Research Article

Endoparasitic Infections and the Associated Risk Factors in Trade Donkeys (*Equus Asinus*) in Ganawuri District Market, Riyom Local Government Area, Plateau State, North Central Nigeria

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Abstract | A cross-sectional study design was carried out between November 2017 and May 2018 to determine the prevalence and risk factors for endoparasitic infections in donkeys at Ganawuri district market, Plateau State, North Central Nigeria. Fecal and blood samples were collected from 300 donkeys and analyzed using a standard laboratory procedure. Coprological examination conducted using flotation and sedimentation techniques showed that 276 (92.0%) were positive for gastrointestinal nematodes. A greater proportion (70.7%) of the nematodes were Strongyles followed by mixed infection of Strongyles and Parasacaris equorum (15.2%) and Strongyloides westeri (14 1%). Chi-square test and odds ratio were used to analyzed data obtained. The prevalence of the gastrointestinal nematodes was not found to be associated with factors such as sex, age and location with p= values of 0.57, 0.20 and 0.50 respectively. The prevalence ranges between 22.2% and 48.9% across the types of management practice with those managed extensively having the highest (p=0.001). Gastrointestinal nematodes infection was significantly associated with the body condition of the donkeys with the highest prevalence in those with poor body condition (p=0.03). Of the blood samples collected, 108 (36.0%) were positive for hemoparasites. The hemoparasites identified were Trypanosoma congolense, Trypanosoma vivax, Babesia cabali and Babesia equi. Greater proportions (50.0%) of the hemoparasites were Babesia spp. followed by Trypanosoma spp. (36.1%) and mixed infection of Trypanosoma spp. and Babesia spp (13.9%). The prevalence rate of hemoparasitic infections in donkeys was significantly associated with the sex, age, body conditions, and management systems. The prevalence ranges between 25.9% and 47.4% across body conditions (p=0.001; OR=23.1) and was higher (52.6%) in males than in females (25.8%) (p=0.006; OR=7.303). The prevalence rate based on the source of origin of the donkeys did not show any significant difference but was higher in those from Yobe state (p=0.06). Lower range (21%-29%) of packed cell volume was found in donkeys positive for haemoparasites with a mean value of 25.56± 2.63 than in those that were negative (38.44±5.80) (p<0.001). Donkeys brought to Ganawuri district market have high parasite burden with attendant effect on their body condition. Improved management system and routine strategic control measures such as screening and treatment of infected animals are therefore recommended.

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Introduction

Parasites have great potentials for reducing the efficiency and production success as they compete with the host for nutrient utilization. Endoparasites are usually protozoa and helminthes that live inside the body of their host and poses a serious threat to their health (Ademola et al., 2004). Donkeys (*Equus asinus*) are among the early members of the horse family-Equidae that lived in close association with man and have been a working animal for thousands of years (Saul et al., 1997). At present, report has shown that about 44million donkeys are distributed throughout the world (Starkey et al., 2004). The animal plays an important role in the transportation of people and goods in arid and semi-arid areas despite advancement in technology throughout the world (Pearson et al., 1999). In Africa, the population of donkeys has been estimated to be about 13 million. Nigeria an example of one of the semi-arid areas alone has an estimated population of 7 million donkeys with the majority owned by small-holder and low-income farmers who do have little or no access to veterinary care (Kyewalabye et al., 1988; Starkey et al., 2000).

In addition to being kept as working animals, the meat of donkeys is considered as a traditional delicacy in some parts of Nigeria and is seen to be of very high nutritional value due to its high levels of unsaturated fatty acids (Polidori et al., 2009). Many diseases, however, affect donkeys and reduce their viability, lower their ability to work and their carcass (meat) quality through the reduction in body weight or failure to gain weight or even increase the mortality in acute cases (Khalifa et al., 1988; Mezgebu et al., 2013).

A majority of farmers who keep donkey do practice an extensive management system. This practice exposes donkeys to many infectious disease agents which could be parasitic, bacterial, fungal, and or viral (Ibrahim et al., 2011). According to Getachew et al. (2010), the commonly reported parasitic diseases that usually lead to the death of donkeys are haemoparasite such as babesiosis, trypanosomiasis and gastrointestinal helminthosis. The economic losses caused by trypanosomiasis are due to a loss in productivity, cost of treatment and the dead of the animal. These losses along with the control measures caused by trypanosmiasis alone have been estimated to be over 4.2million USD annually. Donkeys are a host to a variety of gastrointestinal tract parasite of the family strongylidae, commonly called strongyle nematodes (Ayana et al., 2012). The most common gastrointestinal parasites of donkeys include large and small *Strongyles*, *Ascaris*, *Oxyuris equi*, *Gasterophilus*, lungworms, fluke and tapeworms and are commonly encountered in the most veterinary parasitological examination (Atawalna et al., 2015). Some of the gastrointestinal tract parasites especially strongyles, are active bloodsuckers, the commonly encountered manifestation is anemia, weakness, emaciation and sometimes colic and diarrhea (Burden et al., 2010). These parasites usually deprive their host of sufficient nutrients resulting in retarded growth, impaired productivity, discomfort, pains and sometimes death (Mezgebu et al., 2013). The various degree of damage depends on factors such as the species affected, nutritional and immune status of the animals (Mezgebu et al., 2013).

The free grazing of donkeys exposes them directly to infective stages of parasites, or indirectly to disease-transmitting agents such as ticks, and flies. These to a great extent affect the productivity and performance of the animal. According to Zerihun et al. (2011), parasitic helminthes are one of the factors that affect the health and performance of donkeys worldwide. Most importantly, the lack of adequate attention given to the health of donkeys and in some cases, the highly under reporting of the disease condition has resulted in the decline of their general wellbeing (Taylor et al., 2007; Sugun et al., 2015; Ismail et al., 2016). This study was therefore undertaken to assess the health status and risk factors visa-vis parasitic infections in trade donkeys at Ganawuri district, Riyom Local Government Area, Plateau State.

Materials and Methods

Study area

The study was conducted in Ganawuri district, Riyom Local Government Area Plateau State, Nigeria (Figure 1). Its headquarters is in the town of Riyom to the north of the Area at 9°3800′N, 8°4600′E. It has an area of 807km^2 and a population of 131,557 at the 2006 census, which is predominantly Berom. The Local Government Area has boundaries with Kaduna and Nasarawa state. Between 20 and 30 donkeys from mostly North-eastern part of Nigeria are presented to Ganawuri market for slaughter.

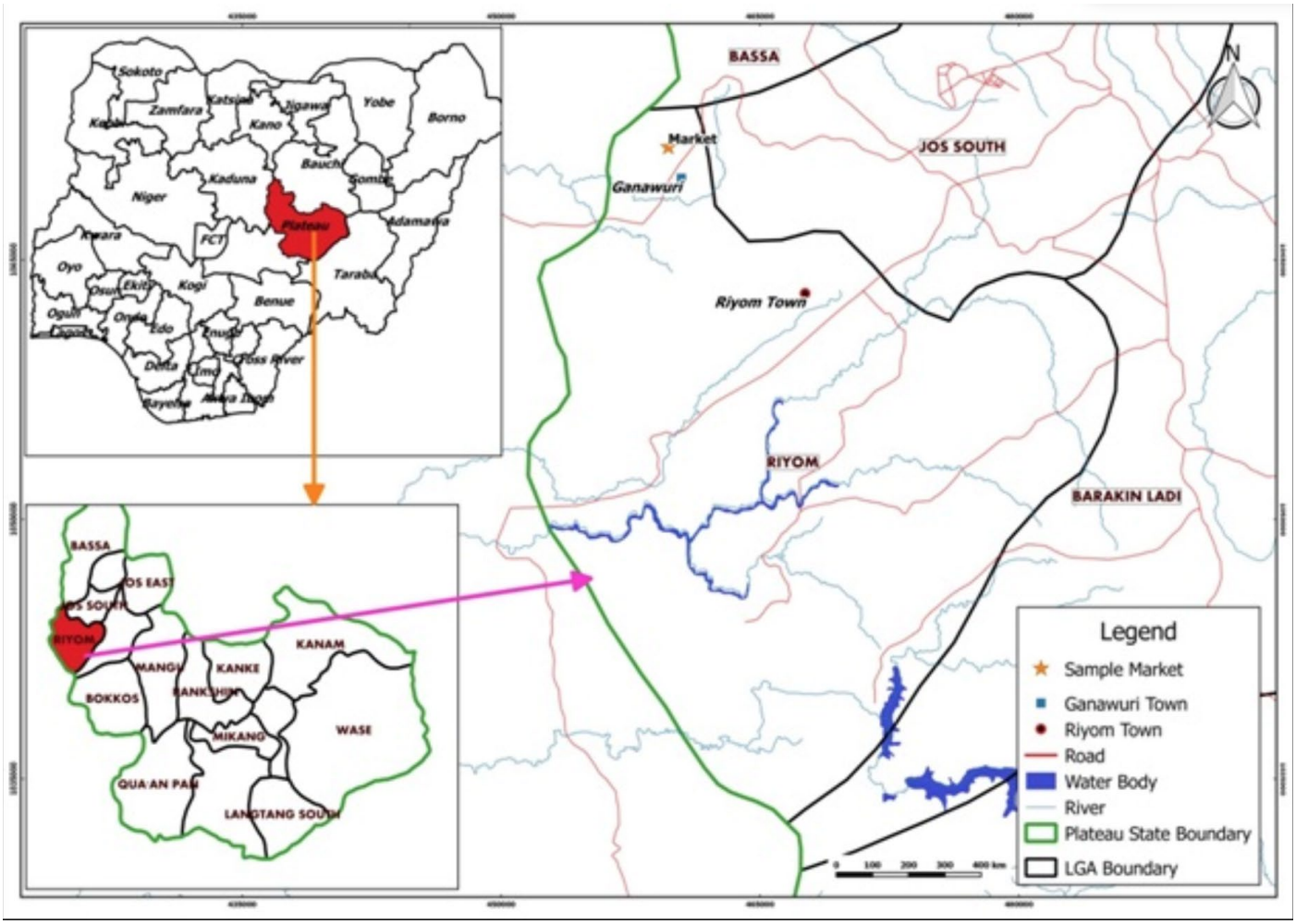

Figure 1: *Map of Nigeria showing the study area*

Study design and study population

A market-based cross-sectional study design was carried out. A total of 300 donkeys were selected using systematic random sampling technique. Approximately 30-35 donkeys are presented at each market day. Donkeys brought to the market for slaughter were first tied to a stake. Each donkey in each market day was assigned a number and one out of every three donkeys was included in the study and for sample collections. Approximately 10-12 samples were collected per visit. Information on age, sex, management system, source of the animal and body condition was recorded. Sample collection was between the months of November 2017 and May 2018.

Ethical consideration

This study was approved by the Animal Health Department, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom, project committee before sample collection.

Blood sample collection and handling

Approximately, 5 ml of blood was collected from each donkey from the jugular vein before or at slaughter and poured into Ethylenediaminetetraacetic acid EDTA bottle to prevent coagulation. The tube was gently rotated to ensure proper mixing of the blood with the anticoagulant without damaging the integrity of the cells. Samples were labeled and transported on ice within 1 h to the Department of Animal Health Parasitology Laboratory, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom for immediate processing.

Fecal sample collection

The fecal samples were collected directly from the rectum of the donkeys using gloved fingers. Each sample was labeled and also transported to the Department of Animal Health Parasitology Laboratory, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom on ice for immediate processing and examination.

Laboratory procedure

Detection of hemoparasites: Identification of blood parasites and determination of packed cell volume (PCV) were done using thin and thick blood smear, and hematocrit centrifuge as described by Woo, (1969), Murray et al. (1983) and Urquhart et al. (2003). Examination of blood was done by the dark ground buffy coat and of smear after Giemsa staining using a light microscope under oil immersion (×100). The *Trypanosoma* and *Babesia* species were classified based on the morphology as described by Uilenberg (1998) and Soulsby (1982) respectively.

Faecal sample analysis: Floatation and sedimentation techniques were carried out as described by Urquhart et al. (2003) and Soulsby (1982). At the end of 10-15 min, the various slides were observed under the microscope using a magnification of ×10 and ×40 objective lenses.

Data analysis: Data obtained were analyzed using a Statistical Package for Social Sciences version 23. For categorical data, the chi-square test was used to determine the association between the presence of endo-parasites and factors such as age, sex, management systems, location and body condition of donkeys at slaughter in Ganawuri district. Student *t*-test was used to determine the statistically significant difference in mean values of pack cell volume in hemoparasite infected and non-infected donkeys. The *p*-values less than 0.05 were considered statistically significant. The result was summarized in tables and figures.

Results and Discussion

This study was carried out to determine the prevalence of endoparasites in donkeys at Ganawuri market, Plateau State. Greater proportions of the donkeys sampled were from the North-eastern part of the country (Figure 1). Based on coprological examination conducted using flotation and sedimentation technique, 276 were positive for gastrointestinal nematodes giving a prevalence of 92.0% (Table1). The result showed that greater proportions of the gastrointestinal nematodes identified were *Strongyles* (70.7%) (Figure 2).

The result showed that there was no statistically significant difference in the prevalence of gastrointestinal nematodes based on sex, age and location (p= 0.57; 0.20; 0.50). (Table 2). The study showed that there was a statistically significant difference in the prevalence based on body condition (p=0.03) and the type of management system. The prevalence was higher (48.9%) in those managed extensively (Table 2).

Table 1: *Prevalence of endoparasitic infection in trade donkeys at Ganawuri district market, Riyom Local Government, Plateau State.*

Variable	No. examined	No. positive	% prevalence
Gastrointestinal nematodes (fecal)	300	276	92.0
Haemoparasite (blood)	300	108	36.0

Table 2: *Prevalence and risk factors for gastrointestinal nematodes in trade donkeys at Ganawuri district market, Riyom Local Government, Plateau State.*

Variables	No. examined	No. positive	% prevalence	p value
Sex				
Male	114	105	92.1	0.57
Female	186	171	91.9	
Age				
7-9	120	108	90.0	0.20
10-12	180	168	93.3	
Body condition				
Good	81	69	85.2	0.03
Moderate	105	99	94.3	
Poor	114	108	94.7	
Management				
Extensive	131	128	97.7	
Semi-extensive	105	95	90.5	0.001
Intensive	64	53	82.8	

One hundred and eight of the 300 blood samples collected from the donkeys at Ganawuri market were positive for hemoparasites giving an overall prevalence of 36.0% (Table 1). The hemoparasites identified were *T. congolense, T. vivax, B. cabali and B. equi*. The proportion of the hemoparasites was; *Babesia* (50.0%), *Trypanosoma spp.* (36.1%) and mixed infection (*Trypanosoma* and *Babesia*) (13.9%) (Figure 3). There was a statistically significant difference in prevalence of haemoparasites in donkeys based on sex, (p=0.006; OR=7.303), body condition (p=0.001; OR=23.1), age (p=0.008) and management system (p=0.041) (Table 3). The prevalence was higher (41.72)

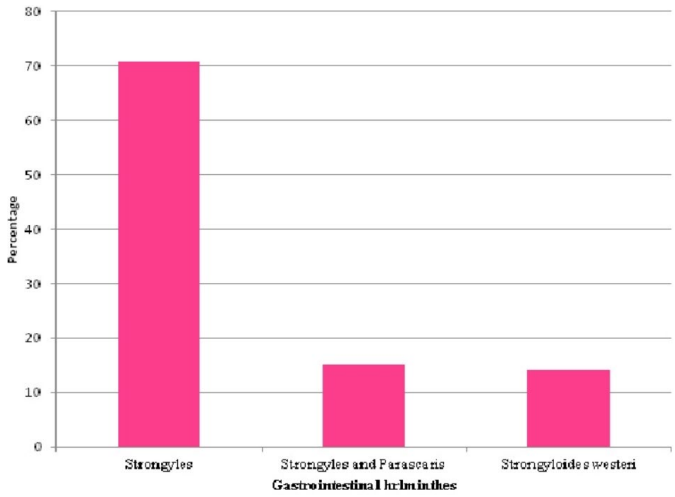

Figure 2: *The distribution of gastrointestinal nematodes in trade donkeys at Ganawuri district market, Riyom Local Government, Plateau State, Nigeria*

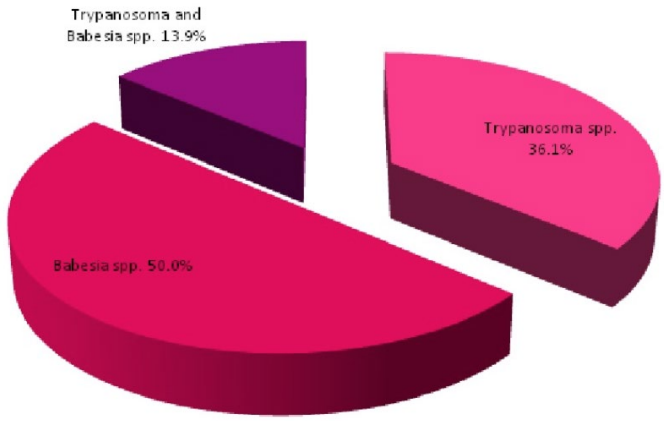

Figure 3: *The distribution of haemoparaistes of trade donkeys at Ganawuri district market, Riyom Local Government Area, Plateau State Nigeria*

in age 10-12 yr, than in 7-9 yr (27.5) (Table 3). Prevalence based on source did not show any statistically significant difference (p=0.06). Lower range (21%-29%) of packed cell volume was found in donkeys positive for hemoparasites with a mean value of 25.56± 2.63 than in those that were negative (38.44±5.80) (p<0.001).

Ganawuri district market, Riyom Local Government Area, Plateau State, North Central Nigeria always has an influx of donkeys from mostly the North-eastern and western part of the country for sale and or slaughter. Prevalence and risk factors for endoparasites infection in these animals from November 2017 to May 2018 were examined. The prevalence of gastrointestinal nematodes in donkeys in this study was found to be 92.0%. Comparatively, lower prevalence was reported by some authors in Ethiopia and South Sudan (Sawsan et al., 2008; Regassa and Yimer, 2013; Tesfu et al., 2014; Enigidaw et al., 2015). Studies conducted in some parts of Ethiopia however reported a high prevalence of gastrointestinal nematodes similar to that in this study (Yoseph et al., 2001; Ayele et al., 2006; Ibrahim et al., 2011; Mezgebu et al., 2013; Tsegaye and Chala, 2015). In the North eastern part of Nigeria, Jajere et al. (2016) reported a prevalence of 98.3%. Factors such as climatic conditions, management system and access to veterinary care have been shown to influence the distribution of gastrointestinal helminthes. The relative difference or similarity in the prevalence of gastrointestinal nematodes in donkeys observed in the different studies could be due to differences or similarities in climatic conditions, management system and access to veterinary care. Variation in the sample size and sampling time and or season may also explain the reason for the differences observed. Greater proportions of the donkeys screened in this study were sourced from the North-eastern region of Nigeria. This could explain the reason for the similarity in the high prevalence reported by Jajere et al., 2016.

Table 3: *Prevalence and risk factors for haemoparasites in trade donkeys at Ganawuri district market, Riyom Local Government, Plateau State.*

Variable	No. examined	No. positive	% prevalence	p-value	Odds ratio
Sex					
Male	114	60	52.6	0.006	7.303
Female	186	48	25.8		
Age					
7-9	120	33	27.5	0.008	2.13
10-12	180	75	41.7		
Body condition					
Good	81	21	25.9		
Moderate	105	33	31.4	0.001	23.1
Poor	114	54	47.4		
Management					
Extensive	141	58	41.1		
Semi-extensive	105	38	36.2	0.041	0.21
Intensive	54	12	22.2		

Strongyle species accounted for greater percentage of the nematodes identified in this study. Two studies by Enigidaw et al. (2015) and Jajere et al. (2016) also reported a high occurrence rate of *Strongyle* than other gastrointestinal tract nematodes. *Strongyles* have been reported to require a longer period to complete their

life cycle and the worm population and burden are not influenced by different anthelmintic pressures. This may explain the reason for the high occurrence of *Strongyles* than other gastrointestinal tract nematodes.

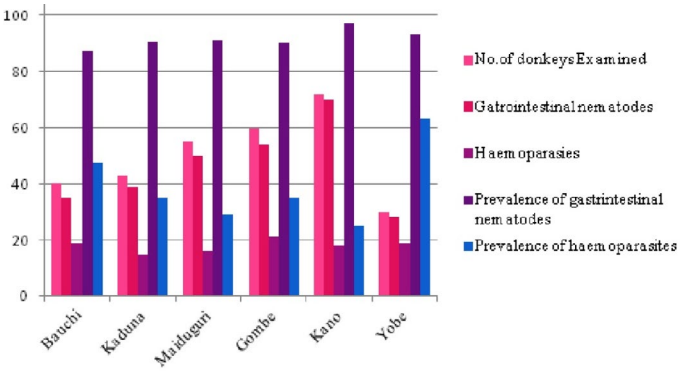

Figure 4: *Prevalence of endoparasitic infection based on the sources of trade donkeys in Ganawuri district market, Plateau State, North central Nigeria*

Single infection with *P. equorum* was not found in this study. Yoseph et al. (2001) and Fikru et al. (2005) have reported a prevalence of *Parascaris* eggs in donkeys to be 15.7% and 17.3% respectively. Though mixed infection, this study has also revealed a prevalence of 14.0%. Gizachew et al. (2010) reported a prevalence of 33.0% of mixed infection of *Parascaris* and *Strongyles* in donkeys.

Table 4: *Mean Packed Cell Volumes of infected and non-infected trade donkeys with haemoparasites in Ganawuri district market, Riyom Local Government, Plateau State Nigeria.*

Parameters	Mean ± SD	Range	p value
Positive	25.56± 2.63	21-29	<0.001
Negative	38.44±5.80	30-50	

Factors such as sex, age and location were not significantly associated with gastrointestinal nematodes infections in donkeys in the study area. Previous studies have also shown that age and sex were not significant factors in the prevalence of gastrointestinal helminthes in donkeys (Tolossa and Ashenafi, 2013; Mezgebu et al., 2013; Jajere et al., 2016). This shows that the prevalence of gastrointestinal nematodes is not sex dependent particularly since both sexes have equal chances of being exposed to the parasitic stages of the nematodes. However, some studies have revealed significant association between gastrointestinal helmiths in donkeys and sex and age (Worku and Afera, 2012; Tesfu et al., 2014; Enigidaw et al., 2015). Most of the donkeys sampled were adults. Increase in age usually increases exposure of animals to parasitic infection in the environment. Since all of the donkeys are adult, it did not show any difference in the prevalence between the ages. Donkeys from the Northeastern part of the country accounted for the majority of animals screened in this study. Similarity in the agroclimatic conditions in this region and within the states could be the reason for the lack of variation based on location. The management system practiced by farmers has been reported to be a risk factor for gastrointestinal helminthes infection in donkeys in a study conducted in North eastern Nigeria (Jajere et al., 2016). The type of management system of the donkeys in this study was also found to be a risk factor for the gastrointestinal tract nematode infection in this study. Those managed extensively had a higher prevalence than those intensively managed. This could be due to the fact that animals that are allowed to graze freely are more likely to pick up infective stage of these gastrointestinal tract nematodes and so the high prevalence.

The overall prevalence of hemoparasites in donkeys in this study was comparably similar with the finding of Pam et al. (2013) who reported a prevalence of 36.1% in horses in Jos South Local Government Area, Plateau State, Nigeria. The occurrence of *Babesia* species was higher in this study followed by *Trypanosoma* species. Although Pam et al. (2013) did not identify *Trypanosoma* species in horses; their study reported a high occurrence of *Babesia* species. Studies in Central Ethiopia reported a low prevalence of *Babesia* in donkeys (Mekibib et al., 2009; Tefera et al., 2011). In a related study in some regions of Gambia, and Northwest Ethiopia, lower prevalence of trypanosomes was reported (Faye et al., 2001; Bedada and Dagnachew, 2012). Differences in ecological/environmental factors and tsetse and ticks abundance visa-vis available control measures may be the reason for the variation in the prevalence of hemoparasites in the different locations. The prevalence however did not vary significantly with respect to the source of the donkeys. Studies reported by Mekibib et al. (2009) also showed no significant variation in the prevalence of both *Babesia* spp and *T. vivax* infection between Adigudem and Kwiha districts of Tigray region Northern Ethiopia. As earlier stated, the donkeys in this study were sourced mostly from North eastern parts of the country with possibly similar climate, vegetation and management practice. This explains the reason for lack of variation

in the prevalence of hemoparasites with respect to the source of donkeys. It has been established that in the absence of appropriate tsetse flies, some trypanosome species can be transmitted mechanically between infected and susceptible donkeys (Radostits et al., 2007). Therefore, the high prevalence of trypanosome species may not suggest tsetse fly abundance. The high prevalence of trypanosome in this study may suggest that donkeys may serve as an important reservoir in the transmission and maintenance of the parasite cycle. Trypanosomiasis has a direct impact on livestock productivity, reducing meat and milk production (Onyekwelu et al., 2017). This is likely due to the chronic nature usually associated with *T. congolense* and *T. vivax* infections. Therefore, donkeys in the study area may be experiencing a reduction in activity due to the impact of hemoparasitic infection. Blood parasites identified in the study are intraerythrocytic. They usually cause hemolysis of Red blood cells (RBCs) leading to anemia, loss of appetite etc. This may account for the association between hemoparasite infection and poor body condition observed in this study. It invariably implies that the animals' body condition can be useful in identifying those that need immediate attention. This was also supported by the low range of PCV recorded among those with the hemoparasite infection as donkeys that are positive with hemoparasites had lower PCV values ranging from (21-29), than the negative donkeys (30-50). The low PCV in donkeys with parasitic infestations as opposed to their healthy counterparts could therefore be attributed to the effect of the parasites.

Conclusion

Donkeys at slaughter in Ganawuri district market have a high prevalence of gastrointestinal nematodes and a moderate occurrence of hemoparasites. The gastrointestinal and hemo-parasites identified were *Strongyles*, *P. equorum*, *S. westeri*, *B. cabali*, *B. equi*, *T. congolense* and *T. vivax*. Factors such as age, sex and location did not influence the prevalence with gastrointestinal nematode infection. Management system influences gastrointestinal nematode and haemoparasites infection. The prevalence of endoparasitic infections varies across body condition. Those with poor body condition had the highest prevalence. Lower range of PCV was found in donkeys with hemoparsite infection. Donkeys in the area may serve as reservoir of transmission of *Trypanosoma* species and in maintaining the cycle.

Recommendations

There is a need for further studies that will utilize a more sensitive technique such as PCR that picks up trypanosomes especially in chronic cases. Improved hygienic practices, routine strategic deworming and treatment of infected donkeys are recommended. To reduce environmental contamination, all newly introduced stock should be quarantined, screened and treated with anthelminthics and antiprotozoal.

Authors Contribution

The research was carried out in collaboration with all the authors. Bata, Ishaku Shalangwa and Batim Turdam conceived, designed and developed the project. Batim, Turdam contributed in the sample collection and laboratory analysis. Batim Turdam, Maimadu Abdullahi and Waziri Ibrahim Anjili produced the tables and figures. Batim Turdam, Maimadu Abdullahi and Waziri Ibrahim Anjili also wrote the first draft of the article. Mayowa Olabode and Bata, Ishaku Shalangwa proof read and wrote the final draft of the article. Bata, Ishaku Shalangwa carried out the data analysis using statistical package for social sciences version 21. All the authors read the final draft of the manuscript.

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