RESEARCH ARTICLE

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X: E-ISSN 2315-6201)

http://dx.doi.org/10.4314/sokjvs.v23i1.4

Mohammed *et al.*/*Sokoto Journal of Veterinary Sciences*, **23**(1): 38 - 45.

Prevalence of gastrointestinal parasites of the horse in Maiduguri metropolis, Borno State

A Mohammed[1]*, SM Tukur[1], BK Kayeri[1], M Sani[2], AH Mustapha[1], CA Midala[1], HP Mshelia[1], EA Malgwi[1] & BB Ijaw[1]

1. *Department of Parasitology and Entomology, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria*
2. *Department of Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria*

*Correspondence: Tel.: +2348032097911; E-mail: alimohvet@unimaid.edu.ng

Publication History:
Received: 14-08-2024
Revised: 09-12-2024
Accepted: 01-01-2025

Abstract

This study assessed the prevalence of gastrointestinal parasites in horses within Maiduguri Metropolis using the faecal flotation technique. Based on the owners ' consent, one hundred and fifty faecal samples were properly labelled and stored for analysis. The study revealed a 39.3% overall prevalence of gastrointestinal parasites in equines. The results showed a predominance of male horses in the sample (115, 76.7%) compared to females (35, 23.3%). The prevalence of helminths was higher in females (100%, 35/35) than in males (20.7%, 24/115). Among the identified parasites, Strongylus was the most common (45.8%, 27/59), while Trichomonas was the least prevalent (10.2%, 6/59). Age-specific data indicated that horses aged 9-11 years had the highest prevalence of infections (75.0%, 6/8), whereas horses aged <1-2 years had the lowest prevalence (10.2%, 6/59), with no infections found in horses over 11 years old. In terms of location, samples collected within Jere had the highest prevalence of 64.8% (35/54) compared to Maiduguri with 25.0% (24/96). There was a statistically significant association ($p<0.05$) between age, location and helminth infection. The study identified Strongylus, Gastrodiscus, Dictyocaulus, and Trichomonas as the most common gastrointestinal parasites. Female horses and those aged 9-11 years were more susceptible to these parasites compared to males and older horses (≥11 years).

Keywords: Faecal flotation technique, Gastrointestinal parasite, Horse, Maiduguri, Prevalence

Introduction

The Horse (*Equus caballus*) has long been domesticated by man and since then it has been a loyal friend and a trusted partner in man's day to day life. Horses play a vital role in many aspects of human life, either as livestock pets or companion animals (Bulgaru & Tudor, 2016; Ola-Fadunsin *et al.,* 2018). Horses are known to be important to man in many ways, including working activities such as police

service, pleasure riding, polo games, ceremonies, crowd control, entertainment, agriculture and research. Also, meat, milk, hide, bones, blood, hooves and pharmaceuticals are other important products derived from horses (Abiola *et al.,* 2016; Ola-Fadunsin *et al.,* 2018). Horses are associated with royalty and some special traditional festivals in some northern parts of Nigeria (Kaduna, Bauchi and Borno States) (Ehizibolo *et al*., 2012; Ola-Fadunsin *et al.,* 2018).

In Borno State, majority of domesticated horses serve as a symbol of prestige especially at traditional durbar festivals, while only the remaining few are used as polo horses or for transport (Biu *et al.,* 2006). Domesticated equids (horses and donkeys) are susceptible to a large variety of gastrointestinal helminthes, of which nematodes of the family Strongylidae commonly named Strongyles are most important, (Ogbein *et al.,* 2022). These helminthes are ubiquitous, and it is hardly possible to find any grazing animal of these equines not harboring a number of species at any particular time (Imam *et al.,* 2008), horses amongst most domestic animals have been reported to be more susceptible to a large number of parasites and may harbor different species at a given time (Wannans *et al.,*2012). Horses are economically devastated by gastrointestinal parasites with clinical presentations of unthriftness, anaemia, colic and diarrhea (Saeed *et al.,* 2010). Equines are generally considered hardy and resistant animals. Despite this belief, they do suffer from a number of diseases (Takele & Nibret, 2013), including parasitism, which causes a major impact on their production in the tropics, including Nigeria (Regassa & Yimer, 2013). Equines harbour many species of parasites in their gastrointestinal tract, as it provides a suitable environment for their survival and proliferation (Umar *et al.,* 2013).

Gastrointestinal helminth parasite infection is a major limitation factor against profitable animal production over the world, (Hinney *et al.,* 2011; Mathewos *et al.,* 2021). An apparently healthy horse can harbour over half a million gastrointestinal parasites. This is because the gastrointestinal tract provides a suitable environment for the survival and proliferation of many of these parasites (Umar *et al.,* 2013). Parasitic diseases have been reported to be the most prevalent disease of horses in Zaria, an area in the derived savannah zone of Northern Nigeria, accounting for 82.3% of the cases presented in a Veterinary clinic over a period of 28 years (Useh *et al*., 2005), 82.4% had been reported in Jos (Ogbein *et al.,* 2022 while 93% had been reported in Port harcout (Chinwe *et al.,* 2019) Effect of gastrointestinal parasites on horses cannot be over emphasized. They decrease the performance, production and productivity in the animals mainly in the reduction of body weight or failure to gain weight or even increase the mortality in acute case (Ramaswamy, 1994). A number of studies conducted to detect association between poverty and animal diseases identified gastrointestinal parasitism as one of the most important problems for equids in developing countries (Baranowski *et al*., 2002; Fikru *et al.,* 2005). Therefore, the scope of this study was to observed and report the prevalence of gastrointestinal helminths of horses in Maiduguri Northeast Nigeria.

Materials and Methods

Study area

The present study was conducted in Maiduguri Metropolis, formerly Yerwa founded in 1902, the capital city of Borno state, Nigeria. It is the largest Metropolis in the northeastern region of Nigeria (Waziri, 2009). The study area lies within the semi-arid (Sahel savannah) zone of the north-eastern part of Nigeria, Maiduguri is located on latitude 11°48'N and 11052' N and longitude 13°02' E and 13912' E, at about 350m (1161 ft) above sea level with an ambient temperature range of 32℃ to 45℃. The relative humidity is generally low throughout the state, ranging from as low as 13% in the driest months of February and March to the highest values of 70% to 80% in the rainy months of July and August, the rainy season averagely lasts for less than eighty days in the extreme north, the mean annual rainfall is about 600mm or less than 500mm in the extreme north around Chad republic Abatcha *et al*. (2024). The state shares borders with Cameroon to the east, Chad republic to the north-east and Niger republic to the north, (Abdulrahman *et al.,* 2012).

Sample size determination

The number of samples was calculated by using Thrusfield (2005) formula:

$$n = \frac{(1.962 \times Pexp\ (1-Pexp))}{0.052}$$

Description

n = required sample size

d^2 = allowable error = 5% $(0.05)^2$

P_{exp} = prevalence of 63% (Mesfin *et al.,* 2021)

The sample size is 128

To increase the precision, the number of samples was increased to 150 horses within Maiduguri metropolis and some parts of Jere and Konduga LGAs.

Faecal sample collection

Faecal samples were collected as described by the Food and Agriculture Organization (FAO, 2011). Faecal samples were collected directly from the rectum of individual animals using transparent polythene hand gloves under proper restraints according to standard procedures described by Stoltenow & Purdy (2003). The tails of the restrained horses were raised gently and the gloved fingers were inserted into the anal opening from which a small quantity of faeces were collected, tied and labelled appropriately. Collected samples were transported under cool chain to the Veterinary Parasitology Laboratory in the Faculty of Veterinary Medicine, University of Maiduguri. At the laboratory, samples were analyzed within 12-24 hours, faecal samples were observed macroscopically for the presence of adult helminths and microscopic examination was carried out by direct smear and flotation techniques employing saturated sodium chloride solution as the floating medium as described by Gallimore *et al*. (2005). Eggs were identified based on their morphology using the standard identification key of Soulsby (1982) as adopted by Chinwe *et al*. (2019).

Sample processing

During sample processing, the faeces were recovered from the gloves and 2g was put in a plate cup placed on a scale. Furthermore, the weighed part is transferred to a laboratory mortar where is grinded manually with a pestle, 26ml of a saturated salt solution was mixed with the grinded sample and sieved using a strainer, the filtrate collected was shaken gently to avoid the possibility of eggs not being evenly distributed within the solution, the filtrate was then poured in a bijou bottle filled to the brim and cover slip was placed on top of the bijou bottle and was allowed to stand for 10 minutes. The cover slip was thereafter carefully lifted and immediately placed on a grease-free glass slide and observed under a light microscope at ×10 and ×40 objective lens to allow for the identification and counting of the parasite eggs present in the faeces.

Data analysis

The data were analyzed using SPSS Statistics software version 23. Association between and among variables were tested using Chi-square and $p \leq 0.05$ was regarded as significant throughout the study.

Results

Out of the 150 equine species sampled in this study majority were males, 115 (76.7%), with a minority of females, 35 (23.3%). Breeds distribution revealed that the majority were Dongola 146 (97.3 %), with a minority of Arab Barbs 4 (2.7%) of equine species. The age category between 3-5 years of equine species sampled had the highest number, 66(44.0%), compared to the other age groups (Table 1).

Sex specific prevalence of gastrointestinal parasites among equine species sampled in this study revealed that females had a higher prevalence of 57.6% (34/59) of helminth load, as compared to the males who had the least of 42.4% (25/59). There was a statistically significant association ($\chi^2 = 9.45$, $P = 0.003$) between the presence of helminths and the sex of the equine species sampled in this study (Table 2). The occurrence of helminths in equine species sampled revealed that Strongylus had the highest prevalence, 27 (45.8%), while Trichomonas parasites had the lowest prevalence, 6(10.2%) (Table 2).

Table 1: Demographic features of equine species sampled in Jere and MMC Local Government Areas

Variables	No. sampled (%)
Sex	
Female	34 (23.3)
Male	115 (76.7)
Breed	
Arab-Barb	4 (2.7)
Dongola	146 (97.3)
Age	
<1-2	34 (22.7)
3-5	66 (44.0)
6-8	40 (26.7)
9-11	8 (5.3)
>12	2 (1.3)
Total	150 (100)

Age specific prevalence of gastrointestinal parasites among equine species sampled in this study revealed that the age categorized between 3-5years recorded higher prevalence of 47.5% (28/59) while age group between 9-11 years recorded the lower prevalence of 10.2% (6/59). However, age group >11 years had no infection for all parasite. There was no statistically significant association (χ^2 = 7.564) between the presence of helminth parasites and the age of the equine species sampled (Table 3).

Distribution of equine gastrointestinal parasites based on location revealed that, Unguwan doki recorded the highest infection rate 22.0% (13/59), while Maiduguri had the least infection rate, 1.01% (6/59). There was a statistically significant association (χ^2 = 38.840, p = 0.001) between the presence of helminth and the location of the equine species sampled (Table 4).

Distribution of equine gastrointestinal parasites based on breeds revealed that, Dongola Breed had higher prevalence of 96.6.0% (57/59) while Arab-Barb breed with lower infection rate of 3.38% (2/59). There was no statistically significant association (χ^2 = 1.84; P = 0.175) between the presence of helminths and the breed of the equine species sampled (Table 5).

Discussion

The results obtained in this study gave the current status of the prevalence of gastrointestinal parasites of horses in Jere and Maiduguri metropolis, Borno state, Nigeria. Where the overall prevalence of gastrointestinal helminths was 39.3%, the high prevalence of infection recorded in the study agrees with the findings of other researchers in Zaria, Bauchi and Kaduna respectively (Useh *et al.,* 2005; Ehizibolo *et al.,* 2012; Umar *et al*., 2013). Only four gastrointestinal helminth parasites (*Strongylus*, *Dictyocaulus*, *Gastrodiscus* and *Trichomonas* species) were recorded in the study area. Nwosu & Stephen (2005) recorded only two parasite species (*Gastrodiscus* spp. and *Strongylus* spp.) in the horses

Table 2: Sex specific prevalence of gastrointestinal parasites among equine species sampled in Jere and MMC Local Government Areas

Sex	No.examined	Overall No. of +ve helminths(%)	No. positive for individual helminths parasites (%)					
			Strongylus	Dictyocaulus	Trichomene	Gastrodiscus	$\chi 2$	P value
Male	115	24(20.7)	13(54.2)	9(37.5)	1(4.2)	1(4.2)	24.6	0.0001
Female	35	35(100)	14(40.0)	9 (25.7)	5(14.3)	7(20.0)		
Total	150	59(39.3)	27 (45.8)	18(30.5)	6(10.2)	8(13.5)		

Table 3: Age-specific prevalence of gastrointestinal parasites among equine species sampled in Jere and MMC Local Government Areas

Age (yrs)	No. examined	Overall No. of +ve helminths (%)	No. positive for individual helminths parasites (%)					
			Strongylus	Dictyocaulus	Trichomene	Gastrodis	$\chi 2$	P value
<1-2	34	9(26.5)	4(44.4)	2(22.2)	1(11.1)	2(22.2)	1.211	0.55
3-5	66	28(42.4)	14(50.0)	8(28.6)	3(10.7)	3(10.7)		
6-8	40	16(40.0)	6(37.5)	7(43.8)	1(6.3)	2(12.5)		
9-11	8	6(75.0)	3(50.0)	1(16.7)	1(16.7)	1(16.7)		
>11	2	0(00)	0(00)	0(00)	0(00)	0(00)		
Total	150	59(39.3)	27(45.8)	18(30.5)	6(10.2)	8(13.5)		

Table 4: Location of specific prevalence of gastrointestinal parasites among equines species sampled in Jere and MMC Local Government Areas

Location	No. examined	Overall No. of +ve helminths (%)	No. positive for individual helminths parasites (%)					
			Strongylus	*Dictyocaulus*	*Trichomonas*	*Gastrodiscus*	$\chi 2$	P value
Baga road	9	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	15.8	0.05
Galtimari	17	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)		
G. madara	11	10 (16.9)	5 (18.5)	3 (16.6)	2 (33.3)	0 (0.0)		
Hausari	15	8 (13.5)	4 (14.8)	2 (11.1)	1 (16.6)	1 (12.5)		
Maiduguri	17	6 (1.01)	2 (7.40)	3 (16.6)	0 (0.0)	1 (12.5)		
Ngomari	14	7 (11.8)	6 (22.2)	1 (5.55)	0 (0.0)	0 (0.0)		
Old GRA	14	8 (13.5)	3 (11.1)	1 (5.55)	2 (33.3)	2 (25.0)		
Shehuri	16	7 (11.8)	3 (11.1)	3 (16.6)	0 (0.0)	1 (12.5)		
Unguwan doki	37	13 (22.0)	4 (14.8)	5 (27.7)	1 (16.6)	3 (37.5)		
Total	150	59 (39.3)	27 (45.8)	18 (30.5)	6 (10.2)	8 (13.5)		

Table 5: Breed-specific prevalence of gastrointestinal parasites among equine species sampled in Jere and MMC Local Government Areas

Breed	No. examine	Overall No. of +ve helminth	No. Positive for individual helminth parasites (%)					
			Strongy.	Dictyoc.	Trichom.	Gastrodis	$\chi 2$	P value
A.barb	4	2(50.0)	2(100)	0(00)	0(00)	0(00)	0.08	0.68
Dangola	146	57(39.0)	25(43.9)	18(31.6)	6(10.5)	8(14.0)		
Total	150	59(39.3)	27(45.8)	18(30.5)	6(10.2)	8(13.5)		

kept by the Mounted troop, Borno State Command in Northern Nigeria, while Ehizibolo *et al.* (2012) recorded seven gastrointestinal parasite species (*Strongylus* spp., *Strongyloides* spp., *Oxyuris equi*, *Parascaris equorum*, *Paragonimus* spp. and *Dicrocoelium* spp.) in the horses kept by institutions and private owners studied across three Northern States (Bauchi, Kaduna and Plateau) in Nigeria. This study also showed that infection rates were higher in female than in male animals examined, with a significant difference, which agrees with the findings of Francisco *et al.* (2009). However, in their studies on horses in different areas of Ethiopia, Fikru *et al.* (2005) and Mezgebu *et al.* (2013) reported no significant difference in the influence of sex in parasitic infections in horses, while Umar *et al.* (2013) reported a higher prevalence of infection in male than female horses.

Tola *et al.* (2013), in a study conducted at South Western Ethiopia, reported a high prevalence of (94.8%) in donkeys while a low prevalence in horses (14.43%) amongst 406 animals examined, with 307 (75.6%) positive for different types of gastrointestinal parasites.

The overall prevalence recorded in this present study was lower as compared with the work of Yoseph *et al.* (2005) and Fikru *et al.* (2005), who have reported 100% and 98.2% in Equines of Wonchi highlands of Wollo province and western highlands of Oromia, respectively. This variation could be due to the variation in management and ecological conditions such as temperature, altitude and humidity according to (Mayaki, 2017). He also presented a 94.82% prevalence in donkeys, which was slightly lower than reports of Ayele *et al.* (2006), who have reported 100% in the Dugda Bora district. This variation could arise due to climatic condition and the management system of the study area. Most of the horses in the present study were taken from Semi-arid areas, and on the other hand, were cart Horses where the feeding system was a stabled feeding method. Mezgebu *et al.* (2013) also reported that there is a higher occurrence rate of gastrointestinal parasitism in donkeys than in horse, the observed higher parasitism in donkeys could be attributed to the fact that less attention is given to these animals that is by far lower than their workload (Alemayehu & Etaferahu, 2013). Out of the total positive horses infected, the result showed that a greater percentage had a single infection with one of the four parasites identified, while the remaining had a mixed infection

with two or more parasites, which could be due to feeding and management systems.

The results indicated that horses in this study area were usually infected with different species of parasites. findings show that despite the attention given to horse management in the Northern part of Nigeria, compared with other domestic livestock, parasitism is still a major problem as reflected in the horse stables examined. It is noteworthy that most of the economically important parasites (*Strongylus, Dictyocaulus, Gastrodiscus* and *Trichomonas* species) recorded in the present study have direct life cycles, where adult parasites living within the horse sheds ova (eggs) which are excreted in pasture, the larvae develop, hatch and moult to the infective third stage (L3) which serve as a source of contamination of housing facilities, exercise areas, pasture and feedstuff, resulting either in infection or re-infection of susceptible horses. This could lead to the high prevalence recorded in the study, despite veterinary care given to the horses in the study area.

It was thus concluded that the most prevalent enteric parasites in the study area were *Strongylus, Gastrodiscus, Dictyocaulus* and *Trichomonas* species. Female were more susceptible to these parasites than males, and growing horses aged 3-5 years were also more susceptible compared to adults aged 9- 11 years. From the investigation on the management systems practised in the study area, it was concluded that the management system played a major role in the overall prevalence of parasitism in the study area.

Funding

No funding was received.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

Abatcha IA, Mustapha AA & Barkindo AI (2024). Comprehensive analysis of rainfall variability in urban Maiduguri, Nigeria: Implications for climate resilience and sustainable development. *International Journal of Environment and Climate Change*, **14**(3): 149-159.

Abdulrahman F, Akan J, Chellube Z & Waziri M (2012). Level of heavy metals in human hair and nail samples from Maiduguri Metropolis, Borno State, Nigeria. *World Environment,* **2**(4): 81-89.

Abiola OJ, Olaogun SC, Emedoh OM & Olalekan TJ (2016). A retrospective study of ruminant cases presented between 1996 and 2005 at the Veterinary Teaching Hospital, University of Ibadan, Ibadan, Nigeria. *International Journal of Livestock Research,* **6**(7): 16-23.

Agajie T, Tamirat D, Pearson A & Temesgen T (2000). Socio-economic Circumstances of Donkeys Use and Management in the Rural and Urban Areas of Central Parts of Ethiopia. Proceedings of a Workshop on Promoting Peri-Urban Livelihoods, Through Better Donkey Welfare. Addis Ababa, Ethiopia. Pp 16-25.

Alemayehu R & Etaferahu Y (2013). Gastrointestinal Parasites of Equine in South Wollo Zone, North Eastern Ethiopia. *Global Veterinary,* **11**(6): 824-830.

Ayele G, Feseha G, Bojia E & Joe A (2006). Prevalence of gastrointestinal parasites of Donkeys in Dugba Bora District, Ethiopia. *Livestock Research of Rural Development,* **18**(10): 14-21.

Baranowski T, Perry CL & Parcel GS (2002). How individuals, environments, and health behavior interact. *Health Behavior and Health Education: Theory, Research, and Practice*, **3**, 165-184.

Biu AA, Ahmed MI & Yunusa AI (2006). Prevalence of equine Babesiosis in Maiduguri, Nigeria. *International Journal of Biomedical Health Science,* **2**(2): 81-83.

Bulgaru A & Tudor P (2016). The prevalence of helminth parasites in horses raised in modern conditions. *Scientific Works Series Veterinary Medicine,* **61**(2): 271-274.

Chinwe EN, Amawulu E & Francis GC (2019). Survey of Gastrointestinal Parasites and Ectoparasites of horses (Equine Equine) in Port Harcourt and Abarka Polo Field, South Southern Nigeria. *International Journal of Science and Research,* **8**(8): 1471-1476.

Ehizibolo DO, Kamani J, Ehizibolo PO, Egwu KO, Dogo GI & Salami-Shinaba, JO (2012). Prevalence and significance of parasites of horses in some states of Northern Nigeria. *Journal of Equine Science,* **23**(1): 1-4.

Fabiyi JP (1979). Late dry season outbreak of clinical haemonchosis and cooperiosis in cattle in Northern Nigeria. *Veterinary Resources,* **105**(17): 399-400.

FAO (Food and Agriculture Organization) (2011). Food and Agriculture Organization of the United Nations. *Caramel Colours. Combined Compendium of Food Additive Specification, Monograph,* **11***:* 1817-7077.

Fikru R, Reta D, Teshale S & Bizunesh M (2005). Prevalence of equines gastrointestinal parasites in western Highlands of Oromia,

Ethiopia. *Bulletin of Animal Health and Production in Africa,* **53**(3): 161-166.

Francisco I, Arias M, Cortinas FJ, Francisco R, Mochales E, Dacal V, Suarez JL, Uriate J, Morrondo P, Sanchez-Andrade R, Diez-Banos P & Paz-Silva A (2009). Intrinsic factors influencing the infection by helminth parasites in horses under an oceanic climate area Spain. *Journal of Parasitology Reserved,* **5**(7): 81-87.

Hinney B, Wirtherle NC, Kyule M, Miethe N, Zessin KH & Clausen PH (2011). Prevalence of helminths in horses in the state of Brandenburg, Germany. *Parasitology Research,* doi.10.1007/s00436-011-2362-z.

Gallimore CI, Cheesbrough JS, Lamden K, Bingham C, & Gray JJ (2005). Multiple norovirus genotypes characterised from an oyster-associated outbreak of gastroenteritis. *International Journal of Food Microbiology*, **103**(3): 323-33.

Imam SMA, Hassan T, Seri HI & Zolain HB (2008). Field Investigation of Gastrointestinal Nematodes in Horses and Donkeys in South Darfur State, Sudan. The 13th Scientific Congress of Faculty of Veterinary Medicine, Assiut University, Egypt. Pp 723-729.

Mayaki AM (2017). Retrospective study of equine cases at the Veterinary Teaching Hospital, Usmanu Danfodiyo University, Sokoto, Nigeria (2001-2015). *Nigeria Veterinary Journal,* **38**(3): 208-214.

Mathewos M, Girma D, Fesseha H, Yirgalem M & Eshetu E (2021). Prevalence of gastrointestinal helminthiasis in horses and donkeys of Hawassa District, Southern Ethiopia. *Veterinary Medicine International,* **2021**(1): 6686688.

Mesfin M, Dawit G, Haben F, Metages Y & Eyo E (2021). Prevalence of gastrointestinal helminthiasis in Horse and Donkeys of Hawassa District, Southern Ethiopia. School of Veterinary Medicine, woloita sodo University. Pp 21-27.

Mezgebu T, Ketema T & Tamiru F (2013). Prevalence of gastrointestinal parasites of Horses and Donkeys in and around Gonmdar Town, Ethopia. *Journal of Veterinary Medicine,* **3**(6): 267-272.

Nwosu CO & Stephen M (2005). Parasites associated changes in parked cell volume of horses (*Equus caballus*) in the semi-arid zone, North-Eastern Nigeria. *Animal Resources International,* **2**(2): 329-331.

Ogbein KE, Dogo AG, Oshadu DO & Edeh ER (2022). Gastrointestinal parasites of horses and their socio-economic impact in Jos Plateau–Nigeria. *Applied Veterinary Research,* **1**(2): 2022010-2022010.

Ola-Fadunsin SD, Ganiyu IA, Hussain K & Rabiu M (2018). Occurrence of parasitic diseases of horses in Osun State, Nigeria: A retrospective evaluation. *Alexandria Journal of Veterinary Sciences,* **56**(1): 175-181.

Ramaswamy NS (1994). Draught Animals and welfare. *Ravue Scientifique et technique de I" office International des epizooties,* **13**(1): 195-216.

Regassa A & Yimer E (2013). Gastrointestinal parasites of equine in South Wollo Zone, North Eastern Ethiopia. *Global Veterinarian,* **11**(6): 824-83.

Saeed K, Qadir Z, Ashraf K & Ahmad N (2010). Role of intrinsic and extrinsic epidemiological factors on Strongylosis in horses. *The Journal of Animal and Plant Sciences,* **20**(4): 277-280.

Soulsby EJL (1982). Helminths, arthropods and protozoa of domesticated animals. Seventh Edition, Balliere Tindall, London. Pp 771.

Stoltenow CL & Purdy CH (2003). Internal parasites of horses.

Takele B & Nibret E (2013). Prevalence of gastrointestinal helminthes of donkeys and mules in and around Bahir Dar, Ethiopia. *Ethiopian Veterinary Journal,* **17**(1): 13-30.

Tola M, Tafess K & Tamiru F (2013). Prevalence of gastrointestinal parasites of horses and donkeys in and around Gondar town, Ethiopia. *Journal of Veterinary Medicine,* **3**(6): 267.

Thrusfield M (2005). The application of epidemiological techniques in sampling to resolve contemporary veterinary problems. *British Veterinary Journal*, **144**(5): 455-469.

Umar YA, Maikaje DB, Garba UM & Alhassan MAF (2013). Prevalence of gastro-intestinal parasites in horses used for Cadets' training in Nigeria. *Journal of Veterinary Advances,* **3**(2): 43-48.

Useh NM, Oladele SB, Ibrahim ND, Nok AJ & Esievo KA (2005). Prevalence of equine disease in the Northern guinea savannah of Zaria, Nigeria. *Journal of Equine Science,* doi.10.1294/jes.16.27.

Wannans HY, Dawood KA & Gassem GA (2012). Prevalence of gastro-intestinal parasites in horses and donkeys in Al Diwaniyah Governorate. *Al Qadisiya Journal of Veterinary Medicine Science,* **11**(1): 147-155.

Waziri M (2009). The Geography of Borno State: An Overview of Issues Concerning the

Geography of Borno State. Adamu Joji Publisher. Pp 6-12.

Yoseph S, Smith DG, Mengistu A, Teklu F, Fire T & Betere Y (2005) Seasonal Variation in the Parasite Burden and Body Condition of Worling Donkeys in east Shewa Region of Ethiopia. *Tropical Animal Health and Production,* **37**(1): 35-45.