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Epidemiology of Gastrointestinal Helminth Parasites of Goats in Abeche Area, Ouaddai State, Chad

O.H. Adam[1] , A. A. Mohammed [2] and A. E. Bashar[3]

[1] National Institute of Science and Technology, Abeche, Ouaddai State, Chad.
[2]Department of Preventive Medicine and Public Health, Faculty of Veterinary Science, niversity of Nyala, Sudan.
[3] Department of Parasitology, Faculty of Veterinary Science, University of Nyala, Sudan.
Corresponding author: A. A. Mohammed, E-mail: abbakarad67@yahoo.com

Abstract: *Gastrointestinal helminth parasites of goats remain one of the main constraints to goat production in Chad as they cause economic losses through lowered fertility, low weight gain, low milk production, treatment and control measure costs, involuntary culling, and mortality in heavily parasitized animals. An epidemiological study was carried out to determine the prevalence, distribution and intensity of gastrointestinal helminth parasites of goats and the effect of seasonal and climatic factors as disease determinants in Abeche area in Ouaddai State, Chad, from March 2015 to February 2016. Examination of 1121 (838 male and 283female) pre-slaughtered goats faecal samples and 34(26 males and 8 females) gastrointestinal tracts (GIT) of slaughtered goats of different ages were randomly collected from Abeche abattoir and tested for the presence of gastrointestinal helminth parasites in different seasons. The effect of animal sex, seasonal and climatic factors on the prevalence and intensity of gastrointestinal helminth parasites infections were determined. Faecal examination for GIT parasites eggs, revealed an overall prevalence of (53.9%),while females showed slightly higher prevalence (55.1%) than males (53.5%), with overall mean total faecal egg count (TFEC ±SE) of 561.52±42.14. Female showed slightly higher overall mean (±SE) of TFEC (562.90±80.85) compared to male (561.05±49.34) goats. The seasonal overall prevalence of GIT helminth parasites based on faecal egg detection was observed to be highest (72.3%) in hot wet and lowest in hot dry (45.9%) seasons. Twenty eight (82.35%) of examined goats were found infected with adult gastrointestinal helminth parasites. Rainfall, relative humidity and temperature are the main climatic factors associated positively with the seasonality and distribution of gastrointestinal helminth parasites. The species of (GIT) helminth parasites observed during this study were Haemonchus contortus, Oestertagia oestertagia, Trichostrongylus colubriformis, Strongyloides papillosis, Nematodirus spathinger, Bonustomum trigonocephalum, Trihuris ovis, Oesophaostomum columbianum, Dicrocoelium dendreticum, Paramphistomum cervi and Moniezia expansa. The study concluded that nematodes, trematodes and cestodes were prevalent in the area with high prevalence in hot wet season, which necessitates deworming programme during the rainy season.*

Keywords: goats, GIT Helminth Parasites, Prevalence, Ouaddai, Chad.

Introduction

Goats are an important resource for poor communities. They play a vital economic role by providing substantial income for rurals, pastoralists and the governments through the provision of meat, milk, household income, manure and skins (Ardo and Bitrus, 2015). Due to their low body mass and low metabolic requirements which in turn minimize their water requirements and maintenance needed (Petros and Lakew, 2014), goats have also been reported to survive better in arid and semi-arid regions and hardy conditions with high temperatures, low humidity and minimal available feed (Liang and Devendra, 2014).

Goats under intensive and extensive production systems are extremely susceptible to the effects of a wide range of helminth infections. Gastrointestinal helminth parasite infections are worldwide problem for both small and large scale farmers, but their impact is greater in sub- Saharan Africa due to the availability of a wide range of agro-ecological factors suitable for diversified host and parasites species development (Almalaik *et al*., 2008). Gastrointestinal helminth parasites cause economic losses through lowered fertility, involuntary culling, reduction in food intake, lower weight gain, lower milk production, treatment and control measure costs and mortality in heavily parasitized animals (Kumsa and Wossene, 2006). The most serious economic consequences of gastrointestinal parasites based on, the overall number of worms, of genera and species present, general level of pathogenicity and widespread distribution (Soulsby, 1986).

In spite of the presence of huge ruminant populations in Chad that generates cash income from export of live animals, meat and skins, it fails to optimally exploit this resources due to number of factors such as recurrent drought, infrastructure problems, rampant animal diseases, poor nutrition, poor genetic potential of animals, traditional system of husbandry and management, shortage of trained manpower and lack of government policies for prevention and control of animal diseases (Mopate and Issa, 2008). In Ouaddai State of Chad, no work has ever been conducted in the prevalence of gastrointestinal parasites in goats, since the sole Graber's study in 1965 on the helminthes of ruminants. Therefore, there is limited information or reports about the prevalence of gastrointestinal helminth parasites of goats in the study area.

The current study was performed to determine the magnitude of GIT helminth parasites infections among goats, over a consecutive 12 months of study period and to investigate the seasonal and climatic factors associated with prevalence rate and intensity of infection, enabling to design feasible and strategic control of gastrointestinal helminth parasites infections of small ruminants in the study area.

Materials and Methods

The study area

Chad is landlocked country located in the heart of Central Africa, and borders Libya to the North, Sudan to the East, Niger to the West, Cameroun and Nigeria to Southwest and Central African Republic to the South (Figure 1). It lies between latitudes 8^0-24^0 North and longitudes 14^0-24^0 East (Mopate and Issa, 2010). The climate is desert in the north, poor savannah type in the middle and rich savannah type in the south of the country, with mean annual rainfall ranges from 800 mm in the southern part, 400 mm in the middle and 50 mm in the northern part of the country (Mopate and Issa, 2008). It has an altitude of 450 to 1100 meters above sea level (Provincial development office Abeche, 2010).

The State of Ouaddai is located in the Eastern part of Chad. It lies between the latitudes 13^0 -15^0 North and longitudes 20^0 - 23^0 East. It has a total human population of 721166 (Ministry of Planning, 2009). The main activities of the population are agriculture and rearing animals (nomads, semi-nomads and sedentary farmers). Livestock population in Ouaddai State was estimated as 529629 cattle,111873 sheep, 219486 goats,177541camels, 9832 horses and 59001donkeys (Anon, 2016). The breeds of goats are desert, (local) and kirdimis or dwarf (Anon, 2016).

Figure (1). The map of Chad showing Ouaddai State

Faecal samples collection and examination

During the study period that extended from March 2015 to February 2016, faecal samples were randomly collected from the rectum of 1121 (838 male and 283 female) goats brought from different parts of the country before slaughtering at Abeche abattoir for local consumption. The collected faecal samples were placed in a clean dry leakage-proof plastic cups, carefully labeled with animal species, age, sex and date of the collection, then immediately transported to the laboratory of the National Institute of Science and Technology of Abeche for faecal examination. When the examination delayed the samples were preserved in 10% formalin and examined later. Quantitative and qualitative examinations of parasites eggs were performed by Mac-Master Method and flotation techniques as described by Soulsby, (1986); Hansen and Perry, (1994).

The collection and identification of adult gastrointestinal tract parasitic worms:

A total of 34 gastrointestinal tracts (GITs), samples (26 males and 8 females) were randomly collected from goats slaughtered at Abeche abattoir. Directly after the opening of the abdominal cavity of slaughtered animal, all the gastrointestinal contents were removed away, double ligated to separate the abomasum from the small intestines at one end and at the junction between the small and the large intestines on the other end. The removed organs were transported to the laboratory of the National Institute of Science and Technology of Abeche for processing. Each of the three parts of the (GIT) was separated, cut open, and the contents were powered over a bowl. The inner walls of the organs were washed thoroughly under a stream of water and the mucous membranes were rabbled carefully with the fingers for removal of any adhering worms. From the content of each part of (GIT), 200 ml was transferred to a wash jar (one liter volume) covered with a sieve of 40 meshes per linear inch while mixing thoroughly. The wash jar was then filled with water, inverted and shaken repeatedly until most of the fluid and faecal colouring matter was removed. Up to 50 ml of water was added to the wash jar and then poured into Petri dishes and the worms were collected, counted and preserved in a solution of 10% formalin and identified later using dissecting microscope according to Hansen and Perry, (1994).

Data Analysis:

Data presentation was performed using SPSS computer programme (Microsoft version No. 21, USA). Data was analyzed using one sample T-test and correlation coefficient. Numbers of eggs and worms recovered were transformed to geometric means to normalize the data, and inference was made accordingly.

Results

Out of 1121 goats, faecal samples examined, 604(53.9%) were found positive for GIT helminth parasites eggs. The prevalence rate in 838 male and 283 female goats was (53.5%) and (55.1%) respectively. Seasonally, the overall prevalence rate based on faecal eggs detection was found highest (72.3%) in the hot wet and lowest (45.9%) in the hot dry seasons (Table1).

The findings of the study showed that 582 (51.9%) and 2(0.2%) of goats were infected with (GIT) nematodes and trematodes as a single infection respectively, 8(0.7%) as mixed infection with nematodes, cestodes and trematodes, 7(0.6%) with nematodes and trematodes and 5(0.4%) with nematodes and cestodes.

Table (1). Seasonal prevalence of GIT Helminth parasites in goats at Abeche abattoir, Ouaddai State, Chad during the study period (March 2015 to February 2016) based on faecal egg count.

Season	male			female			overall		
	N0. examined	N0. positive	%	N0. examined	N0. positive	%	N0. examined	N0. positive	%
Hot dry	365	165	45.2	117	56	47.9	482	221	45.9
Hot wet	202	147	72.8	72	51	70.8	274	198	72.3
Cold dry	271	136	50.2	94	49	52.1	365	185	50.7
total	838	448	53.5	283	156	55.1	1121	604	53.9

N.B. : Hot dry = summer (March, April, May and June). Hot wet = autumn (July, August, September and October). Cold dry = winter (November, October, January and February).

The species-specific prevalence of the encountered (GIT) helminth parasites in examined male and female goats in different seasons of the year was shown in Table (2). The intensity of infection for the detected (GIT) helminth parasites based on total faecal egg count (TFEC) mean (±SE) in male and female goats in different seasons of the year was shown in Table (3).

The monthly and seasonal overall mean total egg count (TEPG) of GITs helminth parasites in male and female goats were presented in Figures (2) and (3) respectively.

The seasonal prevalence (%) of GIT adult nematode, cestode and trematode species identified in slaughtered goats in the study area during the study period was shown in Table (4) and Table (5) respectively.

Table (2). Species - specific prevalence (%) of GIT helminth parasites encountered in goats at Abeche abattoir, Ouaddai State, Chad, during March 2015 to February 2016

Season	No. +Ve/Prevalence (%)									
	Strongyle eggs		*Strongyloides papillosis*		*Trichuris ovis*		*Dicrocoelium dendreticum*		*Moniezia expansa*	
	Male	Female	male	female	male	female	male	female	male	female
Hot dry	158(43.3%)	49(41.9%)	27(7.4%)	8(6.8%)	10(2.7%)	5(4.3%)	1 (0.3%)	1 (0.9%)	4 (1.1%)	4 (3.4%)
Hot wet	133(65.8%)	53(73.6%)	16(7.9%)	11(15.3%)	13(6.4%)	8(11.1%)	8 (4%)	4 (5.6%)	2 (1%)	1 (1.4%)
Cold dry	127(46.9%)	47(50%)	8(3%)	5(5.3%)	1 (4%)	3(3.2%)	2 (0.7%)	1 (1.1%)	0	2 (2.1%)
Total	418(49.9%)	149(52.7%)	51(6.1%)	24(8.5%)	24(2.9%)	16(5.7%)	11(1.3%)	6 (2.1%)	6(0.72%)	7 (2.5%)
Overall	567/1121(50.6%)		75/1121(6.7%)		40/1121(3.6%)		17/1121(1.5%)		13/1121(1.2%)	

Table (3). The intensity of infection (overall Mean ±SE) of GIT helminths infection, in goats at Abeche abattoir, Ouaddai, Chad in different seasons during March 2015 to February 2016.

Season	Mean ±SE									
	Strongyle eggs		*Strongyloides papillosis*		*Trichuris ovis*		*Dicrocoelium dendreticum*		*Moniezia expansa*	
	Male	female	male	female	male	female	male	female	male	female
Hot dry	327. 7±36,83	297.44±60,70	8.77±1,81	10.7±3,83	5.6±1.89	4.27±2.32	0.8±0.82	0.9±0.85	4.1±2.07	19.2±9.8
Hot wet	1353.5±193.22	1267.4±295.48	45.3±8.12	33.3±10.33	14.1±4.39	25.0±9.64	8.7±3.60	7.6±4.27	10.6±8.69	9.7±9.72
Cold dry	271.4±31.83	281.4±51.45	6.6±2.47	10.1±4.39	0.7±0.7	9.0±5.66	2.0±1.18	2.1±2.13	0.0	40.4±28.52
Overall	556.7±52.59	538.9±84.57	16. 9±2.32	16.3±3.49	6.1±1.37	11.1±3.26	3.1±1.02	3.0±1.56	4.4±2.28	23.9±10.58

Table (4). Seasonal prevalence (%) of GIT adult nematode species identified in goats at Abeche abattoir, Ouaddai State, Chad during March 2015 to February 2016

Seasons	No. examined	No. of infected animals / Prevalence (%)							
		Haemonchus contortus	*Oesertagia oestertagia*	*Trichostrongylus colubriformis*	*Strongyloides papillosis*	*Nematodirus spathinger*	*Bonustomum trigonocephalum*	*Trichuris ovis*	*Oesophaostomum columbianum*
Hot dry	13	8 (61.5)	1 (7.7)	1(7.7)	2(15.4)	(00)	0 (00)	2 (15.4)	5 (38.5)
Hot wet	13	12 (92.3)	4(30.8)	2(15.4)	4(30.8)	1 (7.7)	2 (15.4)	3 (23.1)	7 (53.8)
Cold dry	8	4 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.3)	0 (0.0)	1 (12.5)

Overall	34	24 (70.6)	5 (14.7)	3 (8.8)	6 (17.7)	1 (2.9)	3 (8.8)	5 (14.7)	13 (38.2)

Table (5). Seasonal prevalence (%) of GIT adult cestode and trematode species identified in goats at Abeche abattoir, Ouaddai State, Chad during March 2015 to February 2016.

Seasons	No. examined	***Moniezia expansa***	***Paramphistomum cervi***	
		No.+Ve Prevalence (%)	No. examined	No.+Ve Prevalence (%)
Hot dry	13	2 (15.4)	13	4 (30.8)
Hot wet	13	2 (15.4)	13	7 (53.9)
Cold dry	8	0.00	8	2 (25)
Overall	34	4 (11.8)	34	13 (38.2)

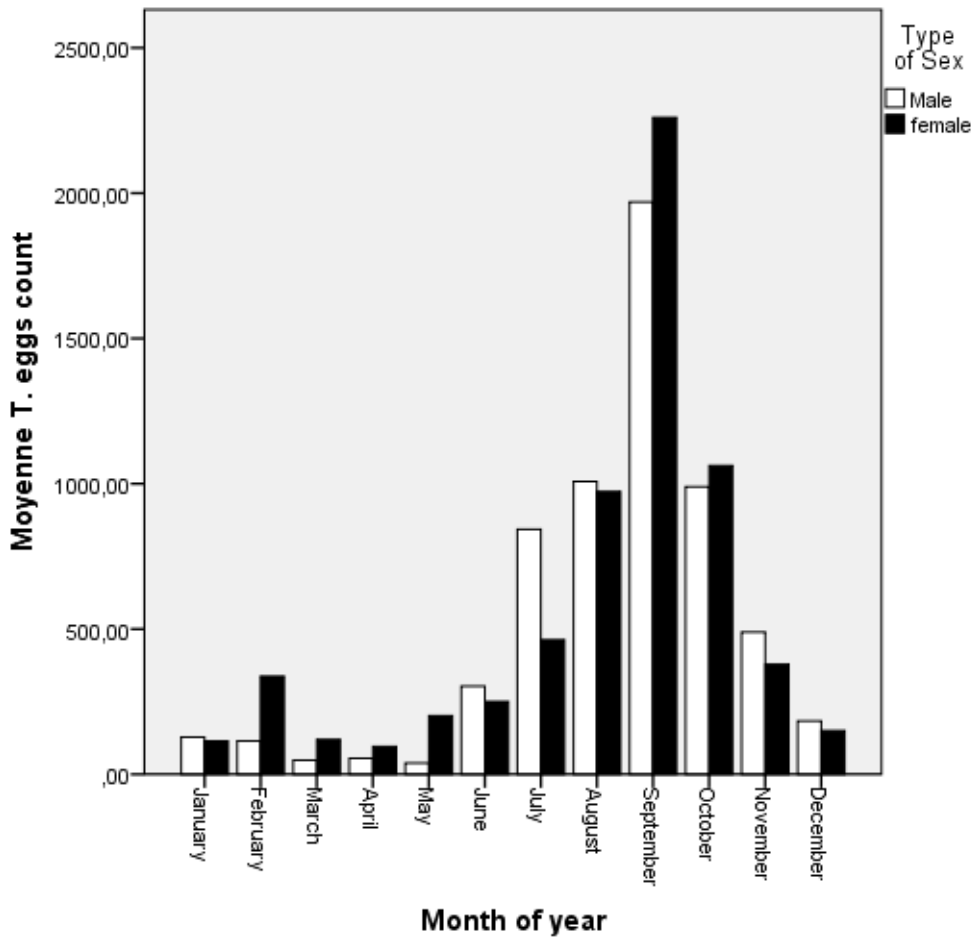

Fig. 2. Monthly overall mean total egg count (TEPG) of GIT helminth parasites of goats at Abeche, Ouaddai State, Chad during March 2015 to February 2016.

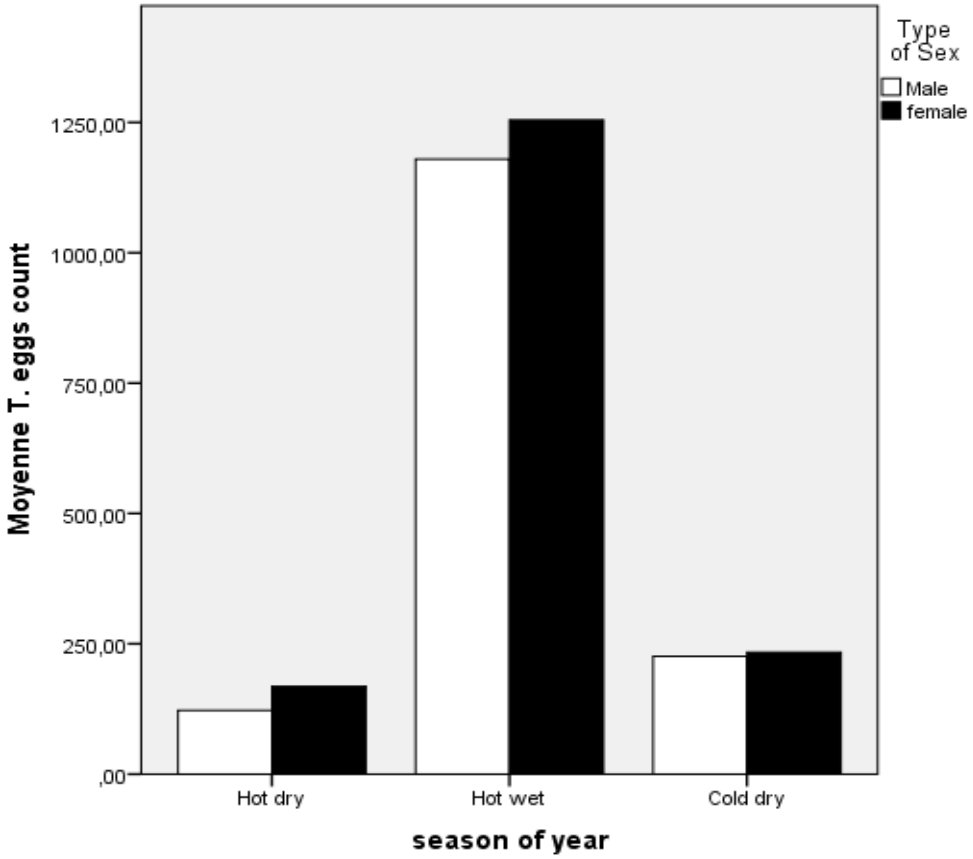

Fig. 3. Seasonal overall mean total egg count (TEPG) of GIT helminth parasites of goats at Abeche, Ouaddai State, Chad during March 2015 to February 2016.

Discussion

The present study was focused on the epidemiology of GIT helminth parasites of goats in Abeche area, Chad. The result of the study revealed an overall prevalence rate of (53.9%) and this is in agreement with the report of Almalaik *et al*. (2008) in Sudan who found (52.3 %). Worldwide, (90.4%) prevalence rate was reported by Ntonifor, *et al* (2013) in Cameroon, 89.3% in Nigeria (Oyeduntan *et al* (2014), (81.95%) and 82.4% by Yousif (2010) and Mohammedsalih *et al* (2019) respectively in Sudan, but Ardo and Bitrus (2015) reported lower prevalence (43.7%) in Nigeria.

These variations in the prevalence rate may be due to techniques used for diagnosis or due to animal husbandry practices, deworming, or climatic factors that affect survival and spreading of these parasites.

Female goats were found slightly more infected (55.1%) than males (53.5%). This is in line with Almalaik *et al*. (2008) who reported prevalence of 55.74 % in female and 48.82 % in male goats in South Darfur State of Sudan. In contrast, Okorafor *et al* (2015) in Nigeria reported 25.0% and 19.74% infection rate in male and female goats respectively. This may be attributed to the number of examined goats and the period of data collection or may also be due to the level of deworming practices offered for males and females for purposes of marketing or breeding.
The variations in the climatic factors in different seasons play an important role in the prevalence of gastrointestinal helminth parasites. The highest prevalence was observed in the hot wet season (72.3%) and the lowest in hot dry season (45.9%).
This result is in agreement with Almalik *et al*. (2008), Bashar *et al* (2002), Yaro *et al*.(2015), Gebeyehu *et al* (2013), Blackie (2014), Kouidri *et al* (2015) and Sheikh *et al* (2016).

Although parameters such as type of pasture, animal weight and health status or local humidity and temperatures were not recorded, the rainfall and relative humidity appear to be the main factors associated with the GIT helminth parasites prevalence as high infection rate was observed in hot wet season and low prevalence in the hot dry season. This variation of prevalence indicated

clearly that the environment of the dry season is unfavorable for the development and survival of the extra host stages of the GIT helminth parasites in the pasture and the survival of intermediate hosts in the environment (Soulsby, 1986).

The GIT helminth parasites identified in this study based on faecal examination were Strongyle

eggs, *Strongyloides papillosis, Trichuris ovis, Moniezia expansa* and *Dicrocoelium dendreticum*. These species were also reported by Graber (1965) in Chad.

In this study Strongyle eggs were reported as predominant gastrointestinal parasites in goats with a prevalence of (50.6%). This is in line with Oyeduntan *et al* (2014), Mhoma *et al* (2011), Mohammedsalih *et al* (2019), Tareq *et al*.(2014) , Koinari *et al* (2013) , Tigist *et al* (2015) , Kouidri *et al* (2015) and Mpofu *et al* (2020).Within Strongyle group identified in this study , *Haemonchus contortus* was being the most predominant Strongyle worm identified (70.6%), which is in agreement with Mohammedsalih *et al* (2019) who reported that *Haemonchus contortus* showed highest percentage (90%) of Strongyle identified in goats in three localities in South Darfur State, Sudan. Similarly, Salma *et al* (2019) claimed that *Haemonchus contortus* was the dominant nematode species recorded in three farms in Nyala Area, Sudan with prevalence ranging from 40% to 73%.
As for trematodes and cestodes, *Dicrocoelium dendreticum, Paramphistomum cervi* and *Moniezia expansa* were reported with low rates of infection in this study either single or mixed infection with nematodes. Similarly, compositions of classes of helminth populations recovered from faecal cultures have been reported previously with low rates from goats in South Darfur, Sudan (Mohammedsalih *et al* ,2019 and Almalaik *et al*,2008) and from other tropical regions (Khan *et al*,2010 and Zvinorova *et al*,2016). Based on total faecal egg count, the intensity of infection for the detected (GIT) helminth parasites was recorded highest for Strongyle parasites, while recorded lowest for *Dicrocoelium dendreticum.* Seasonally, the highest and lowest intensity were recorded in hot wet and hot dry seasons respectively for all detected nematodes and trematodes, but *Moniezia expansa* recorded highest intensity in cold dry season. The high intensity of infection in hot wet season (autumn) is due to the favourable environmental conditions, in particular high humidity that favours survival of infective larvae on pasture (Rashid and Irshadullah, 2018). The development and growth of most helminth species requires warm and wet conditions that make hatching eggs possible and improves the development of eggs to L_3 (Haile *et al*, 2018).

The study concluded that gastrointestinal helminth parasites were prevalent in the area with high prevalence in hot wet season. The authors recommend further survey studies on ruminants in the study area and in contact areas in Chad and improving grazing management practices to minimize animals' overcrowdings in a limited area and application of deworming programme using effective anthelmintics to control the infection.

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