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## Survey of parasites in domestic pigeons (*Columba livia*) in Tripoli, Libya

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### Abstract

This study was a preliminary survey for identification of parasites (endoparasites and ectoparasites) and their prevalence in domestic pigeons (*Columba livia*) in Tripoli; Libya. One hundred adult domestic pigeons were purchased from different markets of Tripoli. Blood smears were prepared from each bird and examined using light microscopy with oil immersion lens for the presence of blood parasites. Oropharyngeal swab was taken from each pigeon and were processed through direct smear method and staining with Giemsa to identify *Trichomonas gallinae*. Each pigeon was examined for ectoparasites. Moreover, intestinal parasites were investigated and all helminths were counted before being fixed in 70% ethyl alcohol for further identification. Out of 100 pigeons examined, 76% (76/100) were infected with *Haemoproteus* spp. and 55% (55/100) with *T. gallinae*. The overall prevalence of ecto-parasitic infestation was 89% (82% *Columbicloa columbae*, 18% *Goniodes gallinae*, 3% *Menopon gallinae* and 1% *Pseudolynchia canariensis*). The overall prevalence of intestinal helminths in examined pigeons were 56% (56/100). Three species of Cestoda (2% *Raillietina tetragona*, 32% *R. echinobothrida* and 4% *R. cesticillus*) and three species of Nematoda (18% *Heterakis gallinarum*., 22% *Ascaridia galli* and 4% *Capillaria* spp.) were identified. Also, this study revealed that the pigeons examined were found infected with mixed parasites. The study highlights that pigeons are hosts of helminths of veterinary importance and may act as an important source of infection for other avian host, which share the common parasitic fauna.

**Keywords:** *Columba livia*, Ectoparasite, Endoparasite, Libya, Tripoli.

### Introduction

Pigeons are live side by side with other animal species in the nature. Also, causes contamination of surroundings with their droppings. In Libya, pigeons are mainly kept for fancy and performing purposes. However, in many parts of the country pigeons are seen daily search for food together with other poultry species. Pigeons may be infected with many organisms, as a reservoir of many parasitic diseases for poultry and the close contact of pigeons with other domestic birds increases risk of parasitic infestation in birds (Piasecki, 2006; Sari *et al.*, 2008).

Nematodes are one of the endoparasitic problems of pigeons. According to the studies conducted in different regions of the world, *Ascaridia columbae*, *Capillaria* spp., *Dispharynx* spp., and *Tetrameres* spp. were commonly identified in pigeons (Harlin, 1994; Dovc *et al.*, 2004). Adang *et al.* (2008) in Zaria, Nigeria; they found that speckled pigeons were infested with *Menopon gallinae*, *Columbicola columbae*, *Pseudolynchia canariensis* and were infected with cestodes; *Raillietina tetragona*, *Raillietina cesticillus*, *Amoebotaenia cuneata* and *Hymenolepis carioca* (Magalhaes). In green mountain (El- Jabal Akhtar) region in Libya, Eljadar *et al.* (2012) they are found

90% of 30 pigeon (*Columba livia*) examined were infected with *Eimeria* spp., Nematodes (20% for *Capillaria* spp., 10% for *Heterakis* spp. and 5% of the fecal samples were infected by multiple parasites and 1% *Haemoproteus* spp.

The prevalence rate of trichomoniasis in domestic and wild birds maintained at the Zoological Garden, Lahore, Pakistan was found to be 26% and 60%, respectively (Saleem *et al.*, 2008). In Khorasan province, Iran, Borji *et al.* (2011), found that 156 out of 418 pigeons (*Columba livia*) examined were infected with *Trichomonas gallinae*. The prevalence of trichomoniasis in pigeons in Bursa, Turkey, was 75.78% (Gulegen *et al.*, 2005).

The conception of parasitic diseases of pigeons will help in contemplate the measures to improve health of these birds in Libya. The reason for studying the parasites of domestic pigeons is because they are might transmit their parasites to other domestic birds and wild birds. Several research works have been conducted on parasitic diseases of pigeon in several countries of world but limited works conducted in Libya. Therefore, the aim of this study was performed to identify internal and external parasites and their prevalence in domestic pigeon in Tripoli, Libya.

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### Materials and Methods

One hundred adult domestic pigeons (*Columba livia*) were purchased from the different markets of Tripoli (which captured from the city).

Blood samples for the preparation of blood smears were obtained from a wing vein of each bird by using 2 ml syringe and needle. Blood was poured into EDTA anticoagulant vacutainer tubes. The air-dried blood smears were subsequently fixed in absolute methanol and stained with Giemsa's solution for 45 minutes. The smears were later examined using light microscopy with an oil immersion lens for the presence of blood parasites.

Oropharyngeal swab was taken from each pigeon. They were processed through direct smear method and staining with Giemsa (Coles, 1980) to identify the *T. gallinae*. After the decapitation each pigeon, it was immediately placed in a polythene bag and the ectoparasites were collected after leaving the pigeons. Also, each bird was visually inspected and their whole body was fully examined. The external parasites of each were preserved in 70% alcohol for identification. For intestinal parasitic investigation, the postmortem examination was done according to Fowler (1996) and all helminths were collected in dishes and counted under a dissecting microscope. The worm burden per bird was determined then fixed in 70% ethyl alcohol and then cleared in lactophenol (Searle, Essex, England) for 10-15 minutes. The specific identity of collected helminths was determined according to criteria described by Yamaguti (1959, 1961) and Soulsby (1986).

### Results

Of one hundred pigeons examined, 76% and 55% were infected with *Haemoproteus* spp. and *T. gallinae* respectively. The ectoparasites were found in 89 pigeons (89%). Four different species were identified: *Columbicloa columbae* (82%), *Goniodes gallinae* (18%), *Menopon gallinae* (3%) and *Pseudolynchia canariensis* (1%) (Table 1). Cestodes and nematodes worms were also found in examined pigeon, whereas no trematodes were found. The overall prevalence of intestinal helminths in investigated pigeons were 56% (56/100). Three species of Cestoda were identified (Table 2): *Raillietina tetragona* (2%), *R. echinobothrida* (32%) and *R. cesticillus* (4%). Three species of Nematoda (Table 2): *Heterakis gallinarum* (18%), *Ascaridia galli* (22%) and *Capillaria* spp. (4%) were also identified. The number of cestodes (*R. tetragona*, *R. echinobothrida* and *R. cesticillus*) and nematoda worms (male and female) were numerated (Table 3 and 4). In addition, this study revealed that the pigeons investigated were found infected with mixed parasites. Different species of ectoparasites, endoparasites and type of helminth infections were found in the same examined pigeon (Table 5 - 7).

**Table 1.** Prevalence of external parasites found in infected pigeons.

Total samples	Ectoparasites	Prevalence %
100	<i>C. columbae</i>	82 (82/100)
	<i>G. gallinae</i>	18 (18/100)
	<i>M. gallinae</i>	3 (3/100)
	<i>P. canariensis</i>	1 (1/100)
Over all prevalence		89%

**Table 2.** Prevalence of helminths (Cestodes and Nematodes) found in infected pigeons

Helminths	Prevalence %	Prevalence %
Cestodes	<i>R. tetragona</i>	2 (2/100)
	<i>R. echinobothrida</i>	32 (32/100)
	<i>R. cesticillus</i>	4 (4/100)
Nematodes	<i>H. gallinarum</i>	18 (18/100)
	<i>A. galli</i>	22 (22/100)
	<i>Capillaria</i> spp.	4 (4/100)
Over all prevalence		57%

**Table 3.** Total and number of nematodes worms found in infected pigeons

Nematodes	Positive samples	Male	Female	No. of worms	Total worms
<i>H. gallinarum</i>	18	66	81	147	576
<i>A. galli</i>	22	113	311	424	
<i>Capillaria</i> spp.	4	-	5	5	
Total samples		100			

**Table 4.** Total and number of cestodes worms found in infected pigeons.

Cestodes	Positive samples	No. of worms	Total worms
<i>R. tetragona</i>	2	2	135
<i>R. echinobothrida</i>	32	95	
<i>R. cesticillus</i>	4	38	
Total samples		100	

**Table 5.** Percentage of pigeons found infected with multiple parasites.

Parasites	Prevalence %
<i>C. columbae</i> + <i>G. gallinae</i>	10
<i>C. columbae</i> + <i>M. gallinae</i>	2
<i>Haemoproteus</i> + <i>T. gallinae</i>	18
<i>C. columbae</i> + <i>G. gallinae</i> + <i>P. canariensis</i>	1
Total samples	100

**Table 6.** Type of helminth infections in examined pigeons.

Infection type	Prevalence %	Total %
<b>Single infection</b>		
<i>H. gallinarum</i>	2	37
<i>A. galli</i>	8	
<i>R. echinobothrida</i>	26	
<i>R. tetragona</i>	1	
<b>Double infection</b>		
<i>R. tetragona</i> + <i>R. echinobothrida</i>	1	11
<i>R. echinobothrida</i> + <i>R. cesticillus</i>	1	
<i>H. gallinarum</i> + <i>A. galli</i>	7	
<i>R. cesticillus</i> + <i>H. gallinarum</i>	1	
<i>R. echinobothrida</i> + <i>H. gallinarum</i>	1	
<b>Triple infection</b>		
<i>H. gallinarum</i> + <i>A. galli</i> + <i>Capillaria</i> spp.	4	8
<i>R. echinobothrida</i> + <i>R. cesticillus</i> + <i>H. gallinarum</i>	1	
<i>R. echinobothrida</i> + <i>H. gallinarum</i> + <i>A. galli</i>	2	
<i>R. cesticillus</i> + <i>H. gallinarum</i> + <i>A. galli</i>	1	

**Table 7.** Percentage of pigeons found infected with multiple infection.

Parasites	Total positive samples
Ectoparasites and endoparasites	97%
Ectoparasites and haemoparasite	69%
Ectoparasites and helminths	46%
Helminths and protozoa	54%
Total samples	100

## Discussion

### Prevalence of protozoan Parasitic Infections

Trichomoniasis in pigeons is a disease caused by the flagellated protozoan (*T. gallinae*). It causes a condition known as "canker". Infected birds frequently show no clinical signs of disease. Chickens, Turkeys and various of wild birds species were parasitized with different degrees of pathogenicity (Levine, 1973). *T. gallinae* is a protozoan parasite usually found in the upper digestive tract of columbids and avian predators that feed on columbids (Conti, 1993). The present study revealed that the prevalence of trichomoniasis in pigeons was 55% (55/100). In comparison Villanua *et al.* (2006) found the prevalence of trichomoniasis in common wood pigeon in Spain as 34.2%. In south khorasan in Iran, Radfar *et al.* (2011) recorded 57.84%; in Qualiobia governorate Egypt, Abd El-Rahman *et al.* (2008) revealed 68.92 % and in Colombia, Pérez-García *et al.* (2015) reported (40%). The differences in

the prevalence rate in the various studies is predictable for many factors which affect the occurrence of the disease such as the host resistance, feeding habits, climatic conditions, geographical difference and housing conditions. In the present study, trichomoniasis was reported in apparently healthy pigeons. The reason for the high prevalence may be due to transmission of the parasite when the adults feed their young or through food feeder and water. Adult birds may remain infected for a year or more and are a constant source of infection for their young (Soulsby, 1986).

*Haemoproteus columbae* and its vector *P. canarensis* are widely distributed in the world especially in tropical and subtropical regions (Soulsby, 1986). Out of 100 pigeons examined for blood parasites in the current study, 76% (76/100) were positive only for *Haemoproteus* spp. Many studies have determined that the most common blood parasite found in pigeons is *Haemoproteus*. Our result agreed with the studies done in Uganda by Dranzoa *et al.* (1999) found *Haemoproteus* spp. (76.5%). More-over, In Kirikkale Province, Turkey, Sürsal *et al.* (2017) recorded that this parasite was detected in 73.9% of pigeons over 1 year old. in Colombia, Pérez-García *et al.* (2015) reported (73%). In other countries, the studies reported that the prevalence of this blood parasite was lower than that found in this study. Youssefi and Rahimi (2010) found a prevalence of 30% in three different locations in Iran. Also, Samani *et al.* (2013) in Southwest Iran was 24%. Hussein and Abdelrahim (2016) in different localities of Qena Governorate, Egypt reported a prevalence of (57.2%). No other haemoprotozoan parasite was observed in the blood smear of examined pigeon. Previous studies reported the prevalence of this haemoparasite in chicken, in Ghana, Poulsen *et al.* (2000); in Zimbabwe, Permin *et al.* (2002) was 37 and 35%, respectively. The higher prevalence of haemoparasites in pigeons could be attributed to the unhygienic nature of the environment where these birds are kept.

### Prevalence of Ecto-Parasitic Infestations

External parasites are living on the skin or feathers, using the host as a shelter and source of food. Ectoparasites have significant impacts on health and productivity of animal. The overall prevalence of ectoparasites found in this study was 89% (89/100) of pigeon examined. Four different species were identified: *C. columbae* (82%), *G. gallinae* (18%), *M. gallinae* (3%) and *P. canariensis* (1%). In addition, the current investigation observed a mixed infestation. Radfar *et al.* (2011) mentioned that double infestation of pigeon could be due to that ectoparasites can live together without causing any hurtful effects on each other. Higher prevalence of *C. columbae* in pigeons also reported by many authors, Dranzoa *et al.* (1999) and Foronda *et al.* (2004) found 94.1 and 100% in

Uganda and Tneriffe respectively. In south khorasan in Iran, Radfar *et al.* (2011) reported higher prevalence of ectoparasites in pigeon, *C. columbae* (79.41%), *M. gallinae* (44.11%) and *P. canariensis* (63.72%). Jahantigh *et al.* (2016) in Zabol, southeast of Iran, 78.40% of pigeons were infected with *C. columbae*. Pérez-García *et al.* (2015) in Colombia, recorded that *C. columbae* (64%), *P. canariensis* (52%), *M. gallinae* (24%). In the other study in Mashhad city Iran, Borji *et al.* (2012) found that *C. columbae* (42.8%), *P. canariensis* (16.1%) and *M. gallinae* (7.1%).

These ectoparasites were also reported in the free-range chicken. Radfar *et al.* (2012b) observed that *M. gallinae* had the highest prevalence (55.93%) in free range backyard chickens and followed by *C. columbae* (41.30%) in domestic pigeons. The infestation with *C. columbae* in this study agreed with Harlin (1994) who recorded that *C. columbae* is the most common malophagian parasite of pigeons. The infestation of pigeons is probably quite like that of chickens and other birds (Hamad-Ameen and Al-Iraqi, 2007). So, the pigeon management programs should be taken place to reduce the risk of the transmission of parasites in the country.

#### **Prevalence of Intestinal Parasitic Infections**

All the cestodes identified in the pigeons of this study belonged to the genus *Raillietina*. This agree with similar studies in other parts of the world, reporting that the most common internal parasites of the rock pigeon are the tape worms of the genus *Raillietina* (Dede and Richards, 1998; Dehlawi, 2006). In the current study, the overall prevalence of intestinal helminths in pigeons was 56% (56/100). However, in Egypt, Nagwa *et al.* (2013) reported prevalence rate of 51.7% in Gharbia provinces. Furthermore, 23.18% in Urmia, Iran (Khezerpour and Naem, 2013) and 74% in Bursa Province, Turkey (Senlik *et al.*, 2005).

The prevalence of cestodes was 35% (35/100). However, Nagwa *et al.* (2013) found prevalence rates of 30.9% in domestic pigeons in Gharbia provinces, Egypt. In our study the prevalence of *R. tetragona*, *R. echinobothrida* and *R. cesticillus* were 2%, 32% and 4% respectively. In comparison with Ashrafihelan *et al.* (2010) recorded that the prevalence of tapeworms was 28.13% in domestic pigeons in Iran. The prevalence of *R. echinobothrida* in the current study was similar to that reported by Radfar *et al.* (2011) 32.35% in South Khorasan, Iran but higher than found by Nagwa *et al.* (2013) 17.7% in domestic pigeons, Gharbia, Egypt, Natala *et al.* (2009) in Nigeria 7.6% and lower than those recorded by Sam-Wobo and Mafiana (2003) in Nigeria and Ashenafi and Eshutu (2004) in Central Ethiopia with prevalence of 35.9 and 65.3% respectively. This Variation might be related to the presence of intermediate hosts, decreased host immunity and bad control and management in either

birds or the surrounding environment. A higher number of the infected pigeons had single infection were 27% (27/100) compared to those that had a mixed infection with *R. echinobothrida* and *R. cesticillus* 1 pigeon (1 %) and *R. echinobothrida* and *R. tetragona* also 1 pigeons (1%) while no triple infection was recorded. Adang *et al.* (2008) and Borji *et al.* (2012) recorded in a similar study that single infection was higher than mixed ones. Therefore, the higher prevalence of single species infection depends on the initiation of infection in the host which may acquire higher habitat and less suitable for late infection.

The current study revealed that the overall prevalence of nematodes was 27% (27/100) which was higher than that reported by Nagwa *et al.* (2013) in Egypt, 14.3% and lower than that recorded by Tanveer *et al.* (2011) in Pakistan, 40.5%. The prevalence of *Ascaridia galli* (22%) in our investigation was higher than those determined by Radfar *et al.* (2012a) in Iran, Nagwa *et al.* (2013) in Egypt, Natala *et al.* (2009) in Nigeria and Djelmoudi *et al.* (2014) in Algeria, 16.66%, 12%, 1.2 % and 4.2% respectively but was lower than those reported by Permin *et al.* (2002) in Zimbabwe, Sam-Wobo and Mafiana (2003) in Nigeria and Abed *et al.* (2014) in Al-Dewaniya city, Iraq which had 69, 73.4% and 38.94% respectively. *A. columbae* is one of the common nematodes of pigeons which have been reported in different parts of the world (Mushi *et al.*, 2000; Senlik *et al.*, 2005; Msoffe *et al.*, 2010). The prevalence of *Capillaria* spp. (4%) was like that recorded by Baris *et al.* (2008) in Turkey, (4.3%). It was higher than that recorded by Khezerpour and Naem (2013) in domestic pigeons in Iran (0.72%) but lower than those recorded by Ghosh *et al.* (2014) in Bangladesh and Eljadar *et al.* (2012) in Green Mountain Region, Libya, 22 and 20% respectively. The prevalence of *Heterakis* spp. was 18% which was found to be lower than done by Ashenafi and Eshutu (2004) in Central Ethiopia 32.6 in chickens but higher than those reported by Eljadar *et al.* (2012) in domestic pigeon in Green Mountain Region, Libya 10%; Borji *et al.* (2012) in Mashhad Iran 1.85% and Baris *et al.* (2008) in Turkey 3.7%. The nematode, *H. gallinarum* is non-pathogenic, but a vector for *Histomonas meleagridis* which is highly pathogenic causing Black-head disease which lethal to chickens, turkeys, pheasants and other fowls. The overall mixed infection of nematodes 14% (10% with *H. gallinarum* and *A. galli*; 4% with *H. gallinarum*, *A. galli* and *Capillaria* spp.).

Our study revealed mixed infection with helminths which agree with El-Dakhly *et al.* (2016) in Beni-Suef, Egypt, found that *R. echinobothrida* was shown to be an important cestode of pigeons and one harboured a single nematode and a single cestode. Msoffe *et al.* (2010) in Tanzania; Abed *et al.* (2014) in Iraq, they

reported multiple parasites infection in pigeons. However, in the present study none of the pigeon harboured trematode parasites. This our result agrees with many studies done by Abed *et al.* (2014) in Iraq; Borji *et al.* (2012) in Mashhad city. This might be due to absence of lakes and non-accessibility of intermediate hosts in these areas.

The worm burden in pigeons in this study (worms/bird) ranged from (1-119) for *A. galli*, (1-42) for *H. gallinarum* and (1-2) for *Capillaria* spp. For cestodes; (1) for *R. tetragona*, (1-14) for *R. echnobothrida* and (1-30) for *R. cesticillus*. Msoffe *et al.* (2010) reported that worms/bird was ranged from (2-160) for *A. galli*, while cestode; (1-6) for *R. tetragona* and (1-18) for *R. echnobothrida*. El-Dakhly *et al.* (2016) who recorded (1-170) for *Ascaridia* spp., (1-5) for *R. tetragona*, (2-41) for *R. echnobothrida*, (2-7) for *R. cesticillus* and (1) for *Capillaria* spp. Based on the authors' knowledge, infective dose, availability of intermediate hosts may be indicative to the variability of the worm burdens.

#### Conclusion

In conclusion, our study indicated that more studies are required for different parts of Libya in pigeon and other birds particularly chickens, turkey and ducks. Almost all the birds were found to be infested with different types of endoparasites and ectoparasites. Mixed infections were also seen in pigeons. Therefore; it was concluded that pigeon management programs and public education should be implemented to reduce the risk of a pigeon to livestock transmission of pathogenic agents and parasites in the country. However, this study will make the way to take further extensive study related to these infections which will help to take necessary preventive and control measures against them.

#### Conflict of interest

The authors declare that there is no conflict of interest.

#### References

- Abd El-Rahman, M.A.M., Seddiek, Sh.A. and Soliman, A.S. 2008. Some Studies on Trichomoniasis of Pigeons at Qualiobia Governorate. Egyptian J. Comp. Pathol. Clin. Pathol. 21(2), 123-141.
- Abed, A.A., Naji, H.A. and Rhyaf, A.G. 2014. Investigation study of some parasites infected domestic pigeon (*Columba livia domestica*) in Al-Dewaniya city. IOSR- JPBS. 9(4), 13-20.
- Adang, K.L., Oniye, S.J., Ajanusi, O.J., Ezealor, A.U. and Abdu, P.A. 2008. Gastrointestinal helminths of the domestic pigeons (*Columba livia domestica* Gmelin, 1789 Aves: Columbidae) in Zaria, Northern Nigeria. Sci. World J. 3(1), 33-37.
- Ashenafi, H. and Eshutu, Y. 2004. Study on Gastrointestinal Helminths of local chickens in Central Ethiopia. Revue. Med. Vet. 155(10), 504-507.
- Ashrafihelan, J., Noroozi, R., Hosseini, S.H., Nematollahi, A.R., Mahpaekar, H.A. and Arefi, A. 2010. Identification and infection rate of alimentary tract to helminth parasites in domestic pigeons (*Columba livia domestica*) of Tabriz. Sci. Res. Iranian Vet. J. 6(3), 52-58.
- Baris, S., Karatepe, B., Karatepe, M. and Murat, K. 2008. Parasites of domestic (*Columba livia domestica*) and wild (*Columba livia livia*) pigeons in Niğde, Turkey. Bull. Vet. Inst. Pulawy. 52, 551-554.
- Borji, H., Moghaddas, E., Razmi, G.H., Bami, M.H., Mohri, M. and Azad, M. 2011. Prevalence of pigeon haemosporidians and effect of infection on biochemical factors in Iran. J. Parasit. Dis. 35(2), 199-201.
- Borji, H., Moghaddas, E., Razmi, G.R. and Azad, M. 2012. A survey of ecto- and endo-parasites of domestic pigeons (*Columba livia*) in Mashhad, Iran. Iranian J. Vet. Sci. Technol. 4(2), 37-42.
- Coles, E.H. 1980. Veterinary Clinical Pathology. 3<sup>rd</sup> Ed., W.B., Sounder's Company, Philadelphia USA.
- Conti, J.A. 1993. Diseases, parasites and contaminants. In Ecology and management of the morning dove. Baskett, T.S., Sayre, M.W., Tomlinson, R.E. and Mirachi, R.E. (eds.). Stackpole Books, Harrisburg, Pennsylvania, pp: 205-224.
- Dede, P.M. and Richards, W.S. 1998. Prevalence of helminthiasis in wild and domestic pigeons from North-east zone of Nigeria. Bull. Anim. Health Prod. Afr. 46, 193-195.
- Dehlawi, M.S. 2006. New records of cestodes from birds in Saudi Arabia. Saudi J. Biol. Sci. 13, 13-16.
- Dovc, A., Zorman-Rojs, O., Vergles-Rataj, A., Bole-Hribovsek, V., Krapez, U. and Dobeic, M. 2004. Health status of free-living pigeons (*Columba livia domestica*) in the city of Ljubljana. Acta Vet. Hung. 52, 219-226.
- Djelmoudi, Y.A., Daoudi-Hacini, M.S. and Doumandji, S. 2014. Common endoparasites of wild rock Pigeon (*Columba livia livia*) and wood Pigeon (*Columba palumbus*) in the Algiers Sahel, Algeria. Int. J. Zoo. 4(3), 99-106.
- Dranzoa, C., Ocaido, M. and Katete, P. 1999. The ecto-, gastro-intestinal and haemoparasites of live pigeons (*Columba livia*) in Kampala, Uganda. Avian Pathol. 28, 119-124.
- El-Dakhly, K.M., Mahrous, L.N. and Mabrouk, G.A. 2016. Distribution pattern of intestinal helminths in domestic pigeons (*Columba livia domestica*) and turkeys (*Meleagris gallopavo*) in Beni-Suef province, Egypt. J. Vet. Med. Res. 23(1), 112-120.
- Eljadar, M., Saad, W. and Elfadel, G. 2012. A study on the prevalence of Endoparasites of domestic Pigeons (*Columba livia domestica*) inhabiting in the

- Green Mountain Region of Libya. *J. Am. Sci.* 8(12), 191-193.
- Foronda, P., Valladares, B. and Rivera-Medina, J.A. 2004. Parasites of *Columba livia* (Aves: Columbiformes) in Tenerife (Canary Islands) and their role in the conservation biology of the Laurel pigeons. *Parasitol.* 1, 311-316.
- Fowler, N.G. 1996. How to Carry Out a Field Investigation. In: Jordan, F.T.W. and Pattison, M. (Editors) *Poultry Diseases*, 4<sup>th</sup> edi. Saunders, London, England.
- Ghosh, K.K., Islam, M.S., Sikder, S., Das, S., Chowdhury, S. and Alim, M.A. 2014. Prevalence of Ecto and Gastrointestinal Parasitic Infections of Pigeon at Chittagong Metropolitan Area, Bangladesh. *J. Adv. Parasitol.* 1(1), 9-11.
- Gulegen, E., Senlik, B. and Akyol, V. 2005. Prevalence of trichomoniasis in pigeons in Bursa province, Turkey. *Indian Vet. J.* 82(4), 369-370.
- Hamad-Ameen, K.A. and Al-Iraqi, R.A. 2007. Survey and identification of lice species on chicken in Erbil governorate. *Iraqi J. Vet. Sci.* 21, 13-21.
- Harlin, R.W. 1994. Pigeons. *Veterinary Clin. North Am. Small Anim. Pract.* 24, 157-173.
- Hussein, N.M. and Abdelrahim, E.A. 2016. *Haemoproteus Columbae* Infection and its Histopathological Effects on Pigeons in Qena Governorate, Egypt. *J. Pharm. Biol. Sci. (IOSR-JPBS)* 11(1), 79-90.
- Jahantigh, M., Esmailzade Dizaji, R. and Teymoori, Y. 2016. Prevalence of external parasites of pigeon in Zabol, southeast of Iran. *J. Parasit. Dis.* 40(4), 1548-1551.
- Khezerpour, A. and Naem, S. 2013. Investigation on Parasitic Helminths of Gastrointestinal, Liver and Lung of Domestic Pigeons (*Columba livia*) in Urmia, Iran. *Int. J. Livest. Res.* 3(3), 35- 41.
- Levine, N.D.C. 1973. *Veterinary Protozoology*. Iowa State Univ. Press, Ames.
- Msoffe, P.L.M., Muhairwa, A.P., Chiwanga, G.H. and Kassuku, A.A. 2010. A study of ecto- and endoparasites of domestic pigeons in Morogoro Municipality, Tanzania. *African J. Agric. Res.* 5(3), 264-267.
- Mushi, E.Z., Binta, M.G., Chabo, R.G., Ndebele, R. and Panzirah, R. 2000. Parasites of domestic pigeons (*Columba livia domestica*) in Sebele, Gaborone, Botswana. *J. S. Afr. Vet. Assoc.* 71(4), 249-250.
- Nagwa, E.A., Loubna, M.A., El-Madawy, R.S. and Toulan, E.I. 2013. Studies on Helminths of Poultry in Gharbia Governorate. *Benha Vet. Med. J.* 25(2), 139-144.
- Natala, A.J., Asemadahun, N.D., Okubango, O.O., Ulayi, B.M., Owolabi, Y.H., Jato, I.D. and Yusuf, K.H. 2009. A survey of parasites of domesticated pigeon (*Columba livia domestica*) in Zaria, Nigeria. *Int. J. Soft Comput.* 4(4), 148-150.
- Pérez-García, J., Monsalve-Arcila, D. and Márquez-Villegas, C. 2015. Presencia de parásitos y enterobacterias en palomas ferales (*Columba livia*) en áreas urbanas en Envigado, Colombia. *Rev. Fac. Na.c Salud Pública.* 33(3), 370-376.
- Permin, A., Esmann, J.B., Hoj, C.H., Hove, T. and Mukaratirwa, S. 2002. Ecto-, endo- and haemoparasites in free-range chickens in Goromonzi District in Zimbabwe. *Prev. Vet. Med.* 54, 213-224.
- Piasecki, T. 2006. Evaluation of urban pigeon (*Columbia livia f. urbana*) health status in relation to their threat to human's health. *Medycyna Wet.* 62, 531-535.
- Poulsen, J., Permin, A., Hindsho, O., Yelifari, L., Nansen, P. and Bloch, P. 2000. Prevalence and distribution of gastro-intestinal helminths and haemoparasites in young scavenging chickens in upper eastern region of Ghana, West Africa. *Prev. Vet. Med.* 45, 237-245.
- Radfar, M.H., Fathi, S., Asl, E.N., Dehaghi, M.M. and Seghinsara, H.R. 2011. A survey of parasites of domestic pigeons (*Columba livia domestica*) in South Khorasan, Iran. *Vet. Res.* 4(1), 18-23.
- Radfar, M.H., Asl, E.N., Seghinsara, H.R., Dehaghi, M.M. and Faith, S. 2012a. 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.
- Radfar, M.H., Khedri, J., Adinehbeigi, K., Nabavi, R. and Rahmani, K. 2012b. Prevalence of parasites and associated risk factors in domestic pigeons (*Columba livia domestica*) and free-range backyard chickens of Sistan region, east of Iran. *J. Parasit. Dis.* 36(2), 220-225.
- Saleem, M.H., Khan, M.S., Chaudry, A.S. and Samad, H.A. 2008. Prevalence of Trichomoniasis in Domestic and Wild Pigeons and Its Effects on Hematological Parameters. *Pakistan Vet. J.* 28(2), 89-91.
- Samani, A.D., Khairtabadi, K.P. and Samani, A.D. 2013. Prevalence and Rate of Parasitemia of *Haemoproteus columbae* in *Columba livia domestica* in Southwest of Iran. *Iran. J. Parasitol.* 8(4), 641-644.
- Sam-Wobo, S.O. and Mafiana, C.F. 2003. Prevalence and Identification of Helminth Parasites of local chickens of Abeokuta, Nigeria. *Asset. Series.* 2(2), 141-147.
- Sari, B., Karatepe, B., Karatepe, M. and Kara, M. 2008. Parasites of Domestic (*Columba livia domestica*) and Wild (*Columba livia livia*) Pigeons in Niğde, Turkey. *Bull. Vet. Inst. Pulawy.* 52, 551-554.

- Senlik, B., Gulegen, E. and 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. Hungarica* 53(4), 449-456.
- Sürsal, N., Atan, P., Gökpınar, S., Duru, Ö., Çakmak, A. and Yıldız, K. 2017. Prevalence of *Haemoproteus* spp. in Tumbler Pigeons (*Columba livia domestica*) in Kirikkale Province, Turkey. *Turkiye Parazitoloj Derg.* 41(2), 71-75.
- Soulsby, E.J.L. 1986. *Helminths, Arthropods and Protozoa of Domesticated Animals.* 7<sup>th</sup> Edn. Bailliere and Tindall, London, UK.
- Tanveer, M.K., Kamran, A., Abbas, M., Umer, N.C., Azhar, M.A. and Munir, M. 2011. Prevalence and chemo-therapeutical investigations of gastrointestinal nematodes in domestic pigeons in Lahore, Pakistan. *Trop. Biomed.* 28(1), 102-110.
- Villanua, D., Hofle, U., Perez-Rodriguez, L. and Gortazar, C. 2006. *Trichomonas gallinae* in wintering common wood pigeons *Columba palumbus* in Ibis, Spain. *Intern. J. Avian Sci.* 148(4), 641-648.
- Yamaguti, S. 1959. *Systema Helminthum.* Vol II. The Cestodes of Vertebrates. Interscience Publishers Inc. New York, pp: 860.
- Yamaguti, S. 1961. *Systema Helminthum.* Vol III. The Nematodes of Vertebrates. Interscience Publishers Inc. New York, pp: 679.
- Youssefi, M.R. and Rahimi, M.T. 2010. *Haemoproteus Columbae* in *Columba livia domestica* of Three Areas in Iran in 2010. *Global Vet.* 7(6), 593-595.