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Sudan University of Science and Technology
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Survey on Gastrointestinal Parasites in One Humped Camels
(*Camelus dromedarius*) in Al-Butana Area, River Nile State,
Sudan

مسح لطفيليات القناة الهضمية في الإبل وحيدة السنام بمنطقة البطانة بولاية
نهر النيل - السودان

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قال تعالى

{ أَفَلَا يَنْظُرُونَ إِلَى الْإِبِلِ كَيْفَ خُلِقَتْ }

صدق الله العظيم

سورة الغاشية الآية (17)



Dedication

This work is dedicated to my parents and all whom I love.

Acknowledgements

Firstly, I would like to thank " Allah" who desired me to complete this work. A great thankful to my supervisor Prof. Atif Elamin Abdelgadir , Faculty of Veterinary Medicine, University of Khartoum, for his guidance, supervision and support. I would like also to thank and appreciate the, pastoralists for providing information, regarding, study animals and sampling. My Thanks to Veterinary Diagnostic and Research Laboratory Center for their friendly cooperation.

Finally, I must express my very profound gratitude to my parents and to my husband for supporting and encourage me throughout the research work.

ABSTRACT

A cross – sectional study was conducted from August – September (2018)to determine the prevalence of gastrointestinal parasites of camels and associated risk factors such as age groups ,sex, breed, health status and water sources in Al-Butana Area in River Nile State. For that purpose, a total of 148 camels were sampled according to non–probability multi stage cluster sampling method. Faecals samples were collected direct from the rectum of the camels. The faeces collected in plastic containers in formalin solution 10%, labeled, and transferred to the laboratory for faecal examinations (flotation and sedimentation). Both descriptive and analytical statistics were used for data analysis by using SPSS version 20. The result revealed that the overall prevalence of gastrointestinal parasites of camel in Al-Butana Area in River Nile state was 58.8% (n= 87). The prevalence by location revealed that the highest prevalence 64.2% (n = 43) was recorded in the East (Umm Shadeeda – Wadi Bseria) followed by South (Meaa Al-Gedehat and Oagad -Alegool) 60.0% (n = 24), West (Wadi Taweel , Shandi and Hafeer Umm- Sunot) 53.1% (n = 17) and North (Aldamer) 33.3% (n = 3). Statistically, there was no significant difference observed ($\chi^2 = 3.658$, P -value = 0. 301). The most dominant gastrointestinal parasites were *Strongyle/Trichostrongyle* egg 76.8% (n = 67) and (*Eimeria* Spp.) 18.4% (n = 16). In contrast, *Moniezia* Spp. And *Trichuris* Spp.were observed with low percentage 2.3% (n = 2), and 2.3% (n=2), respectively. On the other hand, a positive

association ($\chi^2 = 30.973$, P -value 0.014) was reported for different age group with respect to presence of gastrointestinal parasites and highest positive cases were observed in age group > 5 years. Furthermore, breed was shown a great effect on presence of gastrointestinal parasites in camels ($\chi^2 = 10.993$, P -value = 0.012). The highest prevalence was recorded for Araby 73.6 % (n= 39) followed by Anafy 60.0% (n=24), Dlaamy 48.6% (n= 17) and Bushari 35.0% (n= 7). Similarly, poor health status and source of water such as Meaa and Hafeer were found to be associated with the presence of gastrointestinal parasites at significant level P -value < 0.05 .

In conclusion, a high prevalence of gastrointestinal parasites was recorded in the current research work which indicates spread of infection that may reduce the productivity of the camels. Hence, more epidemiological studies are required as well as an attention should be made regarding application of control measures to minimize the level of infection.

المستخلص

أجريت هذه الدراسة في الفترة من اغسطس الي سبتمبر (2018) م لتحديد معدل الاصابة بالطفيليات الداخلية للابل وعوامل الخطر المرتبطة بها(العمر ، الجنس ، السلالة ، مصادر مياه الشرب و علامات الصحة الظاهريه للابل) بمنطقة البطانة في ولاية نهر النيل ، لهذا الغرض تم اخذ (عدد 148) عينة بطريقة التجميع متعددة المراحل غير الاحتمالية . اخذت عينات البراز من المستقيم مباشرة وتم حفظها في عبوات بلاستيكيه بها فورمالين 10% وتم وضع ديباجات توضيحيه وارسالها للفحص المختبري وقد استخدمت اختبارات الطفو والترسيب لعينات البراز كما استخدم الاحصاء الوصفي والتحليلي معاً لتحليل البيانات باستخدام برنامج التحليل الاحصائي SPSS (اصدار 20). أظهرت النتائج ان معدل الاصابة بالطفيليات الداخلية للابل بمنطقة البطانة في ولاية نهر النيل 58.8% (عدد العينات الموجبة الاصابة = 87) . معدل الاصابة الاعلى 64.2% (عدد العينات الموجبة الاصابة = 43) سجلت في شرق البطانة (ام شديدة ووادي بصيريه) ، جنوب البطانة (مبيع القديحات ومبيع عقد العجول) 60.0% (عدد العينات الموجبة الاصابة = 24) ، غرب منطقة البطانة (وادي طويل ، حفير ام سنط وشندي) 53.1% (عدد العينات الموجبة الاصابة = 17) ، شمال البطانة (الدامر)(عدد العينات الموجبة الاصابة = 3) 33.3% . إحصائياً ليس هنالك اختلاف معنوي ملاحظ (مربع كاي 3.658 والقيمة الاحتمالية 0.301). كانت الطفيليات الداخلية السائدة من جنس الاسترونقلس 76.8% (عدد العينات الموجبة الاصابة = 67) والاميريا 18.4% (عدد العينات الموجبة الاصابة = 16)، خلافاً لذلك فقد سجلت المونازا والترايكورزأدنى نسبة 2.3% (عدد العينات الموجبة الاصابة = 2).

هنالك ارتباط ايجابي سجل لاعمار المجموعات في الابل لوجود طفيليات داخلية لوحظت في المجموعة اكبر من 5 سنوات. بالاضافة الى ذلك وجد أن السلالة لها تاثير كبير لوجود الطفيليات الداخلية (10.993) ، القيمة الاحتمالية 0.012)، سجلت السلالة النوع العربي أعلى نسبة للاصابة مقارنة بالعنابي والدلامي والبشاري وكانت النسب 73.6% (العدد 39) و60.0% (العدد 24) و48.6% (17) و35.0% (العدد 7)

على التوالي. وجد أن هنالك علاقة للحاله الصحيه ومصدر المياه مرتبطاً بوجود الطفيليات الداخلية بمستوى معنوي ، القيمة الاحتمالية اصغر من 0.05.

أوضحت هذه الدراسة أن نسبة الاصابة بالطفيليات الداخلية عالية في الدراسة الحالية ومن المحتمل أن تقلل من انتاجية الابل ، لذلك مطلوب مزيداً من الدراسات الوبائية بالاضافة يجب الاهتمام بتطبيق معايير السيطرة والرقابة لتقليل معدل الاصابة.

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Introduction

The one-humped camels (*Camelus dromedarius*) are structurally unique animals in semi-arid and arid tropical areas of Africa (Abdel Rahman, *et al.*, 2001). Camel is well adapted to harsh climatic conditions where others animal suffers to survive. Camel-keeping represent a type of culture found on ancient time of human civilization till now consequently it looked at as a valuable asset and has a high economic value providing meat, milk and wool as well as transportation and labor (Yakaka,*et al.*, 2017). Camel population in the Sudan exceeds (4.85) millions of heads and in River Nile (83.550) heads. (Department of Statistic and Information, 2017).

Sudanese camels harbor a number of helminths (Kheir,*et al.*, 1982, Elamin,*et al.*, (1984), Siddiqand El Hussein .(1997), Burger,*et al.*, (1989) and Abdel Rahman,*et al.*, 2001). These studies confirmed presence of internal parasites: nematode, such as, *Haemonchus longistipes*, *Trichostrongylus probolurus*, *Trichostrongylus spp.Cooperiapectinata*, *Oesophagostomum columbianium*, *Trichuris globulosa* and *Setaria labiatopapilosa* as, well as trematodes, such as *Fasciola gigantica* and *Schistosoma bovis* and Cestodes, such as *Avitellina*Spp. and *Moniezia expansa*.

Diagnosis of internal parasites could be achieved by clinical signs (fever, colic, emaciation or growth disorders, and diarrhea) or by microscopic examination of faecal sample. Worms cannot be eradicated but should be cured early to stop increasing worm burden, which can lead to death, (Dennis, *et al.*, 2016). Oral,

drench or bolus (Albendazole), injectable dewormed (subcutaneous injection) e.g. Ivermectin (1%), as well as pasture control (animal movement) and husbandry is very important in control and management, (Stacey, 2015).

In Sudan, Abdel Rahman *et al.*, (2001) reported, high number of *Trichostrongyles* Spp., and *Haemonchus* Spp. in camels and they were detected only during the rainy season. (Siddig and El Hussein .1997) reported that infection rate of gastrointestinal parasites was (85.4%). Moreover, Agab (1993) stated that shortage of veterinary services, parasitic diseases and diarrhea in calf camel, poor pasture, scarcity of water resources and security problems reduce herd fertility camel production in AL- Butana Region. Therefore the objectives of the current study are:

- 1- To determine the prevalence proportion of gastrointestinal parasites in one humped camel (*Camelus dromedarius*) in Al-Butana Area, River Nile State, Sudan.
- 2- To identify the risk factors associated with gastro intestinal parasites in one hummed camels such as age, sex, breed, health status and source of water.

CHAPTER ONE

LITERATURE REVIEW

1.1 Economic Importance of Camel

Camels play an important socio-economic role within the pastoral and agricultural system in the dry and semi-dry zones of Asia and Africa. The survival of millions of human being is dependent on the camel in such areas, for meat, milk and hair production and still an important mean of drought and transportation for large sectors of pastoral societies (Mona, *et al.*, 2008).

1.2 Distribution of Gastrointestinal Parasites of Camels in the World

Several investigations have reported the occurrence of different gastrointestinal parasites in camels in different parts of the world. Some parasites diseases of *Camelidae* have received the most attention by researchers on account of the high morbidity rate, the wide distribution of the parasites and the simplicity of methods of investigation. An inventory of parasites with reference to ecological conditions has been prepared in many countries, notably Chad, Egypt, Ethiopia, India, Iraq and Niger. All the surveys carried out to date have shown a relatively high rate of infestation. Mohamed. (1987). In Iraq, Azhar (2017) found that (86.36%) of camels have been infected, with gastrointestinal parasites. In Pakistan, Muhamad and Abdul. (2017), stated that the highest percentage of internal parasites in camels was *Eimeria spp.* (35%). Yakaka, *et al.*, (2017) in Nigeria recorded that the overall prevalence of gastrointestinal parasites in camels was 69.3%. Magan, *et al.*, (2017) in Ethiopia stated that the prevalence

of gastrointestinal parasites in camels (79 %) and the most commonly encountered parasites were *Strongylus Spp.* (64.7%). Abdalla, *et al.*, (2016) in Somalia, reported that the overall prevalence of camel gastrointestinal parasites was (50.3%). Wafa. (2015) from Riyadh, Saudi Arabia reported that the positive cases of the examined camels were (59.6%). In Ethiopia, Ararsa *et al.*, (2014) found that the prevalence was (73.8%) and *Strongylus Spp.* was the highest (55.59%). In Iran, Mohammad and Mansour.(2013) found that, camel calves and camels aged below five years old were more susceptible with the *Eimeria Spp.* than older ones. In Egypt, Nagwa *et al.*, (2013) found that infection rate of gastrointestinal parasites in camels was higher in spring followed by summer and lowest in autumn. Moreover, Swai, *et al.*, (2011) in Tanzania reported (62.7%) excreted eggs and oocysts in camel's faeces and *Strongyle Spp.* recorded the highest prevalence (89.2%). Abdullihi, (2009) in Nairobi, found that the prevalence of gastrointestinal parasites in camels was (90.9%) and *Trichostrongylus* was the highest (62.14%). Furthermore, Parsani, *et al.*, (2008) stated that the common gastro-intestinal nematodes of camel in India were *Haemonchus*, *Nematodirella Nematodirus*, *Trichostrongyle*, *Strongyloides*, *Ostertagia*, *Marshallagia*, *Cooperia*, *Trichuris* and *Strongylus*. Maximum prevalence and intensity of these infections were observed in rainy season and minimum in summer season as well as age of the animal also plays significant role in acquiring these infections.

1.3 Distribution of Gastrointestinal Parasite of Camels in the Sudan

Previous studies in Sudan (Kheir, *et al.*, 1982, Elamin, *et al.*, 1984, Siddiq and El Hussein 1997, Burger, *et al.*, 1989 and Abdel Rahman, *et al.*, 2001) indicated that the most dominant helminthes in camels: nematodes, (*Haemonchus longistipes*, *Trichostrongylus probolurus*, *Trichostrongylus* Spp., *Cooperia pectinata*, *Impatiatuberculata*, *Oesophagostomum columbianum*, *Trichuris globulosa* and *Setaria labiatopapilosa*), trematodes, (*Fasciola gigantica* and *Schistosoma bovis*) and Cestodes, (*Avitellina* Spp., *Moniezia expansa*).

Abdel Rahman, *et al.*, (2001) reported that *Trichostrongyles* Spp, *Haemonchus* spp. and *Haemonchus* Larvae were decreased in winter and disappeared completely in summer as they were detected only during the rainy season. In Atbara Region Siddig and El Hussein (1997) reported that infection rate of gastrointestinal parasites in camels was (85.4%) and *Moniezia expansa* was (80%). Most of the previous studies explained that poor husbandry, management system, climate and sub-optimal feeding of camels may influence in occurrence and pattern of infection. Fadl *etal.*, (1992) reported that camels which examined in the market and butchery in Tempol, the prevalence was 69%. The author explained that the nematodes were the highest percentage in particularly in July and the lowest infection rate was observed from February to April and from November to January. Study from Eastern Region of Sudan recorded *Eimeria rajasthani*, *Eimeria dromedarii* and *Eimeria cameli* (Adris, 1989).

1.4 Clinical Signs of Gastrointestinal Parasites

Many gastrointestinal parasites cause diseases in animals and may be epidemic, harmful and severe, but the greatest damage is in the form of chronic, low-grade and debilitating, (Dennis et al., 2016). The nutritional status of the animal and number of parasite effecting had been strongly effect in infection, clinical signs may be seen are weight loss, reduce feed intake, diarrhea, mortality, reduce carcass quality and reduce wool production and qualities, parasites often results in anemia, odema in the submandibular region .(Jorgen and Brian, 1994).

1.5 Diagnosis of Gastrointestinal Parasites

Diagnosis of gastrointestinal parasites could be achieved by determining of the organisms and it necessary, quantify the intensity of the parasite. Parasite detection depend on direct observation of developmental stages in the faeces (Dennis *et al.*, 2016). For detecting motile protozoa, direct fecal smears are useful, while examination of fecal sediments is suitable for heavy eggs (e.g Fluke). Flotation technique is used for detection of both Nematodes and Cestodes eggs (Michael *et al.*, 2006).

Serological methods for detecting antibodies or antigens, and PCR techniques indicating the occurrence of unique genetic sequences are becoming more frequently used as diagnostic tools in Veterinary Parasitology .(Dennis, *et al.*, 2016).

1.6 Control of Gastrointestinal Parasites

Control of parasites is based on maintaining parasite populations below which clinical signs are observed. It does not involve the complete elimination of all parasites from a herd for several reasons. A low level of parasites develops immunity in the animals, decreases drug resistance, saves money for the owner, and finally because complete elimination is impossible. Anthelmintic should complement but not replace good management and sanitation practices. (Dennis,*et al.*, 2016).

Oral dewormers, Drench or bolus (Albendazole), injectable dewormed (subcutaneous injection) e.g. Ivermectin(1%), Pasture control (animal movement) and husbandry is very important in control and management, (Stacey, 2015).

1.7 Important Gastrointestinal Parasites of Camels

Gastrointestinal parasites of camel are classified into four broad group Cestodes, Nematodes, Trematodes and Protozoa.

1.7.1 *Nematodes*

The most important and widespread nematodes are the *Trichostrongyle* group (*Haemonchus*, *Ostertagia*, *Trichostrongylus*, *Mecistocirrus*, *Cooperia* and *Nematodirus*), *Oesophagostomum* and *Bunostomum*. The life cycles of most *Trichostrongyles*, *Oesophagostomum* and *Bunostomum* are similar and direct, these *nematodes* do not require other animals to complete their life cycles. (Jorgen and Brian 1994).

1.7.2 Trematodes

Fasciola gigantica and *F. hepatica*, these parasites may survive for years, when there is a permanent source of infection for successive generations of snails. The intermediate hosts (the snails of the families of *Planorbidae* and *Lymnaeidae* are abundant breeding of these snails ensures the presence of *sercaria* in large numbers and may live infected snails in the mud for several months, usually *paravestoma* is limited to the driest months, during this period, the population of snails around the natural sources of water As these areas may provide grazing in the only dry season, animals may become severely infected, older animals, and appear to be immune to infection.(Jorgen and Brian 1994).

1.7.3 Cestodes

Some of them are *Moniezia*, *Avitellina*, *Cysticercus bovis*, *Cysticercus tenuicollis*, *Thysaniezia*, *Coenurus cerebralis*, *Stilesia* and *Hydatid cysts*. Cestodes in ruminants can conveniently be classified into two distinct groups; one in which ruminants act as the final host (the intestinal and hepatic cestodes) and one in which act as the intermediate hosts for the larval stages (*Cysticercus*, *Coenurus* and *hydatid cysts*) of various tapeworm species. In the latter group, the adult parasites live in the small intestines of domesticated and wild carnivores (*Taeniaovis*, *T. hydatigena*, *T. multiceps*, *Echinococcus granulosus*) and man (*T. saginata*). This group comprises species of the genera *Moniezia* (cosmopolitan), *Thysaniezia* (Africa) and *Avetellina* (Africa, Asia). (Jorgen and Brian 1994).

1.7.4 Protozoa

Coccidiosis parasites

(*Eimeria* Spp.) is a problem for young animals (not previously exposed) or immune impaired. Members of this family *Eimeriidae* are referred here as the *Coccidia protozoan* parasites common in the intestines of ruminants, (Jorgen and Brian (1994).

CHAPTER TWO

MATERIALS AND METHODS

2.1 Study Area

The study was conducted in River Nile State which is located between 22 – 16° N latitude and 36 – 32° Longitude exactly in AL-Butana Area of the State, between the east bank of the River Nile and west bank of the Atbara River. A temperature of 48°C may occur during the summer with hot dry weather and low humidity. During winter the weather is cool and dry with a mean daily temperature of 8°C. The maximum rainfall (58mm – 9.8 mm) (Fig 1).

2.2 Study population

Indigenous camels raised in herds from (15-150) heads in free grazing land and housing, were the study animals, information such as location, age, sex, breeds, health status and source of water (Well, Hafeer which is a dug by machines in pasture land where the water from rain and floods are assembled for drinking to animal and human, Meaa is natural depression in the pasture land which rain and flood accumulate), was recorded (Appendix 1) (Table 1).

Table 1: Descriptive of Animal Population in AL-Butana Area in River Nile State in Sudan

Parameters		Sites				Total
		North	West	East	South	
sex	Male	3 2.0%	3 2.0%	6 4.1%	14 9.5%	26 17.6%
	Female	6 4.1%	37 25.0%	61 41.2%	18 12.2%	122 82.4%
	Total	9 6.1%	40 27.0%	67 45.3%	32 21.6%	148 100%
Age	≤ 2	2 1.4%	0 0.0%	1 0.7%	6 4.1%	9 6.1%
	3- 5	6 4.1%	9 6.1%	18 12.2%	14 9.5%	47 31.8%
	> 5	1 0.7%	31 20.9%	48 32.4%	12 8.1%	92 62.2%
Total	9 6.1%	40 27.0%	67 45.3%	32 21.6%	148 100.0%	
Water sources	Hafeer	0 0.0%	0 0.0%	0 0.0%	22 14.9%	22 14.9%
	Well	9 6.1%	0 0.0%	5 3.4%	10 6.8%	24 16.2%
	Meaa	0 0.0%	40 27.0%	62 41.9%	0 0.0%	102 68.9%
	Total	9 6.1%	40 27.0%	67 45.3%	32 21.6%	148 100.0%
Breed	Anafi	7 4.7%	3 2.0%	13 8.8%	17 11.5%	40 27.0%
	Bushari	2 1.4%	5 3.4%	0 0.0%	13 8.8%	20 13.5%
	Araby	0 0.0%	13 8.8%	38 25.7%	2 1.4%	53 35.8%
	Dlaamy	0 0.0%	19 12.8%	16 10.8%	0 0.0%	35 23.6%
	Total	9 6.1%	40 27.0%	67 45.3%	32 21.6%	148 100.0%

2.3 Study Design

Across sectional study was conducted to determine the prevalence of gastrointestinal parasites infection and associated risk factors.

2.4 Sampling Method and Sample Size

Anon – probability multi stage cluster sampling method was used as described by Thrusfield (2005). A total number of 148 camels were sampled and the selection was done based on different level(location ,herd ,camels) as well as only 10% for each herd was sampled(Table 2).

Figure 1: Study site in Al- Butana Area in River Nile State –Sudan

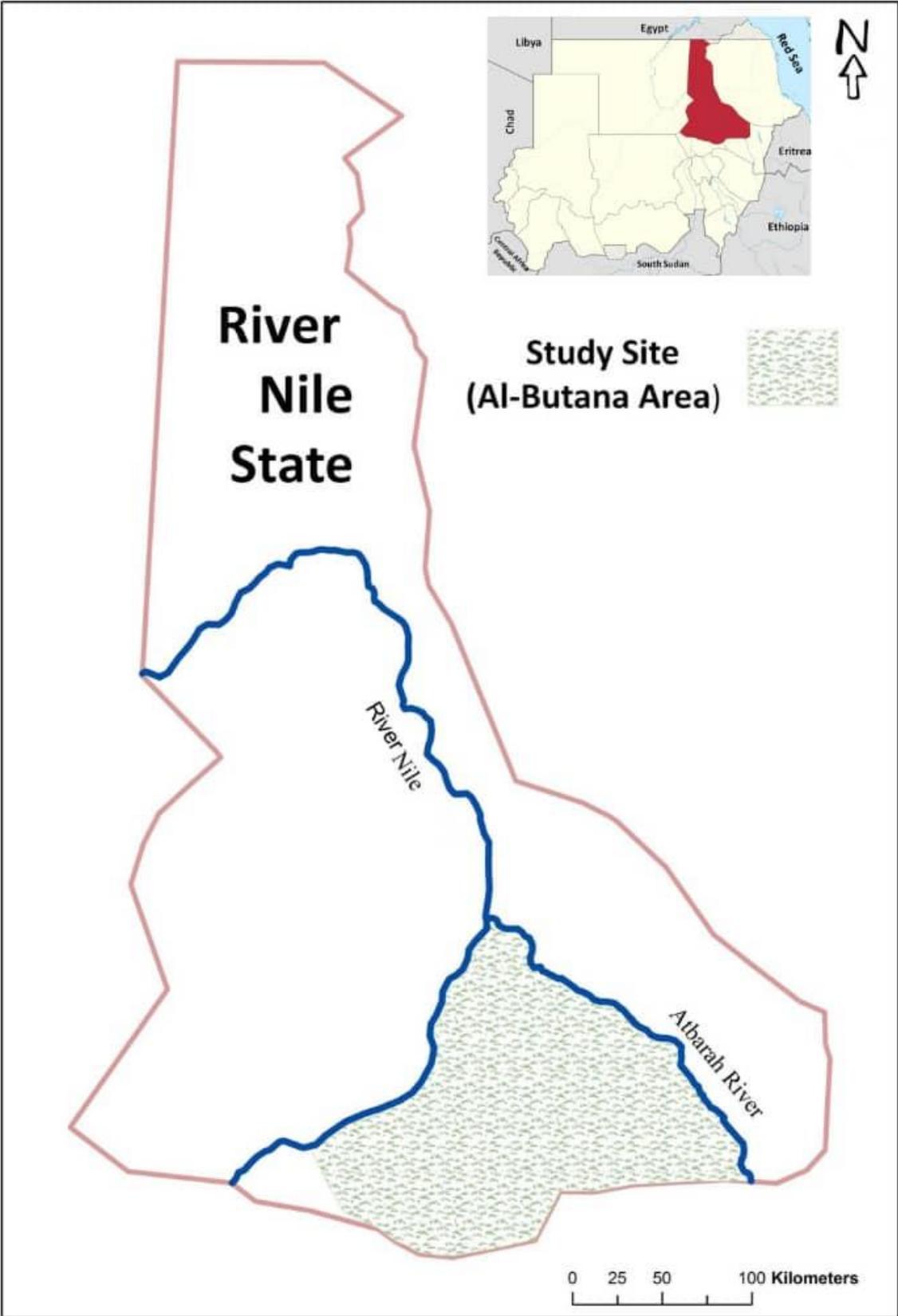


Table 2: Determination of the sample size

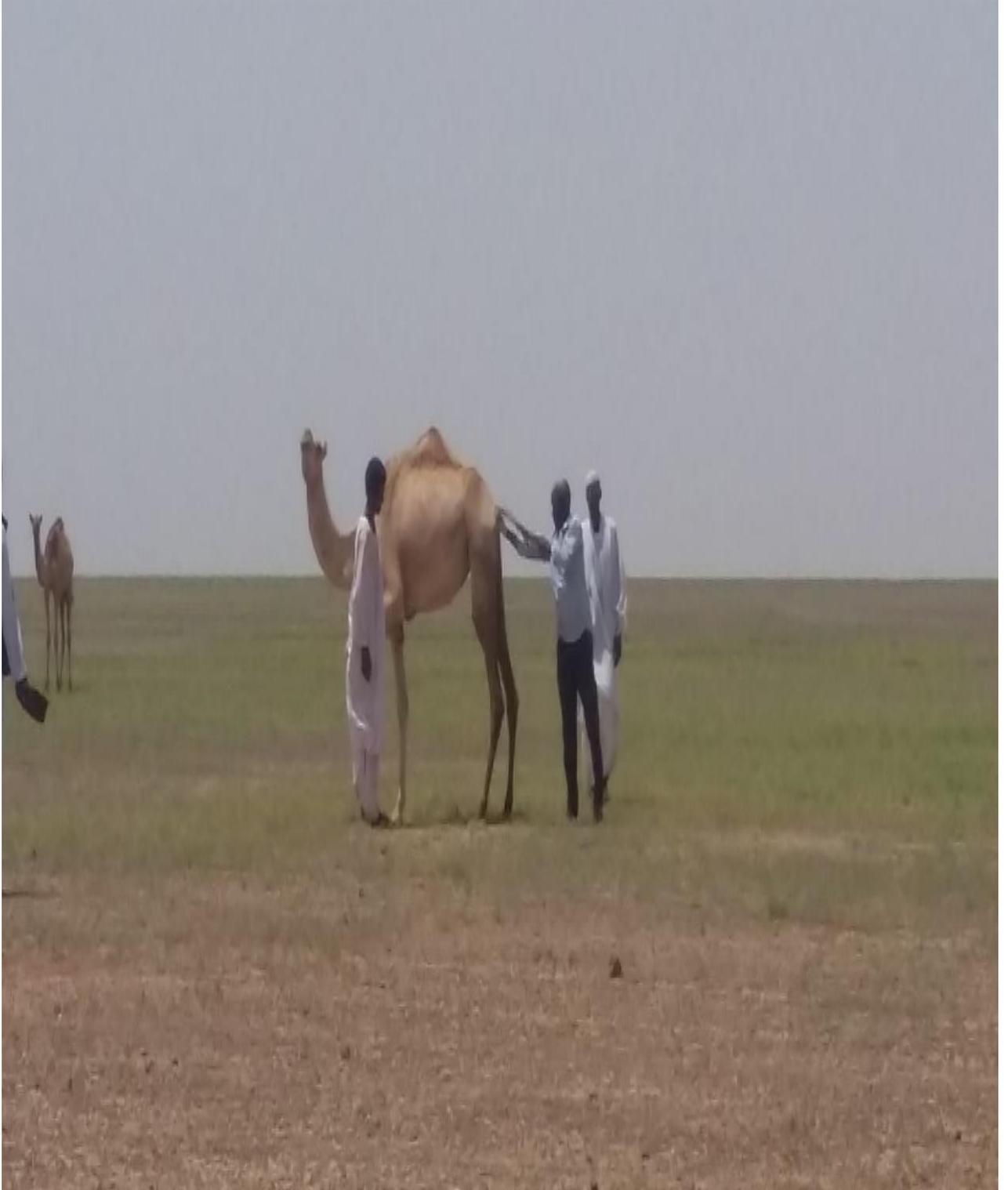
Site	No. of herds	No. of Animals	No. of Samples
North	6	92	9
West	9	429	43
South	8	404	40
East	14	557	56
Total	37	1482	148

2.5 Faecal Examination

2.5.1 Faecal samples collection

Faecal samples were directly collected from the recta (15-30 gram) of the camels in plastic containers in formalin solution 10% to prevent hatching of the egg and development of larvae, labeled, and transferred to the laboratory for fecal examinations.

Plate 1: Faecal samples collection



2.5.1.1 Flotation method

The test was used to detect the presence of the eggs of nematodes and cestodes, as well as oocysts protozoa. Two to three grams of faeces has been taken in a mortar washed from formalin with tap water three times and then emulsified with 42-50 ml salt solution (sodium chloride). The suspension was then poured through sieve into a beaker to remove the large particles. The sieve suspension was then poured in a test tube until it was completely full and then covered with a cover slip. The cover slip was removed after 20 min and it was placed into a clean slide and examined under the microscope (Angus and Todd, 1978).

2.5.1.2 Sedimentation method

The test was used for detecting those eggs which do not float well in available flotation solutions. Those are the operculate eggs such as fluke infestation, *Fasciola*, *Paramphistomes* and *Schistosoma*. Two to three grams of faeces were taken in a mortar to be broken down and washed from formalin, emulsified with 42-50 ml tap water. The suspension was then poured through a sieve into a beaker to remove the large particles. The sieved suspension was then poured in a centrifuge tubes and centrifuged at 1500 rpm for two min (this was the first wash). The dirty supernatant was poured off and re-suspended in water and centrifuged at 1500 rpm for two min. This was repeated four times till the supernatant fluid was clear. A bit of the deposit was taken and smeared on slide covered and examined under the microscope (Angus and Todd, 1978).

2.6 Statistical Analysis

SPSS for Windows version 20 was used for data analysis. Descriptive statistic was used for all variables, while chi-square was used for risk factors analysis.

CHAPTER THREE

RESULTS

3.1 Prevalence of Gastrointestinal Parasites in Camel of Al-Butana Area in River Nile State, Sudan

The overall prevalence of gastrointestinal parasites in camels in Al-Butana Area in River Nile State was 58.8 % (n = 87). The highest prevalence 64.2% (n = 43) was recorded in the East of Al-Butana Area (Umm Shadeeda – Wadi Bseria) followed by South (Meaa Al-Gedehat and Oagad Alegool) 60.0% (n = 24), West (Wadi Taweel, Shandi and Hafeer Umm- Sunot) 53.1% (n = 17) and North (Aldamer) 33.3% (n=3). Statistically, no significant difference was observed ($\chi^2=3.658$, *P-value* 0.301) (Table3).

3.2 Type of gastrointestinal parasites in Camel of Al-Butana Area in River Nile State, Sudan

A different genera of gastrointestinal parasites of camels was recorded in River Nile State. The prevalence of different parasites were, *Eimeria* Spp.18.4% (n =16), *Strongyles/ Trichostrongyle* egg 76.8 % (n = 67). In contrast, low percentage was reported for *Moniezia* Spp.2.3% and *Trichuris* Spp.2.3%. A significant difference was observed for location and different species of gastrointestinal parasites ($\chi^2 = 61.021$, *P-value* 0.000). Results are summarized in Table 4.

3.3 Risk Factors Analysis

A positive association ($\chi^2 = 30.973$, P -value = 0.014) was reported for age groups with respect to different genera of gastrointestinal parasites in camels. Highest positive cases were observed in age group > 5 years in camels infected with *Strongyles* group. A percentage of 76.8% (n=67) was recorded for *Strongyles* group, followed by infection with *Eimeria* Spp. 18.4% (n=16) and then equally infection with *Moniezia* Spp. And *Trichuris* Spp. 2.3% mentioned age group in (Table 5). Furthermore, a similar positive relationship was obtained for sex and different genera of gastrointestinal parasites in camels ($\chi^2 = 16.351$, P -value = 0.038). The prevalence was found high in female 81.6% (n=71) compared to male 18.4% (n=16). The results were summarized in (Table 5 and 6). Breed has shown a great effect on presence of gastrointestinal parasites in camels ($\chi^2 = 10.993$, P -value = 0.012). The highest prevalence was recorded for Araby 73.6% (n=39) followed by Anafi 60.0% (n=24), Dlaamy 48.6%. The result is shown in Fig 2. Moreover camels with poor health status showed high prevalence of gastrointestinal parasites 88.5% (n=77) compared to camels with good health status (determined by signs of health) 11.5% (n=10) and statistically the difference was significant ($\chi^2 = 8.607$, P -value = 0.014). The result were shown in Table 7. Regarding source of water, more gastrointestinal parasites of camels infection was observed for Meaa and Hafeer 45.3% (n=67)

and 7.4% (n=11), respectively. Statistical significant difference was also recorded ($\chi^2=7.194$, $P\text{-value}=0.027$). The result were shown in Fig 3.

Table 3: The prevalence of gastrointestinal parasites in camels in River Nile State, Sudan

Site	No. examined	No. of positive cases	Prevalence %	χ^2	df	$P\text{-value}$
North	9	3	33.3%	3.658	3	0.301
South	40	24	60.0%			
East	67	43	64.2%			
West	32	17	53.1%			
Total	148	87	58.8%			

Table 4: Types of gastrointestinal parasites in camels of different sites of River Nile State, Sudan

<i>parasite</i>	Sites				Total	χ^2	df	<i>P-value</i>
	North	South	East	West				
<i>Strongyles/ Trichostrongyle egg</i>	2 2.9%	20 29.8%	35 52.2%	10 14.9%	67 76.8%	61.021	24	0.000**
<i>Trichuris spp.</i>	0 0.0%	0.0 %0.0	0.0 %0.0	2 100%	2 2.3%			
<i>Moniezia spp.</i>	0 0.0%	1 50.0%	0 0.0%	1 50.0%	2 2.3%			
<i>Eimeria Spp.</i>	1 6.25%	3 18.75%	8 50.0%	4 25.0%	16 18.3%			
Total	3 3.4%	24 27.6%	43 49.4%	17 19.5%	87 100%			

**** P-value =0.000<0.01(highly significant)**

Plat 2: *Strongyles* group/*Trichostrongyle* egg

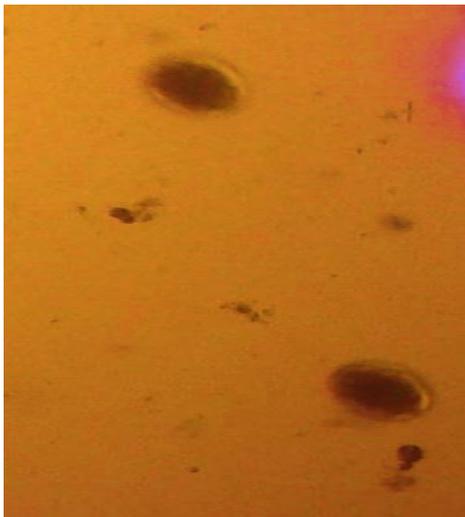
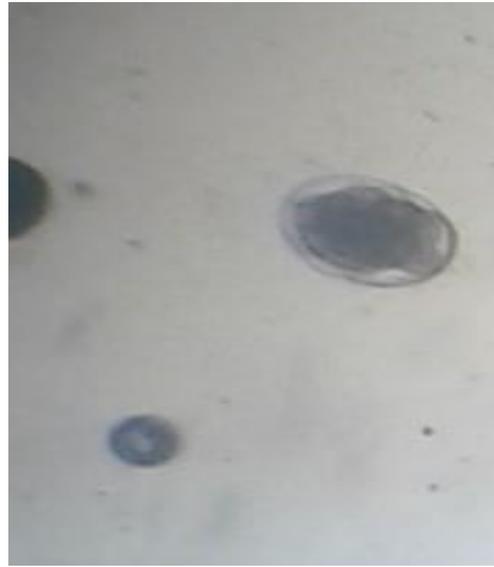


Plate 3: *Trichuris* Spp.

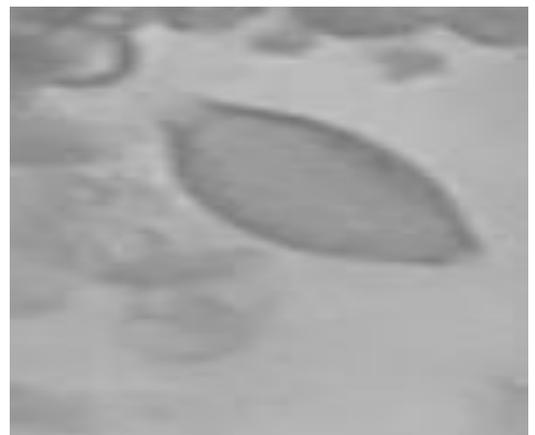


Plate 4: *Moneiza* Spp.



Plate 5: Coccidia (*Eimeria* Spp.)

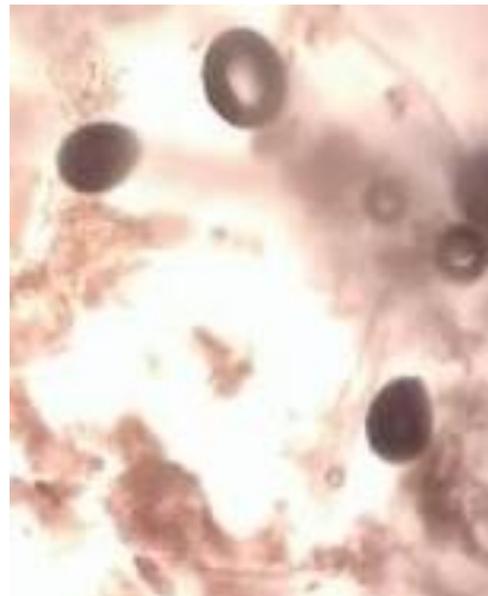


Table 5: Association between age groups and presence of different of gastrointestinal parasites in camels in River Nile State, Sudan

parasite	Age groups (years)			Total	χ^2	df	p-value
	≤ 2	3-5	>5				
<i>Strongyles/ Trichostrongyle egg</i>	4 5.9%	16 23.8%	47 70.1% ¹	67 76.8%	30.973	16	0.014*
<i>Trichuris Spp.</i>	0 0.0%	1 50.0%	1 50.0%	2 2.3%			
<i>Moniezia Spp.</i>	1 50.0%	1 50.0%	0 0.0%	2 2.3%			
<i>Eimeria Spp.</i>	2 12.5%	7 43.75%	7 43.75%	16 18.4%			
Total	7 8.0%	25 28.7%	55 63.2%	87 100%			

* *P-value* = 0.014 < 0.05 (significant)

Table 6: Association between Sex and presence of different species of gastrointestinal parasites in camels in different sites of River Nile State, Sudan

parasite	Sex		Total	χ^2	df	p-value
	Male	Female				
<i>Strongyles/ Trichostrongyle egg</i>	9 13.4%	58 86.6%	67 76.8 %	16.351	8	0.038*
<i>Trichuris Spp.</i>	2 100%	0 0.0%	2 2.3%			
<i>Monezia Spp.</i>	1 50.0%	1 50.0%	2 2.3%			
<i>Eimeria Spp.</i>	4 25.0%	12 75.0%	16 18.4%			
Total	16 18.4%	71 81.6%	87 100%			

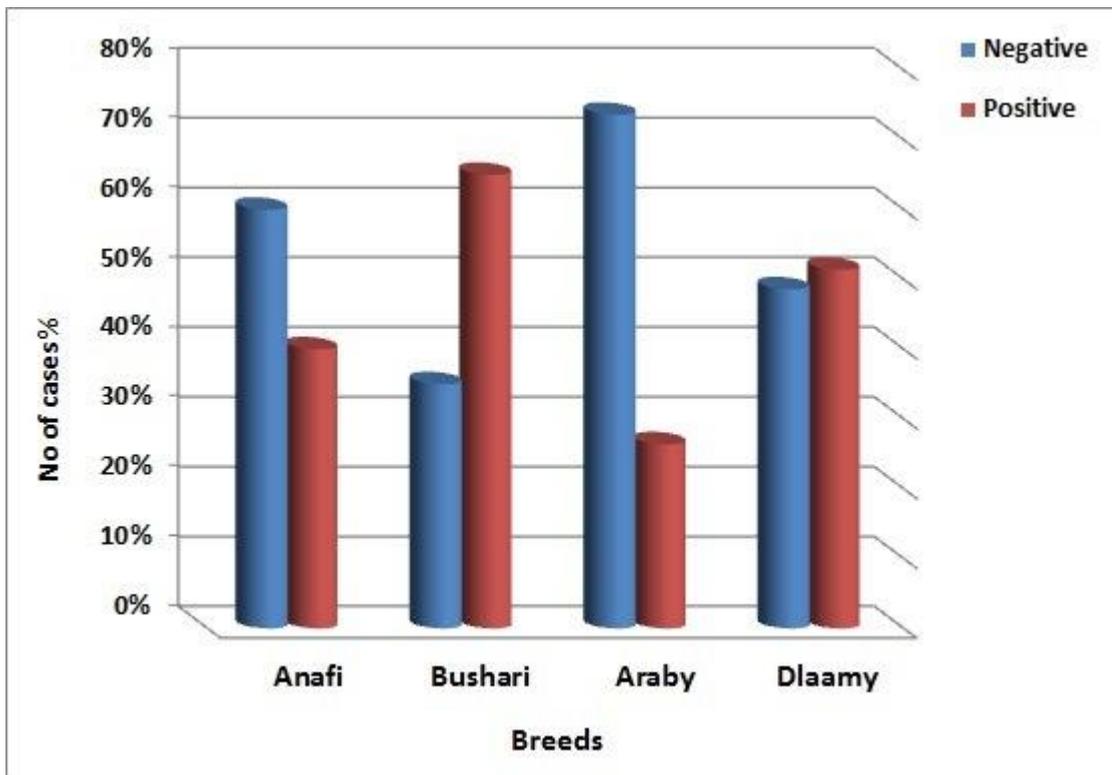
***P- value= 0.038 <0.05 (significant)**

Table 7: Association between health status and Presence of gastrointestinal parasites of camels in River Nile State, Sudan

Result	Health Status		Total	χ^2	df	p - value
	Poor	good				
Negative	7 11.5%	54 88.5%	61 41.2%	8.607	2	0.014*
Positive	77 88.5%	10 %11.5	87 58.8%			
Total	84 56.7%	64 43.3%	148 100%			

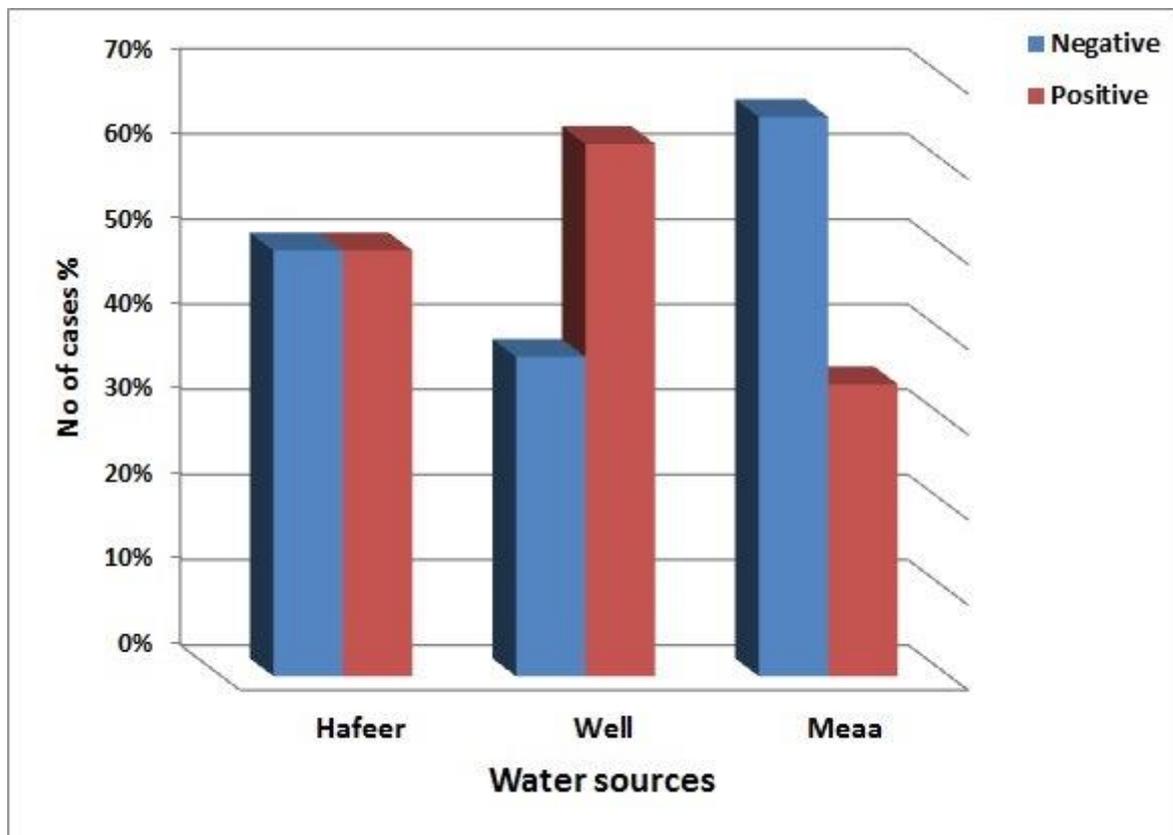
P- Value = 0.014 < 0.05 (significant)

Figure 2: Relationship between breed and presence of gastrointestinal parasites of camels in River Nile State, Sudan:



$\chi^2 = 10.993$ $P - Value = 0.012 < 0.05$ (significant),

Figure 3: Relationship between water source and result of gastrointestinal parasites of camels in River Nile State, Sudan



$\chi^2=7.194, p - Value = 0.027 < 0.05$ (significant)

Plate 6: Water source (Hafeer) in River Nile State



Plate 7: water source (well) in River Nile State



Plate 8: water source (Meaa) in River Nile State



CHAPTER FOUR

DISCUSSION

Camels are better adapted than any other domestic animal to the very hot and dry desert or sub desert regions. Nevertheless, it suffers from various internal and external parasites infection which are major constrains in improvement of camel health. These infection cause substantial economic losses due to decrease in working capacity, growth and productivity.

In current research work, high overall prevalence 58.85% (n= 87) of gastrointestinal parasite infection in camels was recorded in Al-Butana Area in River Nile State. This results are in agreement with Wafa (2015) who found that 143 cases (59.6%) were positive for gastrointestinal parasites in camels in the Riyadh region central Kingdom of Saudi Arabia. Similar results 62.75% (n =121) by Swai *et al.*, (2011) were obtained for prevalence of faecal intestinal parasite eggs in camels in the Northern Tanzania. Fadl *etal.*, in Al –Butana plains Sudan (1992) reported that the prevalence was 69.0% and the nematodes were the highest percentage particularly in July. A cross-sectional study for determination the prevalence of major gastrointestinal parasites affecting camels in Yabello district, Southern Rangeland of Ethiopia revealed that 73.8% (n=304) of the camels excreted helminthes eggs /protozoon oocyst in their faeces (Ararsa *et al.*, 2014). Furthermore, the overall prevalence of gastrointestinal parasites in

semi-intensive dairy camels systems and free grazing system in Mogadishu, Somalia (Abdalla *et al.*, 2016) was 50.3% (n=167).

As seen from the results, *Strongyles* group (76.8% n=67) was the most prevalent gastrointestinal parasites infection in Al-Butana Area in River Nile State. High prevalence of *Strongyle* type eggs 49 % (n=100) was reported in indigenous camels, with traditional husbandry and management in Iran (Mohammed and Mansour, 2013). In Borno State Nigeria Yakaka *et al.*, (2017), the authors confirmed that the *Strongyle* eggs 41.1 % (n=83) was the most dominant gastrointestinal parasites in one humped camels (*Camelus dromedarius*) slaughtered at the Maiduguri Metropolitan abattoir.

Coccidia was found in faecal samples of camels 18.4 % (n=16) in Al- Butana Area in River Nile State. Similar result were detected in 17.4% (n=40) from camels in the Eastern Region of Sudan, Adris (1989). Yakaka *et al.*, (2017) confirmed the presences of Coccidia (7.4 %) (n=15) in camels slaughtered at the Maiduguri Metropolitan abattoir Borno State in Nigeria. On the other hand, *Moniezia* Spp., and *Trichuris*Spp. were observed with low percentage in camels in the current study. Similarly, Yakaka *et al.*, (2017), Ararsa *et al.*, (2014) and Magan *et al.*, (2017) were found these internal parasites of camels in Nigeria and Ethiopia.

As seen from the result, highest positive cases 63.2 % (n=55) of gastrointestinal parasites in camels was observed in age group greater than five years in River Nile State . This finding was confirmed by Yakaka, *et al.*, (2017) , who stated

that prevalence was found to be higher in adult compared to young camels. Moreover, camels with poor health status showed high prevalence of gastrointestinal parasites in camels compared to camels with good health status in this study ($\chi^2= 8.607$, $p\text{-value}= 0.014$). Yakaka *etal.*, (2017), stated that the occurrence of these parasites are more frequent in slim body condition score compared to camels in good body condition.

CONCLUSION

- 1- The overall prevalence of gastrointestinal parasites in camels in River Nile State was high (58.8%) and *Strongyles* group were the most frequent infection.
- 2- Factors such as age, sex, breed; health status and sources of water were found to be associated with occurrence of gastrointestinal parasites of camels in River Nile State, Sudan.

RECOMMENDATIONS

- Control measures should be applied in order to reduce the gastrointestinal parasites infection to minimum level in different camel herds.
- An attention should be made in order to increase the awareness of the owners about impact of gastrointestinal parasites infection particularly on productivity of the camels.
- Further epidemiological studies are required regarding gastrointestinal infection in different regions of Sudan.

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Appendices

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Questionnaire

Date.....

Area.....

Camel owner.....

Herd size.....

Camel ID.....

Sample No.....

Source of Drinking water.....:

Meaa Well Haffer

Breed:

Dlaamy Arabi Bushari Anafi

Sex:

Male Female

Age:

> 5 years. 3years-5 Less than 2 years

General health:

Poor Good

Remarks :.....

.....