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Sudan University of Science and Technology
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Prevalence of Internal parasites of sheep In Khartoum State in summer

التقصي عن الطفيليات الداخلية في الضأن في ولاية الخرطوم في الصيف

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A research submitted in partial fulfillment of the requirements of the bachelor degree in Veterinary Medicine and animal surgery (honour)

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October 2018

الإهداء

بدأنا بأكثر من يد وقاسينا أكثر من هم وعانينا الكثير من الصعوبات وها نحن اليوم والحمد لله نطوي سهر الليالي وتعب الأيام وخلاصة مشوارنا بهذا العمل المتواضع

شكرا ،، لك يا شمعه أحرقت نفسها لتضئ لمن هم حولها ،، شكرا لك يا ورده فاح عبيرها وطاب شذاها ،، شكرا لك يا وره ذاد بريقها ورونقها ،،

ماذا بوسعنا أن نقول لقد هربت منا الكلمات وتشتت شمل العبارات ،، لا ندري أي الكلام يفيك حقك ،، بل أي العبارات تليق بمقامك ،،

إلى ينبوع العطاء الذي زرع في نفسي الطموح والمثابرة ،،،،،،، أبي العزيز

إلى نبع الحنان الذي لا ينضب ،،،،،،،،،،،،،،،،، امي الغالية

إلى من ضاقت السطور عن ذكرهم فوسعهم قلبي ،،،،، اصدقائي/صديقاتي

إلى من يحملون في عيونهم ذكريات طفولتي ،،،،، إخوتي وأخواتي

Acknowledgment

Firstly , we thank God for giving us the health, strength and determination to carry out this work.

Deep appreciation and gratitude is due to our supervisor Dr. Inas Ahmed Altayeb of the Department of parasitology, Faculty of Veterinary Medicine, SUST, for her constructive guidance and encouragement throughout this work.

Special thanks and gratitude is due to Dr. Majbour , the director of the parasitology laboratory, for his advice and technical support.

Special sept of gratitude is due to Suba Scheme for giving us samples from their farms.

Finally we are indebted to our families for their unfailing moral support and encouragement that have been the back bone of this work.

Abstract

This study was focused on the prevalence of GIT parasites that infect sheep in Khartoum State and influence of breed, locality, age, sex, and body condition on infection rate.

Eighty five faecal samples were collected from sheep from three different localities in Khartoum State. These include Elmowelih (Omdurman), Bahri Livestock market (Bahri) and Wester Soba Project (Khartoum). 64sheep were found to be infected with an overall prevalence of 75.2%.*Eimeria spp* oocysts were the most common(75.2%) followed by *Haemonchusspp*(9.4%) and *Moneiziaexpansa*(2.3%). Infestation with one species of parasite per animal was the commonest (63.5%) while, mixed infection was the least encountered (11.7%).

Khartoum locality was highly infected with *Eimeriaspp*. (80%) followed by Omdurman (76.6%) and Bahari (70%). No record concerning *Haemonchus* was observed at Khartoum locality. While, Omdurman and Bahri showed the same record (13.3%). *Moneizia expansa* was found only at Khartoum locality with record of 8%.

According to the breed, Zagawa ecotype showed the highest prevalence of *Eimeria spp*. (100%), followed by Baladi (84.6%), Hamari (78.9%) while the lowest prevalence (67.5%) and (50%) were recorded in Kabbashi and Shukri respectively. The highest prevalence of *Haemonchusspp* was demonstrated in Zagawa ecotype (22.2%) followed by (10.5%) and (10%) in Hamary and Kabbashi, respectively.

There is no record of *Haemonchus* in Baladi and Shukri ecotypes. *Moneiziaexpansa*was only occurred in the Baladi with prevalence rate of (15.3%).

Infection with *Eimeria spp.* was more prevalent in young sheep (80.4%) compared with(69.2%) in the adults. Meanwhile*Haemonchus* in adult sheep showed prevalence rate of 12.8% compared with (6.5%) in the young.*Moneizia expansa* was found only in young withprevalence rate of 4.3%.

Sex wise prevalence of *Eimeria spp* was (78.2%) and (71.7%) in males and females, respectively. Moreover, regarding *Haemonchus* was (10.8%) and (7.6%), respectively.*Moneizia expansa* was relatively same in male and female with prevalence rate(2.1%),(2.5%) respectively.

No significant association was found between *Eimeria spp*and *Moneizia expansa* prevalence and body condition. But considering *Haemonchus*, animals in poor body condition showed infection rate of (19.1%) compared with (6.25%) in animal with good body condition.

Nine species of *Eimeria* were detected in this studyon the basis of theirmorphological characteristic. These are *E. ovina*,*E.ovinoidalis* , *E. pallida*, *E. parva*, *E. faurei*, *E. ahsata*, *E. crandalis*, *E. intricata* and *E. granulose*

Keywords: Internal Parasites,Sheep,Khartoumstate,GastroIntestinal Tract.

الملخص

هذه الدراسة ركزت على معرفة معدل انتشار اصابة الضأن بالطفيليات الداخلية في ولاية الخرطوم , وتأثير السلالة , المنطقة ,العمر, الجنس والحالة الجسدية على معدل الاصابة . تم جمع 85 عينة براز من الضأن من مختلف الأماكن في ولاية الخرطوم وهذه الأماكن هي:المواليح (أمدرمان),سوق المواشي بحري (بحري) ومشروع سوبا جنوب(الخرطوم).

وجد أن أن 64 من الضــأن مصاب بنسبة (75.2%). ووجد أن *Eimeria spp*هي الأكثر انتشار بنسبة (75.2%) ويليها*Haemonchus*spp بنسبة (9.4%) و*Moneiziaexpansa*بنسبة (2.3%) . كانت نسبة الأصابة بنوع واحد من الطفيليات الداخلية الأكثر شيوعا بنسبة(63.5%)وبينما كانت نسبة الأصابة بأكثر من واحد بنسب(ة11.7%)

كانت أعلي معدل اصابة ب *Eimeria spp*في منطقة الخرطوم بنسبة (80%) ويليها امدرمان (76.6%) *وبحري بنسبة*(70%). لم يسجل اي اصابة ب*Haemonchus spp*في منطقة الخرطوم, بينما وجد في منطقتي امدرمان و بحري بنفس معدل الأصابة ب*Haemonchus spp* *بنسبة* (13.3%.) ووجد أن معدلالأصابة ب*Moneizia expansa* فقط بمنطقة الخرطوم بنسبة(8%).

ووفقا للسلالة ,كانت سلالة الزغاوي الأعلى اصابة بنسبة(100%) , ويليها البلدي بنسبة (84.6%) والحمري (78.9%) . بينما كانت اقل معدل نسبة اصابة في سلالتي الكباشي والشكري بنسبة (69.5%) و(50%) على التوالي .كان أعلى معدل اصابة ب *Haemonchus spp* *في سلالة الزغاوي* بنسبة (22%) ويليها الحمري والكباشي بنسبة (10.5%) و(10%) على لتوالي . لم يسجل اي اصابة ب *Haemonchus spp* *في سلالتي البلدي والكباشي . تم ايجاد* *expansaMoneizia* *إلا في سلالة البلدي* (15.3%) .

كانت نسبة الاصابة ب *Eimeria spp* فى ضغار الضأن أعلي (80%) من البالغين من الضأن(69.2%) .

ومن جهة أخرى كانت نسبة الاصابة ب *Haemonchus spp* في البالغين (12.6%) أعلى من الصغار (6.5%). ووجدت *Moneizia expansa* فقط في صغار الضأن بنسبة (4.3%).

ومن ناحية الجنس كان معدل الاصابة ب *Eimeria spp* (78.2%)و(71.7%) في الذكور والاناث على التوالي . علاوة على ذلك فيما يختص ب *Haemonchus spp* *كان معدل الاصابة* (10.8%)و(7.6%) *في الذكور والاناث على التوالي وكان معدل الاصابة في* *Moneizia expansa* يتراوح نسبيا بين (2.1 %) و (2.5%) في الذكور والاناث على التوالي .

لا توجد علاقة ملحوظة بين معدل الاصابة ب*Eimeria spp*و*Moneizia expansa*مع الحالة الجسدية *لكن بما يخص ال* *Haemonchus* *كانت نسبة أصابة الحيوانات في الحالة الجسدية السيئة* (19.1%) *مقارنة ذات الحالات الجسدية الجيدة بنسبة*(6.25%)

في هذه الدراسة تم ايجاد تسعة انواع من*Eimeria*اعتمادا على الخصائص الشكلية وهي كالاتي :

E. ovina,*E .ovinoidalis* + *E. pallida*, *E. parva*, *E. faurei*, *E. ahsata*, *E. crandalis*, *E. intricata* and *E. granulose*

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Introduction

Sudan is a vast country and is characterized by a wide spectrum of climatic conditions. Because of its enormous pastoral and agricultural potentialities, the country is regarded as one of the major food reservoirs in the world. 90% of the animal population is owned by nomads who are moving with their herds searching for water and pasture. Due to this system of animal husbandry, chancing of contracting diseases is great.

Parasitism is of supreme importance in many agro-ecological zones and still a serious threat to the livestock economy worldwide (Vercruysse and Claerebout, 2001). Sheep are known to suffer from various endoparasites of which helminth infection are of great importance. Helminth infections remain one of the major constraints to small ruminant production in tropics (FAO, 1992). Infection with gastrointestinal nematodes is regarded as one of the important factor causing production losses of livestock. Parasitic infection ranged from acute disease with high rate of mortality and chronic disease frequently with disease resulting in various degrees of morbidity and premature culling to subclinical infection with sheep appearing relatively healthy but frequently performing below their full potential. Helminthiasis adversely affects ruminants, causing hematological and biochemical disturbances (Ijaz *et al.*, 2009), anorexia, weight loss, poor reproductive performance, and even death of lambs (Hussain and Usmani, 2006).The infections are either clinical or sub clinical, the latter being the most common and of great economic importance.

In Sudan, parasitological investigations of small ruminants in some regions of the country have demonstrated that nematodes of the genera

Haemonchus,Trichostrongylus,Oesophagostomum,Bunostomum,Strongyloides , Cooperia, Nematodirus and Trichuris are the most common (Hassan, 2000).

Livestock population of Sudan amount 114 millon head of which sheep comprises about 40 millon of all head(fisheries range of the Sudan 2016). The sheep are raised in different parts of the country for their meat, milk, skin, export of live sheep and mutton.80% of the sheep slaughtered in

Sudan are of desert breed which greatly conibute in Sudan economy.

Objective of the study:

1. To determine the prevalence of gastrointestinal parasites in sheep in Khartoum State.
2. To study some factors that might influence prevalence of GIT parasitesin sheep reared in the State

Chapter 1

Literature Review

1.1 Importance of gastrointestinal parasite of sheep:

Gastrointestinal parasites are categorized into worms (helminths) and oocyst-forming protozoa known as coccidia. Nematodes, trematodes and cestodes are the three major types of parasitic helminths of economic importance (Kusiluka and Kambarage, 1996). Nematodes are the most serious parasites in terms of disease and production loss (Singh, 2013).

Gastrointestinal parasites have become a problem for sheep production worldwide, especially when the movement or grazing of sheep on pastures is restrained and/or when their forage type or range is not controlled (Roeber *et al.*, 2013). This can increase the likelihood of sheep becoming infested and thus heightens the need for parasite control.

Globally, gastrointestinal parasites cost sheep farmers significant amount of money each year because of treatment cost, increased level of management, loss of production and mortality in severe cases (Matebesi, 2014). Furthermore, Fikru *et al.*,(2006) reported that gastrointestinal parasites cause losses through lowered fertility, reduced workcapacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, treatment costs and mortality in heavily parasitized animals.

Parasites take an advantage of causing a disease when they are present in large numbers or when the host animal is weakened by another disease or by poor nutrition (Van, 2010).

Susan (2013) indicated that sheep are more vulnerable to internal parasites because they are slow to acquire immunity since it takes about 10-12 months for the lambs to develop immunity. This can also be aggravated by the fact that at lambing, sheep suffer a loss of immunity, which does not restore itself until approximately four weeks after lambing and their faecal pellets disintegrate easily hence the worm larvae are released on pastures (Susan, 2013).

In small ruminants, helminthiasis is determined by several factors governed by parasite –host environment interactions. The major epidemiological variable influencing worm burdens of grazing ruminants is the infection rate from pastures, which is in turn influenced by the climatic requirement for egg hatching, larval development and survivability (Vlassoff *et al*., 2001). Host-related factors are age, immunity, sex, species and genetic resistance; parasite-relatedfactors include life history, duration of the histotropic phase, survival of larvae in the environment and their location in the host; environmental factors include climate, weather, season, type of vegetation and microclimate (Roeber *et al.*, 2013).

1.2. Effect of age on gastrointestinal parasites infestation

There is an inverse relationship between an age of sheep, the prevalence and FEC of gastrointestinal helminths in sheep (Horak *et al.*, 1991). Fikru *et al.,* (2006) indicated that young animals were more susceptible to the parasite infections than older animals above one year of age.On contrary, Tehmina *et al.*, (2014) found that the prevalence of gastrointestinal parasites are higher in sheep of two or more years old which are adult sheep, but lower in young sheep of one year and lower. Biu and Oluwafunmilayo (2004) also reported higher prevalence of gastrointestinal parasites in adult sheep than in young sheep. On the other hand, Zvinorova *etal.* (2016); Admasu and Nurlign (2014) in their study indicated that GIT parasites affected both ages equally.

Coccidiosis is generally associated with young animals because their immune system has not developed the ability to combat heavy infections as indicated by Joseph (2003). The author also observed that coccidiosis is very common in sheep, especially young, growing lambs. Older sheep serve as sources of infection for young sheep. The immune capability of lambs is initially low but increases with the magnitude and duration of exposure to infection (Vlassoff *et al*., 2001). Alade and Bwala (2015) reported that higher infestation of these parasites in suckling lambs is attributed to a weaker immunological response of young lambs but older animals recover quickly from parasitic infection because immunity increases with age due to repeated exposure to gastrointestinal parasites infection. Although *Eimeria* species are frequently found in faecal samples, their appearance is influenced by age and immunity status of a host (Hashemnia *et al.,* 2014).

Narsapur (1988) indicated that Moneizia (tape worm) infection in lambs causes a serious weight loss, convulsion and death. Other authors (Nilon and Feuvre, 2012) have shown that tapeworm have no significant effect on production and growth performance of sheep despite the intensity of infection. Furthermore, Lewis *et al.* (2016) found that lambs are very resilient towards tapeworms before weaning and adults though maybe infected with tapeworms, the effect is not severe except on heavy infection when they suffer intestinal blockages and pulpy kidney may result.

1.3 Effect of sex on gastrointestinal parasites infestation:

Female sheep have higher faecal egg count of gastrointestinal parasites (nematodes and tapeworms) because of pregnancy and lambing periods which makes them to be more susceptible than the male sheep (Alade and Bwala, 2015). Similarly, Tehminas *et al.* (2014) and Bashir *et al.,* (2012) also indicated that there is higher prevalence of gastrointestinal parasites in female sheep than male sheep. Ewes, at parturition stage are more exposed to gastrointestinal parasites and susceptible to infection than male sheep due to the loss of immunity at parturition. (Parkins and Holmes, 1989).

On the contrary, Strongyle egg counts are generally higher in males than females and they decrease significantly with age in females and to the yearling stage in males (Wilson *et a*l 2004). Furthermore, Urquhart *et al*, (1996) showed that the higher susceptibility of males is due to the production of androgen hormone which is known to reduce immune response in males. Mushtag and Tasawar (2011) also stated that the production of oestrogen in females stimulate immunity against gastrointestinal parasites. In addition, Raza *et al*. (2007) reported high prevalence and intensity of infestation in males than females except at parturition and a decrease of infestation with age of hosts in both sexes. Admasu and Nurlign (2014); Tefera *et al.,* (2009) showed that sex of animals did not show significant association with the prevalence of GIT parasites. Meanwhile Qamar *et al.* (2009) in their study indicated that GIT parasites affected both ages equally.

1.4 Effect of Body condition:

Significant difference of GIT parasites infection was observed between body conditions of the animals (Admasu and Nurlign 2014). A higher prevalence of GIT parasites was recorded in animals with poor body condition than other group of animals. This might be due to malnutrition, other concurrent disease or the current parasitic infection lead to poor immunological response to infective stage of parasite. Faecal samples from lambs (3 months to 1 year), yearlings (1–2 years) and adult breeding ewes (2–4 years) were examined for helminth egg output and helminth genus composition at 3-week intervals. The results indicated that the prevalence of *Strongyle* and tapeworms infections were highest for lambs, followed by the adult breeding ewes and then for the yearlings (Ng‘an‘ga *et al.*, 2004).

1.5 Prevalence of GIT parasites in Sudan:

In a study a total of 498 fecal samples and 45 gastrointestinal tracts of sheep from Central Kordofan were examined for gastrointestinal helminths. Mixed helminth infections were found to be common in 91.1% of gastrointestinal tracts examined. Nematode infections were the commonest, reaching 82.2% of the examined animals. *Haemonchus contortus* and *Trichostrongylus colubriformis* were, having the highest prevalence 68.9% and 60%, respectively. Other identified nematode species were *Cooperia pectinata*, *Oesophagostomum columbianum, Strongyloides papillosus, Trichuris globulosa and Skrjabinema oviswith* a frequency of 35.1%, 59.2%, 62.2%, 27% and 8.1, respectively. *Cestodes* were recovered in 57.8% of the gastrointestinal tracts. The identified species were *Stilesia globipunctata, Avitellina centripunctata, Moniezia expansa and Moniezia benedeni*. The most prevalent cestode species were *S. globipunctata* and *A. centripunctata* with a frequency of 37.8% for each species. There was a seasonal effect on nematode infection in sheep as judged by egg output and worm burden. Both parameters showed their highest levels during the rainy season (Ghada *et al.,* 2011).

Almalaik *et al.,* (2008) reported the occurrence of the following worms at Tulus locality in south Darfur State in western Sudan: Seven nematodes species (99.8%) and *monezia expansa* (0.2%) in sheep beside eight nematodes species (99.9%) and *monezia expansa* (0.1%) in goat were Identified. In sheep the nematodes were in order of prevalence: *Haemonchus contortus*(53.4%),*Strongyloides papillosus*(26.2%) *Trichostrongyloides colabriformis*(14.7%), *Cooperia pectinata*(3.1%), *Oesophagastmum columbianum*(2.2%), *Skrjabinema ovis*(0.3%) and *Trichuris globulosa*(0.1%) while in goat were: *Strongyloides papillosus*(26.5%), *Haemonchus contortus*(26%), *Trichostrongylus colubriformis*(24.4%), *Skrjabinema globulosa*(0.6%) and *Cooperia pectinata*(0.1%).The intensity of the parasite infection was light to moderate. The mean worm burden was 497.3 and 472.4 for sheep and goat respectively. The total worm burden was shown has association with season and sex in goat but not in sheep while no association was observed between total worm burden and age of the animals in both sheep and goats. The effect of climatic factors on worm burden revealed a significant positive correlation with rainfall and relative humidity but not with temperature.

Another study was conducted to determine the prevalence of internal parasites in sheep and goats at White Nile State, Southern Sudan. The overall prevalence of infection in sheep and goats was 79%, and about 36% – 57% of sheep and 41% – 44% of goats had single infections. The parasites detected were *Coccidia* (41.2% in sheep and 50.2% in goats), *Strongylids* (24.5% in sheep and 31.2% in goats), *Schistosoma* (23.0% in sheep and 26.8% in goats), *Monezia*(25.5% in sheep and 15.6% in goats), *Fasciola* (5.9% in sheep and 6.8% in goats), *Paramphistomum* (2.0% in sheep and 2.9% in goats), *Trichuris* (0.5% in sheep and 2.9% in goats), and *Strongyliodes* (0.97% in goats). In general, the prevalence of parasitic infections goats and sheep were 81.95% and 76.96%, respectively. Otherwise, *Coccidia*, *Strongylids* and *Schistosoma* infection were the most obvious. (Abakar 2010).

1.5.1 *Haemonchus contortus:*

The worms occur in the abomasum or fourth stomach of sheep and goats. They are up to 3 cm long. Female worms have a red and white striped appearance, hence the name ‘barbers pole’. The life cycle is typical of roundworms of sheep. Adult worms lay eggs which pass out in the faeces of the host. Barbers pole worms are the highest egg producers of all sheep worms (Brown, 2011). The life cycle of *H. contortus* consists of free-living stages on the pasture and parasitic stages within the host’s abomasum (Terefe, 2005)*H.contortus*, in common with other nematode parasites of livestock, exhibits considerable ecological and biological plasticity to overcome unfavourable conditions either in the external, or host, environment (Waller *et al.,* 2005).

1.5.1.1 Hypobiosis phenomenon:

Hypobiosis is the "temporary cessation of development of a nematode at a particular point in its parasitic development" It is usually due to an unfavorable environmental stimulus, such as cold weather or dry conditions, received by the free-living L3 prior to ingestion and usually coincides with onset of winter or very dry conditions. Others factors and host factors are involved such as blood group, breed of sheep may play role (Soulsby, 1982).

1.5.1.2 Clinical manifestations and Signs:

Haemonchosis in sheep may be classified as hyper acute, acute, or chronic. In the hyper acute form, death may occur within one week of heavy infection without significant signs. This form of the disease is very rare and appears only in highly susceptible lambs. The acute form is characterized by severe anaemia accompanied by oedema ("bottle jaw"). Anaemia is also characteristic of the chronic infection, often of low worm burdens and is accompanied by progressive weight loss. The chronic form is the most commonly observed during natural infections. The lesions are associated to anaemia resulting from blood loss. With the exception of the L3, all other stages of development feed on blood. *Haemonchus contortus* is known to produce calcium and a clotting factor binding substance known as calreticulin, enabling the parasite to feed easily on host blood (Getachew *et al.*, 2007).

1.5.2 *Eimeria species:*

1.5.2.1 Classification of *Eimeria*

Coccidia are intracellular protozoan parasites of vertebrates and invertebrates that parasitize gastrointestinal tract and other organs such as liver and kidney (Levine, 1973). The majority of coccidia of veterinary importance belong to families Eimeriidae and Sarcocystidae (Soulsby, 1982). Coccidia are classified by Levine *et al.* (1980) under the phylum Apicomplexa which has a characteristic by structure known as apical complex that is only visible under the electron microscope.

1.5.2.2 Life cycle of *Eimeria* spp.

The life cycle of all members of family Eimerridae is divided into three phases: sporulation, infection and schizogony, and finally, gametogony and oocyst formation (Urquhart *et al.*, 1996). The cycle begins when oocysts are passed in faeces and ingested by the animal. Once inside, the parasite invades cells and then reproduces and invades more cells. The original oocysts ingested can be multiplied many times and cause a great deal of damage to intestinal cells before the coccidia can be detected in the animals' faeces. Animals may die before showing any signs of coccidiosis if exposure is sudden and high (lots of oocysts in the young animals' environment) and if the animals are stressed (Chartier and Paraud, 2012). When an animal is gradually exposed on coccidial infection several times, its immune system can develop resistance that slows the rate of coccidial reproduction in the host's intestinal tract. Developing this resistance takes time (five to six months). Afterward the animal will still pick up infections and shed coccidia in its faeces, thus contaminating the environment, but it generally will not show signs of illness (Chartier and Paraud, 2012).

1.5.2.3 prevelance of sheep coccidiosis in Sudan:

In the Sudan, seven species were reported for the first time from clinical cases of sheep in Khartoum Province (Osman, *et al.*, 1990). The prevalence of these species was as follows: *E.ovina*(40%), *E. intricata* (23%), *E. ahsata* (13%), *E. parva* (7%), *E. crandalis* (7%), *E. ovinoidalis* (7%), and *E. pallida* (3%). Later, Abakar, (1996) conducted coccidian infections survey in various part of the Sudan and indicated the presence of eleven species in Sudanese sheep. He added a new four species namely *E. faurei*(28%), *E. marsica* (13%), *E. granulosa* (8%), and *E. Punctata*(0.03%). The overall prevalence of infection was 59%. Recently, *Abakar et al.* (2001) reported the prevalence of 67% of enteric coccidia in sheep in south Darfur (Nyala) and eight species were detected. In the Red Sea State, cases of sheep coccidiosis represented 13% and 33% of sheep diseases diagnosed at Port Sudan Veterinary laboratory during years 2000 and 2001, respectively, (Anon, 2000, 2001).

1.5.2.4 Clinical symptoms of ovine coccidiosis

The first sign of clinical coccidiosis is usually the sudden onset of severe diarrhea with foul smell and fluid faeces containing mucus and/or blood and progressive body weight loss (Blood and Radostitis, 1989). The blood may appear as dark tarry staining of the faeces or as flakes, or the evacuation may consist of large clots of fresh, red blood. The degree of hemorrhagic anaemia is variable depending on the amount of blood lost. Pale mucus membranes, weekness, staggering, dyspnea, dehydration and recumbency were observed by Osman, *et al.* (1990). Inappetance, dullness, pallar of mucus membrane and slight pyrexia were reported by Abakar (1996**).**

1.5.3 *Moneizia expansa :*

Also known as sheep tape worm or double-pored ruminant tape worm. It's a large tape worm inhabiting the small intestine of ruminant (Gomez Puerta *et al.*, 2008). It is characterized by un armed scolex (i.e hooks and rostellum are absent), presence of two sets of reproductive system in each proglotted and each proglotted beuing very short but very broad .*Monizia expansa* infection were generally harmless and a symptomatic even when the tape worm are present in large numbers in young lambs however heavy infection may cause intestinal obstruction (Elliot D.C 1986).

Cestode eggs released from gravid segments embryonate to produce six-hoowkedembryos (hexacanth oncospheres), which are ingested by intermediate hosts. The oncospheres penetrate host tissues and become metacestodes (encysted larvae). When eaten by definitive hosts, they excyst and form adult tapeworms.

Chapter 2

Materials and Methods

2.1. Study area:

The study was conducted in three selected sites representing different localities of Khartoum State. These included Elmowaleh, Bahri Live Stock markets, Soba West project, representing Omdurman, Bahri, Khartoum localities, respectively.

2.2. Collection of sample

A total of 85 fecal samples were collected directly from rectum of the sheep, put into labeled plastic container. Each sample was clearly labeled with animal identification, date and place of collection. Then fecal sample were transported to the Laboratory of Parasitology at the College of Veterinary Medicine, University of Sudan. Further they stored at 4°C until examined within 48 hours

2.3. Materials:

- Microscopic slides.
- Fecal samples.
- Cover slips.
- Sodium chloride.
- Test tubes.
- Potassium dichromate
- Pestle and Mortar.
- Light Microscope.
- Glass jars.
- Guaze.

- Petri dishes
- Sieve
- Dropper
- Rack
- Methylene blue

2.4 Coprological examination:

2.4.1 Direct Method:

A clean, dry and glass slides free from scratches were used. A drop of distilled water was placed in the middle of the slide and small amount of faeces was added and mixed with tooth pick or match stick. A plastic coverslip was then placed on the mixture. The preparation was then examined under microscope for the presence of parasitic ova.(Agarwal and Chauhan 2008)

2.4.2 Flotation method:

One gram of faeces was taken, mixed with few ml of distilled water and filtered through a fine sieve. The filtrate was then mixed with 4-5 ml of saturated salt solution. The mixture was placed in a tube and filled up to the top with the solution. A clean glass slide was placed on the top of tube. This was left for 30 to 60 minutes at room temperature. After that, the slide was removed, covered with coverslip and examined under the microscope for the presence of parasites' ova. (Agarwal and Chauhan 2008)

2.4.3 Sedimentation Method:

Three grams of faeces were weighted and placed into a container; 40-45 ml of tap water was added, mixed and filtrated through tea strainer. The filtered material was placed in a test tube for 5 minutes. Then the supernatant was removed carefully. The sediment was stained with drop of methylene blue, transferred to slide with a coverslip and examined under the microscope for the presence of parasitic ova. (Reborts and O'sulliovan 1950)

2.4.4Oocyst sporulation:

For proper identification of *Eimeria spp*. oocysts, the faecal material was kept for sporulation of coccidia to its infective stage which was easily identifiable. The faeces were mixed with 2.5% potassium dichromate solution in a ratio 1:5 or 1:10. The suspension was transferred to petri dish to make a thin layer (1 -2 mm). The sporulation occurs within few days to weeks. The sporulated oocyst was examined by taking some amount on slide under the microscope. The oocyst could be stored in refrigerator for long period.(Agarwal and Chauhan 2008)

2.4.5 Identification of different *Eimeria* oocysts:

The identification of sporulated oocysts was based on oocyst morphology.

Morphological characteristics of the oocyst undertaken included the oocyst shape (ellipsoidal, spherical or ovoidal) and the presence or absence of micropaylar caps (Christensen, 1938; Morgan, 1951; Shah, 1963; Levine, 1973; Norton and Catchpole, 1976; and Anon, 1977). In addition to that, photographs of ovine oocyst previously documented by Christensen, 1938; Morgan, 1951; Levine, 1973; O'callghan *et al*., 1986; and Abakar, 1996 were considered as an aid in the identification of oocyst.

2.5.6 Fecal Culture:

Eighty fivefecal samples from individual sheep were cultured. The third infective stage larvae were obtained by the method described by Reborts and O'sulliovan (1950).

Firstly 20 grams of feces were ground using pestle and morter and wrapped in a piece of. Then suspended in a close marmalade jar containing a small amount of water to provide the media with moisture which is important in hatching of eggs and processing of larvae.

The jar was kept at room temperature from 7-10 days. On the last day, the culture was over flooded until the wrapped feces were soaked in water and then left overnight. During that time the larvae migrated from suspended faces and settled at the bottom of the jar. On the next day most of the water was decanted and small amount was left. The amount of water was then distributed into a number of test tubes. The test tubes were standing in the rack for 1-2 hours in order to concentrate the larvae in the bottom. The water on the top was removed and all the sample were then collection in the test tube, labeled and stored in refrigerator at 4°C till the time of examination

Chapter 3

Results

3. Overall prevalence of gastrointestinal parasites of sheep in Khartoum State:

Out of 85 sheep faecal samples examined, samples were found positive for gastrointestinal parasites indicating prevalence of (75.2%). The faecal examination revealed that *Eimeria spp*. oocysts were the most common 64 (75.2%) followed by *Strongyle/Trichostrongyle* eggs (Haemonchus) 8 (9.4%) and *Moniezia expansa*eggs 2 (2.3%)(Table 1) (fig 1,2 and 3)

The highest percentage of gastrointestinal parasites 80% was observed in sheep examined in Khartoum locality, followed by Omdurman 76.6% and a relatively lowest prevalence of infection (70%) occurred in Bahri (Table 2).

With regard to the five local ecotypes of the sheep examined, it appeared that the highest prevalence of gastrointestinal parasites was recorded in Zagawa ecotypes (100%) followed by Baladi (84.6%), Hamari (78.9%), while the lowest prevalence 67.5%, 50% were found in kabbashi and shukri,respectively (Table 3). Also the present study revealed that infestation with one species of parasite per animal was the most common 54(63.5%), while mixed infection was the least encountred 10 (11.7%).(Table 4)

Table (1): Prevalence of gastrointestinal parasites of Sheep at Khartoum state:

Parasite	**Sheep(85)**	
	No. of animals infected	**Prevalences (%)**
Coccidia	64	75.2%
Strongylids/Trichostrongyle(Haemonchus)	8	9.4%
Moneizia expansa	2	2.3%

Table (2): Prevalence of gastrointestinal parasites in three different localities at Khartoum State:

Locality	**No. of animal examined**	**No. of Animal infected**	**Prevalences (%)**
Omdurman (Elmowaleh)	**30**	**23**	**76.6%**
Bahri (Bahri Live Stock markets)	**30**	**21**	**70%**
Khartoum (Soba West project)	**25**	**20**	**80%**

Table (3): Prevalence of gastrointestinal parasites according to the different breeds of sheep:

Breed	**No. of animal examined**	**No. of Animal infected**	**Prevalences (%)**
Kabashi	**40**	**27**	**67.5%**
Hamary	**19**	**15**	**78.9%**
Baladi	**13**	**11**	**84.6%**
Zagawa	**9**	**9**	**100%**
Shukri	**4**	**2**	**50%**

Table (4): Infection status with gastrointestinal parasites of different ecotypes of sheep at Khartoum State:

Breed of sheep	Single infection	Mixed infection	Negative	Total
Kabashi	23	4	13	40
Hamary	13	2	4	19
Baladi	9	2	2	13
Zagawi	7	2	0	9
Shukri	2	0	2	4
Total	54(63.5%)	10 (11.7%)	21	85

with regard to sex, the overall copro-prevalence of GIT parasites in sheep showed that among 39 female animals examined, 28 (71.7%) were found infected. Similarly, among 46 male animals examined 36 (78.2%) male animals were found infected. (Table 5).

In this study, the animals were divided into age groups, viz, (young < 1.5 year) and (adult > 1.5 year). Age wise, the overall prevalence between young and adult group showed that young (< 1.5year) were significantly more susceptible to the infection with the prevalence of80.4% as compared to adult animals 69.2% (Table 6).

According to body condition, there was no significant difference in the prevalence of GIT parasites between good and poor body condition. The prevalence rates were 75% and 76% in both good and poor body condition, respectively (Table 7).

3.1 Oocyst sporulation:

3.1.1 Identification of *Eimeria spp.*

In the present study, ten species of *Eimeria* were identified on the basis of theirmorphological characteristic. The species recovered and their prevalence wasas follows: *E. ovina*, *E. ovinoidalis* , *E. pallida*, *E. parva*, *E. faurei*, *E. ahsata*, *E.marsica*, *E. crandalis*, *E. intricata* and *E. granulose* as shown in (Table 8) & (Fig 1)Photomicrographs of isolated species are shown in Figs (6a-2g).

3.2 Faecal culture:

Culture of faecal samples from sheep revealed only the presence of infective third larva of *Haemonchus contortus.*

Characters used for Identification:

The Identification of Haemonchus third stage larvae based on the following morphological features:

-Have a kinked sheath

-Have a rounded head.

-Have a pointed tail

-Medium size of tail sheath (Fig 3)

Table (5): Number and percentage of Sheep Infected accordinxg to sex

Sex	No. of animal examined	No. of Animal infected	Prevalences (%)
male	**46**	**36**	**78.2%**
female	**39**	**28**	**71.7%**

Table (6): Number and percentage of Sheep Infected according to Age:

Age	No. of animal examined	No. of Animal infected	Prevalences (%)
Young	**46**	**37**	**80.4%**
Adults	**39**	**27**	**69.2%**

Table (7): Number and percentage of Sheep Infected according to Body condition:

Body condition:	No. of animal examined	No. of Animal infected	Prevalences (%)
good condition	**64**	**48**	**75%**
poor condition	**21**	**16**	**76.1%**

Table (8): Number and percentage of *Eimeria* infection in sheep in Khartoum state

***Eimeria* spp. (N=96)**	**Number**	**Prevalences (%)**
E. ovina	**30**	**31.2%**
E. ahsata	**11**	**11.4%**
E. parva	**14**	**14.5%**
E. faurei	**12**	**12.5%**
E. crandalis	**5**	**5.2%**
E. ovinoidalis +E. pallid	**10**	**10.4%**
E. granulose	**9**	**9.3%**
E. intricate	**5**	**5.2%**

* N= number

3.2 Factors affecting the prevalence of identified GIT eggs and oocysts:

Several factors were found to have an influence on the rate of prevalence of GIT eggs and oocysts. These included the age, sex, body condition, breeds and different localities.

3.2.1 The effect of age on the prevalence of identified GIT eggs and oocysts:

Infection with *Eimeria spp.* was more prevalent in young (80.4%) compared with 69.2% in the adults. There was a significantly lower prevalence in adult sheep when compared to young. Regarding *Haemonchus spp.*, adult sheep showed prevalence of 12.8% compared with 6.5% in the young. Meanwhile, among 46 young sheep examined only two animals were found infected with *Moneizia expansa*. No record of Moneizia was occurred in the adult sheep. (Table 9).

3.2.2 The effect of sex on the prevalence of identified GIT eggs and oocysts:

The prevalence of infection with *Eimeria spp.* was 78.2% (36 samples out of 46) and 71.7% (28 out of 39 samples) in males and females' sheep, respectively. Similarly, the prevalence of infection with *Haemonchus spp.*was 10.8% (5samples out of 46) and 7.6% (3 out of 39 samples) in males and females sheep, respectively. However, the infection rate of *Moneizia expansa*in males(2.1%) and females(2.5%) sheep was almost the same. No significant difference occurred between different sexes this is shown in Table (10).

3.2.3The effect of body condition on the prevalence of identified GIT eggs and oocysts:

The body condition of animals and the presence of *Eimeria spp*. were investigated. Sixty four animals were found in good condition. Among these 48 animals were found infected with an infective rate of 75%. On the other hand, 21 animals in poor condition, among these 16 animals was found infected and the rate of infection was 76.1%. No significant association was found between *Eimeria spp.* prevalence and body condition. Considering *Haemonchus contortus*, animals in poor condition showed prevalence rate of 19.1% compared with 6.25% in animal with good condition. So we noticed that there was significant difference on prevalence rate of Haemonchus in contrast with different body condition of sheep. Among the good conditioned and poor conditioned animals *Moneizia expansa* showed the lowest prevalence rate of 1.5% and 4.7%, respectively (Table 11)

3.2.4 The effect of breed on the prevalence of identified GIT eggs and oocysts:

Considering *Eimeria spp.* the highest prevalence rate was recorded in Zagawa ecotypes (100%) followed by Baladi (84.6%) and Hamary (78.9%), while the lowest prevalence rate was recorded in Kabbashi (67.5%) and Shukri (50%). The highest prevalence rate of Strongyle/Trichostrongyle eggs (Haemonchus)spp.was observed also in Zagawa ecotypes (22.2%) followed by almost relatively records of 10.5% & 10% in Hamary & Kabbashi, respectively. Meanwhile, there is no record in the Baladi & Shukri ecotypes. Moneizia expansa was only occurred in the Baladi with prevalence rate of 15.3% (Table 12).

3.2.4 The effect of localities on the prevalence of identified GIT eggs and oocysts:

The result revealed that Khartoum locality was highly infected with Eimeria spp. (80%) followed by Omdurman (76.6%) and Bahri (70%). No record of *Haemonchus contortus* were observed at Khartoum while, Omdurman & Bahri showed the same records of 13.3%. Moneizia expansa 8% was found to be the least frequently record at Khartoum. No record of Moneizia was occurred in both Omdurman & Bahri (Table 13).

Table (9): Number and percentage of parasites isolated from sheep according to Age:

Age	No. of animal examined	*Eimeria spp*		*Haemonchus spp*		*Moniezia expansa*	
		No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)
young	46	37	80.4%	3	6.5%	2	4.3%
adults	39	27	69.2%	5	12.8%	0	0%

Table (10): Number and percentage of parasites isolated from sheep according to sex:

Sex	No. of animal examined	*Eimeria spp*		*Haemonchus spp*		*Moniezia expansa*	
		No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)
male	46	36	78.2%	5	10.8%	1	2.1%
female	39	28	71.7%	3	7.6%	1	2.5%

Table (11): Number and percentage of parasites isolated from sheep according to Body condition:

Body condition:	No. of animal examined	*Eimeria spp*		*Haemonchus spp*		*Moniezia expansa*	
		No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)
good condition	64	48	75%	4	6.25%	1	1.5%
poor condition	21	16	76.1%	4	19.1%	1	4.7%

Table (12): Number and percentage of parasites isolated from sheep according to Breed

Breed	No. of animal examined	*Eimeria spp*		*Haemonchus spp*		*Moniezia expansa*	
		No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)	No. of Animal infected	Prevalences (%)
Kabashi	40	27	67.5%	4	10%	0	0%
Hamary	19	15	78.9%	2	10.5%	0	0%
baladi	13	11	84.6%	0	0%	2	15.3%
zagawa	9	9	100%	2	22.2%	0	0%
Shukri	4	2	50%	0	0%	0	0%

Table (13): Number and percentage of parasites isolated from sheep according to localities:

Study area	No. of animal examined	*Eimeria spp*		*Haemonchus spp*		*Moniezia expansa*	
		No. of Animal infected	**Prevalences (%)**	**No. of Animal infected**	**Prevalences (%)**	**No. of Animal infected**	**Prevalences (%)**
Omdurman	**30**	**23**	**76.6%**	**4**	**13.3%**	**0**	**0%**
Bahri	**30**	**21**	**70%**	**4**	**13.3%**	**0**	**0%**
Khartoum	**25**	**20**	**80%**	**0**	**0%**	**2**	**8%**

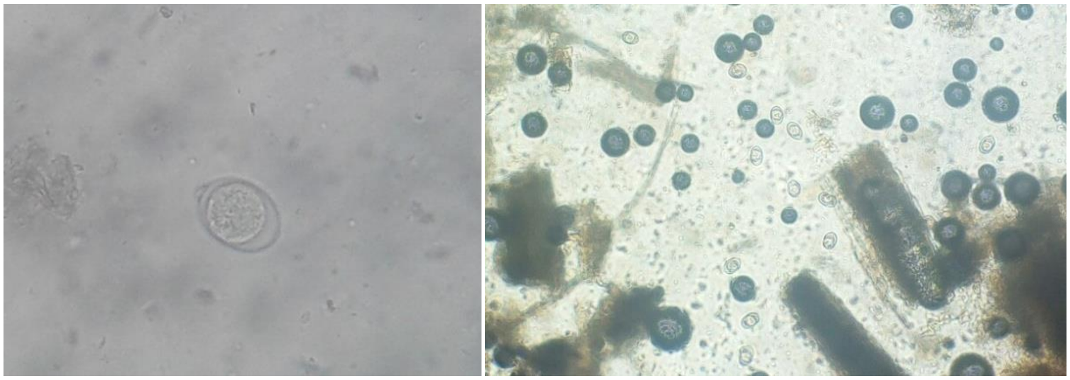
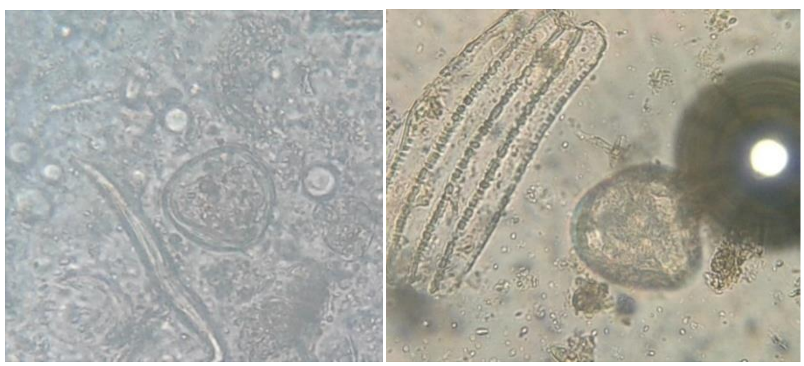
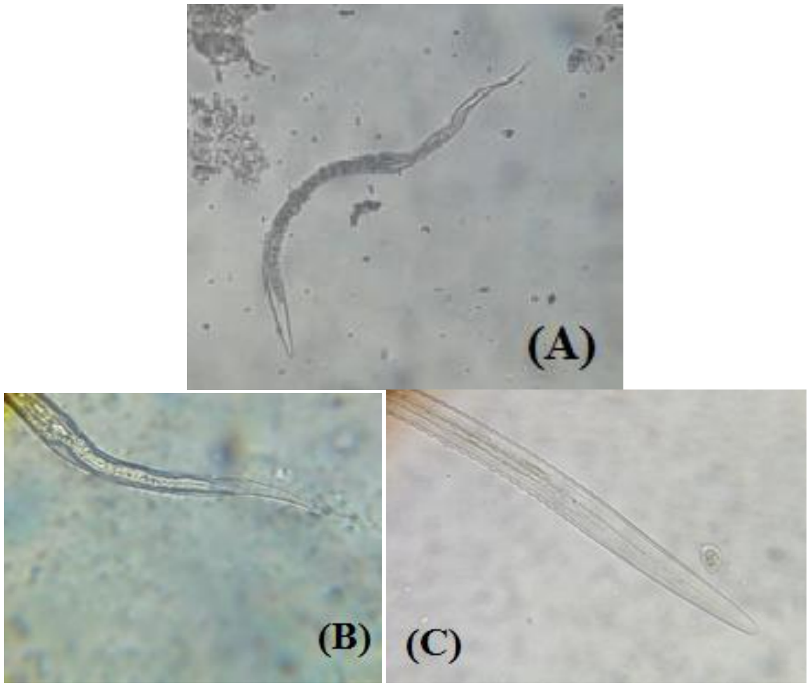


Fig (1): Non sporulated *Eimeria* oocyst(40x).

Fig (2):*Egg of Strongyles/trichostrongyles* (40x).



Fig(3): Egg of*Moniezia expansa*(40x).



Fig(4):(A)The larvae of *Haemonchus cotortus*(10x), (B)*Haemonchus* head(40x) and(C) tail sheath(40x)

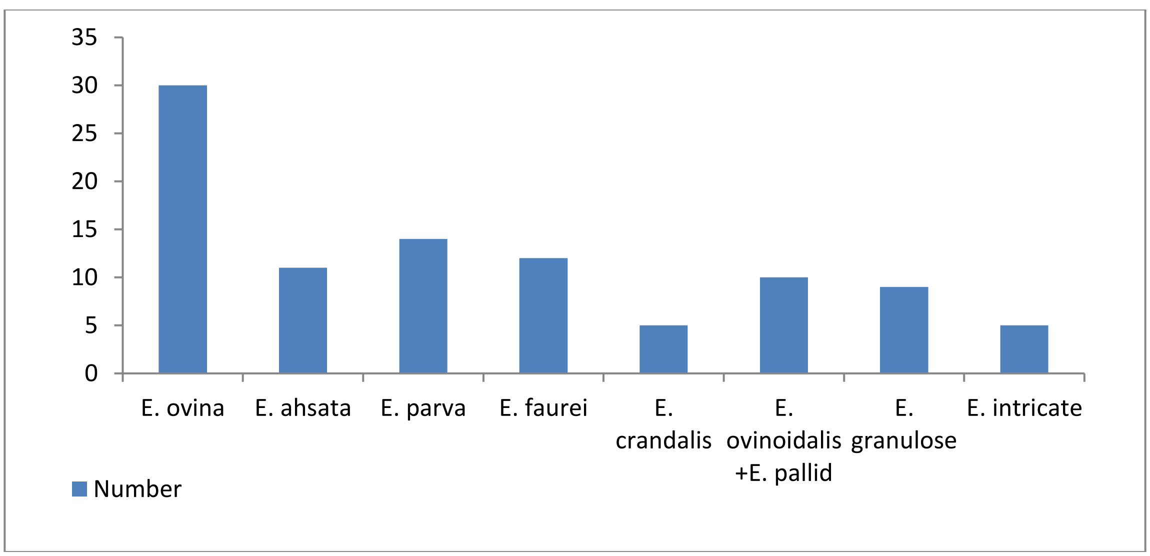


Fig (5): Prevalence of *Eimeria* infection in sheep in Khartoum state

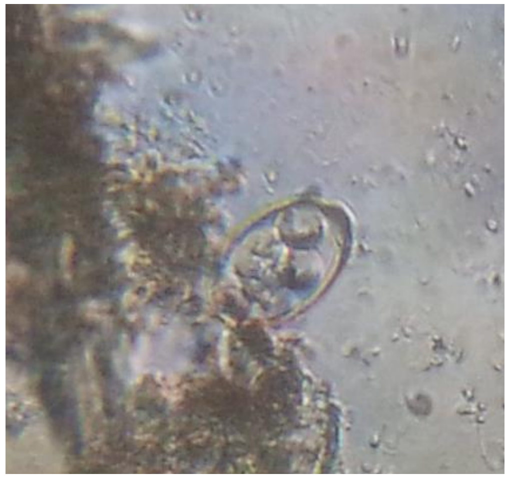


Fig (6a): ***E. ahsata*** **sporulated oocyst, ellipsoidal with adome- shaped polar cap. (40x)**

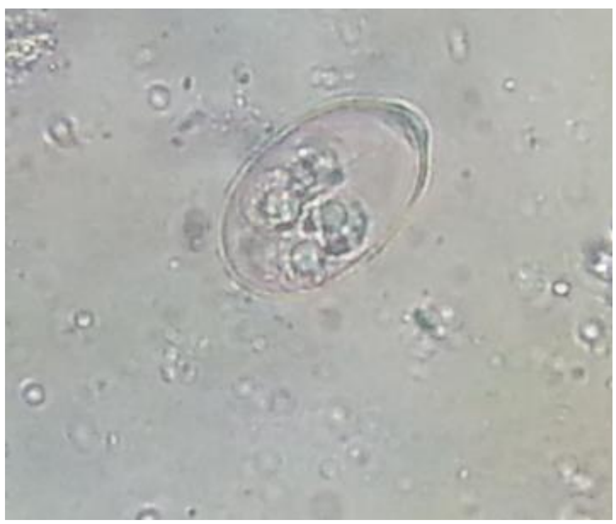


Fig (6b)*:* ***E. ovina*** **sporulated oocyst, ellipsoidal, with micropylar cap. (40x)**

Fig (6c): ***E. granulosa*** **sporulated oosyst, urn- shaped with polar cap (40x).**

Fig (6d): ***E. parva*** **sporulated oocyst, spherical to subspheical, no polar cap (40x)**

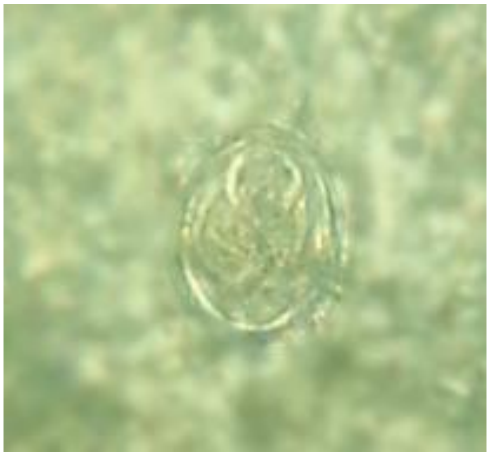


Fig (6e): ***E. faurei*** **sporulated oocyst, ovoid (hen's egg shaped), no polar cap (40x)**

Fig (6f): ***E. crandalis*** **sporulated oocyst, spherical to broadly ellipsoidal, visible micropylar cap (40x)**

Fig (6j): ***E. ovinoidalis&E. pallida*** **sporulated oocyst, ellipsoidal, no polar cap (40x).**

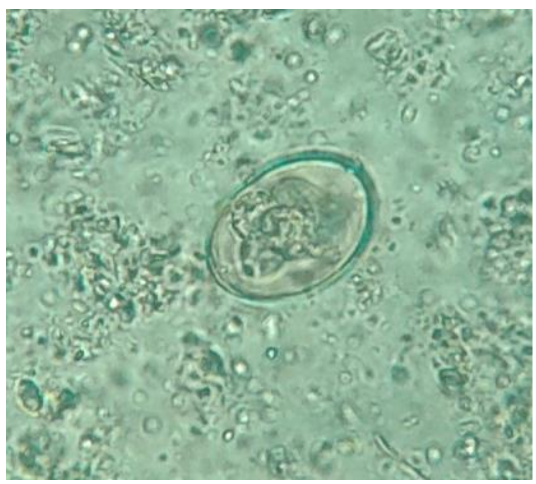


Fig (6g): ***E. intricata*** **sporulated*:* oocyst, ellipsoidal with distinct light–coloured polar cap (40x)**

Chapter four

DISCUSSION

The present study revealed that the overall prevalence of GIT parasites in Khartoum State was 87%. These include *Eimeria spp* 75.2%,*Strongyle/Trichostrongyle (Haemonchus)* 9.4% and *Moneizia* 2.3%. The current finding is in line with previous study on overall prevalence of GIT parasites in small ruminants reported by Abakar (2010) in White Nile State, Southern Sudan with a prevalence of 76.96%. *Haemonchus* and *Eimeria* infection were the most abundant. Similar results were observed by Abakar (2010) and Fikru *et al.,* (2006) but with variation in percentage.

Coccidia showed the highest prevalence of GIT parasites in sheep in the three selected sites surveyed. This is in agreement with Abakar (2010) who reported prevalence of 67% of enteric coccidia in sheep in South Darfur (Nyala) and Shmaon (2005) who reported 86% in sheep in Red Sea State. The reason of high prevalence of coccidia observed in our study might be contributed to that the survey was conducted on April which was the end of dry season where sheep are congregated a round water points after rain fall. In addition, coccidiosis is not usually treated (most drugs was anthelmentics).

Nine species of *Eimeria* were detected in sheep in this study. *E. ovina* was the most prevalent species in the study area. These results were similar to those detected by Abakar (1996) and Shmaon (2005).

The results of this study indicated that the prevalence of *haemonchus*in sheep at Khartoum state, Sudan was 9.4%. It was lower than the results conducted from previous studies which were 36.4% in North Kordofan, (Mubarak 2013), 53.4% in

South Darfur State (Almalik *et al.,* 2008) and 32% in Omdurman slaughterhouse (Fayza *et al.,* 2003). Our results coincide with those reported in Iran which was 9.3% (Tehrani *et al.*, 2012) and 6.5% reported at Khartoum State (Elsadig 2015). A variety of factors like grazing habits, level of education and economic capacity of the farmers, standard of management and anthelmentic used can influence the prevalence of internal parasites. Other reason which might be responsible for the low prevalence of *Haemonchus* reported in our study is Hypobiosis. This phenomenon is the temporary cessation of development of a nematode at a particular point in its parasitic development. It is usually due to an unfavorable environmental stimulus, such as cold weather or dry conditions.

The prevalence of *Haemonchus* by localities was investigated in this study. No record observed at Khartoum locality (Western Suba project), while Omdurman (Elmowelih) and Bahri (livestock market) showed the same records of 13.3%. There was significant association with Haemonchus and localities. This is similar to (Elsadig 2015) and also the reported result in Ethiopia (Dagnachew *et al.,* 2011). Considering coccidian, Khartoum locality was highly infected with Eimeria spp. (80%) followed by Omdurman (76.6%) and Bahri (70%). The high infection was found to be in Khartoum locality (Soba project). This may be attributed to the fact that Western Soba project is an agricultural area; therefore, the area might act as suitable environment for development of coccidian oocyst. This finding is similar to the observation of Shmoan (2005) who observed that inspite of the insignificant difference in prevalence rates between different locations in Red Sea State (Tokar, Port Sudan and Halaib), the intensity of infection was found to be high in Tokar.

The highest prevalence rate of *Haemonchus* was recorded in Zagawa ecotype (22.2%) followed by almost relatively records of 10.5% and 10% in Hamary and Kabbashi, respectively. Meanwhile there was no record in the Baladi and Shukri ecotypes. Zagawa ecotype has the highest rate of infection. This could be attributed to the nature of pasture grazing, pattern of animals, immune response towards the parasites and the topographic location of pasture. These findings are consistent with the observation reported in different breed of sheep at Khartoum State in Sudan (Elsadig 2015) who demonstrated that the prevalence of *H. contortus* infection related to breed of animals was 5.7% in Kabashi breed and 3.8 % in Hamary breed and 25% in dubasy breed, and disagree with finding that carried out in Iran. The study showed that there is no association between haemonchosis and breed (Garedaghi2013). Immunity to helminth parasite was recorded in certain breeds of sheep and goats in Sudan (Fayza *et al.*, 2003).

All the five breeds investigated in this study were found infected with coccidia. The highest prevalence rate was recorded in Zagawa ecotypes (100%) followed by Baladi (84.6%) and Hamary (78.9%), while the lowest prevalence rate was recorded in Kabbashi (67.5%) and Shukri (50%).

Sex wise prevalence of *Haemonchus* was studied in this result. The higher prevalence of infection was in males 10.8% as compared to females 7.6%. These results are in agreement with the studies carried out in the valley of Kashmir (Irfan *et al.*, 2013) and (Gorskiet *et al.*, 2004). Raza *et al.*, (2007) reported high prevalence and intensity of infestation by nematodes in males than females except at partiurition. Urquhart *et al.*, 1996) showed that the higher susceptibility of males is due to production of androgen hormone which is known to reduce immune response in male. Mushtag and Tasawas (2011) also stated that the production of oestrogen in females stimulale immunity against gastrointestinal parasites.

Our result is in disagreement with Alade and Mbwala (2015), Tehminas *et al.*, (2014) and Bashir *et al.*, (2012). They demonstrated that there is a higher prevalence of GIT parasites in female sheep than male. This is because of pregnancy and lambing periods which make them to be more susceptible than male sheep. Admasu and Nurlign (2014) and Tefera *et al.*, (2009) showed that sex of animals did not show significant association with the prevalence of GIT parasites.

Sex of the examined animals didn't show significant effect on prevalence of coccidian infection in sheep. This finding agrees with observation of Shmoan, (2005).

Age wise overall prevalence of GIT parasites in sheep between young and adult group was studied. The study revealed that young (< 1.5 year) were significantly more prone to parasitic infection with prevalence of 80.4% as compared to adult 69.2% This result are in agreement with the result carried by Fikru et al., (2006). Regarding *Haemonchus* adult sheep showed prevalence rate of 12.8% Compared with 6.5% in young one. This agrees with Bin and Oluwafunmilayo (2004) and Tehmina *et al.,* (2014). The study revealed significant high prevalence of coccidian oocysts in the young sheep than in adult. Similar observations were reported in sheep (Abakar 1996 and Shmoan 2005). This could be attributed to lower resistance in the young compared to older animals.

A higher prevalence of GIT parasites was recorded in animal with poor body condition than the other group of animals which agrees with the previous study conducted by Abmasu and Nurlign (2014) and Ng‘an‘ga *et al,*. (2004). This might be due to malnutrition, other concurrent disease or the current parasitic infection lead to poor immunological response to infective stage of the parasite.

Conclusion

- Eimeria spp. oocysts were the most common 75.3% followed by *Haemonchus* 9.4% and *Moneizia expansa* 2.5%.
- A higher prevalence of infection was in males as compared to females.
- Young animals > 1 year more highly affected as compared with adult < 1 year old in *Eimeria spp*., but not in *Haemonchus.*
- Higher prevalence in animal with poor body condition than the good one.
- The highest prevalence rate of gastrointestinal parasites was in Khartoum (80%). Then Omdurman and Bahri.

Recommendation

The present study was based only on faecal examination of eggs and oocysts of GIT parasites to estimate its current prevalence and some associated risk factors so

- Further characterization of GIT parasites circulating in the area including investigation of the gastrointestinal tracts of sheep to confirm the present results.
- Determination of number of oocyst/eggs per gram using modified McMaster technique to determine the rate of infection.
- More different risk factors should be considered in designing nationwide control of GIT infection.
- Appropriate control measures against their infections still be necessitates reducing their prevalence to tolerable.
- Appropriate control strategies (Periodic and strategic deworming).

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