Journal of Bacteriology and Parasitology

Sowemimo and Ayanniyi, J Bacteriol Parasitol
2017, 8:3
DOI: 10.4172/2155-9597.1000311

Research Article OMICS International

Gastrointestinal Helminth Parasites of Domestic Dogs in Ilesa, Osun State, Nigeria: A Faecal Examination Survey Study

Oluyomi A Sowemimo* **and Oluyomi A Ayanniyi**

Department of Zoology, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

***Corresponding author:** Oluyomi A Sowemimo, Department of Zoology, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria, E-mail: yomi_showemimo@yahoo.com

Received date: June 07, 2017; **Accepted date:** June 23, 2017; **Published date:** June 28, 2017

Abstract

Toxocariasis remain the most important parasitic infections affecting companion animals worldwide and pose a risk to animal and human health. There is still inadequate information on these infections in dogs in some parts of Nigeria. A cross sectional study was undertaken between August and December, 2015 to determine the prevalence and intensity of intestinal helmiths of domestic dogs in Ilesa, Osun State, Nigeria. A total of 174 faecal samples collected randomly from dogs were processed and examined for helminth eggs using modified Kato-Katz technique. The overall prevalence of gastrointestinal helminth was 41.7%. *T. canis* was the most frequently observed helminth parasites with a prevalence of 30.5%, while prevalence of 28.2% and 9.8% were obtained for *A. caninum* and *D. caninum* respectively. Prevalence patterns in *T. canis* were age dependent showing a decreasing prevalence with age of host. There was a significantly ($p<0.05$) greater prevalence and intensity in dogs that roam freely (39.8%; 118.2 ± 25.7 epg) as compared with kenneled dogs (10.7%; 19.3 ± 11.2 epg). *T. canis*, *A. caninum* and *D. caninum* were the zoonotic gastrointestinal helminths prevalent in dogs in the study area. Interventions should include establishment of a program focusing on zoonotic diseases.

Keywords: Helminth parasites; Dogs; *Toxocara canis*; *Ancylostoma caninum*

Introduction

Intestinal helminths are among the most common pathogenic agents encountered in dogs, especially in newly whelped or neonates and they constitute one of the main causes of pathologies of the intestinal tract in dogs [1]. Some of these helminths are responsible for zoonotic diseases such as toxocariasis or visceral larva migrans, ancylostomitidosis or cutaneous larva migrans, tungiasis, hydatid disease as well as emerging and re-emerging infections such as cryptosporidiosis and giardiasis [2-4].

The role of dogs as companion animals and the close relationship between human and dogs, although offering significant benefits to many people, also represent a potential public health risk, since natural transmission of parasitic infections from dogs to man may occur, directly or indirectly *via* non-favourable environmental and human behavioural factors [5,6].

Toxocara canis is one of the most common gastrointestinal helminths living in the intestine of domestic and stray dogs. *T. canis* is the causative agent of toxocariasis, and it has been reported in nearly all parts of the world with prevalence of up to 100% in some population of puppies [7]. Transmission of toxocariasis occurs in different ways depending upon the age and management of dogs. Adult dogs become infected with *T. canis* through ingestion of infective eggs or infective larvae in tissue of paratenic hosts such as mice, birds, pigs, earthworms and others [8]. Various surveys conducted worldwide indicate that prevalence of *Toxocara* spp. infection in canid definitive hosts ranged from 86-100% in puppies and 1-45% in adult dogs [9-12].

The clinical symptoms of helminth infected dogs depend on the age of animal, the number, location and developmental stage of the worms. Majority of dogs infected with worms are asymptomatic, however young puppies show clinical signs which include poor growth, enlarged abdomen, vomiting, diarrhoea, coughing or nasal discharge. Death is rare but has been reported in severe cases as a result of obstruction of the intestine or ulceration and perforation on the intestinal wall [13].

In Nigeria, dogs are left to roam freely in public places, children's playgrounds, scavenging waste dumps, decaying food materials and faecal matter. They contaminate the environment with helminth eggs which are passed out with their faeces. In most rural and urban resource limited communities, children play outdoors and adults walk the streets bare-foot picking up infections from contaminated soils.

Several studies of gastrointestinal helminths of dogs have been reported in Nigeria and other parts of the world [4,13-19]. However, there is dearth of information on the status of gastrointestinal helminth infection in dogs in Ilesa, Osun State, Nigeria. Knowledge of the type of gastrointestinal helminths in dogs in a particular area is important to identify the zoonotic risk in the prevention and control of infections. The aim of the present study was to determine the prevalence and intensity of intestinal helminths in dogs in this locality with special attention to potential zoonotic diseases.

Materials and Methods

Study area

The study was conducted in Ilesa, one of the major towns in Osun State, Nigeria. The town is strategically positioned as a gateway to the North, South and Eastern part of Nigeria. It is located on latitude 7° 37 ´N and longitude 4° 44´E. It is in the rainforest zone and has an

estimated population of 310,000 people. The people from this town are known for their potentials in agriculture especially in tree crops such as cocoa, kolanut, palm produce, plantain and fruits. A substantial proportion of the inhabitants keeps dogs and has limited access to veterinary services.

Study design

Dogs sampled were drawn from community dogs whose owners were available at the time of sampling and willing to have their dogs sampled. The sampling was conducted between August and December, 2015. The households owning dogs were identified after reconnaissance visits have been made to the community between June and July, 2015. The owners of dogs were approached and the purpose of the study was explained after which their cooperation was sought for the collection of faecal samples. Structured questionnaire was given to house hold owning dogs to obtain information as regards the approx. age of dog, sex, mode of life, breed type, defecation sites and disease related knowledge of owners. The dogs were classified according to the age; aged 6 months and below were considered puppies, 7-12 months as young adults and 12 months and above as adult dogs, breed; local (African shepherd) and exotic (Alsatians, mongrel, Rottweiler etc.).

Faecal sample collections and processing

Freshly passed faecal samples from dogs were collected into clean, sterile, specimen bottles labelled with dog's identification number (ID), age and sex of dogs. The faecal samples collected were first examined physically for larvae, adult worms and tapeworm eggs before transferring some quantity into the specimen bottles. The faecal samples were preserved by the addition of 10% formaldehyde solution and then transported to the parasitology laboratory of the Department of Zoology, Obafemi Awolowo University, Ile-Ife for processing for the recovery of helminth eggs.

Faecal samples were processed for microscopic examination for helminth eggs by modified Kato-Katz technique [20]. The faecal samples were first homogenized by shaking vigorously to form a paste. Thereafter a small portion of the sample was sieved through double-ply gauze to remove debris and rough materials. The filtrate was centrifuged at 2500 rpm for 5 min, the supernatant decanted and the tube was allowed to stand for 2 min. 41.7 mg of the sediment delivered by Kato-Katz template was taken onto a degreased glass slide, and covered with a cellophane strip soaked overnight in 50% solution of glycerol-malachite green. Slides were examined for helminth eggs under a light microscope. Observed helminth ova in 41.7 mg of sieved stool were identified using known structural and morphometric features [21]. In addition to qualitative diagnosis, indirect measure of helminth intensity was obtained by counting eggs and expressed as eggs/g of faeces (epg) by multiplying the number of eggs counted with a factor of 24 [22].

Statistical analysis

For the statistical analysis of the data, the animals were grouped by age (6 months and below, 7-12 months, 13-18 months, 19-24 months and 25 months and above), gender (male and female), Breed type (local and exotic), mode of life (free range and kennel). The overall prevalence for all parasites and the particular prevalence of each helminth were determined. Statistical analyses were performed by using the SPSS for windows, version 17 (Chicago, Illinois, USA). Differences in parasite prevalence between subgroups were determined using the Chi-squared test and p-values of ≤ 0.05 were considered significant. The one-way analysis of variance (ANOVA) test was used to determine significance of difference of mean egg counts.

Results

In total, 174 dogs comprising 93 (53.4%) males and 81 (46.6%) females were examined; out of which 82 (47.1%) dogs were infected with one or more helminth species. Eggs of three helminth species comprising two nematodes, *Toxocara canis* with the highest prevalence of 30.5%, and *Ancylostoma caninum* with a prevalence of 28.2%; and a cestode, *Dipylidium caninum* with the lowest prevalence of 9.8% were identified.

Male					Female				Both sexes			
Age group (months)	Number	Number infected	%	Mean ± SEM	Number examined	Number infected	%	Mean ± SEM	Number examined	Number infected	%	Mean ± SEM
0 - 6	38	15	39.5	147 ± 52.5	21	7	33.3	106.9 ± 67.3	59	22	37.3	132.6 ± 41.1
7-12	28	6	21.4	72.0 ± 45.4	33	13	39.4	90.2 ± 41.4	61	19	31.1	81.8 ± 30.4
13-18	16	6	37.5	75.0 ± 30.7	15	4	26.7	41.6 ± 21.5	31	10	32.3	58.8 ± 18. 9
19- 24	9	1	11.1	32.0 ± 32.0	7	1	14.3	13.7 ± 13.7	16	2	12.5	24.0 ± 18.6
≥ 25	2	0	0.0	0.0 ± 0.0	2	0	0.0	0.0 ± 0.0	4	0	0.0	0.0 ± 0.0
Total	93	28	30.1	97.8 ± 26.3	81	25	30.9	73.2 ± 24.6	174	53	30.5	86.3 ± 18.1

Table 1: Prevalence (%) and Intensity (I) of *Toxocara canis* in relation to host age and sex.

Prevalence and intensity of *Toxocara canis* relative to age and sex of dog

The prevalence and intensity pattern of *T. canis* is depicted in Table 1. In general, the prevalence and intensity in both sexes were observed to be highest in dogs less than six months old and decreased as the age grew older. There was no significant difference in the overall prevalence and intensity of *T. canis* infection between male (30.1%; 97.8 ± 26.3 epg) and female dogs (30.9%; 73.2 ± 24.6 epg) (p>0.05).

Prevalence and intensity of *A. caninum* relative to age and sex of dog

The prevalence and intensity pattern of *A. caninum* is depicted in Table 2. Overall, the prevalence and intensity of *A. caninum* infection among male and female dogs were highest in puppies (dogs less than 6 months old) and least in adult dogs, but within each age bracket both prevalence and intensity were comparable between male and female dogs. The overall prevalence and intensity of *A. caninum* infection between male (29.0%; 60.1 ± 13.3 epg) and female dogs (28.4%; 43.9 ± 11.6 epg) were not statistically different (p>0.05).

Prevalence and intensity of *T. canis* infection in relation to breed type and mode of life

The prevalence of *T. canis* infection was significantly higher in local (African shepherd) breed (35.5%) than in exotic breed (9.1%) (p<0.05) while the intensity of infection between the two breeds are comparable. The prevalence and intensity of infection in dogs that roam freely (39.8%; 118.2 ± 25.7 epg) was significantly higher than those that are kennelled (10.7%; 19.3 ± 11.2 epg) (p<0.05).

Male					Female				Both sexes			
Age group (months)	Number examined	Number infected	%	Mean ± SEM	Number examined	Number infected	%	Mean ± SEM	Number examined	Number infected	%	Mean ± SEM
0 - 6	38	15	39.5	80.8 ± 23.2	21	7	33.3	89.1 ± 35.0	59	22	37.3	83.8 ± 19.3
7-12	28	4	14.3	37.7 ± 25.1	33	8	24.2	27.1 ± 11.1	61	19	19.7	28.7 ± 11.4
13-18	16	6	37.5	76.5 ± 33.7	15	5	33.3	48.0 ± 29.8	31	10	35.5	62.7 ± 22.4
19- 24	9	2	22.2	26.7 ± 19.4	7	2	28.6	30.9 ± 27.1	16	2	25.0	28.5 ± 15.5
≥ 25	2	0	0.0	0.0 ± 0.0	5	1	20.0	16.0 ± 16.0	4	0	14.3	12.0 ± 12.0
Total	93	27	29.0	60.1 ± 13.3	81	23	28.4	43.9 ± 11.6	174	50	33.9	52.6 ± 8.9

Table 2: Prevalence (%) and Intensity (I) of *A. caninmu* in relation to host age and sex.

Single and multiple infections

Out of 82 (47.1%) infected dogs, 49 (59.8%) had single infection comprising 22(44.9%) of *T. canis*, 22(44.9%) of *A. caninum* and 5(10.2%) of *D. caninum*. 28 (34.1%) had double infection comprising combinations of *A. caninum* and *T. canis* (75%); *T. canis* and *D. caninum* (17.9%); *A. caninum* and *D. caninum* (7.1%). 5 (6.1%) dogs had triple infections.

Discussion

The findings of this study revealed a high prevalence (47.1%) of gastrointestinal helminths of zoonotic importance, namely *Toxocara canis*, hookworm (*Ancylostoma caninum*) and *Dipylidium caninum*. The parasites observed in this study have been reported in dogs and other canids in different studies and locations within Nigeria and other parts of the country with a pronounced difference in the prevalence and intensity between regions [4,16,23-28]. In this study, the overall prevalence of intestinal helminths (47.1%) was lower than 68% reported from different ecological zone in Nigeria [4] and comparable with prevalence of 52.5% reported from Southeast Nigeria [29]. It is also lower when compared with studies reported from Spain (71%) [15], Ghana (62.6%) [30], Mexico (85%) [27]. However, the prevalence in this study was higher than prevalence of 34% reported from Western Europe [7] and 36% reported from the United States [31]. This could have been due to the tropical conditions in the African countries which are conducive for the development, survival and transmission of infective stages of the parasites.

The presence of hookworm (*A. caninum*) and *Toxocara* in this study is significant due to their zoonotic implications considering the high prevalence of intestinal helminth infections recorded in dogs and the close bond in which dogs live together with people. The risk of transmission of these parasites to humans seems to be obvious. The prevalence of *T. canis* in dogs examined in this study was 30.5%. Several syndromes have been ascribed to *Toxocara* species which include visceral larva migrans, ocular larva migrans and some neurologic and atopic symptoms [11]. The high prevalence of *T. canis* presents a potentially serious condition that might increase the possibility of many children in the study area harbouring *T. canis*. Studies on the prevalence and other intestinal parasites of dogs in various areas of the United States of America (USA) have shown that a prevalence of 7% for *T. canis* infection among a population of dogs should be considered hazardous to children [32]. This is because of the daily shedding of many thousands of eggs into the environment which may lead to environmental contamination and thereby exposing

children to accidental ingestion of the eggs as a result of their play habit [32,33].

The prevalence pattern of *T. canis* in this study was age dependent; *T. canis* decreased with age of dog. This pattern has been observed previously [4,16,23,27]. This study observed the highest prevalence of toxocariasis in puppies under six months of age. This is consistent with previous studies which reported similar findings [4,16,34,35]. The high prevalence of ascarid infections in puppies is in accordance with the transmission pattern of the parasite which is mainly by transplacental and transmammary routes in the first few days of puppy's life which increase the occurrence of the parasite at an early age. The acquired age-dependent immunity by adult dogs decreases the establishment as well as the fecundity of the parasite [36], probably as consequence of repeated exposure.

D. caninum, a zoonotic tapeworm was found in 9.8% of the examined dogs. Dogs, cats and wild carnivores are the definitive hosts, although man becomes occasional host [37]. The presence of this parasite in the study area is of public health importance, particularly to children. Children have been reported to be more likely infected with dipylidiasis than adults [38].

This study has also revealed that the prevalence of *T. canis* in local breeds (African shepherd) was significantly higher than in exotic breeds (Alsatians, mongrels German shepherd and Rottweiler). This is consistent with the findings of Anene et al. [24] who reported that prevalences and intensities of different parasite infections were significantly higher in local breeds than in exotic breeds. However, Fontanarrosa et al. [28] reported similar parasite prevalence among pure and mixed breed. Senlik et al. [39] reported that the prevalence of infection in Belgian breed differed significantly ($p<0.001$) from those of German shepherd, Labrador retriever and Irish setter breeds.

In this study, most of the dogs sampled in the study area are free range and receive only limited care from their resource limited owners. This might have accounted for the significantly higher prevalence of *T. canis* (39.8%) recorded in this dogs compared to their kennelled counterparts (10.7%). The high prevalence of *T. canis* infection in free range dogs could also be due to their scavenging habits which exposed them to natural infections. They can also contaminate the environment with faecal matter, many of which contains viable and infective ova and under suitable environmental conditions such as that in tropical area become embryonated in the soil and thereby poses risk to humans.

The number of intestinal helminth parasites species per host revealed that single infection was more common, and polyparasitism with more than two parasites were less commonly detected. These results are in agreement with the findings of previous studies [4,13,28,29]. Fontanarrosa et al. explained that interactions among parasite species depend on parasite burden rather than the mere presence of other species. Schmidt and Roberts [40] suggested that two or more parasites would occur in one host only if they are not in competition or if they have divergent physiological needs. While this study did not investigate these factors, it is important to note the observed high rate of *T. canis*/*A. caninum* combinations and the low rates of their separate combination with other species. That is, what drives *T. canis* and *A. caninum* combination affinity and why they refractory of other species? Answers to these questions are essential for adequate understanding of the epidemiology and control of these diseases.

In this study, only three helminth species were observed as compared to higher number reported from previous studies within and outside Nigeria. In a study conducted by Ramirez-Barrios et al. [13] in Maracaibo, Venezuela, seven helminth species were reported from 614 dogs examined. In another study conducted by Sowemimo and Asaolu [16] in Ibadan, Nigeria, six helminth species were reported from 959 dogs examined. The low number of helminth specied recovered could be as a result of the fewer dogs (174) examined in this study.

In conclusion, the present study has revealed that the three gastrointestinal helminth parasites identified in this study, *T. canis*, *A. caninum* and *D. caninum* are zoonotic parasites with high prevalences constituting public health problems in the study area. Hence, intervention measures are necessary to reduce the risk of transmission of parasites from dogs to humans.

Declaration of Interest

The authors declare that they have no competing interests.

References

1. Blagburn BL, Lindsay DS, Vaughan JL, Rippey NS, Wright JC, et al. (1996) Prevalence of canine parasites based on fecal flotation. Compen Conti Educ Pract Veter 18: 483-509.
2. Heukelbach J, Wilcke T, Meier A, Sabóia Moura RC, Feldmeier H (2003) A longitudinal study on cutaneous larva migrans in an impoverished Brazilian township. Travel Med Infect Dis 1: 213-218.
3. Akao N, Ohta N (2007) Toxocariasis in Japan. Parasitol Int 56: 87-93.
4. Ugbomoiko US, Ariza L, Heukelbach J (2008) Parasites of importance for human health in Nigerian dogs: high prevalence and limited knowledge of pet owners. BMC Vet Res 4: 49.
5. Malgor R, Oku Y, Gallardo R, Yarzabal I (1996) High prevalence of Ancylostoma species infection in dogs associated with endemic focus of human cutaneous larva migrans in Tacuaremba Uruguay. Paras 3: 131-134.
6. Patz JA, Gractzyk TK, Gella N, Vittor AY (2002) Effects of environmental changes on emerging parasitic diseases. Int J Parasitol 30: 1395-1405.
7. Overgaauw PA (1997) Prevalence of intestinal nematodes of dogs and cats in The Netherlands. Vet Q 19: 14-17.
8. Maqbool A, Raza SH, Hayat CK, Shafiq M (1998) Prevalence and chemotherapy of toxocariasis in the dog in Faisalabad (Punjab), Pakistan. Vet Arch 68: 121-125.
9. Dai RS, Li ZY, Li F, Liu DX, Liu W, et al. (2009) Severe infection of adult dogs with helminths in Hunan Province, China poses significant public health concerns. Vet Parasitol 160: 348-350.
10. Soriano SV, Pierangeli NB, Roccia I, Bergagna HF, Lazzarini LE, et al. (2010) A wide diversity of zoonotic intestinal parasites infects urban and rural dogs in Neuquen, Patagonia, Argentina. Vet Parasitol 167: 81-85.
11. Overgaauw PA, van Knapen F (2013) Veterinary and public health aspects of Toxocara spp. Vet Parasitol 193: 398-403.
12. Schär F, Inpankaew T, Traub RJ, Khieu V, Dalsgaard A, et al. (2014) The prevalence and diversity of intestinal parasitic infections in humans and domestic animals in a rural Cambodian village. Parasitol Int 63: 597-603.
13. Ramirez-Barrios RA, Barboza-Mena G, Munoz J, Angulo-Cubillan F, Hernandez E, et al. (2004) Prevalence of intestinal parasites in dogs under veterinary care in Maracaibo, Venezuela. Vet Parasitol 121: 11-20.
14. Minnaar WN, Krecek RC, Rajput JI (1999) Helminth parasites of dogs from two resource-limited communities in South Africa. J South Afr Vet Assoc 70: 92-94.
15. Martinez-Moreno FJ, Hernandez S, Lopez-Cobos E, Becerra C, Acosta I, et al. (2007) Estimation of canine intestinal parasites in Cordoba (Spain) and their risk to public health. Vet Parasitol 143: 7-13.
16. Sowemimo OA, Asaolu SO (2008) Epidemiology of intestinal helminth parasites of dogs in Ibadan, Nigeria. J Helminthol 82: 89-93.

17. Sowemimo OA (2009) The prevalence and intensity of gastrointestinal parasites of dogs in Ile-Ife, Nigeria. J Helminthol 83: 27-31.
18. Mahmuda A, Magaji AA, Yakubu Y, Salihu MD, Lawal MD, et al. (2012) Prevalence of intestinal parasites of dogs slaughtered at Mami market area, Sokoto, Nigeria. J Anim Sci 1: 126-130.
19. Mekbib B, AlemayehuRegassa A, Desie-Sheferaw D (2013) Gastrointestinal helminthes of dogs and owners' perception of dogs parasitic zoonoses in Hawassa, Southern Ethiopia. J Vet Med Anim Hlth 5: 20-26.
20. Forrester JE, Scott ME (1990) Measurement of Ascaris lumbricoides infection intensity and dynamic of expulsion following treatment with mebendazole. Parasitol 100: 303-308.
21. Bowman DD (1999) Georgis' parasitology for veterinarians. London, WB Saunders.
22. Katz N, Chaves A, Pellegrino J (1972) A simple device for quantitative stool thick-smear technique in Schistosomiasis mansoni. Rev Inst Med Trop Sao Paulo 14: 397-400.
23. Chiejina SN, Ekwe TO (1986) Canine toxocariasis and the associated environmental contamination of urban areas in Eastern Nigeria. Vet Parasitol 22: 157-161.
24. Anene BM, Nnaji TO, Chime AB (1996) Intestinal Parasitic infections of dogs in the Nsukka area of Enugu, Nigeria. Prev Vet Med 27: 89-94.
25. Oliveira-Sequeira TC, Amarante AF, Ferrari TB, Nunes LC (2002) Prevalence of intestinal parasites in dogs from São Paulo State, Brazil. Vet Parasitol 103: 19-27.
26. Minnaar WN, Krecek RC, Fourie LJ (2002) Helminths in dogs from a peri-urban resource-limited community in Free State Province, South Africa. Vet Parasitol 107: 343-349.
27. Eguía-Aguilar P, Cruz-Reyes A, Martínez-Maya JJ (2005) Ecological analysis and description of the intestinal helminths present in dogs in Mexico City. Vet Parasitol 127: 139-146.
28. Fontanarrosa MF, Vezzani D, Basabe J, Eiras DF (2006) An epidemiological study of gastrointestinal parasites of dogs from Southern Greater Buenos Aires (Argentina): Age, gender, breed, mixed infections, and seasonal and spatial patterns. Vet Parasitol 136: 283-295.
29. Okoye IC, Obiezue NR, Okorie CE, Ofoezie IE (2011) Epidemiology of gastrointestinal helminth parasites of stray dogs in Obollo-Afor and Ekwulobia markets, Southeast Nigeria. J Helminthol 85: 415-420.
30. Johnson SAM, Gakuya DW, Mbuthia PG, Mande JD, Maingi N (2015) Prevalence of gastrointestinal helminths and management practices for dogs in the Greater Accra region of Ghana. Heliyon 1: e00023.
31. Samuel WM, Pybus MJ, Kocan AA (2001) Parasitic diseases of wild mammals. Iowa State University Press. Can Vet J 43: 130.
32. Williams RW, Menning E (1961) Intestinal helminths in dogs and cats of the Bermuda Islands and their potential public health significance, with a report of a probable case of visceral larva migrans. J Parasitol 47: 947-951.
33. Sowemimo OA (2007) Prevalence and intensity of Toxocara canis (Werner, 1782) in dogs and its potential public health significance in Ile-Ife, Nigeria. J Helminthol 81: 433-438.
34. Daryani A, Sharif M, Amouei A, Gholami S (2009) Prevalence of Toxocara canis in stray dogs, northern Iran. See comment in PubMed Commons below Pak J Biol Sci 12: 1031-1035.
35. Othman RA (2011) Prevalence of Toxocara canis in dogs, North West Bank of Palestine. Korean J Parasitol 49: 181-182.
36. Pereckiene A, KaziÅ«naite V, Vysniauskas A, Petkevicius S, Malakauskas A, et al. (2007) A comparison of modifications of the McMaster method for the enumeration of Ascaris suum eggs in pig faecal samples. Vet Parasitol 149: 111-116.
37. Adam AA, Abu OAR, Abdel SMN, Abdel MNI (2006) Cutaneous myiasis due to Dermatobia hominis: A case report eastern Sudan. Sudan J Med Sci 1: 147-148.
38. Molina CP, Ogburn J, Adegboyega P (2003) Infection by Dipylidium caninum in an infant. Arch Pathol Lab Med 127: e157-159.
39. Senlik B, Cirak VY, Karabacak A (2006) Intestinal nematode infections in Turkish military dogs with special reference to Toxocara canis. J Helminthol 80: 299-303.
40. Schmidt GD, Roberts LS (1989) Foundation of Parasitology. Toronto, Times Mirror/Mosby College Publishers.