بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate studies

Prevalence and Risk Factors of Ovine Trichostrongylosis in Atbara Locality-River Nile State

نسبه الإصابة وعوامل الخطر لمرض الترا يكواسترنقاليس في الضان في محلية عطبره – ولاية نهر النيل

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بسم الله الرحمن الرحيم
قُلْ لَوْ كَانَ الْبَحْرُ مِدَادًا لِكَلِمَاتِ رَبِّي
لَنَفِدَ الْبَحْرُ قَبْلَ أَنْ تَنْفَدَ كَلِمَاتُ رَبِّي وَلَوْ
جِئْنَا بِمِثْلِهِ مَدَدًا
الكهف - الآية 109-

Dedication

To the soul of my father, for my Kind unfailing support mother,

To my aunt ,brother ,uncle, and sisters .

With love and gratitude . .

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Firstly , my thanks are due to Almighty ALLAH for blessing and guidance for this work to be concluded **.** I would like to express my deep thanks to m Supervisor : Prof . Siham Elias for her keen supervision ,direction and continuous interest and constructive criticism in reviewing the dissertation.

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Abstract

Across sectional study was conducted to determine prevalence of *Trichostrongylus spp* in sheep and to investigate some associated potential risk factors from June 2018 to April 2019 in Atbara locality, River Nile State. A total of 391sheep feacal samples were collected from abattoir(132animals), diseased animals in Atbara Veterinary Hospital (184animals) and some sheep farms(75 animals) ,They were examined by using direct flotation test for the presence of the parasite . The risk factors investigated were sex, breed, body condition, nutrition, age and season . The results revealed that the prevalence rate of trichostrongylosis in sheep was 31.7%.The questionnaire was used to determine the risk factors(sex ,age ,breed, body condition ,season , nutrition). The following risk factors showed association with sheep trichostrongylosis in the univariate analysis under significant level of p-value $\leq$ 0.25: sex (p-value = 0.000), breed (p-value = 0.448), body condition (p-value =0.000), nutrition (p-value = 0.331), age (p-value =0.194) and season (p-value =0.000) . Using multivariate analysis to determine possible significant association between *Trichostrongylus* and potential risk factors, the result showed that there was significant association with some of the investigated risk factors(sex, body condition and season) .It can be concluded that this *Trichostrongylus* parasite was prevalent in a high percentage in Atbara locality . As a trichostrongylosis is a zoontic disease its essential practices to cleaning and cooking of vegetables before used is required for prevention in human.

ملخص البحث

أجريت دراسة مقطعية لتحديد معدل انتشار مرض ترايكواسترنقايلس في الضان ودراسة بعض عوامل الخطر المحتملة المرتبطة بها من يونيو 2018 إلي ابريل 2019 في محلية عطبرة في ولاية نهر النيل . تم جمع 391 عينات براز من الضان، من المسلخ (132حيوان) ، الحيوانات ألمريضه بمستشفي عطبرة البيطري (184حيوان)و من بعض مزارع الضان (75حيوان) , تم استخدام اختبار التعويم المباشر لفحص الطفيل.عوامل الخطر التي تمت دراستها هي الجنس،العمر، السلالة ، حالة الجسم ،التغذية، الفصل السنوي .وأظهرت النتائج أن عدوى ترايكواسترنقايلس كانت منتشرة بين الأغنام في محلية عطبرة بنسبة انتشار 31.7%. تم استخدام الاستبيان لتحديد عوامل الخطر (الجنس ,العمر, السلالة ,حالة الجسم, الفصل, الغذاء). وأظهرت عوامل الخطر التالية الارتباط مع مرض ترايكواسترنقايلس في تحليل وحيد المتغير تحت مستوى كبير من قيمة المعنوية $\leq$ 0.25وكانت القيمة المعنوية لكل من الجنس (=0.000) , السلالة (=0.448) , حالة الجسم(= 0.000), الغذاء (= 0.331), العمر(= 0.194) , الفصل (= 0.001). باستخدام التحليل متعدد المتغيرات لتحديد احتمال وجود ارتباط كبير بين مرض ترايكواسترنقايلس وعوامل الخطر المحتملة وأظهرت النتيجة أن هناك ارتباط كبير مع بعض عوامل الخطر(الجنس,حالة الجسم ,الفصل). يمكن أن نستنتج أن هذا الطفيل كان منتشرا في محلية عطبرة بنسبة عالية . ولأن المرض مشترك بين الحيوان والإنسان لابد من غسل الخضروات وطبخها جيدا قبل الاستخدام مطلوب لوقاية البشر.

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Introduction

Sudan has considered from the large countries that raising of sheep population (47,2 million) and producing of meat for export. Generally sheep are raised for meat ,milk and hides (MARF, 2005). The meat of the sheep is important meat to the human ,while some meat must be produced hygienically ,free from pathogens and retains its natural state and narrative value (Govindargan ,1990) . Sudanese sheep comprise 31% of the total population of sheep in the Arab region) and they are raised in different parts of the country. Exports of live sheep and mutton contribute significantly to the national income from foreign exchange which was estimated to be uses 109 million annually in 1998, sheep also have religion and social importance, they play an important role in public health because they could be a source for several zoonotic diseases transmuted to man. Sheep production in Sudan faces many problems including infectious diseases caused by bacterial, viral, and parasitic agents (AOAD, 1998).

Helminthes are one of the most destructive internal parasites of the vertebrate animals including man ,they caused increase mortality rate and decrease in sheep received the great interest as one of the most important and preferable livestock for human consumption in the world (Schuster, 1998) .

Nematodes are wormlike un segmented invertebrate animals found in marine, freshwater, and terrestrial habitats**.** The life cycle consists of six stages egg, first-stage, second-stage, third-stage , fourth-stage, and adult (Radewald ,1977).

Gastrointestinal tract parasites are common in large and small animals and are one of the most important problems in small ruminants by causing disease ,mortality and production losses (Steel , 1972). Sheep raised under grazing conditions are more susceptible to various parasites and the primary control method is through the use of broad spectrum anthelmintics (Waller,1997). *Trichostrongylus* are most important parasitic nematodes (round worms) of gastrointestinal tract in ruminants horses. pigs, rabbits and fowl and all species are found in small intestine , except *T. axei* is found in abomasums of ruminants and stomach of horses and pigs, while *T. tenuis* also is found in small intestine and caeca of game birds (Urquhart *etal*., 1996).

Trichostrongylus spp causing disease called trichostrongylosis is found in domestic and wild ruminants (Ghadirian and Arfaa , 1975). The most important species of *Trichostrongylus* in sheep in Africa are *T. colubriformis, T axei and T. vitrinus* (Hansen and Perry, 1994).

Haemonchus contortus and *Trichostrongylus* spp. are reported to be the most prevalent and highly pathogenic in livestock, particularly in small ruminants (Getachew *et al*.,2007). These parasites are worldwide distribution cause economic loss due to weight loss, impaired wool and milk production and poor reproductive performance (Lateef *et al*., 2005; Gadahi *et al*., 2009; Cengiz and Deger, 2009; Bailey *et al*., 2009; Hassan *et al*., 2011). The main clinical signs of *Trichostrongylus* is decreasing of the appetite.

The disease is zoontic and 10 species associated with infection in human these are most prevalent in the Middle East and Asia. The infection occurred via ingestion of infective larvae (filariform L3) from contaminated vegetables or water, the highest prevalence rates occur in individuals from regions with poor sanitary conditions, in rural areas, or who are farmers / herders (Wikipedia,2018). *T. colubriformis. T. axei T. vitrinus, T. orientalis* were detected more frequently in human with high prevalence of infection (Ghadirian and Arfa a , 1975). The adult also found in small intestine of human and the diagnosis based on observation of egg in stool the egg are 85-115um, oval elongate and pointed at one or both end (Wikipedia,2018).

Objectives of the study:

1/To determine the prevalence of Trichostrongylosis in Atbara locality.

2/To investigate some risk factors that increasing *Trichostrongylus* infestation .

3/ To obtain additional data on trichostrongylosis in Atbara locality.

Chapter one

Literature Review

1.1.Trichostrongylids:-

1.1.1.classification:

Kingdom : *Animalia*

Phylum : *Nematoda*

Class : *Chromadorea*

Order : *Rhabditida*

Family : *Trichostrongylidae*

Genus : *Trichostrongylus* (Wikipedia,2018).

Species : *T. colobriformis , T. vitrinus, T. axei*, (Hansen and Perry, 1994*)* and *T. probolorus* (Abbas *etal*.,2012)

1.1.2. *Trichostrongylus* species in ruminants:

According to Soulsby (1982) there are many species of these genus in ruminants and these are *T. colubriformis , T. falculatus , T. axei T. rugatus , T. longispicularis , T.drepanoformis , T.hamatis* and *T.orienatus* .These species are found in the small intestine of ruminants but also some times in the abomasums (*T. colubriformis , T. axei*).

1.1.3.Morphology:

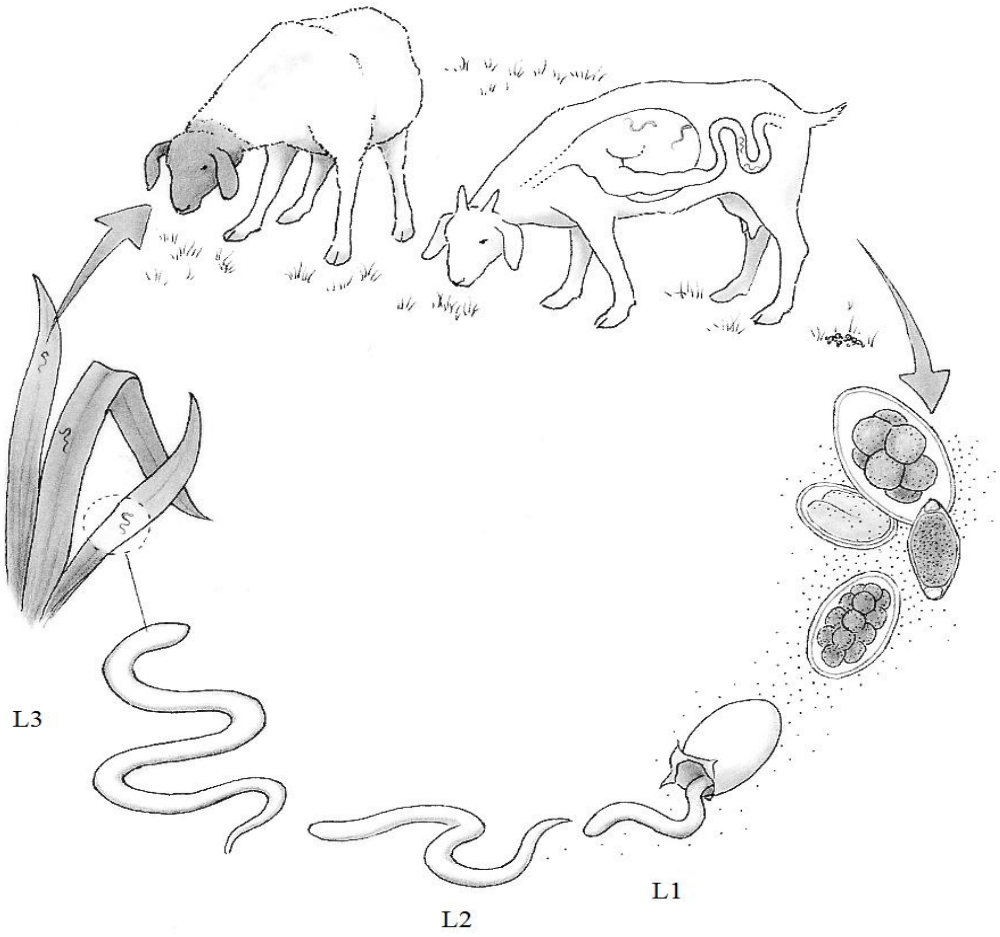
Generally the family Trichostrongylidae are small and the buccal capsule is absent or very small and has no leaf-crown . But the male bursa is well developed with large lateral lobes and small dorsal lop (Soulsby , 1982) . In sheep the adult worms are small and hair - like usually the length of the parasite less than 7.0 mm long and difficult to see by the naked eye , these worm have no obvious buccal capsule . A most useful generic character is the distinct excretory notch in the esophageal region . The spicules are thick and unbranched in addition in *T. axei* the spicules

are unequal in length. The tail of adult female is bluntly (Urquhart *et al*., 1996).The important species in sheep are *T. colobriformis* and characterized by closing of gap back rib in the bottom and each branch is divided into two branches . Spicules slightly unequal length and have a certain structure , with small boat form. But T. *vitrinus* has large balb mating with two spicules equal in size, straight, short, light brown in colour was light brown. Also *T. proboloros* has much thicker spicules than other species and dark brown in colour with two triangularbulges in the abdominal. Spicules are approximately equal in length and gubernaculums brown transparent. (Abbas *et al*.,2012).

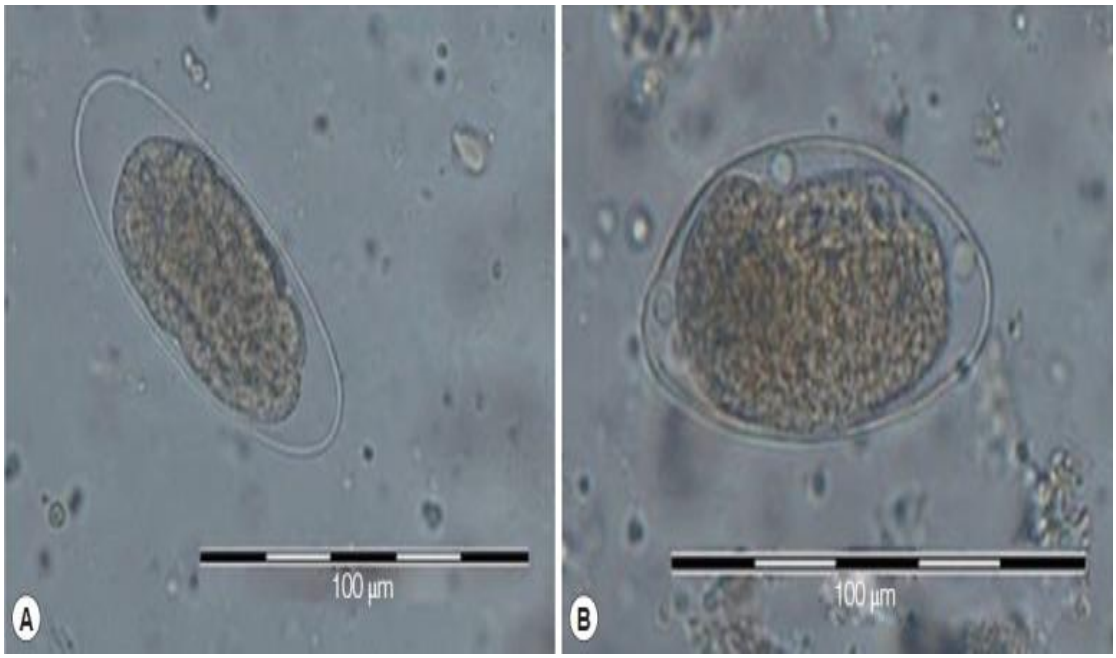
1.1.4. life cycle:

All gastrointestinal nematodes (GIN) have direct life cycles (without an intermediate host) . These parasites similar in all species and enable the worms to be readily transmissible in livestock .Adult worm found in small intestine and abomasums. Adult female in gastrointestinal tract produce eggs that are release with the faeces of animals , eggs development within the faecal mass they are embryonate and hatch in to first stage (L1),then these stage moult to second – stage larva (L2) and shedding their protective cuticle during these time larvae feed on bacteria . The L2 moult into third stage (L3), but retain the cuticle from the previous moult . L3 it's the infective stage and migrate onto surrounding vegetation where they become available for ingestion by grazing sheep (Sissay,2007). Trichostrongylosis infection occur by L3 by a free living larvae in the field .The L3 of the *Trichostrongylus* worms penetrate the epithelial layer of the mucus membrane in the small intestine (Soulsby, 1982; Urquhart *et al*., 1996).

Sissay (2007) reported that L3 after 2-3dayes moult to fourth –stage (L4) which remain in mucous membrane or in gastric gland for about 10 to14 days then these stage moult to become young adult parasite . The time between ingestion of L3 and the parasite becoming mature adults between 3 and 5 weeks.



life-cycle of *Trichostrongylus*(GI nematodes) (Sissy,2007).



Egg of *Trichostrongylus* (Meysam *et al*. , 2017)**.**

1.1.5.Mode of transmission:

In animals *Trichostrongylus* is transmitted orally by contaminated feed by feces (Baker , 2007; Bowman, 2009; Hoberg *et al*., 2001).
In human infections occur mainly via ingestion of filariform larvae from contaminated vegetables or water or rarely by penetrating through the skin **(**Phosuk *et al*., 2013).

1.2.Trichostrongylosis:-

1.2.1.Pathogenesis:

Parasites in all stages of development and until become adult in the small intestine are found in the tunnels beneath the epithelial cell of the basement membrane (Taylor and Pearso,1979). The ingested L3 during developing to adult worms leading to thicking ,edematous with inflammated cell of lamina propria and distortion of villi and become flattened which reducing the absorption area of intestine. The loss of plasma protein into the intestine are developed leading to hypo albuminaemia (Barkar, 1973, Urquhart *etal*., 1996). The infestation of *Trichostrongylus* spp resulting in depression of phosphorus, calcium and selenium (Horak *etal*.,1968;Symon and Steel,1978;Coop,1981). After

ingestion the L3 in the intestine penetrates between the epithelial gland of mucosa and formation tunnels below the epithelium . L3 developing to worms and lead to rupture the tunnels then release young worms leading to hemorrhage , edema and enteritis .The villi distorted and flattened this lead to reduce the absorption area of intestine (Urquhart *etal.,* 1996) .

1.2.2.Clinical signs:

The onset of the disease generally insidious and the young animal failing to grow and becoming unthrifty, reducing feeding and dullness .Severely affected animal are pass dark green or blackish soft feces rhich foul in odor. Dehydration and diarrhea in the terminal stage (Radostits *etal*., 2007).

Baker(2007) ; Bowman (2009) and Hoberge *etal*.,(2001) recording that the infection asymptomatic or can be mild in manifestations and heavy infestation characterized by wasting , blackish – watery diarrhea , depression and anorexia . In some infected animals pica is developed , reduced growth , chronic , diarrhea (Troncy,1989 ; Fritsche *etal* ., 1993). At post mortem in intestine the lesion is varies there is hemorrhage, edema in lumen of the gut ,enteritis and the villi become deformed and flattened(Urquhart *et al*.,1996). Adult worms can be seen in the small intestine, abomasums of ruminants, stomach of monogastrics or ceca of birds.They are very fine and if are placed against a dark background, they look like small hairs(Barker *et al*.,2007;Bowman ,2009; Hoberg *et al.*, 2001).

In human the signs of the disease are asymptomatic or associated with mild symptoms characterizes by abdominal pain, nausea , diarrhea , flatulence, dizziness, generalized fatigue , and malaise . Heavy infection of parasite leading to anemia cholecystitis , and emaciation (Wikipedia ,2018).

1.2.3. Diagnosis:-

1.2.3. 1. Parasitological techniques :

1.2.3.1.1. Direct smear method:

A clean microscopic slide is prepared and amount of feces are put in it ,1-2 drop of water are mixed with feces, all debris is removed then a cover slip is placed carefully over slide and examined under microscope for the presence of *Trichostrongylus* egg (Kelley , 1984).

1.2.3.1.2. Modified Mc master technique :

This technique was used to count faecal egg with saturated solution of sodium chloride medium in each case. Three grams (3g) from faeces are mixed in 42 ml of saturated solution of sodium chloride then the number of egg per g of faeces is obtained by multiplying the total number of egg counted in two squares of the counting chambers of Mc \master slide with dilution factor of 50 *Trichostrongylus* egg present are identified using standard parasitological criteria (Kelley , 1984).

1.2.3.1.3. Centrifugal flotation technique :

This method's is more saved and accuracy by obtained a sample of faeces ,1-5g is mixed with water about 30-50ml and strained through sieve (1 mm mesh)to remove coarse faecal material .The mixture is sedimented fore 10-15 minutes on the bench or by light centrifugation for two or three occasions , until the supernatant is clear .The sediment is then mixed with saturated solution of sugar ,salt or zinc sulphate in tube (15-50ml volume) .Centrifugation of the mixture for one or two minute at 500 round per mints (rpm) the eggs are floated to the surface and then touched with cover slip was placed on a clean slide and examined using a compound microscope at 10 x 10 magnification (Soulsby,1982).

1.2.3.2.Serological diagnosis :

Dot –ELISA has been used for the detection of parasite as soluble antigen in sheep sera . This test with immune affinity purified somatic could detect infection as early as one week post infection during pre patency (Lone *etal*.,2012).

1.2.3.3.Molecular diagnosis:

Using of polymerase chain reaction that needs specific primers and amplicon for each target c DNA and based on known ovine gene sequences(Lone *etal*.,2012).

1.2.3.4.Necropsy finding:

Trichostrongylids are small , translucent and thread like so the adult escapes and is not detected by naked eye at necropsy . The counting of these parasite by washing the mucosa , sieving , washing of luminal content (Radostits *etal*.,2007**).**

In gross pathological findings there are no lesion in the intestine. But in acute cases generally the carcass is emaciated ,dehydrated , moderate anemia and evidence of scouring .Also there is fatty changes in the liver ,intestinal mucosa is thickened , inflamed and ulcerated in chronic cases . In histological examination there is villous atrophy , catarrhal inflammation with necrosis and erosion (Soulsby , 1982 and Radostits *etal*.,2007).

1.2.4.Treatment and control :-

The treatment of *Ttrichostrongylus* should be preceded by removal the source of infection (infected animal) and symptomatic medication to destroy the parasite . Broad anthelmintics can be used (Troncy ,1989) . Many broad - spectrum anthelmintic are used .There drugs have high efficiency again larval and adult worms with low toxicity in animal (Radostits *etal* ,2007). Adams (2001) demonstrated the available nematocidal drugs for most host species in a few chemical classes and these group are:

1.2.4.1. Benzimidazoles (B Z Ds) :

This group include thiabendazole ,flubendazole,cambendazole, fenbendazole , albendazole, oxfendazole ,oxibendazole and parbendazole .They are acted on nematode tubulin in cellular metabolism or disrupt nutrient uptake . They effective against all nematodes and ovicidal are more effective because they stays longer time in animal body (Soulsby , 1982).

1.2.4.2. Levamisole (LM):

These are imidazothiazoles and tetrarahydro pyrimidines these drug causing paralysis of the parasite acted directly in cholins and paralyzed nematodes by sustained muscle contraction . Larval and immature stages of gastrointestinal parasite of ruminants are effectively removed by levamisole . This group are rapidly absorbed and excreted , for that it is not essential to maintain high concentration in sheep for protection . They are not ovicidal they causing paralysis on parasite . The therapeutic safety index is low (Soulsby , 1982).

1.2.4.3. Macrocyclic lactones :

This are composed of two major groups they are avermectin and milbemycin they are acted on nervous system of the parasites and also interfered with their reproduction of the nematodes . These compound are higly lipophilic after administration and stored in fat tissue from where they are slowly released . These compounds causing paralysis to parasite(Soulsby , 1982) .

1.2.5. Epidemiology :

Survival of the free-living stages of nematode parasites are influenced by micro-climatic factors within the faecal and herbage, These include sunlight, temperature , rainfall , humidity and soil moisture. Under optimal condition (high humidity and warm temperature), the development process takes 7 to 10 days. In most African countries, the temperatures are permanently favorable for larval development. Development of *Trichostrongylid* larvae occurs in a temperature range of approximately10–36°C. The humidity requirement

for free living stage development of most species is 85%. (Donald,1968 and Tembely, 1998). L3 can survive in the desiccated state for several months , but once hydrated they become active and rapidly exhaust their food reserves (Tembely, 1998 and Torina *et al*., 2004). In the rainy seasons rapid translation of eggs to L3 occur and grazing animal acquire the highest infection during these time. In humid tropical climate of west Africa the climate condition permit development of eggs and larval stage more-or-less continuously throughout the year (Chiejina *et al*., 1989; Hansen and Perry, 1994; Tembely, 1998).

In the arid tropical climates of lowland areas of Ethiopia, parts of Somalia and Sudan , there exists an environmental gradation which ranges from deserts, to extensive pasturelands and browse plants, to intensive grazing areas around permanent water courses (lakes and rivers) and to irrigation ,which range from being hostile to those that are most favorable for development and survival of free-living stages of the parasites . The number of eggs produced by an adult female nematode is influenced by the level of host immunity to the parasites . In sheep and goats, adult female nematodes may increase their egg around the time of parturition .This phenomenon, known as the peri-parturient rise (PPR)and of great importance in the epidemiology of GI nematodes of small ruminants , and has been reported in different African countries (Connan, 1976; Agyei *et al*., 1991; Tembely, 1995).

Type I disease in outbreak due to trichostrongylid infection occurs after clinical signs due to developing worms emerge from the mucosa of alimentary tract .When the infective larvae has risen to level sufficient to overwhelm many immunity that may develop .But type II occurs during the winter housing period (Radostits *et al* .,2007).

1.2.6.Control measurement:

The objective of control measure that reducing pasture contamination and this can be minimized the uptake of infective larvae .The cost of the programs and treatment must accord with potential economic benefits. Knowledge of local control epidemiological data for designing control program is necessary .Also routine treatments must be considered to avoiding anthelmintic resistant .Elimination of the per parturient egg rise

dosing the animal toward the end of gestation and again after one month after parturition . Susceptible animals are mainly responsible for contamination of pasture for that contamination rates and parasitic disease reduced by reducing the proportion of susceptible stock on farm . In sheep finishing situation the main aim is to minimize the larval challenge to the most vulnerable and economically sensitive class of stock (Rattary,2003).

For prevention of infection in human vegetables should be washing and good cooking to avoiding these free-swimming stages of infective larvae . Protective food wearing is important when walking in areas contaminated with parasite (Wikipedia , 2018).

CHAPTER TWO

Materials and Methods

2.1. Study area:

Nahr El Neel State lies approximately between 22-35 longitude, east 16-22 latitude North ,and extend from Elsabuloga near River Nil south toward Bayoda desert to the Northern state North (Mohammed *et al*.,1996). Atbara is a town located in Nahr EL Neel State in North Eastern Sudan (Atbara, 2007). It is located at the junction of the Nile and Atbara rivers .It is an important railway junction and rail road manufacturing centre ,and most employment in Atbara is related to the rail lines .It is known as the Railway city ,and The National Railway Company's Headquarters are actually located in Atbara. The city is also a home to one of Sudan's largest cement factories(Atbara cement Corporation). The state surface area is about 124,000$Km^2$and the climate is that of a dry hot desert annual rainfall varies from zero in Northern part to150mm in the Southern .Trees and grasses such as *Acacia*, *Cherenbergiana and Aristida spp*. represent natural pastures beside the irrigation land around the river bank which is considerably small (Mohammed *et al* .,1996).

2.2. Study design :

Across sectional study was conducted on abattoir , veterinary hospital and from sheep farms. Animals were selected randomly to determine the prevalence of *Trichostrongylus spp* in sheep based on coprological examination .

Prevalence of sheep *Trichostrongylus* was calculated by the following equation (Farooq *et al* ., 2012).

$$\text{Prevalence Rate} = \frac{\text{No of sheep with } \textit{Trichostrongylus}}{\text{Total No of sheep tested at particular point in time}} \times 100$$

2.3. Sample size:

Regular visits were made by investigator in abattoir , veterinary hospital cases and livestock farms . A total of 391 sheep faecal samples were examined .The survey period extended from July 2018 to April 2019.During the collection of the samples the age ,sex, breed ,body condition, nutrition and season were recorded . The age of animal was determined for both sexes based on dentition, those animals with the age less than two years were considered as young while those greater than or equal to two were considered as old . Body condition of each animal recorded according to body condition score were ranked as poor or good.

The sample size was calculated according to Thrusfield (2005) formula by using 50% expected prevalence with 5% absolute precision at 95% confidence interval.

$$n = \frac{Z^2 * Pexp(1 - Pexp)}{d^2}$$

Where, n= the sample size.
Pexp= expect prevalence (0.5).
d=desired absolute precision (usually 5%) .
z= required confidence level, (Z=1.96 for 95% confidence interval) .

Therefore, by substituting the values of variables in the formula the sample size was determined to be 390, which is used as representative animal on which the study was done to know the prevalence of trichostrongylosis.

2.4.Samples collection and laboratory diagnosis :-

2.4.1.Faecal collection :

A total of 391 faecal samples were collected directly from the rectum of sheep using hand gloves and carried in a clean plastic container (Troncy ,1989) . All samples were transported to Atbara veterinary labrotary for examination of *Trichostrongylus* spp. Each sample were clearly labeled with animal identification ,date and place of collection. All samples were stored at 4°c in refrigerator until examined within 48hours .

2.4.2 .Direct flotation test :

Detection of *Trichostrongylus* eggs in faeces was carried out by flotation . About 3g of feces were weighted by calibrated teaspoon and placed in a container saturated solution of sodium chloride(Na Cl) was added, mixed and filtered through a tea sieve and strained through a sieve to remove coarse fecal materials .The mixture was put in centrifuge tube (15-50ml volume) until to become dome shaped. Then the cover slip was placed on top of the tube for 10 minutes on the bench . The egg were floated to the surface and touched with a cover slip. The cover slip was placed on a clean slide and examined under the compound microscope at 10x10 magnification (Soulsby,1982) .

2.5.Data collection :

The data were collected through observation structured questionnaires that target the key persons in the farms ,abattoir and clinic selected .Moreover the samples (391) were collected using probability random sampling techniques.

2.6.Questionnaire Survey:

A structured questionnaire with the primary objective of elucidating the multi factorial background of *Trichostrongylus spp* in sheep was conducted in an interactive manner at each farms ,abattoir and clinic .(6) structured questionnaire were filled out by asking the owner .The form including sex ,breed ,body condition, and age .The general management factorial included season and nutrition .

2.7.Statistical analysis :

Frequency table of the distribution according to potential risk factor was constructed . Cross tabulation of trichostrongylosis according to potential risk factor was made . Univarate analysis by the Chi –square test using statistical packets for Social Sciences (SPSS). Multivariate analysis by Logistic Regression models to perform risk factor significant at level ≤ 0.25 in the Unviarate model .The significant level in the Multivariate analysis was be ≤ 0.05.

CHAPTER THREE

Results

The results indicated natural *Trichostrongylus* infection was prevalent among Sudanese sheep at Atbara locality (River Nile State) with an overall prevalence of 31.7% .

Among 391 sheep faecal samples examined 124 animals were found positive but 267 animals were found to be negative for sheep trichostrongylosis (Table 3.1) .

Table 3.1: Prevalence of *Trichostrongylus* infection among 391 sheep examined in Atbara locality .

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
negative	267	68.3	68.3	68.3
Positive	124	31.7	31.7	100.0
Total	391	100.0	100.0	

Table 3.2: Summary of frequency of all animals(n = 391) were examined for trichostrongylosis in Atbara locality.

Risk factors	Frequency	Relative frequency (%)	Cumulative Frequency(%)
Sex:			
Male	247	63.2	63.2
Female	144	36.8	100.0
Breed:			
Dabasi	54	13.8	13.8
Local	337	86.2	100.0
Nutrition:			
Grass + concentrate	94	24.0	24.0
Grass	297	76.0	100.0
Season:			
Summer	105	26.9	26.7
Winter	185	47.3	74.2
Autumn	101	25.8	100.0

Body condition: Good Poor	 245 146	 62.7 37.3	 62.7 100.0
Age: Yong Old	178 213	45.5 54.5	45.5 100.0

Sex of animals:

Among 144 female animals examined67 were found positive for *Trichostrongylus spp* indicating prevalence of 46.5% . Among 247male animals examined 57 were found positive for *Trichostrongylus spp* indicating prevalence of 23.08% (Table 3.3).

The Chi-square test showed that there was highly significant association between *Trichostrongylus* infection (Table :3.4) and sex of animals (P-value0.000) .

Breed of animals:

The total number of Dabasi examined were 54,the positive were 18animals and the rate of infection was 33.3%.The local sheep examined were 337 animals and the number of infected animals were106 with rate of infection 31.5% (Table 3.3).

The Chi-square test showed that there was no significant association between *Trichostrongylus* infection (Table :3.4) and breed of animals (P-value0.448) .

Nutrition :

The animals fed grass were 94 animals and 32 (34.04%) were infected .While the animals fed grass and concentrates were 297 animals but 92(31.0%) were infected (Table 3.3).

The Chi-square test showed that there was no significant association between *Trichostrongylus* infection (Table :3.4) and Nutrition of animals (P-value0.331) .

Season:

The presence of infection were investigated seasonally and the present of infection in summer was 21.9% (105 animals)and positive were 23 , whereas in Winter was 40.5%(185 animals)and positive animals were 75and in autumn was 25.7%(101animals) positive were 26 .(Table 3.3).

The Chi-square test showed that there was significant association between *Trichostrongylus* infection (Table : 3.4) and Season of animals (P-value0.001).

Body condition:

In body condition the total of good animals were 245and animals infected were 49 and the rate of infection was 20%,on another hand the total of poor was146 animals infected and 75 the rate of infection was51.4%.(Table 3.3).

The Chi-square test showed that there was highly significant association between *Trichostrongylus* infection (Table :3.4) and Body condition of animals(P-value0.000).

Age:

The results of age showed that the total number of young (less than 2 years) were178 .The animals infected were 52 and the rate of infection was29.2%.The total of the old animals were (above than 2 years) 213.The animals infected were 72 the rate of infection was 33.8%. (Table 3.3).

The Chi-square test showed that there was no significant association between *Trichostrongylus* infection (Table :3.4) and age animals (P-value0.194) .

Table 3.3: Summary cross - tabulation of Trichostrongylosis in 391 sheep at Atbara locality .

Risk factor	Animals tested	Animals affected	Rate of infection%
Sex			
Male	247	57	23.08%
Female	144	67	46.5%
Breed			
Dabasi	54	18	33.3%
local	337	106	31.5%
Nutrition			
grass	94	32	34.04%
Grass Concentrate	297	92	31%
Season			
Summer	105	23	21.9%
Winter	185	75	40.5%
autumn	101	26	25.7%

Body condition Good poor	245 146	49 75	20% 51.4%
Age Yong Old	178 213	52 72	29.2% 33.8%

Table 3.4 : Summary of univariate analysis for potential risk of Trichostrongylosis in 391 sheep examined in Atbara locality using Chi-square test.

Risk factor	No. inspected	No .affected %	Df	X^2	P-value
Sex					
Male	247	57(23.8)	1	23.1	0.000
Female	144	67(46.5)			
Breed					
Dabasi	54	18(33.3)	1	0.076	0.448
local	337	106(31.5)			
Nutrition					
Concentrate + grass	94	32(31)	1	.310	.331
Grass	297	92(34.04)			
Season					
Summer	105	23(21.9)	1	12.98	.001
Winter	185	75(40.5)			
autumn	101	26(25.7)			

Body condition Good poor	 245 146	 49(20) 75(51.4)	1	41.57	.000
Age young Old	 178 213	 52(29.2) 72(33.8)	1	.943	.194

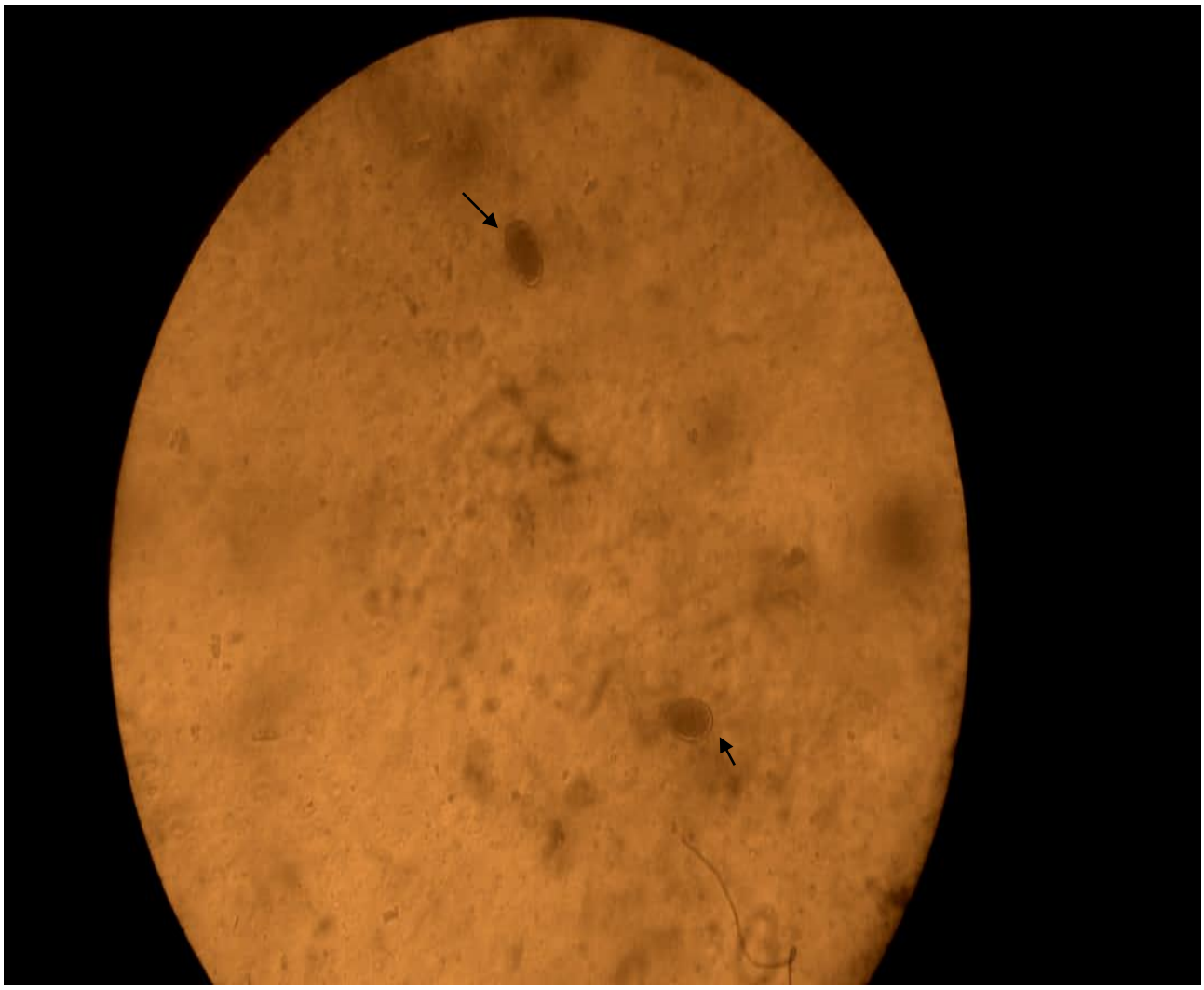
*Means significant value .p-value ≤ 0.05

Table 3.5: Multivariate analysis of Trichostrongylosis and potential risk factors in391 sheep examined at Atbara locality using logistic Regression.

Risk factors	Animals affected%	Exp(B)	95% Confidence Interval for Exp(B)		P-value
			Lower Bound	Upper Bound	
Male	57(23.08)	2.687	1.675	4.308	0.000
Female	67(46.5)	.	.	.	
good	49(20)	4.031	2.513	6.467	0.000
Poor	75(51.4)	.	.	.	
Summer	23(21.9)	.946	.473	1.890	0.009
Winter	75(40.5)	.470	.264	.838	
Ataman	26(25.7)	.	.	.	

* Means significant value .p-value ≤ 0.25.

As shown in table 3.5 there were 3risk associated with disease and these were age , body condition and the seasons .



Egg of *Trichostrongylus* under microscope

CHAPTER FOUR

Discussion

One hundred twenty four out of 391 sheep faecal samples examined were found positive with *Trichostorongylus spp* with over all prevalence rate of 31.7 % in sheep in Atbara locality in River Nile State .This finding was lower compared with previous study in central Kordofan (Ghada,2011) who reported prevalence of 60%. On the other hand ,it is mostly higher than the result reported in Pakistan which was 4.51%(Gadahi *etal*.,2009). The differences in prevalence reported could be accounted on the basis of management Practices (Barger ,1999and Mandonnet *et al* .,2003) , natural resistant (Pal and Qayyum,1992), drug treatment (Ali *etal*.,1997) .

The prevalence of *Trichostrongylus* in sheep according to sex was estimated in these study , the rate of infection in males was 23.08%and in females was46.5%.There was significant association between the sex and the disease (P-0.000) .The highest rate of infection was found in female , this could be attributed to decrease in natural immunity in female due to stress of pregnancy and lactating period for that these flocks became susceptible to parasite (Gibson and Everett, 1971; Connan, 1976; Le Jambre, 1984). This result agreed with that reported in Kashmir (Bashir *etal*.,2012), and disagreed with that in Ethiopia(Uiase *etal*.,2017). They showed that male and female sheep have equal chance of infection if they are exposed to the same contaminated common grazing pasture.

The current study also indicated that there was significant association of the prevalence of parasite in different seasons (P-0.001), The highest rate of infection was found in winter, but hot or dry weather can kill larvae on the pasture and Larvae number peak in late winter .

Regarding the breed distribution of the parasite (*Trichostrongylus),* the current finding revealed that the prevalence in Dabasi and local breed of animals was33.3% + 31.5% respectively ,there was no statistically significant association (P-.448) .The highest rate of infection was found in Dabasi this may be due to nature of pasture grazing pattern and movement between these topographical location for pasture .

There was highly statistically significant variation in the prevalence of *Trichostrongylus* and body condition(P-0.000) in present study, an animal with poor body condition seems to have higher prevalence of trichostrongylosis than prevalence was in good body condition may be due to abettor immunity in good body condition animals may also signify the importance of the parasite is causing weight loss (Urquhart *etal*.,1996) and the lowest in good body condition in these result related to condition of host seem to have influence on the prevalence of infection, the result similar to result reported in Ethiopia
(Uiase *etal*.,2017).

In age of animals the prevalence of trichostrongylosis was 33.8% in old and 29.2% in young. Age wise observation revealed no statistically significant association (P-0.194) between age and trichostrongylosis .Old animals have higher rate of infection , because the young have maternal immunity and depending in their feeding in suckling .This results disagreed with result reported in Ethiopia(Uiase *etal*.,2017).

The prevalence of *Trichostrongylus* related to nutrition of animals was34.04% in grass with concentrate and 31% in grass The highest rate of infection was found in grass with concentrate this may due to sample size variation . Inadequate nutrition increasing susceptibility of parasite infections . (Connan, 1976) .

Conclusion and Recommendation

Conclusion:-

The output of this study indicates , that the overall prevalence of trichostrongylosis was 31.7% . the presence of high rate of *Trichostrongylus spp* parasite in the area was responsible for the loss of production in sheep .A high prevalence of infection was in females as compared to males .Old animals were highly effected as compared to young animals .A high prevalence of infection was in dabasi compared to local . A high prevalence of infection was in poor body condition as compared to good body condition . A high prevalence of infection in animals that fed on grass as compared to animals fed on concentrate and grass. A high prevalence of infection was in winter as compared to autumn and summer.

Recommendation:-

*As prophylactic measure use of anthelminitics to sheep from period to period.

*Improvement of husbandry practices in sheep farms .

*In poor animals using of deworming strategy is important .

* Continuous surveillance and investigation of parasitic disease .

*Study and identification of affecting risk factor of *Trichostrongylus* must be conducted .

*Good personal hygiene is very important to prevent human infection , do not use herbivores manure as fertilizer.

* Vegetables should be cleaning and cooking well to avoiding infection .

References

Abbas,shahbazi; Esmael, Fallah ;Mohammad, Hassan; Kohansal, Koshki; Ahmad, Nematollahi; Ardavan, Ghazanchaei. and Shabnam ,Asfaram.(2012). Morphological characterization of the *Trichostrongylus* species isolated from sheep. Tabriz, Iran. 2(5). 309. Baker, D. G. (ed.).(2007). *Flynn's Parasites of Laboratory Animals.* 2nd ed. Blackwell Publishing, Ames, Iowa. 840 pp.

Adams ,H.R. (2001) . *Veterinary Pharmacology and Therapeutics .Eight edition* . lowa state Pres .AB lack well publishing company .PP947-965.

Agyei, A. D.; Sapong, D. and Probert, A. J. (1991). Periparturient rise in faecal nematode egg counts in west African dwarf sheep in southern Ghana in theabsence of arrested strongyle larvae. *Veterinary Parasitology.*, 39, 79-88.

Ali ,S.;Anwar ,A.H. ;Hayat ,B.; Iqbal, Z. and Haya ,C.S. (1997). Field evaluation of anthelmintic activity of levamisole , Albendazole ,Ivermectin and Morantel Tartrate against gastrointestinal nematodes of sheep . *Pak .Vet*.J.,17:114 .

Annual report.(2009).Ministry of Animal Resources .River Nile State ,*Annual Reports*.

AOAD .(1998) . Arab Organization for agriculture Development .*The Present Status of Livestock Trade in Relation to Animal Disease in the Arab Organization for agriculture Development* . P14 .

Atbara.(2007) .(The,Sudan) (description), *Encyclopaedia Britannica webpage* .EB-Atbara.

Bailey, J.N.; Kahn, L.P. and Walkden-Brown, S.W.(2009). The relative contributions of T. colubriformis, T. vitrinus, T. axei and T. rugatus to sheep infected withTrichostrongylus spp. on the northern tablelands of New South Wales. *Veterinary Parasitology*.165:88-95.

Baker, D. G. (ed.).(2007). *Flynn's Parasites of Laboratory Animals*. 2nd ed. Blackwell Publishing, Ames, Iowa. 840 pp.

Barger ,I.A. (1999). The role of epidemiological knowledge and grazing management for helminth control in small ruminants. *Int.J.Parasitol*.29:41-47.

Barker,I.K.(1973) A study of pathogenesis of *trichostrongylus colibriformis* in lamb with observation on the contribution of gastro intestinal plasma loss .*In T.J parsit*,3,743-757.

Bashir, A.L;Chishti, F.A .and Hidayatullah T.(2012). A Survey of Gastrointestinal Helminthes Parasites of Slaughtered Sheep and Goats. Kashmir. *Global Veterinaria*. 8: 338-341.

Bowman, D.D. (2009). *Georgis' Parasitology for Veterinarians*. 9th ed. 464 pp.

Cengiz, Z.T. and Değer, M.S. (2009). Sheep trichostrongylidosis in Van Province .Türkiye . *Parazitolo ji Dergisi*, 33(3):222-226.

Chiejina, S. N.; Fakae, B. B. and Eze, P. I.(1989). Development and survival of free living stages of gastrointestinal nematodes of sheep and goats on pasture in the Nigerian derived savanna. *Veterinary Research and Communication* . 13: 103-112.

Connan, R. M. (1976). Effect of lactation on the immune response to gastro intestinal nematodes. *The Veterinary Record* 99. 476-477.

Coop,R.I.(1981). Feed intake and utilization by the parasitized ruminal . In ؛ *Isotypes and Radiation in parasitology IV.* Vienna.

Donald, A. D. (1968). Ecology of the free-living stages of nematode parasites of sheep. *Australian Veterinary Journal*., 44:139-144.

Farooq, Z; Mshtaq,S; Iqbalz. and Akhtar ,S.H. (2012).Parasitic Helminthes of Domesticated and Wild Ruminants .Pakistan. *Int.J.Agric.Biol*.,14,No.1.htt//www.fspublishing.org.

Fritsche, T.;Kaufmann, J. and Pfister, K.(1993). Parasites and seasonal epidemiology of gastrointestinal nematodes of small ruminants . Gambia. *Veterinary Parasitology.*, 49: 271-283.

Gadahi, J.A.; Arshed, M.J.; Ali, Q.; Javaid, S.B. and Shah, S.I. (2009). Prevalence of gastrointestinal parasites of sheep and goat in and around Rawalpindi and Islamabad, Pakistan. *Veterinary World*. 2(2):51-53.

Getachew ,T; Dorchies, P.and Jacquiet, P.(2007) .Trends and challenges in the effective and sustainable control of *Haemonchus contortus* infection in sheep. *Review. Parasite*, 14:3–14.

Ghada, Hassan Abdelnab.(2011). *Prevalence of gastrointestinal helminthes in sheep*. in central Kordofan state , Sudan. Khartoum university .

Ghadirian, E and Arfaa, F.(1975). *Present status of trichostrongyliasis in Iran* .Iran. 24: 935-941.

Ghadirian, E.(1977). Human infection with *Trichostrongylu slerouxi* in Iran. *American Journal of Tropical Medicine and Hygiene*. 26:pp1212-1213.

Gibson, T. E. and Everett, G. (1971). The seasonal fluctuations of the larval populations of four species of trichostrongylid nematode on pasture herbage. *Research in Veterinary Science.* 12.pp 602-604.

Govindaragan ,C.V. (1990) . Maintenance of hygienic and sanitary condition including personal hygiene in the meat factory .*Technical paper in first National Seminar and Marketing Meat Food Products* in India ,Aligarh ,India .

Hansen ,J. and Perry ,B. (1990) .*Epidemiology Diagnosis and Control of Helminthes Parasites of Ruminant* .International Livestock Center for Africa . Addis Ababa Ethiopia .PP:90-100.

Hansen, J. and Perry, B. (1994). The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants . *A Handbook* . 2nd ed. (International Laboratory for Research on Animal Diseases). Kenya. 171 pp.

Hassan, M. M.; Hogue,M.A.; Islam, S.K.M.A.; Khan, S. A.; Hoberg, E. P; A. A. Kocan, and L. G. Rickard. (2011) Gastrointestinal

Strongyles in wild ruminants. In*:* Samuel, W. M., M. J. Pybus, and A. A. Kocan (eds.). *Parasitic Diseases of Wild Mammals*, 2nd ed. Iowa State Press, Ames, Iowa. PP. 193-227.

Hoberg, E. P.; Kocan,A.A. and Rickard, L.G.(2001). Gastrointestinal *strongyles* in wild ruminants . In: Samuel, W. M., M. J. Pybus, and A. A. Kocan (eds.). *Parasitic Diseases of Wild Mammals*, 2nd ed. Iowa State Press, Ames, Iowa. pp193-227.

Horak ,I.G ; Clark , R . Gray , R.S.(1968). Pathophsiology of helminth infestations**.** *Trichostrongylus colubriformis .Onderstpoor T.J.Vet.Res*. 35,195-223.

Jambre, L. F. (1984). Stocking rate effects on the worm burdens of Angora goats and Merino sheep. *Australian Veterinary Journa*.l 61:pp 280-282.

Kelley ,W.R.(1984) .*Veterinary Clinical Diagnosis* .Third edtion. BailliereTindall .London . pp245-247 .

Lateef, M.; Iqbal, Z.; Jabbar, A.; Nisar khan, M. and Akhtar, M.S.(2005). Epidemiology of Trichostrongylid nematode Infections in sheep under traditional husbandry system . Pakistan. *International Journal of Agriculture &Biology*. 7:pp596-600.

Lone,B.A.;Chishti,M.Z.; Ahmad,F.; Tak ,H. and Hassan,J. (2012). Faecal examination of farm animals for helmintic parasites. Iranian. *Journal of Veterinary Research.*

Mandonnet ,N.;Ducrocq ,V.;Arquet , R. andAumont , G.(2003). Mortality of Creole Kidsduring infection with Gastrointestinal STtrongyle.asurvival analysis .J.*Anim.Sci*.,81:2401-2408.

MARF.(2005). Ministry of Animal Resources and Fisheries , Statistical Bulletin for Animal Resources .Issue No.14: 3-350.

Meysam, S.; Zahra, H.; Sajad, V. and Eshrat, B.(2017) . Molecular Phylogenetics of *Trichostrongylus* Species. *Korean J Parasito Vol.* 55, No. 3: 279-285.

Mohammed,M.A;Karim,H.L; Mohammed,G. A. and Mustafa ,A.H. (1996). The first Proceedings Agriculture Conference at Nar –ElNile State *Minstry of Agriculture and Animal Resource* pp6-7 .

Pal ,R .L .and Qayyum,M. (1992). Distribution of gastrointestinal helminthes of sheep and goat in Swate Valley NWFP,Pak .*Vet.J.*,13:138-141.

Phosuk, I.; Intapan, P.M.; Sanpool, O.; Janwan, P.; Thanchomnang, T.; Sawanyawisuth, K.; Morakote ,N.; Maleewong ,W.(2013). Molecular evidence of *Trichostrongylus colubriformis and Trichostrongylus axei* infections in humans from Thailand and Lao *PDR.* 89: 376-379.

Radewald, J. D. (1977). Nematode diseases of food and fiber crops of the southwestern United States. Oakland: University of California division of Agricultural and Natural Resources, *Publication 4083*.

Radostits ,O.M. ; Gay ,C.C. ;Hinchcliff, K.W.; Constable, P.D.(2007). *Veterinary Medicine* .Tenth edition. Saunders LL Sevier, Edinburgh , London , New York , Oxford , Philadelphia ,Stlouis , Sydney , Toronto .PP.1541-1548.

Rattary.(2003). Helminth parasites in the New Zealand Meat and Wool pastoral Industries :A review of current Isses .*Report :meat and wool Innovation LTD.*

Roy, K. and Banu, Q.(2011). A prevalence of parasites in black Bengal goats in Chittagong, Bangladesh .*International Journal of Livestock Production,* 2: 40-44.

Schuer ,R.(1998) . Epidemology of sheep Moneizasiss chafes .*parkitsche Tierazt* .79:4 ,pp357-363 .

Sissay, M. M. (2007). Helminth parasite of sheep and goats in Eastern Ethiopia:Epidemiology , and anthelmintic resistance and its management .phD thesis, Swedish University of Agricultural Sciences , *Uppsala, ISSN* 1652-6880,ISBN 978 -91-576 – 7351-0.

Soulsby, E. J. L. (1982). Helminthes, Arthropods and Protozoa of domestic animals .7 th Ed *Baillier Tindall and Cassel* Ltd .London.

Steel, J.W. (1972). Effects of the intestinal nematode Trichostrongylus Colobriformis on ruminal . *Acetate metabolism in Young Sheep*. Proceedings of the Australian Society of Animal Production., 9:402-407.

Symons ,I.E.A. and Steel , J.W.(1978).pathogenesis of loss of production in gastrointestinal parasitism .In: *The epidemiology and control of gastrointestinal parasites of sheep in Australia* ,A.D. Doald, common .Scientific and industrial Research organization ,Australia .

Taylor ,S.M. and Pearson ,G.R.(1979) . Trichostrongylus virinus in sheep .I:The location of nematodes during parasitic development and associated pathological changes in the small intestinal .*J. Comp .Patho*., 89,397-le 03.

Tembely, S. (1995). The effect of genotype, lactation and season on the periparturient rise in faecal egg counts in Ethiopian highland ewes. *Veterinary Parasitology* . Afric*a.* Proceedings of an IFS (InternationalFoundation for Science). pp 351-363.

Tembely, S.(1998). Development and survival of infective larvae of nematode parasites of sheep on pasture in a cool tropical environment. *Veterinary Parasitology* . Afric*a*.79: 81-87.

Thrusfield ,M. (2005). *Veterinary Epidemiology*. (2nd. Ed.). Blackwell Science, UK. pp 180-181.

Torina, A.; Ferrantelli, V.; Sparagano, O. A.; Reale, S.; Vitale, F. and Caracappa, S. (2004). Climatic conditions and gastro-intestinal nematode egg production. observations in breeding sheep and goats. *Annals of New York Academy of Science*. 1026: pp203-209.

Troncy,P.M.(1989). *Manual of TropicalVetrinaryt Parasitology* . by C.A.B International·PP18-140.

Uiase Bin Farooq;Ahmed Abdulla1; Rajni Chaudhary; and Mesele .(2017). A Cross-Sectional Study on the Prevalence and Associated Risk Factors of Gastrointestinal Nematodes of Sheep **.** *International Journal of Livestock Research*. Ethiopia. Vol 8/ (5).pp5-36.

Urquhart, G. M.;Armour, J.;Duncan, J. L.; Dunn, A. M. and Jennings, F. W. (1996). *Veterinary Parasitology*, 2nd ed. Blackwell Science, United Kingdom, p. 307.

Waller, P.J. (1997). Anthelmintic Resistance . *Vet Parasitol*.72: pp.391-4127.

Wikipedia.(2018). "https://en.m.wikipedia.org/w/iki.php?title=Trichostrongylus&oldid=825972076"

Appendix I

Frequency table for the distribution of infection among 391 sheep examined at Atbara locality according to potential risk factors.

A. Frequency distribution of Sex:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	247	63.2	63.2	63.2
	Female	144	36.8	36.8	100.0
	Total	391	100.0	100.0	

B. Frequency distribution of Breed:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dabasi	54	13.8	13.8	13.8
	Ballade	337	86.2	86.2	100.0
	Total	391	100.0	100.0	

C. Frequency distribution of Nutrition:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Concentrate+ grass	94	24.0	24.0	24.0
	Grass	297	76.0	76.0	100.0
	Total	391	100.0	100.0	

D. Frequency distribution of Season :

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sumer	105	26.9	26.9	26.9
	winter	185	47.3	47.3	74.2
	Autumn	101	25.8	25.8	100.0
	Total	391	100.0	100.0	

E. Frequency distribution of Body condition:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	245	62.7	62.7	62.7
	Poor	146	37.3	37.3	100.0
	Total	391	100.0	100.0	

F .Frequency distribution of Age:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	young	178	45.5	45.5	45.5
	Old	213	54.5	54.5	100.0
	Total	391	100.0	100.0	

Appendix II

Cross-tabulation for the distribution of infection among 391 sheep examined at Atbara locality according to potential risk factor.

A. Sheep Trichostrongylosis and Sex cross-tabulation:

Count		Sex		Total
		Male	Femal	
Result	nective	190	77	267
	Positive	57	67	124
	Total	247	144	391

B. Sheep Trichostrongylosis and breed :cross-tabulation:

Count		Breed		Total
		Dabasi	local	
Result	nective	36	231	267
	Positive	18	106	124
	Total	54	337	391

C. Sheep Trichostrongylosis and nutrition:cross-tabulation:

		Nutrition		Total
		Concentrate + grass	Grass	
Result	nective	62	205	267
	Positive	32	92	124
	Total	94	297	391

D .Sheep Trichostrongylosis and Season cross-tabulation:

Count		Season			Total
		Sumer	winter	Autam	
Result	nective	82	110	75	267
	Positive	23	75	26	124
	Total	105	185	101	391

E. Sheep Trichostrongylosis and Body condition cross-tabulation:

Count		Body condition		Total
		Good	Poor	
Result	nective	196	71	267
	Positive	49	75	124
	Total	245	146	391

F .Sheep Trichostrongylosis and Season Age cross-tabulation:

Count		Age		Total
		young	Old	
Result	nective	126	141	267
	Positive	52	72	124
	Total	178	213	391

Appendix III

Univarate analysis for the association of sheep Trichostorongylosis in 391 sheep with potential risk factors using Chi-square test.

A .Sex:

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.100[a]	1	.000
Likelihood Ratio	22.716	1	.000
Linear-by-Linear Association	23.041	1	.000
N of Valid Cases	391		

B .Breed:

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.076[a]	1	.783
Likelihood Ratio	.075	1	.784
Linear-by-Linear Association	.076	1	.783
N of Valid Cases	391		

C .Nutrition:

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.310	1	.578
Likelihood Ratio	.307	1	.579
Linear-by-Linear Association	.309	1	.578
N of Valid Cases	391		

D. Season:

	Value	D.f	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.984a	2	.002
Likelihood Ratio	13.099	2	.001
Linear-by-Linear Association	.407	1	.523
N of Valid Cases	391		

E. body condition:

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	41.571[a]	1	.000
Likelihood Ratio	41.022	1	.000
Linear-by-Linear Association	41.464	1	.000
N of Valid Cases	391		

F . Age:

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.943[a]	1	.331
Likelihood Ratio	.946	1	.331
Linear-by-Linear Association	.941	1	.332
N of Valid Cases	391		

Appendix IV

Questionnaire for data collection to investigate the risk factors which could be associated with *Trichostrongylus* in Atbara locality .

*Animal No ( )

1. Breed of animal

0- Dabaci ( ) 1- Local ( )

2. Age of animal

0- less than two years (young) 1- More than Two years (old)

3.Sex of animal

0- Male ( ) 1- Female ( )

4. Body condition

0- Good ( ) 1- Poor ( )

5-Season

0- Summer ( ) 1- Winter ( ) 2- Autumn ( )

6-Nutrition of animal

0 Grass + Concentrate ( ) 1 Grass ( )

7- Result

0- Negative ( ) 1- Positive ( )