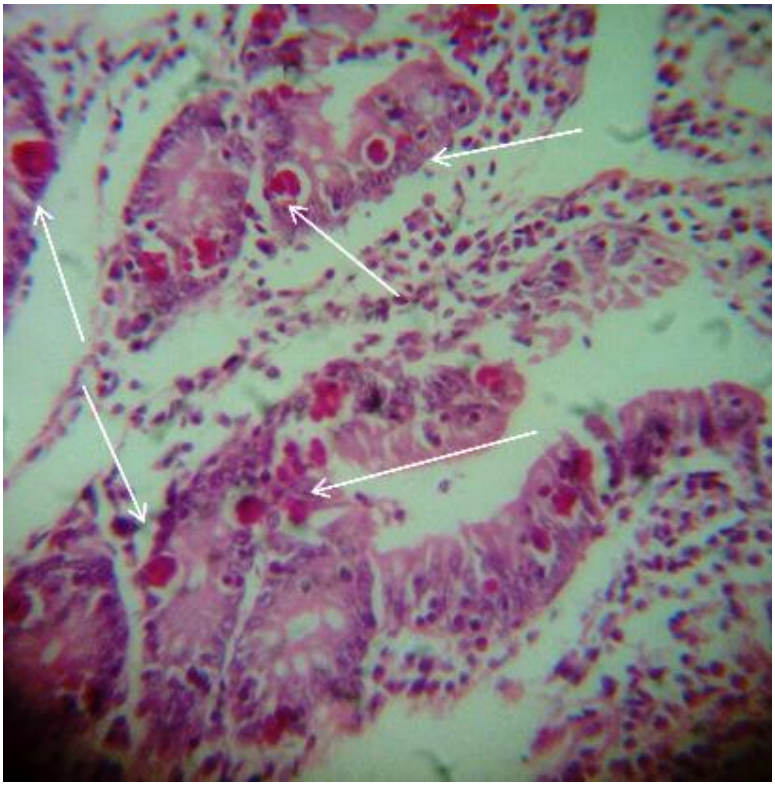

Fig. 2. Different developmental stages of the Eimeria parasite in the mucosa of the intestine .Note different stages and sizes of the parasite (arrows)

Table 1. Prevalence rate of Eimeria infection in the local breed of goats in South Darfur State according to the sex

	≤ 12 months	> 12 months	Over all prevalence
Total No. of examined Animals	85	15	100
Positive	62	3	65
Percentage	72.9%	20%	65%

Table 2. Prevalence rate of *Eimeria* infection in the local breed of goats in South Darfur State according to the sex:

	Male	Female	Over all prevalence
Total No. of examined Animals	34	66	100
Positive	18	47	65
Percentage	52.9%	71.2%	65%

Table 3. The mean of oocysts count in South Darfur State according to age and sex

Age /Sex	The mean of oocysts count (egg\gram)
Male	214±146
Female	257± 326
Age group less than one year	217±226
Age group more than one year	570, ±832.6

4. DISCUSSION

This study was designed to determine the prevalence of coccidiosis in local breeds of goats in South Darfur States, to define the different species of Eimeria and determine the oocysts load, as well as examining the pathological changes of naturally infected goats.

In the present study, the prevalence rate of coccidiosis in goats was 65% in South Darfur State. A high prevalence of coccidiosis in kids was reported as compared to lower rate of prevalence in the adults. This result in agree with Balicka-Ramisz [12] in Poland who found a prevalence of 100% in kids and 81% in adults. Chhabra and Pandy [13] found that the coccidiosis is a very common cause of diarrhoea in young animals including kids between 3 weeks and 5 months of age .

The mean of oocysts load in kids was (217), ± 226 oocysts per gram compared to adult with mean of (570),± 832.6 OPG. There were significant differences and the OPG was high in kids compared to adults. This agrees with Ruiz et al. [14] findings who reported that kids shed higher number of oocysts compared to adults. In contrast, other studies have reported a mild increase in the excretion of oocysts in goats older than seven years of age, which has been interpreted as relative weakness of the host immune system [2].

In this study the prevalence rate in female goats was higher than males, because females have frequent physiological activities (pregnancy, lactation,…etc), which agree with the report of Rehman et al. [1]. The mean of oocysts load in males was 214±146 OPG compared to females with mean of 257± 326 OPG, which showed no significant different in the oocysts count between different sexes. This seems to agree with the report of Sharma et al. [15].

In this study four species of Eimeria were identified. These were: *E. alijevi, E. hirci, E. ninakohlyakimovae, E. caprovina.* In the Sudan Fayza et al. [16] detected five species of Eimeria including *Eimeria christenseni, E. arloingi, E. hirci, E. ninakohlyakimovae* and *E. alijevi.* This agrees with our findings with the exception of *E. arloingi* which was not found in our study. On the other hand *E. caprovina* was not found in her study. In Brazil, Cavalcante et al. [17] studied coccidiosis in goats and identified eight species of Eimeria which agree with the four species in our study in addition to *E. arloingi, E. jolchijevi, E. christenseni* and *E. caprina*. In Turkey, Deger et al. [18] detected 10 Eimeria spp. in goats including the same species detected in our study in addition to *E. arloingi E. caprina, E. pallid, E. aspsheronica, E. christenseni* and *E. jolchijevi* which was not recovered in this study, may be due to differences in the study region, and animal breeds.

The pathological lesions were confined to the small intestine. Grossly there were scattered white nodules in the intestinal wall, and microscopically intestinal tissue showed sloughing, destruction and denudation of the villi. There was also infiltration of the inflammatory cells mainly lymphocytes, plasma cells and eosinophils. These findings agree with the results of Kahn and Line [19]. There was different developmental stages of the parasite in the mucosa. These results were similar to that reported by Kheirandish et al. [20].

5. CONCLUSION

In conclusion, in the present study four species of Eimeria were detected in local breeds of goats in South Darfur States. Coccidiosis in goats resulting from complex interactions between parasites and host with many factors contributing to the severity of the disease. Goat kids are more susceptible to infection with the clinical coccidiosis. A Negative faecal examination will not confirm the absence of coccidiosis, but the necropsy findings are diagnostic.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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