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MICROSCOPIC AND NESTED-PCR DETECTION OF *TOXOCARA CANIS* AND *TOXOCARA CATI* IN DOGS AND CATS FROM AL-QADISIYAH PROVINCE

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ABSTRACT

Toxocara cati and *Toxocara canis* are roundworms, nematodes belonging to the order Ascaridida. They are common intestinal parasites in pets, particularly cats and dogs, respectively. These parasites are significant because they are zoonotic diseases, meaning humans can be infected accidentally through the ingestion of parasite eggs, leading to various illnesses. This study investigated *T. cati* and T. canis in cats and dogs in Al-Qadisiyah Governorate, from December 2024 to September 2025. It involved microscopic examination of 200 fecal samples (100 from cats and 100 from dogs). The results showed an infection rate of (19%) in cats and (16%) in dogs. According to lifestyle, the infection rate was higher in stray cats and dogs than in domestic cats and dogs, the results in cats showed statistically significant difference (P= 0.045), while in dogs there is no significant difference (P= 0.568). According to age and living site, the infection rate in kittens and puppies, also rural areas higher than among adults and urban areas, and the results were statistically significant difference at ($P \leq 0.05$), while the differences according to gender and months did not have a statistically significant at ($P>0.05$). The positive samples were confirmed using molecular methods by the Nested PCR technique, which is considered more sensitivity and specificity. The results demonstrated the importance of studying the parasite due to its pathological and economic impact on domestic animals.

KEYWORD: *Toxocara cati*, *Toxocara Canis*, Cats, Dogs, PCR.

INTRODUCTION

Toxocara cati and *Toxocara canis* are among common nematodes of felids and canids, causing toxocariasis (Natália *et al*., 2020). The definitive hosts of *T. cati* and *T. canis* are cats and dogs respectively, both are have zoonotic importance. In the intestine of the definitive host, mature worms lay eggs. Unembryonated eggs are excreted with feces into the environment and be embryonated to be infective eggs, when ingested by human, the larval migration occur by larvae migrate to different viscera (Carvalho and Rocha 2011). Dogs are most often by ingesting mature eggs from the environment or by consuming paratenic hosts such as rodents or poultry. Vertical transmission also occurs in dogs from mother to puppies via the placenta, transplacental or through breast milk, transmammary during the puppy stage (Bowman, 2020). Cats are infected by ingesting mature eggs or by consuming paratenic hosts like mice and birds and transmission through transmammary may also occur in kittens (Taylor *et al*., 2016). Many adults may have no obvious symptoms (Bonilla-Aldana *et al*., 2024), In severe infections or in puppies: you may notice a pot-bellied abdomen, poor growth, malnutrition, cachexia, a generally poor appearance, diarrhea, vomiting, sometimes coughing or respiratory symptoms due to larval migration through the lungs. In rare cases, severe intestinal obstruction or life-threatening complications may occur in puppies with high density infections (Bowman, 2009). Infected kittens may show slowed growth, loss of appetite, bloated abdomen, and general weakness (Wu, 2023). the diagnosis is mainly done by examination of eggs in feces under the light microscope (Okulewicz *et al*., 2012), by serological tests, such as

Western blot and ELISA (Enzyme Linked Immunosorbent Assay) (Noordin *et al*., 2020), or by molecular methods, as PCR (Polymerase Chain Reaction) technique (Khademvatan *et al*., 2013). In recent years, there has been increased interest in toxocara in Iraq; however, research on this parasite remains limited, both in the past and present. Among recent Iraqi studies, (Alani and Kawan, 2024) study in Baghdad province, (Alhayani and Alshawi, 2024) study in Al-Anbar province, (Thamer *et al*., 2022) study in Basrah, (Jarad, *et al*., 2019) study in Al-Diwaniah province, (Rashid *et al*., 2022) study in Sulaimani province and (Al-Daamy and Al-Khaled, 2025) study in Karbala. The study aimed to microscopic diagnosis of *Toxocara cati* and *Toxocara canis* eggs in fecal samples from cats and dogs in Al-Qadisiah province, and to confirm the diagnosis of positive samples by molecular testing using Nested-PCR technique.

MATERIALS AND METHODS

Sample collecting

Two hundred fresh fecal samples were collected from stray and domestic cats and dogs (100 cats and 100 dogs). Samples were collected in plastic containers, and the date, sex, age, location, and whether stray or domestic were recorded. The samples are then sent to the Parasitology Laboratory at the College of Science, Al-Qadisiyah University, for microscopic detection. The samples were collected during the period from December 2024 to September 2025.

Direct Smear

Using a wooden stick, a small amount of fecal sample was taken and placed on a glass slide, mixed with drops of distilled water, then the slide cover was placed and examined under a microscope at 40X and 100X to detect *Toxocara* eggs (Urgel *et al*., 2019).

Floatation Method

Approximately 4 grams of fecal sample were placed in glass beaker and mixed well with a small amount of tap water. The mixture was then filtered and collected in test tubes. The mixture was centrifuged at 1000 rpm for 3 minutes. The supernatant was then decanted and 10 ml of shethear sugar solution was added to the precipitate, mixing well. The mixture was centrifuged again at the same speed for 5 minutes. A drop was then taken from the surface of the tube by a pipette and placed on a glass slide, covered by glass cover slide and examined under a microscope at 40X and 100X (Urgel *et al*., 2019).

Molecular Study

The Nested PCR technique was performed for detection *T. cati* and *T. canis* from cats and dogs fecal samples. Primers based on 5.8S small subunit ribosomal RNA gene and internal transcribed spacer 2 region sequence according to (Pourshahbazi *et al*., 2023) and Nested PCR primers were design using NCBI-Genbank and primer3 plus, table1.

Fecal DNA Extraction

Fecal DNA from fecal samples were extracted by using Presto™ Stool DNA Extraction Kit and done according to company instructions.

Genomic DNA estimation

The extracted genomic DNA from stool samples was checked by using Nanodrop spectrophotometer (THERMO. USA), that check and measurement the purity of DNA through reading the absorbance in at (260 /280 nm).

Nested-PCR

The Nested PCR master mix was prepared by using (Go taq Green PCR Master Kit) and this master mix done according to company instructions. The technique was conducted in two rounds, first round PCR Thermo-cycle and second round nested-PCR Thermo-cycle, As shown in the table 2. The Nested-PCR products was analyzed by agarose gel electrophoresis.

Table 1: primers for *T. cati.*

Primers	Sequence 5'-3'		Product size	Reference and Genbank code
PCR	F	CTTCTGGTGCATTCTTTCGC	204bp	Pourshahbazi *et al*., 2023
	R	CCAAGCAACAACAAACTACGC		
Nested PCR	F	AACGTGCATTCGGTGAGCTA	139bp	KY003083.1
	R	GGAACACATACGCCAATGGC		

Primers for *T. canis*

Primers	Sequence 5'-3'		Product size	Reference and Genbank code
PCR	F	ATTAACGCGCAAGGTTGTGG	260bp	Pourshahbazi *et al*., 2023
	R	TGGCCATGCATTCCTCATTC		
Nested PCR	F	GTGAGCTATGCTGGTGTGGT	206bp	PX062270.1
	R	ATAACGCCACCTCCAACCTG		

Table 2: PCR Thermo-cycler Conditions.

PCR step	Temp.	Time	Repeat
Initial Denaturation	95ºC	5min.	1
Denaturation	95 ºC	30sec.	35 cycle
Annealing	61 ºC	30sec	
Extension	72 ºC	2min.	
Final extension	72 ºC	5min.	1
Hold	4 ºC	Forever	-

Nested PCR Thermo-cycler Conditions

Nested PCR step	Temp.	Time	repeat
Initial Denaturation	95ºC	5min.	1
Denaturation	95 ºC	30sec.	35 cycle
Annealing	60 ºC	30sec	
Extension	72 ºC	1min.	
Final extension	72 ºC	5min.	1
Hold	4 ºC	Forever	-

Statistical analysis

Chi-square test was used to study association between any two categorical variables. The level of significance was considered at P-value of less 0.05 and highly significant level at 0.01 or less (Daniel, 2018).

RESULTS

Microscopic results

T. cati and *T. canis* were detected by microscopic examination by identifying the parasite eggs, *T. cati* egg appears to have a shell with pits slightly spaced apart from each other, comparison of T. canis egg with a shell that has a regular pits that illustrated in the figure 1 and 2.

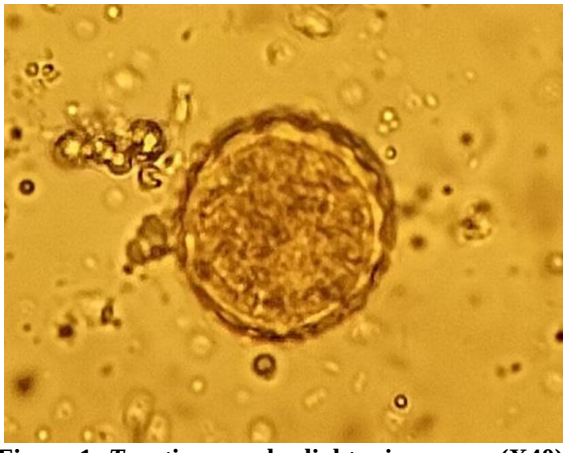

Figure 1: *T. cati* egg under light microscopy (X40).

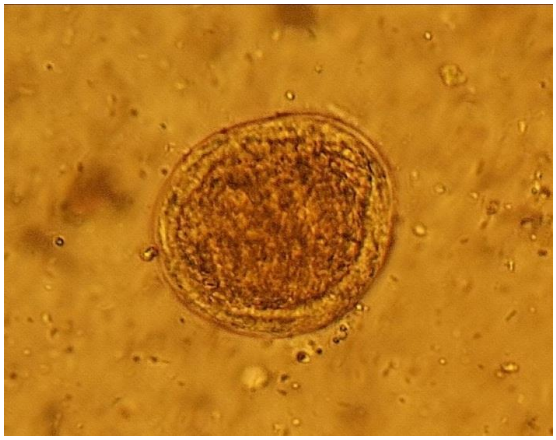

Figure 2: *T. canis* egg under light microscopy (X40).

Prevalence of *T. cati* and *T. canis* infection in cats and dogs

The current study included 100 cats and 100 dogs for microscopic detection of *T. cati* and *T. canis*. The results showed that 19 (19.0%) of the cats were infected with *T. cati*, and 16 (16.0%) of the dogs were infected with *T. canis*, the difference was not statistically significant, as shown in Table 3.

Prevalence of *T. cati* and *T. canis* infection according to Lifestyle of cats and dogs

Depending on the lifestyle of cats and dogs shown in the table 4, the infection of *T. cati* in stray cats was 14(26.4%) higher than that of domestic cats, which was 5(10.6%), and the difference was significant (P= 0.045). The infection of *T. canis* in stray dogs was 10(17.8%), was slightly higher than that of domestic dogs, which was 6(13.6%), but the difference was non-significant (P= 0.568).

Prevalence of *T. cati* and *T. canis* infection according to gender of cats and dogs

As shown in the table 5, the prevalence of *T. cati* infection according to gender included 10(18.2) in male cats, that was slightly lower than 9(20%) female, the

difference was non-significant (P= 0.818). Also the prevalence of infection with *T. canis* included 8(15.1%) in male dogs was slightly lower than 8(17%) in female, also the difference was non-significant (P= 0.793).

Prevalence of *T. cati* and *T. canis* infection according to age of cats and dogs

The results showed that the infection according to age in table 6, *T. cati* infection included 6(10.2%) in Adults cats was lower than 13(31.7%) in Kittens, the difference was significant (P= 0.007). Also the prevalence of infection with *T. canis* in Adults 5(8.6%) was lower than 11(26.2%) in Poppies, also the difference was significant (P= 0.018).

Prevalence of *T. cati* and *T. canis* infection according to living sites of cats and dogs

As shown in the table 7, the prevalence of *T. cati* infection in cats according to living sites included 12(30%) in rural higher than 7(11.7%) in urban, the difference was significant (P= 0.022). Also the prevalence of *T. canis* infection in dogs was 12(27.9%) in rural higher than 4(7%) in urban, also the difference was significant (P= 0.005).

Prevalence of *T. cati* and *T. canis* infection according to months of cats and dogs

The results showed according to the months of study, the highest infection with *T. cati* in cats was 4(40%) in April, and the lowest infection 1(9%) in June, the difference was non-significant (P= 0.520). The highest infection with *T. canis* in dogs was 3(33.3%) in March, and the lowest infection was 1(9%) in July, also the difference was non-significant (P= 0.825) as shown in the table 8.

Table 3: Prevalence of *T. cati* and *T. canis* infection in cats and dogs.

Host	Samples No.	+ ve	Percentage %
Cat	100	19	19
Dog	100	16	16
Total	200	35	17.5
X^2		0.322	
P value		0.577	

Table 4: Prevalence of *T. cati* and *T. canis* infection of cats and dogs according to Lifestyle.

***T. cati* infection**			
Lifestyle	**Samples No.**	**+ ve**	**Percentage %**
Domestic	47	5	10.6
Stray	53	14	26.4
Total	100	19	19
X^2		4.042	
P value		0.045*	
***T. canis* infection**			
Lifestyle	**Samples No.**	**+ ve**	**Percentage %**
Domestic	44	6	13.6
Stray	56	10	17.9
Total	100	16	16
X^2		0.327	
P value		0.568 NS	

*: Significant at P ≤ 0.05, NS: No Significant at P > 0.05.

Table 5: Prevalence of *T. cati* and *T. canis* infection of cats and dogs according to gender.

***T. cati* infection**			
Gender	**Samples No.**	**+ ve**	**Percentage %**
Male	55	10	18.2
Female	45	9	20.0
Total	100	19	19
X^2		0.053	
P value		0.818 NS	
***T. canis* infection**			
Gender	**Samples No.**	**+ ve**	**Percentage %**
Male	53	8	15.1
Female	47	8	17.0
Total	100	16	16
X^2		0.069	
P value		0.793 NS	

*: Significant at P ≤ 0.05, NS: No Significant at P > 0.05.

Table 6: Prevalence of *T. cati* and *T. canis* infection of cats and dogs according to age.

***T. cati* infection**			
Age	**Samples No.**	**+ ve**	**Percentage %**
Adults	59	6	10.2
Kittens	41	13	31.7
Total	100	19	19
X^2		7.291	
P value		0.007*	
***T. canis* infection**			
Age	**Samples No.**	**+ ve**	**Percentage %**
Adults	58	5	8.6
Poppies	42	11	26.2
Total	100	16	16
X^2		5.595	
P value		0.018*	

*: Significant at P ≤ 0.05, NS: No Significant at P > 0.05.

Table 7: Prevalence of *T. cati* and *T. canis* infection of cats and dogs according to living sites.

***T. cati* infection**			
Living sites	**Samples No.**	**+ ve**	**Percentage %**
Rural	40	12	30.0
Urban	60	7	11.7
Total	100	19	19
X^2		5.241	
P value		0.022*	
***T. canis* infection**			
Living sites	**Samples No.**	**+ ve**	**Percentage %**
Rural	43	12	27.9
Urban	57	4	7.0
Total	100	16	16
X^2		7.958	
P value		0.005 *	

*: Significant at P ≤ 0.05, NS: No Significant at P > 0.05.

Table 8: Prevalence of *T. cati* and *T. canis* infection of cats and dogs according to months.

Month	*T. cati* infection			*T. canis* infection		
	Samples No.	+ ve	%	Samples No.	+ ve	%
December	10	1	10	9	1	11.1
January	9	1	11.1	10	1	10
February	9	1	11.1	9	1	11.1
March	10	3	30	9	3	33.3
April	10	4	40	10	2	20
May	12	3	25	12	2	16.6
June	11	1	9	10	1	10
July	10	1	10	11	1	9
August	10	1	10	10	1	10
September	9	3	33.3	10	3	30
Total	100	19	19	100	16	16
X^2	8.143			5.108		
P value	0.520 NS			0.825 NS		

*****: Significant at $P \leq 0.05$, NS: No Significant at $P > 0.05$.

Molecular results

Microscopic diagnosis was confirmed by molecular methods using the Nested-PCR technique. Thirty-five fecal samples were tested (19 fecal samples positive for *T. cati* from cats and 16 fecal samples positive for *T. canis* from dog).

Positive results for *T. cati* appear within the molecular size of 139 bp partial area of ITS2 and 5.8 S rRNA, the positive samples were from 1-19, and the molecular marker ranges from 100-2000 bp, that illustrated in the figure 3.

Positive results for *T. canis* appear within the molecular size of 206 bp partial area of ITS2 and 5.8 S rRNA, the positive samples were from 1-16, and the molecular marker ranges from 100-2000 bp, that illustrated in the figure 4.

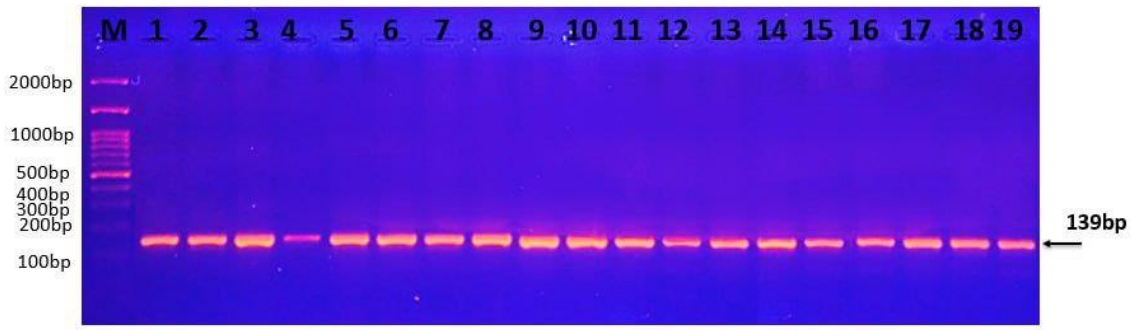

Figure 3: Agarose gel electrophoresis image for *T. cati*.

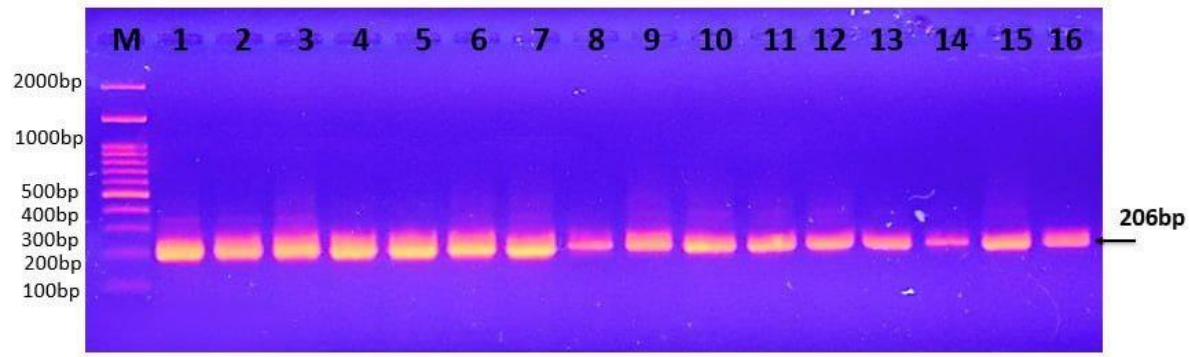

Figure 4: Agarose gel electrophoresis image for *T. canis*.

DISCUSSION

In the study, the infection rate in cats was 19%, which is slightly higher than the global average of 17%, but within the range of regional variation, not an exceptional difference. The rate in dogs was 16%, which is higher than the global average of 11.1% and close to or within the range of high regional estimates, the Eastern Mediterranean, Africa, and some other regions (Rostami *et al*., 2019). The infection rate in cats was slightly lower than Alani and Kawan (2024) study (23%) in Baghdad province, and lower than Alhayani and Alshawi (2024) study (40%) in Al-Anbar province, and higher than Pourshahbazi *et al*., (2023) study (16.52%) in Isfahan. The infection rate in dogs was higher than Thamer *et al*., (2022) study (10.5%) in Basrah, and lower than Jarad, *et al*., (2019) study (58%) in Al-Diwaniah province. This difference is attributed to local environmental and climatic factors, the prevalence of stray animals, and the inadequacy of periodic parasite removal programs (Bonilla-Aldana *et al*., 2024). The infection was higher in stray cats (26.4%) and dogs (17.9%) than in domestic cats (10.6%) and dogs (13.6%), statistically in cats with Significant difference, but in dogs there is no Significant difference. According to lifestyle, the study agreed with Rashid *et al*., (2022) study in Sulaimani province on stray and domestic cats and dogs. Owned animals often receive periodic deworming treatments or follow-up veterinary care, whereas stray animals often do not (Wickramasinghe *et al*., 2021). The infection was higher in female cats (20%) and dogs (17%) than in male cats (18.2%) and dogs (15%), statistically there is no Significant difference. According to gender, the study agreed with Nijsse *et al*., (2016) study on dogs, and (Alani and Kawan 2024) study on cats. It is sometimes noted that males have capabilities that females possess, and sometimes noted that no clear gender difference is mentioned, no clear gender difference. (Rostami *et al*., 2020). The infection in kittens (31.7%) and puppies (26.2%) was higher than in adult cats (10.2%) and dogs(8.6%), statistically, there is a significant difference. According to age, the study agreed with Al-Daamy and Al-Khaled (2025) study in Karbala on dogs, and (Alani and Kawan 2024) study on cats. kittens and Puppies often play on the ground, pick things up with their mouths, and are less careful, which exposes them more to infectious oocysts in the soil or contaminated environment (Bourgoin *et al*., 2022). The infection in cats (30%) and dogs (27.9%) in rural was higher than in cats (11.7%) and dogs (7%) in urban, statistically, there is a significant difference. According to age, the study agreed with Pourshahbazi *et al*., (2023) study on cats and dogs. In rural areas, animals often roam freely, unlike urban animals which may be more restricted. This increases the likelihood of them encountering polluted environments, eating paratenic hosts, or contaminated soil (Studzi´nska *et al*., 2017). The highest infection with *T. cati* in cats was (40%) in April, and the lowest infection (9%) in June, while the highest infection with *T. canis* in dogs was (33.3%) in March, and the lowest infection was (9%) in July, statistically there is no significant difference, the study agreed with Raissia *et al*., (2020) in Tehran. The outer eggs of Toxocara require moderate humidity and not too high temperatures to mature and become infectious. Spring and autumn usually provide better warmth and humidity than winter or harsh summer (Avcioglu and Burgu 2007). The use of Nested-PCR in confirming the diagnosis increases sensitivity, which increase the ability to detect small amounts of the target DNA (Green and Sambrook 2019), Increase specificity, reducing the amplification of unwanted or untargeted fragments, is achieved by using two pairs of primers, the first is used for initial amplification, and the second is used "inside" the first product (Bello, 2023).

CONCLUSIONS

The study results showed that cats were infected with *Toxocara cati*, and dogs with *Toxocara canis*. The infection rate was higher in stray animals than in domesticated ones, and also higher in young animals than adults. Infection was also more common in spring and autumn than in winter and summer. Gender did not have a statistically significant effect. Regarding the confirmation of molecular diagnosis, the Nested PCR technique demonstrated high diagnostic sensitivity, highlighting the importance of using this technique with low concentrations of genetic material to ensure accurate scientific results.

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REFERENCES

1. Natália MN, Fava MN, Cury MC, Santos HA, Takeuchi-Storm N, Strube C, Zhu X, Taira K, Odoevskaya I, Panovag O, Mateus TL, Nejsum P. Phylogenetic relationships among Toxocara spp. and Toxascaris sp. from different regions of the world. Veterinary Parasitology. 2020; 282: 109133. doi: 10.1016/j.vetpar.2020.109133.
2. Carvalho E A, Rocha, R L Toxocariasis: Visceral larva migrans in children. J Pediatr, 2011; 87: 100-10. doi:10.2223/JPED.2074.
3. Bowman DD. Georgis' Parasitology for Veterinarians. 11th ed. Elsevier Saunders. 2020. https://shop.elsevier.com/books/georgis-parasitology-for-veterinarians/bowman/978-0-323-54396-5.
4. Wu T. *Toxocara cati* Infection in Cats. Case by case: Parasitology. Peer reviewed. 2023. https://todaysveterinarypractice.com/wp-content/uploads/sites/4/2022/12/TVP-2023 0102_Feline_Roundworm.pdf
5. Taylor MA, Coop RL Wall R L. Veterinary Parasitology. 4th ed. Wiley Blackwell. 2016. DOI:10.1002/9781119073680
6. Okulewicz A, Perec-Matysiak A, Buńkowska K, Hildebrand J. *Toxocara canis*, *Toxocara cati* and

Toxascaris leonina in wild and domestic carnivores. Helminthologia, 2012; 49: 3–10. https://link.springer.com/article/10.2478/s11687-012-0001-6
7. Noordin R, Yunus MH, Farrizam SNT, Arifin N. Serodiagnostic methods for diagnosing larval Toxocariasis. Advances in Parasitology, 2020; 109: 131-152. DOI: 10.1016/bs.apar.2020.01.003
8. Khademvatan S, Rahim F, Tavalla M, Abdizadeh R, Hashemitabar M. Using feces of stray cats: a study from Southwest Iran. PLOS ONE, 2013; 8(6): e65293. https://doi.org/10.1371/journal.pone.0065293
9. Bowman D. Toxocara canis and Trichuris vulpis – Common dog parasites (Proceedings). MJH Life Sciences. 2009. https://www.dvm360.com/view/toxocara-canis-and-trichuris-vulpis-common-dog-parasites-proceedings
10. Urgel MFM, Ybañez RHD, Ybañez AP. The detection of gastrointestinal parasites in owned and shelter dogs in Cebu, Philippines. Veterinary world, 2019; 12(3), 372. doi:10.14202/vetworld.2019.372-376
11. Pourshahbazi G, Khanahmad H, Khadivi R, Yousefi HA, Mobarakeh S, Boldaji FH, Darani, HY. Toxocara Infection in Dogs and Cats in Isfahan Province of Iran in 2021. Adv Biomed Res, 2023; 12: 201. DOI: 10.4103/abr.abr_88_22
12. Daniel WW, Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons New York. 2018. https://faculty.ksu.edu.sa/sites/default/files/145_stat_-_textbook.pdf
13. Rostami A, Riahi SM, Holland CV, Taghipour A, Khalili-Fomeshi M, Fakhri Y. Seroprevalence estimates for toxocariasis in people worldwide: A systematic review and meta-analysis. Plos Neglected Tropical Diseases, 2019; 13(12): 1-12. https://doi.org/10.1371/journal. pntd.0007809
14. Bonilla-Aldana JL, Espinosa-Nuñez AC, Bonilla-Aldana DK, Rodriguez-Morales AJ. Toxocara cati Infection in Cats (Felis catus): A Systematic Review and Meta-Analysis. Animals, 2024; 14(1022). doi: 10.3390/ani14071022.
15. Wickramasinghe H, Galgamuwa LS, Iddawela D. Canine intestinal parasitic infections and soil contamination by Toxocara spp. in selected areas of Sri Lanka. Tropical Parasitology, 2021; 10(2): 114-119. doi: 10.4103/tp.TP_62_19
16. Rostami, A, Sepidarkish, M, Ma G, Wang T, Ebrahimi M, Fakhri Y, Mirjalali H, Hofmann A, Macpherson CNL, Hotez PJ, Gasser RB. Global prevalence of Toxocara infection in cats. Advances in Parasitology, 2020; 109: 615-639. doi:10.1016/bs.apar.2020.01.025.
17. Bourgoin G, Callait‐Cardinal M, Bouhsira E, Polack B, Bourdeau P, Ariza CR, Carassou L, Lienard E, Drake J. Prevalence of major digestive and respiratory helminths in dogs and cats in France: results of a multicenter study. Parasites & Vectors, 2022; 15(314): 1-12. doi: 10.1186/s13071-022-05368-7.
18. Studzi´nska MB, Demkowska-Kutrzepa M, Borecka A, Meisner M, Tomczuk K, Rocze´n-Karczmarz M, Kłape´c T, Abbass Z, Cholewa A. Variations in the Rate of Infestations of Dogs with Zoonotic Nematodes and the Contamination of Soil in Different Environments. International Journal of Environmental Research and Public Health, 2017; 14(1003): 1-11. doi: 10.3390/ijerph14091003.
19. Avcioglu H, Burgu A. Seasonal Prevalence of Toxocara Ova in Soil Samples from Public Parks in Ankara, Turkey. Vector Borne Zoonotic Diseases, 2007; 8(3): 345-50. doi: 10.1089/vbz.2007.0212.
20. Michael RG, Sambrook J. Nested Polymerase Chain Reaction (PCR). Cold Spring Harb Protocols. 2019. doi: 10.1101/pdb.prot095182.
21. Bello K,. The Principles and New Approaches in Nested Polymerase Chain Reactions. Journal of Data Mining in Genomics & Proteomics, 2023; 14(2). https://www.walshmedicalmedia.com/open-access/the-principles-and-new-approaches-in-nested-polymerase-chain-reactions.pdf
22. Alani ZK, Kawan MH. Prevalence and molecular analysis of Toxocara cati in Baghdad Province. Journal of Advanced Veterinary and Animal Research, 2024; 11(2): 392–397. doi: 10.5455/javar.2024.k788. eCollection 2024 Jun.
23. Alhayani OJ, Alshawi AF. Comprehensive Study of Toxocara cati Infection in Stray Cats in Al-Anbar Province: Molecular Detection and Investigation Vision. The Iraqi Journal of Veterinary Medicine, 2024; 48(1): 25-31. DOI: https://doi.org/10.30539/ijvm.v47i2.1522
24. Thamer NK, Al-Idreesi SR, Farhood NN. Detection Of Gastrointestinal Parasites of Cats and Dogs in Basrah Province. Basrah Journal of Veterinary Research, 2022; 21(1): 67-74. https://iasj.rdd.edu.iq/journals/uploads/2024/12/23/ab624a0a799be501403ff57feead03d4.pdf
25. Jarad NI, Abbas AK, Aȧiz NN. Iraqi Journal of Veterinary Sciences, 2019; 33(2): 367-370. https://scispace.com/pdf/serodiagnosis-of-toxocariasis-by-elisa-test-using-anti-t-3zc3by1v3r.pdf
26. Rashid ZM, Aziz SA, Ali OJ, Kakarash NK, Marif HF. Coprological detection of Toxocariosis in domicile and stray dogs and cats in Sulaimani province, Iraqi Journal of Veterinary Sciences 2022; 36(4): 1047–51. DOI: 10.33899/ijvs.2022.132976.2157
27. Nijsse R, Mughini-Gras L, Wagenaar JA, Ploeger HW. Recurrent patent infections with *Toxocara canis* in household dogs older than six months: a prospective study. Parasites & Vectors, 2016; 9(531). doi: 10.1186/s13071-016-1816-7.
28. Al-Daamy BAF, Al-Khaled MJA. Molecular identification and phylogenetic study of *Toxocara canis* in domestic and stray dogs from Karbala, Iraq.

Acta Scientiarum Animal Sciences, 2025. Doi: 10.4025/actascianimsci.v47i1.71326

29. Raissia V, Saberb V, Zibaeic, M, Bahadoryd S, Akhlaghie E, Raiesia E, Aslanif R, Shamsig L, Grailih A, Ibrahimi A. Comparison of the prevalence of Toxocara spp. eggs in public parks soils in different seasons, from 2017 to 2018, Tehran Province, Iran. Clinical Epidemiology and Global Health, 2020; 8: 450–454. doi: 10.17420/ap6504.220.