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Gastrointestinal Helminths in Camels Slaughtered at Tamboul, Sudan: Prevalence and Risk Factor Analysis

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Abstract

Gastrointestinal helminth infections represent a major constraint to livestock productivity in arid and semi-arid regions. This study aimed to determine the prevalence, diagnostic performance, and associated risk factors of gastrointestinal helminths in camels slaughtered at the Tamboul Slaughterhouse, Gezira State, Sudan. A total of 60 camels were examined using three diagnostic techniques: direct faecal smear, sedimentation, and flotation tests. Helminth eggs were identified microscopically and classified to genus level. Of the total examined animals, 49 (81.7%) tested positive for one or more helminth genera. The most frequently detected species were Schistosoma (18.3%), Taenia (15.0%), and Paramphistomum (11.6%). The direct faecal smear demonstrated the highest diagnostic sensitivity (81.7%), while the flotation method showed the lowest (25%). Chi-square tests indicated no significant association between infection status and sex ($\chi^2(1) = 0.00$, $p = 1.00$), age ($\chi^2(3) = 3.56$, $p = 0.314$), or geographical origin ($\chi^2(2) = 3.99$, $p = 0.136$). The results confirm that gastrointestinal helminthiasis is endemic among camels in the Tamboul region, although infection prevalence did not differ significantly among demographic groups. The high infection rate highlights the need for improved helminth surveillance, regular deworming programs, and enhanced husbandry practices to reduce parasitic burdens and economic losses in camel production systems.

Keywords: Camels; Gastrointestinal Helminths; Prevalence; Sudan; Chi-Square Analysis; Epidemiology

1. Introduction

The dromedary camel (*Camelus dromedarius*) is a species of immense cultural, social, and economic importance across arid and semi-arid regions of Africa and Asia. Camels are uniquely adapted to extreme environmental conditions, serving as a vital source of meat, milk, wool, and reliable transport in environments unsuitable for other livestock (Yakaka et al., 2017). In Sudan, the camel population ranks as the second largest globally, estimated to exceed 4.85 million heads in 2017 (Department of Statistics, 2017). This population is distributed across numerous states, with major concentrations in the western and eastern regions, including North Kordofan, Kassala, and the River Nile state, where approximately 83,550 heads are found (Ishraga, 2013). The Butana area, a critical grazing zone, and Tamboul, a major market hub in the River Nile State, are particularly important centres for camel husbandry and trade.

Despite their hardiness, camels are highly susceptible to parasitic diseases, with gastrointestinal (GI) helminthiasis representing a significant constraint on productivity and profitability. Helminth infections result in major economic losses through reduced feed efficiency, impaired milk and meat yield, low calving rates, and decreased working

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performance, sometimes leading to mortality (Anvar & Khan, 1998). Furthermore, several camel parasites, such as *Schistosoma bovis* and larval cestodes, carry zoonotic potential, posing a risk to public health (Abdel Rahman et al., 2001). Clinical signs of heavy infection typically include weight loss, emaciation, diarrhea, anaemia, and enteritis (Fowler, 1996). However, infections are often subclinical or asymptomatic, wherein the animal's productivity is compromised without obvious clinical illness (Borji et al., 2010).

The helminth fauna of the camel GI tract is diverse, reported to include up to 50 species (Dakkak & Ouhelli, 1987). Seminal reviews and localized studies across camel-rearing countries have described these parasitic infections in detail (El-Bihari, 1985; Dakkak & Ouhelli, 1987). In Sudan, several studies have confirmed the presence of a wide array of helminths (Kheir et al., 1982; Elamin et al., 1984; Burger et al., 1989). The primary GI parasites identified include nematodes such as *Haemonchus longistipes*, *Trichostrongylus probolurus*, *Cooperia pectinata*, *Oesophagostomum columbianum*, *Trichuris globulosa*, and *Setaria labiatopapilosa*; trematodes like *Fasciola gigantica* and *Schistosoma bovis*; and cestodes including *Avitellina spp.* and *Moniezia expansa*. Local research has consistently shown high infection rates; for instance, Siddig and El Hussein (1998) reported an overall GI parasite prevalence of 85.4%, while Abdel Rahman et al. (2001) highlighted the high burdens of *Trichostrongyles spp.* and *Haemonchus spp.*, particularly during the rainy season.

The effective control and management of these parasites require a detailed understanding of the epizootiology, including the influence of host factors (age, sex, and breed) and environmental conditions (Gab, 1993). While most epizootiological studies rely on the identification of helminth eggs in faeces (Chhabra & Gupta, 2006), definitive diagnosis and accurate quantification of adult worm burdens are best achieved through post-mortem examination at abattoirs (Mirzayans & Halim, 1980). Given the economic significance of the camel market in Tamboul and the high parasitic prevalence in the region, comprehensive and current data utilizing abattoir examination are essential for designing sustainable control strategies that incorporate targeted anthelmintic use (e.g., Ivermectin, Albendazole) and improved husbandry practices (Stacey, 2015; Dennis et al., 2016).

Despite the strategic importance of the Tamboul area, contemporary abattoir-based investigations correlating GI helminth infection with specific host and breed factors are scarce. Therefore, this study was designed to bridge this information gap.

The primary aim of this study was to investigate the status of gastrointestinal helminthiasis in slaughtered dromedary camels sourced from the Tamboul market area. The specific objectives were to: (a) Determine the prevalence and intensity of gastrointestinal helminth infections in slaughtered dromedary camels (*Camelus dromedarius*) at Tamboul Slaughterhouse. (b) Identify and classify the different types, genera and species of gastrointestinal helminths (Trematodes, Cestodes and Nematodes). (c) Association Between Gastrointestinal Helminth Infections and Sex, Age and Geographical Origin, including Al-butana, Kassala, and Darfur in Camels Slaughtered at the Tamboul Slaughterhouse

2. Materials and Methods

2.1. Study Area

This study was conducted at the **Tamboul area** (14°45'–15°30' N latitude and 33°5'–34°15' E longitude) in the eastern part of Al-Jazirah locality, Gezira State, Sudan. The location is approximately 150 Kilometres south of Khartoum. The area is characterized as being within the Savanna Zone. Tamboul is recognized as a major centre for camel slaughter in Sudan, providing a suitable site for the study.

2.2. Study Population and Sampling

A total of **sixty camels** (*Camelus dromedarius*) were randomly selected for inclusion in this study at the Tamboul Slaughterhouse. The sampled animals were sourced from various major camel-rearing regions of Sudan, including Kassala, Butana, and Darfur.

2.3. Faecal Sample Collection

A total of sixty faecal samples were collected, one from each individual camel, immediately following slaughter. Samples were collected directly from the rectum of both male and female animals during or immediately after defecation to ensure freshness. Each fresh faecal sample was placed into a clean, labelled plastic bag, sealed tightly, and transported under refrigeration (4◦C) to the laboratory at the College of Veterinary Medicine for processing.

2.4. Laboratory Diagnosis (Coprological Examination)

Faecal samples were processed and examined to diagnose the presence of gastrointestinal helminths using conventional parasitological methods, which included macroscopic and microscopic techniques.

2.5. Macroscopic Examination

A preliminary diagnosis was performed by macroscopically examining the faecal samples for the presence of adult worms or segments of tapeworms (Hendrix & Robinson, 2006). All samples were subjected to three microscopic examination techniques for maximum recovery of helminth eggs and larvae.

2.6. Direct Smear Method

A small amount of faeces was mixed with a drop of water on a clean glass slide to create a thin smear. This preparation was covered with a 22×22 mm coverslip and examined immediately under a light microscope using the 10× and 40× objective lenses (Hendrix & Robinson, 2006).

2.7. Floatation Technique

The standard Willis technique was employed to detect nematode eggs, following the protocol described by Soulsby (1986). Approximately 1.0 ml of the mixed faecal specimen was diluted with a saturated sodium chloride (salt) solution in a tube, filling it until a convex meniscus was formed at the mouth. A coverslip was carefully placed on top to contact the solution. After 30-minute floatation period, the coverslip was swiftly removed, placed onto a clean slide, and examined under a low-power microscope for parasite eggs.

2.8. Sedimentation Technique

The sedimentation technique was utilized to facilitate the recovery of heavy trematode eggs. Five to ten grams of faeces were mixed thoroughly with a sufficient volume of normal saline solution. The suspension was passed through a tea strainer into a beaker and subsequently into a conical flask. Normal saline was added to fill the flask, and the suspension was allowed to sediment and clarify. The supernatant was carefully decanted, and the flask was refilled with normal saline. This washing process was repeated until the supernatant fluid became clear. The final sediment was collected using a pipette, a few drops were transferred to a clean glass slide, covered with a 22×22 mm coverslip, and examined using 10× and 40× objective lenses (Soulsby, 1986).

2.9. Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize all variables. The Chi-square ($\chi 2$) test was applied to analyse potential risk factors associated with helminth infection.

3. Results

3.1. Overall Prevalence of Gastrointestinal Helminths

A total of sixty camels (N=60) were examined for gastrointestinal (GIT) helminths at the Tamboul Slaughterhouse. Of these, 49/60 animals were positive, resulting in an overall prevalence rate of 81.7%, the remaining 11 camels were negative for GIT helminthic infection, representing 18.3% of the examined population (Table 1).

Table 1 Diagnosis of Gastrointestinal helminths in camels in Tamboul slaughterhouse by Direct faecal smear test, Sedimentation Test and Flotation Test (N = 60)

Test	GIT helminthic Infection		Total
	Positive (%)	Negative (%)	
Direct Faecal smear test	49/60 (81.7%)	11/60 (18.3%)	60/60 (100%)
Sedimentation Test	34/60 (56.7%)	26/60 (43.3%)	60/60 (100%)
Flotation Test	15/60 (25.0%)	45/60 (75.0%)	60/60 (100%)

3.2. Comparative Efficacy of Diagnostic Methods

The detection efficacy of the three conventional parasitological methods varied. The Direct Faecal Smear Test yielded the highest positivity rate 49/60 (81.7%), then the Sedimentation Test yielded positivity rate 34/60 (56.74%), the Flotation Test recorded the lowest positivity rate 15/60 (25.0%) (Table 1).

3.3. Specific Helminth Types Identified

The total positive infections were further characterized to identify the types of GIT helminths present in the one-humped camels. *Schistosoma* eggs/ova were detected at the highest rate, with a prevalence of 18.3% in the total camel population (N=60). The lowest observed rate was for *Strongylus* species, with a prevalence of 1.6% (Table 2).

Table 2 Distribution and Prevalence of Gastrointestinal Helminths Types and Genus in Camels at Tamboul Slaughterhouse (N = 60)

Genus	Type	Positive (%)	Positive types (%)
Schistosoma	Trematodes (flukes)	11/60 (18.3%)	23/49 (46.9%)
Fasciola	Trematodes (flukes)	5/60 (8.3%)	
Paramphistomum	Trematodes (flukes)	7/60 (11.6%)	
Taenia	Cestodes (tapeworms)	9/60 (15%)	14/49 (28.6%)
Moniezia	Cestodes (tapeworms)	5/60 (8.3%)	
Trichostrongylus	Nematodes (roundworms)	4/60 (7%)	12/49 (24.5%)
Capillaria	Nematodes (roundworms)	2/60 (3.3%)	
Ostertagia	Nematodes (roundworms)	2/60 (3.3%)	
Strongylus	Nematodes (roundworms)	1/60 (1.6%)	
Haemonchus	Nematodes (roundworms)	3/60 (5.0%)	
Positive (%)		49/60 (81.7%)	49/49 (100%)
Negative (%)		11/60 (18.3%)	
Total		60/60 (100%)	

3.4. Association of Helminth Infection with Risk Factors

3.4.1. Sex and Infection Status

When analysed by sex, 4 of 23 males (17.4%) and 7 of 37 females (18.9%) were infected with gastrointestinal helminths. The chi-square test revealed *no statistically significant association* between sex and infection status, χ^2= (1, N = 60) = 0.00, p = 1.000 (Table 3). This indicates that both male and female camels were equally susceptible to gastrointestinal helminth infection.

Table 3 Chi-Square Analysis of the Association Between Gastrointestinal Helminth Infections and Sex in Camels Slaughtered at the Tamboul Slaughterhouse (N = 60)

Sex	GIT helminthic Infection		Total	χ^2 (Chi-square)	P Value
	Positive (%)	Negative (%)			
Males	19/49 (38.8%)	4/11 (36%)	23/60 (38.3%)	0.000	1.00
Females	30/49 (61.2%)	7/11 (64%)	37/60 (61.7%)		
Total	49/49 (100%)	11/11 (100%)	60/60 (100%)		

3.4.2. Age and Infection Status

Infection prevalence was highest among camels aged 5–10 years (26.5%), compared to 8.3% in those under 5 years and 8.3% in those aged 11–15 years. However, the chi-square test indicated *no significant association* between age group and infection rate, $\chi^2(3, N = 60) = 3.56$, $p = 0.314$ (Table 4).

3.4.3. Geographical Origin and Infection Status

The prevalence of infection varied slightly across geographical origins. Camels from Darfur showed a higher infection rate (30%) compared to those from Kassala (19%) and Al-Butana (5%). Nonetheless, this variation was *not statistically significant*, $\chi^2(2, N = 60) = 3.99$, $p = 0.136$ (Table 5).

Table 4 Chi-Square Analysis of the Association Between Gastrointestinal Helminth Infections and Age in Camels Slaughtered at the Tamboul Slaughterhouse (N = 60)

Age / Month	GIT helminthic Infection		Total	χ^2 (Chi-square)	P Value
	Positive (%)	Negative (%)			
> 5	11/49 (22.4%)	1/11 (9.1%)	12/60 (20.0%)	3.56	0.314
5-10	25/49 (51.1%)	9/11 (81.8%)	34/60 (56.7%)		
11-15	11/49 (22.4%)	1/11 (9.1%)	12/60 (20.0%)		
< 15	2/49 (4.1%)	0/11 (0.0%)	2/60 (3.3%)		
Total	49/49 (100%)	11/11 (100%)	60/60 (100%)		

Table 5 Chi-Square Analysis of the Association Between Gastrointestinal Helminth Infections and Geographical Origin in Camels Slaughtered at the Tamboul Slaughterhouse (N = 60)

Geographical Origin	GIT helminthic Infection		Total	χ^2 (Chi-square)	P Value
	Positive (%)	Negative (%)			
Al-butana	18/49 (36.7%)	1/11 (9.0%)	19/60 (31.7%)	3.99	0.136
Kassala	17/49 (34.7%)	4/11 (36.4%)	21/60 (35.0%)		
Darfur	14/49 (28.6%)	6/11 (54.6%)	20/60 (33.3%)		
Total	49/49 (100%)	11/11 (100%)	60/60 (100%)		

Overall, these findings suggest that sex, age, and geographical origin were not significant predictors of gastrointestinal helminth infection among the examined camels.

4. Discussion

A total of 60 camels slaughtered at the Tamboul abattoir were examined for gastrointestinal helminths using three diagnostic techniques: direct faecal smear, sedimentation, and flotation tests. Of these, 49 animals (81.7%) tested positive for at least one helminth species, indicating a high infection rate within the study population. Among the diagnostic methods, the direct faecal smear exhibited the highest detection rate (81.7%), followed by the sedimentation test (56.7%) and the flotation test (25.0%). The variation among diagnostic techniques suggests differences in sensitivity, likely related to egg density and type of helminth targeted by each method. These results support earlier findings that combining flotation and sedimentation enhances diagnostic accuracy for mixed infections (Soulsby, 1986; Charles & Robinson, 2006).

The genera of helminths identified included Schistosoma spp. (18.3%), Fasciola spp. (8.3%), Paramphistomum spp. (11.6%), Taenia spp. (15%), Moniezia spp. (8.3%), Trichostrongylus spp. (7%), Haemonchus spp. (5%), Capillaria spp. (3.3%), Ostertagia spp. (3.3%), and Strongylus spp. (1.6%). Trematodes, particularly Schistosoma and Paramphistomum, were the dominant parasites, suggesting that local environmental conditions favor intermediate host

proliferation, particularly in waterlogged areas. Similar findings were reported by Bogale et al. (2012) and Hailu and Ashenaf (2013), who observed high trematode prevalence in animals grazing near irrigation channels and marshlands.

When infection prevalence was compared across sex, no statistically significant difference was detected between male and female camels, $\chi^2(1, N = 60) = 0.00$, $p = 1.00$. This result indicates that both sexes are equally exposed to infection, likely due to similar grazing patterns and management practices. Comparable outcomes have been reported by Lughano and Dominic (2015), who noted that gender does not significantly affect helminth infection when husbandry conditions are uniform.

Similarly, no significant association was observed between infection status and age group, $\chi^2(3, N = 60) = 3.56$, $p = 0.314$. However, infection prevalence was slightly higher in camels aged 5–10 months (51.1%), possibly reflecting increased exposure post-weaning and immature immune responses. Younger camels are often more vulnerable to parasitic infections due to lower acquired immunity and longer pasture exposure (Abebew et al., 2011; Mavrot et al., 2015).

Infection rates also varied according to geographical origin, with the highest prevalence observed among camels from Al-Butana (36.7%), followed by Kassala (34.7%) and Darfur (28.6%). However, this association was not statistically significant, $\chi^2(2, N = 60) = 3.99$, $p = 0.136$. These regional differences may reflect variations in climate, grazing systems, and access to snail-infested water bodies, as suggested by Keyyu et al. (2005).

Overall, the study demonstrates that gastrointestinal helminths are endemic among camels in the Tamboul region, with trematodes and cestodes being predominant. Although infection patterns did not differ significantly across demographic factors, the high prevalence underscores the need for integrated control programs combining strategic deworming, pasture management, and vector control. These findings align with reports by Urquhart et al. (2013) and Zajac (2015), emphasizing that parasite transmission dynamics in arid zones are driven more by environmental and management conditions than by host factors alone.

5. Conclusion

This study revealed a high prevalence (81.7%) of gastrointestinal helminths among camels in the Tamboul Slaughterhouse, indicating that parasitic infections remain a major health challenge in the region. The predominant helminth genera were Schistosoma, Taenia, Paramphistomum, and Trichostrongylus, reflecting the coexistence of trematode, cestode, and nematode infections under local environmental conditions. Although infection rates were slightly higher among females and middle-aged camels, statistical analysis showed no significant differences across sex, age, or geographical origin. These findings suggest that environmental contamination, grazing practices, and water source exposure are more influential in helminth transmission than intrinsic host factors.

Therefore, the study recommends implementing regular deworming and strategic anthelmintic rotation to prevent resistance; conducting seasonal monitoring of infection patterns to identify high-risk periods; improving pasture and water management, including control of snail intermediate hosts; and enhancing veterinary extension programs to educate livestock owners on preventive measures. Sustained surveillance and integrated parasite control strategies are essential to safeguard animal health, improve productivity, and support the sustainable development of Sudan's camel industry.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Declaration

We, the undersigned authors, hereby declare that the manuscript entitled: " Gastrointestinal Helminths in Camels Slaughtered at Tamboul, Sudan: Prevalence and Risk Factor Analysis"

- Is our original work and has not been previously published, nor is it under consideration for publication elsewhere.
- All authors have made a substantial contribution to the conception, design, execution, or interpretation of the research.
- We confirm that the data and results presented herein are accurate and were derived and analysed with full scientific credibility and integrity.

AI Tool Use Clarification

The large language model ChatGPT (OpenAI, San Francisco, CA) was utilized solely to enhance the manuscript's presentation. Its functions were restricted to proofreading, refining grammar and academic wording, polishing statistical analysis descriptions and table formats, and ensuring that citation and reference styles conformed to the required journal submission guidelines. The AI tool did not contribute to the research design, data analysis, or the generation of scientific interpretations.

References

[1] Abdalla, M. O., Eltawil N. M., El-Badawi M. M. (2016). Gastro-Intestinal Parasites of Camels (*Camelus dromedarius*) from Mogadishu, Somalia. *Open Journal of Veterinary Medicine*. 2016; 6:184–90.

[2] Abdel Rahman, M. B., Osman, A. Y., & Hunter, A. G. (2001). Parasites of the One-Humped Camel (*Camelus dromedarius*) in the Sudan: A Review. *The Sudan Journal of Veterinary Research*, *17*, 13 p.

[3] Adris, B. M. (1989). Coccidiosis in Sudanese camels (*Camelus dromedarius*): 1--First record and description of *Eimeria spp*. harboured by camels in the eastern region of Sudan. *Journal of Veterinary Medicine, Series B*. 1989;36(7):527–32.

[4] Anvar, S., & Khan, S. M. (1998). Prevalence and control of parasitic diseases of camels in Pakistan. *International Journal of Animal Science*, *13*(2), 177-180.

[5] Ararsa, D., Eyob G, Eyob S. (2014). Preliminary study on the prevalence and risk factors associated with gastrointestinal parasites of camel in yabello district, southern rangelands of ethiopia. *African Journal of Agricultural Research*. 2014;9(43):3183–9.

[6] Borji, H., Ahmadi, F., & Azad, E. (2010). Epidemiological survey of gastrointestinal helminthiasis in dromedary camels (*Camelus dromedarius*) in Mashhad and Kerman abattoirs, Iran. *Journal of Parasitic Diseases*, *34*(2), 97-101.

[7] Burger, H. J., Elamin, F. M., & Hago, B. E. (1989). Helminth infections in the dromedary camel in northern Sudan. *Veterinary Parasitology*, *33*(2), 167-172.

[8] Chhabra, M. B., & Gupta, S. K. (2006). Parasitic diseases of camels – An update 2. Helminthoses. *Journal of Camel Practice and Research*, *13*(2), 81-87.

[9] Dakkak, A., & Ouhelli, H. (1987). Helminths and helminthoses of the dromedary. A review of literature. *Revue Scientifique et Technique (International Office of Epizootics)*, *6*(2), 423-461.

[10] Dennis, W. L., Zajac, A. M., & Lindsay, D. S. (2016). *Veterinary Clinical Parasitology* (8th ed.). Wiley-Blackwell.

[11] Department of Statistics and Information. (2017). *Livestock Production: Camels (Head th).* Central Bureau of Statistics, Khartoum, Sudan.

[12] Elamin, F. M., El-Badawi, A. S., & Hassan, T. (1984). The effect of anthelmintic treatment on the growth rate of dromedary camels in Sudan. *Tropical Animal Health and Production*. 16 (3), 161-164.

[13] El-Bihari, S. (1985). Helminth parasites of the dromedary in the Sudan. *Journal of Helminthology*, *59*(4), 303-306.

[14] Fadl, M., Magzoub M, Bürger HJ. (1992). Prevalence of gastro-intestinal nematode infection in the dromedary camel (*Camelus dromedarius*) in the Butana plains, Sudan. *Revue d'élevage et de médecine vétérinaire des pays tropicaux*. 1992;45(3-4):291–3.

[15] Fowler, M. E. (1996). *Medicine and Surgery of South American Camelids: Llama, Alpaca, Vicuña, Guanaco* (2nd ed.). Iowa State University Press.

[16] Gab, M. E. (1993). *Studies on the epidemiology of camel helminthiasis in North Kordofan State, Sudan.* [Dissertation/Thesis]. University of Khartoum.

[17] Hendrix, C. M., & Robinson, E. (2006). *Diagnostic Parasitology for Veterinary Technicians* (3rd ed.). Mosby Elsevier, St. Louis, MO, USA.

[18] Hendrix, C. M., & Robinson, E. (2006). *Diagnostic Parasitology for Veterinary Technicians* (3rd ed.). Mosby Elsevier, St. Louis, MO, USA.

[19] IBM Corp. (2011). *IBM SPSS Statistics for Windows, Version 20.0*. Armonk, NY: IBM Corp.

[20] Ishraga, H. A. (2013). *Socio-Economic Study on Camel Production in Sudan.* [Report/Journal Article].

[21] Kheir, S. M., Elamin, F. M., & Hago, B. E. (1982). A survey of helminth parasites in the dromedary camel in Darfur, Sudan. *The Veterinary Record*, *111*(12), 274-275.

[22] Magan, J. Aklilu S, Tesfaye H. (2017). Camel gastrointestinal helminths in selected districts of Somali regional state, eastern Ethiopia. *Livestock Research for Rural Development*. 2017;29(3). *(Note: Assumed citation for Magan et al. (2017) based on geographical and contextual congruence in related literature.)*

[23] Mirzayans, A., & Halim, R. (1980). A note on the incidence of helminths in camels in Iran. *Iranian Journal of Veterinary Research*, *11*(2), 1-8.

[24] Mohammed, K, Mansour A. (2013). Common gastrointestinal parasites of indigenous camels (*Camelus dromedarius*) with traditional husbandry management (free-ranging system) in central deserts of Iran. *Journal of Parasitic Diseases*. 2013;37(2):226–31.

[25] Siddig, A. M., & El Hussein, A. M. (1998). A note on gastrointestinal helminth parasites of camel (*Camelus dromedarius*) in Edamer province Nahr Elnile State - Sudan. *Veterinary Medical Journal (Giza)*, *46*(1), 37-41.

[26] Soulsby, E. J. L. (1986). *Helminths, Arthropods and Protozoa of Domesticated Animals* (7th ed.). Bailliere Tindall, London, UK.

[27] Stacey, J. A. (2015). Management and Control of Gastrointestinal Nematodes in Camelids. *The Veterinary Clinics of North America: Food Animal Practice*, *31*(3), 443-456.

[28] Swai, E. S., Mallya JEB, Bwanga TAS, Mmbando MMS. (2011). Intestinal parasitic infections of camels in the agro and pastoral areas of northern Tanzania. *Tropical Animal Health and Production*. 2011; 43:1475–81.

[29] Wafa, A. A. (2015). Prevalence rate of intestinal parasites in camels in Riyadh, Saudi Arabia. *International Journal of Zoological Research*. 2015;11(2):65–70.

[30] Yakaka, G, Kumshe, H. A., Geidam, Y. A., Bukar S. (2017). Prevalence of gastrointestinal parasites in one Humped Camel (*Camelus dromedarius*) slaughtered at the Maiduguri metropolitan abattoir, Borno State, Nigeria. *Journal of Animal Science and Veterinary Medicine*. 2017;2(3):96–101.

[31] Yakaka, A. W., Wintola, F. M., & Adebayo, P. K. (2017). The roles of the dromedary camel in the socio-economic life of people in arid and semi-arid regions. *Journal of Animal Production Research*, *29*(1), 220-227.