

Epidemiological Study on Gastrointestinal Nematodes of Donkeys in Dhamar Governorate Yemen

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Abstract

Cross sectional study was carried out on donkeys in some districts of Dhamar governorate with objectives to identify and determine the prevalence of gastrointestinal nematodes of donkeys from December 2017 to May 2018. Fecal samples were collected randomly from 369 donkeys and examined with flotation, McMaster and Baerman fecal examination techniques. The results revealed that, the overall prevalence of gastrointestinal nematodes was 67.75.5%. Seven species of gastrointestinal nematodes were identified. The species identified in descending order of prevalence are: *Trichostrongylus axie* (35.50%); *Oxyuris equi* (34.42%); *Trichonema* or *Cyathostomins* (24.93), *Strongylus vulgaris* (21.14%), *Strongylus quinus* (15.99), *Strongylus edentatus* (7.046%) and *Parascaris equorum* (4.065%). Statistically, significant differences ($P=0.000$) among prevalence of species were observed. The higher prevalence rate recorded in young animals, month of April, male animal and Maghreb anss district was as 83.57%, 78.26%, 68.06% and 88.24% respectively. The age-wise and month variation showed association ($P=0.001$) with prevalence; while, no with sex and area factors. The higher mean of FEC was recorded in the month of April (1482.04); whereas the lower in the month of December (729.3). It is concluded that working donkeys in study area harbor variety species of gastrointestinal nematodes. Raising awareness regarding gastrointestinal parasites and improved management practices are recommended to control gastrointestinal nematodes of donkeys.

Keywords: Dhamar, Donkeys, Prevalence, Gastrointestinal nematodes, Yemen.

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INTRODUCTION

The domestic donkey belongs to the genus *Equus* and family *equidae*. It is believed that all the domestic donkeys in the world are descended from African wild ass [1, 2]. The equine population of the world is 98.3 million; out of them 40 million heads are donkeys. In the distribution pattern, 98% of all donkeys are found in developing countries [3, 4].

Despite the increase in mechanization throughout the world, donkeys are still well deserving of the name beasts of burden [4, 5]. Equines play an important role as working animals in many parts of the world [6, 7]. They are kept and often used for land tillage, cultivation, riding as well as for pack purpose [7, 8].

Parasitic helminthes are one of the most common factors that constrain the health and working performance of donkeys worldwide. Parasites cause various degrees of damage depending on the species and number present, nutritional and the immune status of equines [8, 9]. In donkeys, infection by internal

parasites are responsible for problems including poor body condition, reduced power output, diarrhea, colic, emaciation, impaired growth, poor reproductive performance, short lifespan and predisposition to other infectious diseases [9-12]. Studies have shown that gastrointestinal nematodes in working donkeys are highly prevalent [5, 9, 13-24] and they reported the prevalence ranging between 11.98% -100%.

Despite the great contributions made by donkeys in different country to the daily life and livelihoods of the people who solely or partly depend on them, they suffer the negative impact of feed shortage, poor health, low social status and poor management [5, 25]. In Yemen, donkeys are the most neglected animals; the attention given by society to them has been far below to what they deserve. To our knowledge no records available on gastrointestinal nematodes of donkeys in Dhamar, Yemen; therefore, the objectives of this study were to estimate the prevalence of gastrointestinal nematodes of donkeys and associated risk factors in Dhamar governorate.

MATERIALS AND METHODS

Study Area

This study was conducted from December, 2017 to May, 2018 in some districts of Dhamar governorate. Dhamar is far approximately 100 km south to Sana'a, the capital of Yemen. It is situated at 14.58°N latitude, 44.43°E longitude and at an altitude of 2425 meter above sea level. Based on metrological data of 2017, the annual precipitation is 40.5 mm most of which falls mainly in the period of April- September. The summer extends from April to September with mean temperature of 17.3°C. The monthly mean of relative humidity is 57.8 %.

Animals study and size of the sample

A total of 369 heads of different breeds and age of donkeys were selected randomly from various districts of Dhamar governorate. The donkeys were managed under the traditional husbandry system and kept mainly for traction power, packing, transport and cart pull. Sample size was determined by taking the expected prevalence of 40% from the previous research work on prevalence of gastrointestinal nematodes of donkeys and absolute precision of 5% with 95% confidence level using the formula given by Thrusfield [26]: $N = 1.96^2 \text{Pexp}(1-\text{Pexp})/d^2$

Where, Pexp = expected prevalence; d= absolute precision; n=sample size. Accordingly, a total of 364 donkeys were used in this study. Five samples were added to size of samples for obtaining better results.

Design and methodology of study

A cross sectional study was conducted from December 2017 to May 2018 on 369 randomly selected donkeys of both sex and different breed from various districts of Dhamar governorate. Bio-information such as sex, age and management system of the study animals were gathered from the owners. The ages of animals were determined using owners' information. Accordingly, animals were categorized as young (<2-4 years), adults (5-8 years) and old (9 years and above). A total of 369 faecal samples were collected directly from the rectum of each animal using disposable glove and put in air tight sample container. Each sample was labeled with code referring to the animal number, species, date, and place of collection and brought to

Central Veterinary Laboratory in Sana'a city and AlHikma laboratory in Dhamar city for coproscopy and coproculture examination. Samples were examined on the day of collection or stored in a refrigerator at 4°C for processing next day. The floatation technique was employed to concentrate parasite eggs in the faeces and examined microscopically for presence of parasites ova according to technique described by Georgi and Georgi [27] and Urquhart *et al.*, [28]. Culture and recovery the infective third stage larvae were carried out using a modified Baermann apparatus as described by Urquhart *et al.*, [28]. Identification and descriptions of L3 were done using the keys given by Urquhart *et al.*, [28]; Zajac and Conboy [29]. The faecal egg counts were performed using a modified McMaster technique according guidance given by Urquhart *et al.*, [28] and Zajac and Conboy [29].

Data Analysis

The collected raw data were organized and arranged using the Microsoft Excel spread sheet computer programme and analyzed using SPSS version 20 statistical software's. Chi-square tests was applied to test the statistical association exists among the risk factor such as age, sex month variation and area with the prevalence of the parasites. The overall prevalence was calculated by dividing the number of animals harboring a given parasite by the total number of animals examined. All results were considered statistically significant when the *P*-value <0.05.

RESULTS

The results of this study revealed that, out of 369 fecal samples examined, 250 (67.75%) samples were positive for one or more species of gastrointestinal nematodes as single or mixed infections (Table 1). Single and Mixed infections were detected in many samples, the prevalence rate for single and mixed infections was as 21.95% and 45.80 % respectively. Signification difference were observed (*p*=0.000) between the prevalence rates and pattern of infection. The parasites nematodes encountered in donkeys in the study period were *Trichostrongylus axie* (35.50%); *Oxyuris equi* (34.42%); *Trichonema* (24.93%), *Strongylus vulgaris* (21.14%), *Strongylus equinus* (15.99), *Strongylus edentatus* (7.046%) and *Parascaris equorum* (4.065%) as presented in Table 2. Significance differences were observed (*P*=0.000) among prevalence rates of different species identified in donkeys.

Table-1: Prevalence of gastrointestinal nematodes of donkeys in Dhamar governorate

Pattern of infection	no. of animals examined	No. of animals infected	Prevalence %	P value
Single infection	369	81	21.95	0.000
Mixed infection	369	169	45.80	
overall	369	250	67.75	

Table-2: Gastrointestinal nematode species of donkeys identified in donkeys at Dhamar governorate

Specie	No. of animals examined	no. of animals infected	Prevalence%	P value
<i>O. equi</i>	369	127	34.42	0.000
<i>T. axie</i>	369	131	35.50	
<i>P. equum</i>	369	15	4.065	
<i>S. vulgaris</i>	369	78	21.14	
<i>S. dentatus</i>	369	26	7.046	
<i>S. equinus</i>	369	59	15.99	
<i>Trichonema</i> (Cyathostomins)	369	92	24.93	

The effect of risk factors such as age, sex, season and area on distribution of gastrointestinal nematodes in donkeys was investigated and the results are presented in Table-3. The results revealed that, the higher prevalence rate was 83.57% in young animals group whereas; the lower rate (60.0%) in old animals group. Significant differences ($P=0.001$) were observed between prevalence and age factor. The higher prevalence rate was recorded in males (68.06%) compared to females (66.67). Significant differences ($P= 0.456$) were not observed between the prevalence

rate and sex factor of animals subjected to investigation. The higher prevalence of infection was recorded in month of April (78.26%) while the lower in December (55.56%). Significant differences ($P= 0.000$) were observed between the prevalence rate and month variation (season). The higher infection rate was recorded in Maghreb Anss area (88.24%); whereas the lower rate in Dhamar city area (50.00%). Significant differences ($P= 0.140$) were not observed between the prevalence rate and the study area factor.

Table-3: Risk factors influencing distribution of gastrointestinal nematodes in donkeys

Risk factor	No. of animals examined	No. of animals infected	Prevalence %	P value
Age	Young	149	83.57	0.001
	Adult	140	60.71	
	old	80	60.00	
Sex	Male	288	68.06	0.456
	Female	81	66.67	
Month	Dec	54	55.56	0.000
	Jan	65	61.54	
	Feb	65	72.31	
	Mar	69	63.77	
	Apr	69	78.26	
	May	47	74.47	
Area	Alhada	42	66.67	0.140
	Almanar	29	65.52	
	Anss	30	80.00	
	Dwran Anes	33	63.64	
	Dhamar city	30	50.00	
	Jabal Alsharq	27	55.56	
	Jahrnan	38	65.79	
	Maghreb anss	34	88.24	
	Myfa`at anss	27	66.67	
	Utoma	29	65.52	
	Wasab alali	25	76.00	
	Wasab Alsafil	25	68.00	

Prevalence rate was calculate from total number of samples examined for each variable

Table-4: Mean faecal egg counts (FECs) of donkeys during different month of study

Month	No. of samples examined	no. of samples infected	Mean
Dec	54	30	729.630
Jan	65	40	1003.07
Feb	65	47	1375.00
Mar	69	44	1082.06
Apr	69	54	1482.04
May	47	35	1444.80

In this study, the highest mean FEC of donkeys was recorded in the month of April

(1482.04); whereas, the lower in the month of December (729.63) as presented in Table-4.

DISCUSSION

The results of this study revealed that gastrointestinal nematodes infections are prevalent in donkeys in study area. These results are in agreement with the findings of other workers [21, 24, 30-40] who reported that helminthosis is one of the main problems in donkeys worldwide.

In this study, out of 369 animals examined, 250 (67.75 %) animals were infected with one or more species of gastrointestinal nematodes. These results are partially in agreement with previous prevalence rate (72.7%) reported by Tesfu *et al.*, [19] in Ethiopia and Seri *et al.*, [41] at Khartoum State, Sudan (70.1%). However, it is lower than prevalence rates reported by Mezgebu *et al.*, [8] in and around Gondar Town, Ethiopia; Ayele *et al.*, [11] in Dugda Bora, Ethiopia; Vercruysse *et al.*, [13] in Burkina Faso; Umur and Aici [15] in the Central Black Sea region, Turkey and Ibrahim *et al.*, [16] in Hawassa town, Ethiopia; Tsegaye and Chala [42] in Hawamya, Ethiopia; who reported prevalence rate as 92.71%, 100%, 100%, 96.60% and 93.75% respectively, and it is higher than prevalence rate reported by Kheir and Kheir [43] at Nyala town, Sudan and Habtamu *et al.*, [44] in Ethiopia who reported the prevalence rate as 56.2% and 60.6% respectively. The similarities and differences observed in the prevalence rates of this study and findings of above workers may be due to the different geographical locations of the study areas, climate and variation in the methods of sample collection and management system being employed by the donkeys' owners.

In current study mixed infections were detected in majority of faecal samples examined, these results are in accordance of findings of previous work conducted in different geographical regions of world [20-23, 31-34, 38, 39, 45, 46]. The prevalence rate of mixed infection recorded in donkeys was 45.85% which is lower than the finding of Tolossa and Ashenafi [46] in equines of Arsi-Bale highlands of Oromiya Region and Uslu and Guclu [47] in Turkey, who reported the prevalence rate as 83.2% and 59.1%, respectively. The higher prevalence rate of mixed infection recorded in this study may be due to the contamination of pasture with variety species of gastrointestinal nematodes and lacking the appropriate hygienic conditions for grazing of donkeys.

In the present study, seven species of gastrointestinal nematodes infecting donkeys and belonging to five genera of nematodes were identified. *Trichostrongylus axei* was the most prevalent species of gastrointestinal nematodes encountered in donkeys during the study period with prevalence rate of 35.50%; whereas, *Parascaris equorum* was found in low percentage (4.1%). These results are lower than findings of Takele and Nibret [3] and Abebew *et al.*,

[48], who reported the prevalence rate as 42.45% and 13.68% for *T. axei* and *P. equorum* respectively. The higher prevalence rate recorded by above worker could be attributed to nutritional status of the animal in the respective study area which can influence the level of immunity of animals. The predominant of *T. axei* in donkeys in study area compared to other species may be related to biology and epidemiology of this species.

The risk factors influencing distribution of gastrointestinal nematodes in donkeys were also investigated. The host's age was found important factor influencing the distribution of gastrointestinal nematodes in donkeys. The higher prevalence rate was recorded in animal group of 1-4 years old (young animal); whereas, the lower rate in age group of 8 and above years (old animals). These results are in line with previous studies [9, 12]. The reason for higher prevalence rate in young animals could be attributed to immunological factors.

The month wise prevalence results revealed that, the highest infection rate was recorded in the month of April; whereas, the lower rate in the month of December. Significant differences were observed between prevalence rate of the infection and month variation (season) factor. The higher prevalence rate gastrointestinal helminthes in April, could be attributed to environmental conditions which may be were conducive for survival and development of eggs and larvae in study area.

The result of this study also showed that there was no statistically significant difference in the prevalence of gastrointestinal helminthes in relation to sex and the infection rate was slightly higher in males compared to females. These results are in accordance with finding of Mezgebu *et al.*, [8] who studied the prevalence of gastrointestinal parasites of horses and Donkeys in and around Gondar Town, Ethiopia and in contrast with findings of Takele and Nibret [3] and Ayele *et al.*, [11] in Ethiopia. The higher prevalence recorded in males may be due to that, females are given more care attention compared to males especially during the pregnancy period.

Considering the area results, the highest prevalence rate of gastrointestinal helminthes was recorded in Maghreb Anss; whereas the lower rate in Dhamar city area. Significant differences were not observed between prevalence rate and area factor. This might be attributed with similarity of the agro-ecological climate of districts of Dhamar governorate. The reason behind high prevalence rate of infection in Maghreb Anss may be due to poor management and inadequate veterinary services provided to donkeys compared to other areas studied.

Faecal egg counts (FECs) are used as indicator factors for estimating the infection level among

animals. In this study, the highest FECs (1482.04) were recorded in month of April and the lower in the month of December (729.63). These results are consistent with previous work of Seri *et al.*, [41] in Sudan, who recorded higher mean value of FECs (1198) in hot season; while, lower mean value (888.6) in winter season. The differences in FECs among different months of year study; this may be due to grazing habit of animal, higher workload, lacking deworming of the donkeys and ecological factors.

CONCLUSIONS

It could be concluded from this study, the results of the current study indicated that helminthiasis is prevalent in the surveyed area and donkeys harbor variety species of gastrointestinal nematodes which represent an important health problem for donkeys. It is highly recommended that proper screening and monitoring of the donkeys should be carried out regularly; deworming programmes with efficacious anthelmintics should be carried out regularly to prevent environmental contamination with helminth parasites. Further researches on the importance and epidemiology of gastrointestinal nematodes of donkey in study area are recommended.

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Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Saul, C., Siefert, L., & Opuda-Asibo, J. (1997). Disease and health problems of donkeys: a case study from eastern Uganda. In *international Animal Traction Network for Eastern and Southern Africa (ATNESA) workshop held* (pp. 5-9).
2. Fielding, D., & Krauser, P. (1998). Donkeys: Tropical Agriculture. Surrvey Macmil. CTA., 2: 86-87.
3. 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.
4. Getahun, T. K., & Kassa, T. Z. (2017). Prevalence and species of major gastrointestinal parasites of donkeys in Tenta Woreda, Amhara Regional State, Ethiopia. *Journal of Veterinary Medicine and Animal Health*, 9(2), 23-31.
5. Enigidaw, S., Assefa, A., Mekonnen, N., & Belete, S. (2015). Prevalence of gastro intestinal nematode parasitic infections of horses and donkeys in and around Kombolcha town. *American-Eurasian J. Scientific Res*, 10(4), 228-234.
6. Belay, M. (2005). Preliminary studies on helminthiosis of equines in South and North Wollo zones. *Journal Ethiopia Veterinary Association*, 9: 25-37.
7. Tsega, A. M., Worku, Y., Tesfaye, T., & Nazir, S. (2016). Prevalence of Wound and Associated Risk Factors of Donkeys in Merawi District, North-Western Ethiopia. *Journal of Animal Research*, 6(5), 765-771.
8. Mezgebu, T., Tafess, K., & Tamiru, F. (2013). Prevalence of gastrointestinal parasites of horses and donkeys in and around Gondar Town, Ethiopia. *open Journal of veterinary Medicine*, 3(6), 267-272.
9. Fikru, R., Reta, D., Teshale, S., & Bizunesh, M. (2005). Prevalence of equine gastrointestinal parasites in western highlands of Oromia. *Bulletin of animal health and production in Africa*, 53(3), 161-166.
10. Yoseph, S., Smith, D. G., Mengistu, A., Teklu, F., Firew, T., & Betere, Y. (2005). Seasonal variation in the parasite burden and body condition of working donkeys in East Shewa and West Shewa regions of Ethiopia. *Tropical Animal Health and Production*, 37(1), 35-45.
11. Ayele, G., Feseha, G., Bojia, E., & Joe, A. (2006). Prevalence of gastro-intestinal parasites of donkeys in Dugda Bora District, Ethiopia. *Livestock research for rural development*, 18(10), 14-21.
12. Naramo, M., Terefe, Y., Kemal, J., Merga, T., Haile, G., & Dhaba, M. (2016). Gastrointestinal nematodes of donkeys in and around Alage, South Western Ethiopia. *Ethiopian Veterinary Journal*, 20(2), 87-97.
13. Vercruysse, J., Harris, E. A., Kaboret, Y. Y., Pangu, L. J., & Gibson, D. I. (1986). Gastro-intestinal helminths of donkeys in Burkina Faso. *Zeitschrift für Parasitenkunde*, 72(6), 821-825.
14. Adam, A. A., Suliman, S. E., & Seri, H. I. (2013). The prevalence and intensity of gastrointestinal helminths in equine in North Darfur, Sudan. *Journal of Science and Technology*, 14, 102-107.
15. Umur, Ş., & Acici, M. (2009). A survey on helminth infections of equines in the Central Black Sea region, Turkey. *Turkish Journal of Veterinary and Animal Sciences*, 33(5), 373-378.
16. Ibrahim, N., Berhanu, T., Deressa, B., & Tolosa, T. (2011). Survey of prevalence of helminth parasites of donkeys in and around Hawassa town, Southern Ethiopia. *Glob Vet*, 6(3), 223-227.
17. Wannas, H. Y., Dawood, K. A., & Gassem, G. A. (2012). Prevalence of gastro-intestinal parasites in horses and donkeys in al diwaniyah governorate. *AL-Qadisiyah Journal of Veterinary Medicine Sciences*, 11(1), 148-155.

18. Bogale, B., Sisay, Z., & Chanie, M. (2012). Strongyle nematode infections of donkeys and mules in and around Bahirdar, Northwest Ethiopia. *Global veterinaria*, 9(4), 497-501.
19. Tesfu, N., Asrade, B., Abebe, R., & Kasaye, S. (2014). Prevalence and risk factors of gastrointestinal nematode parasites of horse and donkeys in hawassa town, ethiopia. *Journal of Veterinary Science & Technology*, 5(5), 2157-7579.
20. Sheferaw, D., & Alemu, M. (2015). Epidemiological study of gastrointestinal helminths of equines in Damot-Gale district, Wolaita zone, Ethiopia. *Journal of Parasitic Diseases*, 39(2), 315-320.
21. Wilson, R. T. (2007). Specific welfare problems associated with working horses. In *The welfare of horses* (pp. 203-218). Springer, Dordrecht.
22. Wubishet, Z., & Yacob, H. (2017). Cross Sectional Survey on Equine Gastro Intestinal Stroglylosis and Fasciolosis in Goba District of Bale Zone, Oromia Regional State, Ethiopia. *Animal and Veterinary Sciences*, 5(5), 84-88.
23. Abdulahi, M., Kefyalew, H., & Muktar, Y. (2017). Major Gastrointestinal Parasites of Donkey in and Around Jigjiga, Somali Region, Ethiopia. *Advances in Biological Research*, 11(3), 144-149.
24. Attia, M. M., Khalifa, M. M., & Atwa, M. T. (2018). The prevalence and intensity of external and internal parasites in working donkeys (*Equus asinus*) in Egypt. *Veterinary world*, 11(9), 1298-1306.
25. Guyo, S., Legesse, S., & Tonamo, A. (2015). A review on welfare and management practices of working equines. *Glob J Anim Sci Liverst Prod Anim Breed*, 3, 203-309.
26. Thrusfield, M. (2007). *Veterinary Epidmiology*. 3rd Ed. Blackwell Science Ltd Oxford, UK. PP.233-261.
27. Georgi, J. R., & Georgi, M. E. (1990). *Parasitology for Veterinarians*. 5th edn, W.B. Saunders Company, London. 140-381.
28. Urquhart, G. M., Armour, J., Dunnican, J. L., & Jennings, F. W. (1996). *Veterinary Parasitology*, 2nd, Blackwell, U. K.
29. Zajac, A. M., & Conboy G. (2006). *Veterinary Clinical Parasitology*. 7th ed. Blackwell Publishing Company, 3-14.
30. Shrikhande, G., Rewatkar, S., Deshmukh, S., Maske, D., & Raghorte, Y. (2009). The Incidence of Helminthes parasites in Donkeys. *Veterinary World*, 2(6): 224.
31. Hosseini, S. H., Meshgi, B., Eslami, A., Bokai, S., Sobhani, M., & Ebrahimi Samani, R. (2009). Prevalence and biodiversity of helminth parasites in donkeys in Iran *Equus asinus*. *Int. J. Vet. Res*, 3(2), 95-99.
32. Postoli, R., Robaj, A., Ceroni, V., Zalla, P., Andoni, E., & Çausi, A. (2010). Epidemiological study on the prevalence of endoparasites of Equines in Albania. *Veterinaria*, 59(1-4), 37-45.
33. Muhammad, W., Khan, M. S., Durrani, A. Z., Khan, M. A., Muhammad, A., Khan, S. A., & dos Santos, F. C. (2014). Prevalence of gastrointestinal parasites, chemotherapy and haematology of strongylosis in donkeys of district Lahore, Pakistan. *International Journal of Current Microbiology and Applied Sciences*, 3(7), 198-207.
34. Berhanu, T., Ibrahim, N., Deressa, B., & Tolosa, T. (2014). Prevalence of Helminth Parasites of Horses in and Around Hawassa Town, Southern Ethiopia. *Acta Parasitological Globalis*, 5, 7-11.
35. Sathiyamoorthy, A., Vivek, S., Selvaraju, G., & Palanivel, K. M. (2016). Study of Endoparasitic Infection in Donkeys in India. Tamil Nadu Veterinary and Animal Sciences University. *International Journal of Science, Environment and Technology*, 5(6): 4545-4549.
36. Mangassa, B., & Mhatebu, W. T. (2016). Prevalence of Strongyle Infection and Associated Risk Factors in Horses and Donkeys In and Around Batu Town, Eastshoa, Oromia Regional State, Ethiopia. *Advances in Life Science and Technology*, 47: 40-45.
37. Mohammed Jajere, S., Rabana Lawal, J., Mohammed Bello, A., Wakil, Y., Aliyu Turaki, U., & Waziri, I. (2016). Risk Factors Associated with the Occurrence of Gastrointestinal Helminths among Indigenous Donkeys (*Equus asinus*) in Northeastern Nigeria. *Scientifica*, 2016.
38. Ismail, A. A., Ahmed, N. K., Bashar, A. E., Seri, H. I., Tigani-Asil, E., & Abakar, A. D. (2016). A survey of seasonal gastrointestinal parasitic infections in donkeys from a semiarid sub-Saharan region, Sudan. *Journal of pathogens*, 2016.
39. Gebreyohans, A., Abrehale, A., & Kebede, E. (2017). Prevalence of Gastrointestinal Helminthes of Donkey in And around Mekelle DVM Research article. *National Science*, 15(1):42-57.
40. Tedla, M., & Abichu, B. (2018). Cross-sectional study on gastro-intestinal parasites of equids in South-western Ethiopia. *Parasite epidemiology and control*, 3(4), e00076.
41. Seri, H. I., Hassan, T., Salih, M. M., & Abakar, A. D. (2004). A survey of gastrointestinal nematodes of donkeys (*Equus asinus*) in Khartoum State, Sudan. *Journal of Animal and Veterinary Advances*. 3:736-739.
42. Tsegaye, B., & Chala, A. (2015). Prevalence of endoparasitic helminths of donkeys in and around Haramaya district, Eastern Ethiopia. *Journal of Veterinary Medicine and Animal Health*, 7(6), 221-224.
43. Kheir, S. M., & Kheir, H. S. M. (1981). Gastrointestinal nematodes of equines in the Southern Darfur State of the Sudan. *The Sudan Journal of Veterinary Science and Animal Husbandry*, 3, 53-57.

44. Habtamu, A., Gizaw T. T., Minalu, B. A., & Tefera, Y. (2017). Cross-sectional study on the prevalence of equine Strongyle infection Inmecha Woreda, Ethiopia. *International Journal Advanced Research Biological Science*, 4(8): 68-77.
45. Pandey, V. S., Ouhelli, H., & Verhulst, A. (1992). Epidemiological observations on stomach worms of donkeys in Morocco. *Veterinary research communications*, 16(4), 273-279.
46. Tolossa, Y. H., & Ashenafi, H. (2013). Epidemiological study on Gastrointestinal Helminths of horses in Arsi-Bale highlands of Oromiya Region, Ethiopia. *Ethiopian Veterinary Journal*, 17(2), 51-62.
47. Uslu, U. Ğ. U. R., & Guclu, F. (2007). Prevalence of endoparasites in horses and donkeys in Turkey. *Bulletin-Veterinary Institute in Pulawy*, 51(2), 237-240.
48. Abebew, D., Endebu, B., & Gizachew, A. (2011). Status of parasitism in donkeys of project and control areas in central region of Ethiopia: a comparative study. *Ethiopian Veterinary Journal*, 15(2), 45-55.