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The Prevalence of Intestinal Parasites in Tumbler Pigeons Raised in Kırıkkale

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ABSTRACT It was aimed to investigate the prevalence of intestinal parasites in tumbler pigeons reared in Kırıkkale. One hundred and five stool samples were obtained as one sample from each cage reached. The fresh stool samples collected were taken separately in containers with caps and delivered to laboratory within approximately 2 hours. Stool samples were analyzed by Carbolfuchsin, Native-Lugol staining and Fulleborn flotation techniques. *Eimeria* spp. oocysts were sporulated in 2.5% potassium dichromate and the species were identified. Parasite species were found in 82.9% of the examined pigeon stool. In the study, *Heterakis* spp., *Ascaridia* spp., *Capillaria* spp., *Strongyle* type eggs and *Eimeria* spp., and *Cryptosporidium* spp. oocysts were detected. The number of feces infected with one parasite (32.4%) species was higher than the number of feces infected with two (22.9%), three (19.0%) and four species (8.6%). While helminth+protozoan mixed infections were detected in 40.9%, helminth parasite eggs in 13.3% and protozoan oocysts were found alone in 28.6% of the stools examined. All of the sporulated *Eimeria* oocysts were identified as *E. labbeana*. In this study, intestinal parasites were detected at a high rate in pigeons fed for hobby purposes. It has been revealed that animal owners should be informed about the issue, attention should be paid to the cleanliness and hygiene of pigeon cages, and more importance should be given to the diagnosis and treatment of intestinal parasites in these animals in order to reduce the prevalence of parasitic infections in pigeons in the region.

Keywords: *Intestine, Parasite, Prevalence, Pigeon.*

ÖZ

Kırıkkale'de Yetiştirilen Taklacı Güvercinlerde Bağırsak Parazitlerinin Yaygınlığı

Bu çalışmada Kırıkkale'de yetiştiriciliği yapılan taklacı güvercinlerde bağırsak parazitlerinin yaygınlığının araştırılması amaçlanmıştır. Ulaşılan her bir kafesten bir örnek olmak üzere 105 dışkı örneği alınmıştır. Toplanan dışkı örnekleri kapaklı kaplara ayrı ayrı alınmış ve yaklaşık 2 saat içerisinde usulüne uygun olarak laboratuvara ulaştırılmıştır. Dışkı örnekleri Karbolfuksin boyama, Native lügol boyama ve Fülleborn flotasyon tekniği ile incelenmiştir. *Eimeria* spp. ookistleri % 2.5'lik potasyum dikromat içerisinde sporlandırılarak tür teşhisine gidilmiştir. İncelenen güvercin dışkılarının % 82.9'unda parazite rastlanmıştır. Çalışmada *Heterakis* spp., *Ascaridia* spp., *Capillaria* spp. ve Strongil tip yumurtalar ile *Eimeria* spp. ve *Cryptosporidium* spp. ookistleri tespit edilmiştir. Bir tür parazitle enfekte dışkı sayısı (% 32.4), iki (% 22.9), üç (% 19.0) ve dört parazitle (% 8.6) enfekte olan dışkı sayısına göre daha yüksek orandaydı. İncelenen dışkıların % 40.9'unda helmint+protozoon miks enfeksiyonları saptanırken, % 13.3'ünde helmint yumurtaları ve % 28.6'sında protozoon ookistleri tek olarak görülmüştür. Sporlandırılan *Eimeria* spp. ookistlerinin tümü *E. labbeana* olarak teşhis edilmiştir. Bu çalışmada hobi amacıyla beslenen güvercinlerde bağırsak parazitlerine yüksek oranda rastlanmıştır. Yöredeki güvercinlerde paraziter enfeksiyonların yaygınlığını azaltmak amacıyla hayvan sahiplerinin konu hakkında bilgilendirilmesi, güvercin kafeslerinin temizlik ve hijyenine dikkat edilmesi, bu hayvanlarda bağırsak parazitlerinin teşhis ve tedavisine daha fazla önem verilmesi gerektiği ortaya konmuştur.

Anahtar Kelimeler: *Bağırsak, Güvercin, Parazit, Prevalans.*

INTRODUCTION

Pigeons involved in the Columbidae family of the Columbiformes order are used for meat production, hobby, competitions, shows and experiments (Sales and Janssens 2003; Yılmaz and Boz 2012). There are criteria for the classification of pigeons including more than 250 species based on simple differences. Pigeons are classified depending on some morphological features such as the body size, color and shape, number of feathers on the wing or tail, long sleeves, skullcap, the rose shape on the chest as well as the purpose of use and flight style (mail,

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tumbler, spinner, wader, roller, ringbeater, ornamental and singing, fleet flyer, highflier) (Yılmaz and Boz 2012). Many parasites detected in pigeons may cause poor performance, delay in development, cessation of egg production, and death in these animals (Dranzoa et al. 1999; Şenlik et al. 2005; Gül et al. 2009).

Helminths are among the important endoparasites of pigeons. The presence of *Capillaria* spp., *Ascaridia columbae*, *Heterakis* spp., *Dispharynx* spp., *Tetrameres* spp., *Syngamus* spp., *Raillietina* spp., *Cotugnia digonophora* and *Strongyle avium* has been reported in pigeons in studies conducted around the world (Şenlik et al. 2005; Gül et al. 2009; Elmajdoub and Mshiheet 2016; Mehmood et al. 2019; Ali et al. 2020; Walteros-Casas et al. 2021; Das et al. 2022; Juby et al. 2022). Helminths are primarily responsible for important clinical and subclinical infections in domestic pigeons (Ali et al. 2020).

Cryptosporidium spp. is an important protozoan parasite that causes infection in humans, mammals, and poultry. The oocysts of *Cryptosporidium* spp. were reported in a 10-day old pigeon in Turkey (Özkul and Aydın 1994). Mehmood et al. (2019) reported that they have detected *Cryptosporidium* spp. in the contents of the cloaca by 50%.

Coccidiosis is one of the most important protozoan parasites of the poultry. The presence of *Eimeria labbeana, E. columbae, E. columbarum, E. pfeifferi, E. tropicalis, E. janovyi, E. waiganiensis, E. curvata E. gourai* and *E. duculai* species in pigeons has been reported in studies conducted around the world. The presence of *E. labbeana, E. columbarum* and *E. columbae* in domestic pigeons has been reported in Turkey to date (Sarı et al. 2008; Gül et al. 2009).

A limited number of studies are conducted for detection of parasites in domestic and wild pigeons in Turkey. There was not any previous study conducted in Kırıkkale where the present study was carried out on detection of intestinal parasites of pigeons. The aim of the present study was to detect the presence and prevalence of intestinal parasites in tumbler pigeons fed for hobby and competition purposes in Kırıkkale.

MATERIAL AND METHODS

Approvals for collection of samples and the carrying out the study were obtained from Kırıkkale University Animal Experiments Local Ethics Committee (12.12.2022 dated and E-608221397-137394 numbered letter). Fecal samples of the pigeons were collected in this study by visiting the houses where tumbler pigeons were raised in Kırıkkale. One hundred and five (105) stool samples were obtained as one sample from each cage reached. A care was exercised to ensure that the samples were fresh during sample collection. The fresh stool samples collected were taken separately in plastic containers with caps and delivered to Kırıkkale University Veterinary Faculty Parasitology Department Laboratory within approximately 2 hours. Stool samples were analyzed by Carbolfuchsin staining, Native-Lugol staining and Fulleborn flotation techniques. Carbolfuchsin staining preparations were examined under a light microscope at x100 magnification; native-lugol staining preparations were examined under a light microscope at x40 magnification; and preparations prepared with Fulleborn flotation technique were examined under a light microscope at x10 magnification. The stools including the oocysts of *Eimeria* spp. detected by the Fulleborn flotation method were taken into 2.5% Potassium dichromate for sporulation of oocysts. Sporulation of these oocysts was followed by examining them daily for a week. Sporulated oocysts were identified according to their morphological features in the light of the relevant literatüre (Aboelhadid et al. 2021).

Statistical Analysis

All data were analyzed with frequency table. Infection rates are calculated as a percentage.

RESULTS

Oocysts and/or eggs belonging to at least one parasite species were found in 82.9% of the stool samples examined during the study. It was detected that stool samples positive for parasites were infected with at least one and at most four species (Table 1). A single infection was found in 32.4% of the stool samples, and a mixed infection was found in 50.5% of the samples.

Table 1: Number of parasite species detected according to stool examination.

Number of species	Number of positive samples (n)	Ratio within positives (%)	Ratio in total (%)
Single species	34	39.1	32.4
Two species	24	27.6	22.9
Three species	20	23.0	19.0
Four species	9	10.3	8.6
Total	87	100	82.9

Four different nematode eggs and oocysts belonging to two different protozoa were found in the stool samples. *Ascaridia* spp., *Heterakis* spp., *Capillaria* spp. and *Strongyle* type eggs were found among nematodes; however, the oocyst of *Eimeria* spp. and *Cryptosporidium* spp. were detected (Figure 1). Helminth+protozoan mixture, single protozoan and single helminth infections were detected, respectively in prevalence order in stool samples which were positive for parasites (Table 2).

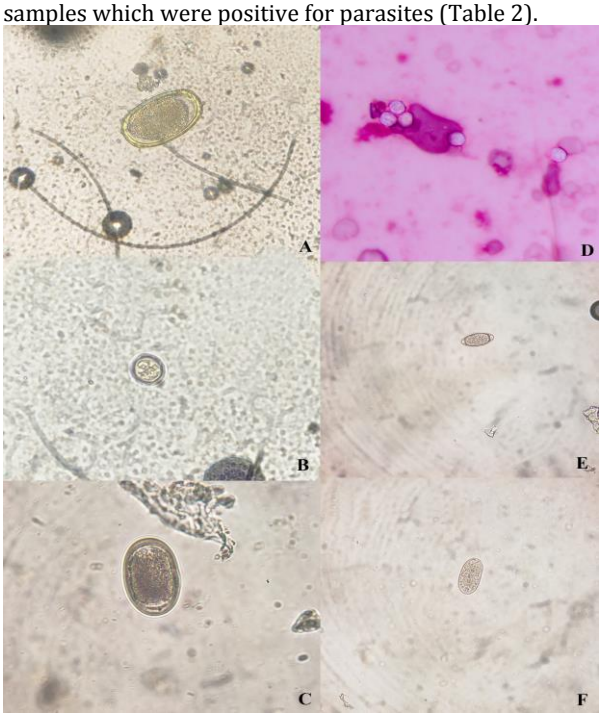

Figure 1: Parasitic eggs and oocysts detected in stool examination. A: *Ascaridia* spp. egg, B: *Eimeria* spp. oocyst; C: *Heterakis* spp. egg; D: *Cryptosporidium* spp. oocyst; E: *Capillaria* spp.; F: *Strongyle* type egg.

Table 2: Ratio of infection types detected by stool examination.

Infection type	Number of positive samples (n)	Ratio within positives (%)	Ratio in total (%)
Helminth (Single)	14	16.1	13.3
Protozoan (Single)	30	34.5	28.6
Helminth+ Protozoan (Mix)	43	49.4	40.9

The most common parasite species in stool samples examined during the study was Eimeria spp. This was followed by *Ascaridia* spp., *Capillaria* spp., *Heterakis* spp., *Cryptosporidium* spp. and *Strongyle* type eggs (Table 3).

Table 3: Parasite rates detected by stool examination in pigeon.

Parasite species	Number of positive samples(n)	Ratio within positives (%)	Ratio in total (%)
Ascaridia spp.	3	3.5	2.9
Capillaria spp.	3	3.5	2.9
Ascaridia spp.+*Capillaria* spp.	3	3.5	2.9
Eimeria spp. +*Capillaria* spp.	7	8.0	6.6
Eimeria spp.	26	29.9	24.8
Ascaridia spp. +*Heterakis* spp.	4	4.6	3.8
Eimeria spp. + *Ascaridia* spp.	7	8.0	6.6
Ascaridia spp.+ *Capillaria* spp. +*Heterakis* spp. +*Eimeria* spp.	6	6.9	5.7
Strongyle type	1	1.1	0.9
Ascaridia spp.+*Heterakis* spp. +*Eimeria* spp.	3	3.5	2.9
Ascaridia spp.+*Capillaria* spp. + *Eimeria* spp.	15	17.2	14.3
Cryptosporidium spp.,	1	1.1	0.9
Eimeria spp.+ *Cryptosporidium* spp.	3	3.5	2.9
Eimeria spp. +*Capillaria* spp. + *Cryptosporidium* spp.	2	2.2	1.9
Ascaridia spp.+*Capillaria* spp. + *Eimeria* spp.+ *Cryptosporidium* spp.	3	3.5	2.9

When the ratios of single and mixed infected feces were combined, *Ascaridia* spp. was detected by 41.9%, *Capillaria* spp. was detected by 33.3%, Eimeria spp. was detected by 68.6%, *Heterakis* spp. was detected by 12.4%, *Strongyle* type eggs was detected by 0.9, and *Cryptosporidium* spp. was detected by 8.6% (Figure 1).

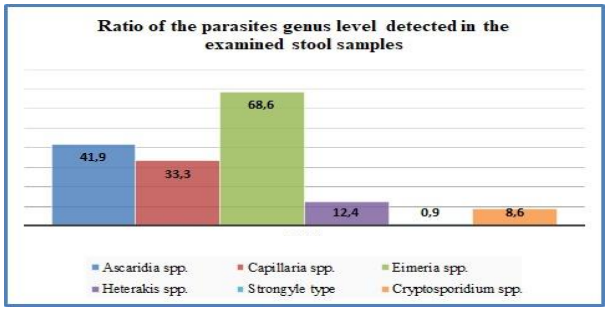

Figure 2: Ratio of the parasite's genus level detected in the examined stool samples.

All samples examined in the native-lugol staining method treated for detection of *Giardia* spp. cysts and/or trophozoites were negative for this protozoan.

DISCUSSION AND CONCLUSION

Endoparasites are infectious agents that may cause growth retardation, loss of condition and death in severe cases. Studies have been carried out to determine intestinal parasites in domestic pigeons. There is limited number of studies conducted about this subject in Turkey, and *Ascaridia* spp., *Heterakis* spp., *Capillaria* spp., *Raillietina* spp., and *Syngamus* spp. among helmiths, and *Eimeria* spp., *Isospora* spp., and *Cryptosporidium* spp. among protozoa were detected. *Eimeria* spp., and *Cryptosporidium* spp. among protozoa, and *Capillaria* spp., *Ascaridia* spp., *Heterakis* spp., and *Strongyle* type eggs among helminths were detected in this study.

Intestinal parasites were found in 82.9% of 105 pigeon feces samples examined in our study. In previous studies, this rate was between 69.16% and 87.1% in Nepal (Gurung and Subedi 2016; Adhikari et al. 2022), 81% in Indonesia (Ashfiyah et al. 2022), 84.56% in Poland (Bartosik et al. 2020); it was detected between 44.10% and 86.8% in India (Sivajothi and Sudhakara 2015; Das et al. 2022; Juby et al. 2022) and between 59.6% and 71.72% in Turkey (Sarı et al. 2008; Gül et al. 2009). It is noteworthy that intestinal parasite rates are close to each other in studies conducted in domestic pigeons around the world.

Helminth infection was found by 16.1%, protozoan infection by 34.5%, and mixed helminth+protozoan infection by 40.9% of the positive samples of this study. Sarı et al. (2008) reported in their study conducted in Niğde that 58% of domestic pigeons in which they detected parasitic agents were positive for coccidia and 42% were positive for coccidia + helminths. The mixed infection rate in stool samples analyzed in this study was 50.5%. In previous studies, Sivajothi and Sudhakara (2015) found the mixed infection rate as 31.8%, and Juby et al (2022) as 35.1% in domestic pigeons; however, Adhikari et al (2022) reported that it was 60% in pigeons fed at home, and 85.6% in those around temples. Especially the high rate of mixed parasite revealed that parasite control in pigeon breeding in Turkey and world are not done enough. This has revealed the necessity of raising the awareness of the breeders about parasitic diseases in order to reduce the presence of parasites in pigeons and to ensure that the pigeons can be reared regularly.

In studies based on fecal examination in Turkey, *Ascaridia* spp. was detected at a rate of 5.1% in Niğde (Sarı et al. 2008), and 11.03% in Van (Gül et al. 2009) in domestic pigeons. The rates revealed in the study conducted around the world were 13.58% in Poland (Bartosik et al. 2020), between 21.66% and 22.6% in Nepal (Gurung and Subedi 2016; Adhikari et al. 2022), 22% in Libya (Alkharigy et al. 2018), 42% in Indonesia (Ashfiyah et al. 2022, and between 18.60% and 33.3% in India (Sivajothi and Sudhakara 2015; Das et al. 2022). In this study, *Ascaridia* spp. was detected at a rate of 41.9%. This rate is the highest with *Ascaridia* spp. detected in domestic pigeons in Turkey which is higher than the rates reported in other countries in the world, with the exception of Indonesia (Ashfiyah et al. 2022). The cause for the higher rate in our study is considered to be due to the fact that pigeon breeders in Kırıkkale are constantly taking new pigeons to their coops in an uncontrolled manner, and

they do not perform parasite examination and anthelmintic treatment.

According to fecal examination, the rates of *Heterakis* spp. eggs detected in different provinces of Turkey were 3.7% in Niğde (Sarı et al. 2008), 6.2% in Van (Gül et al. 2009); such rates were detected by 45% in Tuban, Indonesia (Ashfiyah et al. 2022), and 2.5% in Nepal (Gurung and Subedi 2016). This rate was detected as 12.4% in the present study. *Heterakis* spp. were determined at the highest rate in this study according to the fecal examination of pigeons in Turkey. *Heterakis* spp. detected in this study is quite low compared to the rate found in Indonesia. The difference in the number of samples examined, sampling locations, the diagnostic methods used, and the farming conditions of the pigeons may be effective in the emergence of these different rates.

Capillaria spp. eggs were found in 33.3% of domestic pigeon stools examined in our study. Such rate was found as 18.62% in Van (Gül et al. 2009) and 19.9% in Niğde (Sarı et al. 2008) in other studies conducted in Turkey. The rates in the studied conducted all over the world were 32.71% in Poland (Bartosik et al. 2020), 41% in Indonesia (Ashfiyah et al. 2022), 31.67% in Nepal (Gurung and Subedi 2016), 9.30% in India; *C. obsignata* (Das et al. 2022) by 17.4%, *C. columbae* (Sivajothi and Sudhakara 2015), and *Capillaria* spp. by 19.7% (Juby et al. 2022). This rate is similar to the studies conducted around the world and in Turkey. It is considered that the differences in the results are due to the difference in the number of samples examined and the diagnostic methods used.

Adhikari et al. (2022) detected *Strongyle* spp. by 5.2%, *Strongyle avium* by 12.79% (Das et al. 2022) in India. In our study, the amount of *Strongyle* type eggs was detected as 0.9%. No other study was found in Turkey in which *Strongyle* type eggs were determined in pigeons. The results of this study revealed that *Strongyle* species of intestinal nematodes are also present in pigeons in Turkey. It was concluded that more studies should be carried out to determine the prevalence of *Strongyle* species in domestic pigeons in Turkey.

Coccidiosis is one of the most important protozoal infections of poultry. The rate of *Eimeria* spp. was detected between 59.6% and 67.58% in domestic pigeons in previous studies conducted in Turkey (Sarı et al. 2008, Gül et al. 2009). The *Eimeria* spp. rate was determined as 68.6%. This rate is similar to the rate detected in other studies conducted in Turkey. This result was higher than those detected in China by 52.8% (Dong et al. 2018), in India between 8.13% and 39.5% (Sivajothi and Sudhakara 2015; Das et al. 2022, Juby et al. 2022), in Iraq by 8.1% (Ul-Jabbar et al. 2019), in Colombia by 36% (Walteros-Casas et al. 2021) in Iran by 40.9% (Radfar et al. 2012), and lower than the rates detected in Poland as 80.86% (Bartosik et al. 2020) and Brazil by 100% (Marques et al. 2007). The high detection of *Eimeria* spp. in domestic pigeons made us think that the breeders did not pay enough attention to water and food hygiene, and that they did not comply with the quarantine conditions when new animals were taken into the poultry houses. The *E. labbeana, E. columbarum, E. columbae* and *Isospora* spp. were reported as coccidiosis strains in the studies conducted in Turkey (Sarı et al. 2008; Gül et al. 2009). All of the *Eimeria* spp. oocysts sporulated in this study were identified as *E. labbeana* according to their morphological features.

There are limited studies on the determination of *Cryptosporidium* spp. in pigeons in Turkey and the world (Sarı et al. 2008; Abreu-Acosta et al. 2009; Gül et al. 2009; Radfar et al. 2012; Li et al. 2015; Oliveira et al. 2017; Adhikari et al. 2022). The causative agent could not be detected in pigeons in Turkey based on fecal examination (Sarı et al 2008; Gül et al 2009); however, it was reported that oocysts of the agent were detected histo-pathologically in the necropsy of a 10-day old dovelet (Özkul and Aydın 1994). The rate of *Cryptosporidium* spp. was detected between 0.82% and 50% (Abreu- Acosta et al. 2009; Radfar et al. 2012; Li et al. 2015; Oliveira et al. 2017; Mehmood et al. 2019; Adhikari et al. 2022). In the stool samples examined in this study, 8.6% of *Cryptosporidium* spp. oocysts were detected. This is the first study in Turkey in which the agent was determined according to stool examination. Many reasons such as the care conditions of the pigeons, the care given to the cleanliness of the feeders and waterers, the quality of the water given to the animals may be the reason for the different results in the studies.

Consequently, this is the first study on detection of intestinal parasites in tumbler pigeons in Kırıkkale region. *Cryptosporidium* spp. was detected for the first time in Turkey by fecal examination. The highest *Ascaridia* spp., *Heterakis* spp. and *Capillaria* spp. rate has been detected in the pigeons in Turkey up to date. The higher rate of detection of intestinal parasites in pigeons fed for hobby is an indication that parasite control is not done at an adequate level. It has been revealed that animal owners should be informed about the issue, attention should be paid to the cleanliness and hygiene of pigeon cages, and more importance should be given to the diagnosis and treatment of intestinal parasites in these animals in order to reduce the prevalence of parasitic infections in pigeons in the region.

CONFLICTS OF INTEREST

The authors report no conflicts of interest.

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AUTHOR CONTRIBUTIONS

Idea / Concept: SG, EU, BNP
Supervision / Consultancy: SG
Data Collection and / or Processing: SG, EU, BNP
Analysis and / or Interpretation: SG, EU, BNP
Writing the Article: SG
Critical Review: SG, EU, BNP

REFERENCES

Aboelhadid SM, Arafa WM, Abdelaty AS et al. (2021). Remarks on *Eimeria labbeana* infection in domestic pigeons ‘‘Columbia livia domestica’’. *J Parasit Dis*, 45 (4), 1145-1151.

Abreu-Acosta N, Foronda-Rodríguez P, López M et al. (2009). Occurrence of *Cryptosporidium hominis* in pigeons (*Columba livia*). *Acta Parasitol*, 54 (1), 1-5.

Adhikari RB, Ale PB, Dhakal MA et al. (2022). Prevalence and diversity of intestinal parasites in household and temple pigeons (*Columba livia*) in central Nepal. *Vet Med Sci*, 8, 1528-1538.

Ali M, Ibrahim R, Alahmadi S et al. (2020). Ectoparasites and intestinal helminths of pigeons ın Medina, Saudi Arabia. *J Parasitol*, 106 (6), 721-729.

Alkharigy FA, El Naas AS, El Maghrbi, AA (2018). Survey of parasites in domestic pigeons (*Columba livia*) in Tripoli, Libya. *Open Vet J,* 8 (4), 360-366.

Ashfiyah MA, Koesdarto S, Eliyani H, et al. (2022). Prevalence of digestive endoparasites (helminth and protozoa) in pigeon domestic (*Columba livia*) male and female in Tuban. *JoPS*, 6 (1), 13-18.

Bartosik J, Łojek J, Vetter W et al. (2020). Prevalence of intestinal parasitic infections of carrier pigeons from central Poland in the years 2012-2019. *Med Weter*, 76 (12), 714-717.

Das M, Kumar R, Laha R et al. (2022). Parasites of pigeons (*Columba Livia Domestica*) in the Hilly Region of Meghalaya. *ASVS*, 4 (4), 27-31.

Dong H, Zhao Q, Zhu S, et al. (2018). Prevalence of *Eimeria* infection in domestic pigeons (*Columbia livia domestica*) in Shangai, China. *J Vet Med Res*, 5 (8), 1155.

Dranzoa C, Ocardo M, Katete P (1999). The ecto-gastrointestinal and haemo-parasites of live pigeons (*Columba livia*) in Kampala, Uganda. *Avian Pathol*, 28, 119-124.

Elmajdoub LO, Mshiheet KA (2016). A survey of intestinal parasitic infection among domestic pigeons in Misurata, Libya. *The Third Symposium on Theories and Applications of Basic and Biosciences*. p:63-67.

Gurung A, Subedi JR (2016). Prevalence of gastrointestinal parasites of pigeons (*Columba* sp. Linnaeus, 1758) in three temples of Pokhara valley, Nepal. *J Nat Hist Mus*, 30 (18), 287-293.

Gül A, Özdal N, Değer S et al. (2009). Van'da evcil güvercinlerde (*Columbia livia domestica*) coccidia ve helmint türlerinin yayılışı. *YYU Vet Fak Derg*, 20 (2), 45-48.

Juby T, Tresamol PV, Vijayakumar K et al. (2022). Occurrence of gastrointestinal parasites among pigeons in Kerala. *J Vet Anim Sci*, 53 (1), 39-43.

Li J, Lin X, Zhang L et al. (2015). Molecular characterization of *Cryptosporidium* spp. in domestic pigeons (*Columba livia domestica*) in Guangdong Province, Southern China. *Parasitol Res*, 114 (6), 2237-2241.

Marques SMT, De Quadros RM, Da Silva CJ et at. (2007). Parasites of pigeons *(Columba livia*) in urban areas of lages, Southern Brazil. *Parasitol Lationam*, 62, 183-187.

Mehmood S, Nashiruddullah N, Ahmed JA et al. (2019). Parasitic affections of domesticated pigeons (*Columba livia*) in Jammu, India. *Ann Parasitol*, 65 (1), 53-64.

Oliveira BCM, Ferrari ED, da Cruz Panegossi MF et al. (2017). First description of *Cryptosporidium parvum* in carrier pigeons (*Columba livia*). *Vet Parasitol*, 243, 148-150.

Özkul IA, Aydın Y (1994). Small-intestinal cryptosporidiosis in a young pigeon. *Avian Pathol*, 23, 369-372.

Radfar MH, Asl EN, Seghinsara HR, et al. (2012). Biodiversity and prevalence of parasites of domestic pigeons (*Columba livia domestica*) in a selected semiarid zone of South Khorasan, Iran. *Trop Anim Health Prod*, 44 (2), 225-229.

Sales J, Janssens GPJ (2003). Nutrition of the domestic pigeon (*Columba livia domestica*). *Worlds Poult Sci J*, 59, 221-232.

Sarı B, Karatepe B, Karatepe M et al. (2008). Parasites of domestic (*Columba livia domestica*) and wild (*Columba livia livia*) Pigeons in Niğde, Turkey. *Bull Vet Inst Pulawy,* 52, 551-554.

Sivajothi S, Sudhakara RB (2015). A study on the gastro intestinal parasites of domestic pigeons in YSR Kadapa district in Andhra Pradesh, India. *J Dairy Vet Anim Res*, 2 (6), 216-218.

Şenlik B, Güleğen E, Akyol V (2005). Effect of age, sex and season on the prevalence and intensity of helminth infections in domestic pigeons (*Columba livia*) from Bursa Province, Turkey. *Acta Vet Hung*, 53, 449-456.

Ul-Jabbar A, Aljoburi MH, Jassim NA et al. (2019). Detection of the parasites which infect the pigeons in the Sharqat City, Salah Al-Deen Province. *Assiut Vet Med J*, 651 (60), 25-30.

Walteros-Casas HA, Hernández-Martínez MC, Góngora-Orjuela A et al. (2021). Identification of ecto and endoparasites in domestic pigeons (*Columba livia*) from the urban area of Villavicencio, Meta, Colombia. *Rev MVZ Cordoba*, 26 (3), e2157.

Yılmaz O, Boz MA (2012). Türkiye'de amatör güvercin yetiştiriciliğinin durumu ve kullanılan yöresel tip sınıflandırmaları. *Akademik Ziraat Dergisi*, 1 (1), 41-66.