



Parasites of domestic and wild pigeons in the south of Ukraine

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Article info

Received 20.04.2021

Received in revised form 25.05.2021

Accepted 27.05.2021

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Bogach, M., Paliy, A., Liulin, P., Perots'ka, L., Bohach, O., Pyvovarova, I., & Paliy, A. (2021). Parasites of domestic and wild pigeons in the south of Ukraine. *Biosystems Diversity*, 29(2), 135–139. doi:10.15421/012118

Pigeons are closely related to human life and are both a source of food and object for hobbies and sports. Parasitic diseases of birds are the main reason for their growth retardation, reduced productivity and viability. The article presents the results of studying the prevalence of trichomonosis, cestodes and nematodes among the population of wild and domestic pigeons in the south of Ukraine. According to the results of the conducted researches it is established that in the south of Ukraine endoparasitoses of domestic and wild pigeons are quite widespread, and all species of this bird are carriers of *Trichomonas gallinae*. At the same time, the highest rate of *Trichomonas* infection was recorded in *Columba palambus* and *C. livia domestica*, and the overall infestation of males is higher by 4.4% compared to females. It was determined that domestic pigeons *C. livia domestica* were infested with trichomonosis (27.5%) and nematodes (*Ascaridia columbae*, 57.1%), *C. palambus* – trichomonosis (32.1%) and cestodes (*Raillietina* spp., 82.4%), *Streptopelia turtur* – cestodes (*Raillietina* spp., 12.5%) and *S. decaocto* – cestodes (*Raillietina* spp., 71.4%) and nematodes (*Heterakis gallinarum*, *A. columbae* – 33.3% and 44.4% respectively). The overall rate of infestation of pigeons with cestodes was 28.4% and the incidence in males was higher by 3.9% compared to females. It was found that the most common species among pigeon cestodes is *Raillietina* spp. In addition, 22.9% of pigeons are carriers of nematodes (*H. gallinarum*, *A. columbae* and *Capillaria* spp.). Continuous monitoring of pigeon parasites is necessary because they, in most cases, come into contact with other species of poultry and are a source of general invasion. In terms of further research, it would be promising to study the prevalence of helminthic infestation among wild migratory birds.

Keywords: trichomonosis; cestodes; nematodes; epizootic process; distribution.

Introduction

Ecological and geographical features of the territory are the most important factor in the development of the epizootic process (Boyko & Brygadyrenko, 2018, 2019). In this respect, the south of Ukraine is a unique natural and climatic territory for the intensive development of poultry farming. In addition, millions of migrant birds from around the world stop over in this area every year during spring and autumn. This has largely historically determined the role of Southern Ukraine in the existence of a unique and typical bird helminth fauna.

Given the importance of controlling parasitic diseases for many countries around the world, the 54th World Health Assembly agreed on a strategy to control helminthiasis in animals and birds. Some researchers believe that intestinal parasitoses are primarily a sanitary problem and their prevention should be based on sanitary and parasitological monitoring (Leung & Koprivnikar, 2016; Moravec & Scholz, 2016; Boyko & Brygadyrenko, 2017). One of the main tasks of ecological parasitology at the present stage is to establish patterns of spread of invasive diseases of poultry in the environment through a thorough epidemiological examination, as well as to determine the main directions and factors of spread of parasites in Ukraine (Nakao et al., 2019; Paliy et al., 2020). Helminthiasis has a particularly detrimental or debilitating effect on infected birds, mainly young individuals, slowing growth and preventing healthy development, as well as making adult birds prone to secondary infections (Hembram et al., 2015). Studies by Rohde (1994) show that temperature, humidity, rainfall, feeding habits of the host, the presence of infectious hosts and

parasites, as well as the maturation of parasites are among the important factors influencing the development of parasitic infections.

Pigeons, due to their close interaction with humans and other domestic and wild birds, serve as a potential reservoir of zoonotic parasites (Adang et al., 2008). Both domestic and wild pigeons are not harmless birds, they can serve as hidden potential reservoirs of too many human diseases, and can also transmit parasitic diseases to animals and poultry (Piasecki, 2006). The authors suggest that wild pigeons and domestic pigeons are usually infected with internal and external parasites through a common power source (Ali et al., 2020).

Cities and suburbs are home to a large number of pigeons of various breeds, including wild pigeons, which are permanent residents of parks, playgrounds, markets and other facilities and can serve as distributors of the most common intestinal nematodosis (Vaz et al., 2017; El-Dakhly et al., 2019). The presence of nematodes in some organs (liver, trachea and lungs) of infected pigeons can have serious consequences for human health, especially when eating pigeons. It is also possible that domestic pigeons may serve as alternative hosts for some poultry helminths with which they interact and are closely related phylogenetically (Michel, 1974). Helminths that are localized in the intestines of birds significantly affect the functional activity of the immune system, cause immunodeficiency, reduce the natural reactivity of the infected organism (Biswal et al., 2016; Al Quraishy et al., 2020).

One of the most parasitic diseases for young pigeons is trichomonosis. *Trichomonas gallinae* is a virulent hepatotropic flagellate parasite of pigeons. Initially, the parasite infects the upper digestive tract, causing

ulcers that allow it to enter the circulatory system. Then trichomonads enter the liver, where they cause the formation of caseous ulcers, which leads to serious losses and especially high mortality in young birds (Narcisi et al., 1991).

The causes of invasions are many, however, the most important factor is untimely diagnosis. The time spent on laboratory diagnosis of the disease and bringing the results of research to poultry owners often exceeds the time required for the development of the invasive process in poultry groups and does not ensure the timely implementation of the necessary measures. However, to date there are no data on the spread of endoparasitoses of domestic and wild pigeons in southern Ukraine. Therefore, a clinical examination, autopsy is a sufficient criterion for a preliminary diagnosis in order to take urgent measures to eliminate the disease and conduct health measures.

Given the urgency of this problem, we studied the spread of parasitic diseases (trichomonosis, cestodes, nematodes) and the species composition of pathogens in pigeons of different species in southern Ukraine.

Materials and methods

The research was conducted in the period from August to November 2018 and 2019 in the south of Ukraine (Odessa, Mykolaiv, Kherson regions). Animal experiments do not contradict the current legislation of Ukraine (Article 26 of the Law of Ukraine 5456-VI of 16.10.2012 "On protection of animals from cruel treatment") and "General ethical principles of animal experiments", adopted by the First National Congress on Bioethics (Kyiv, 2001) and international bioethical standards (materials of the IV European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Purposes, Strasbourg, 1985) (Festing & Wilkinson, 2007; Simmonds, 2017; Kabene & Baadel, 2019). The research program was reviewed and approved by the Bioethics Commission of National Scientific Center "Institute of Experimental and Clinical Veterinary Medicine" in the current order. A total of 148 domestic and wild pigeons were studied. Domestic pigeons were studied in private collections, and wild pigeons were caught during sport hunting (Table 1).

To diagnose trichomonosis of pigeons, fresh wet smears were taken from the mucous membrane of the oral cavity and throat of birds, which were examined in the laboratory of epizootology and parasitology of the Odessa research station NSC "IECVM" by staining by the method of Romanovsky-Gimz using a light microscope with increasing $\times 400$ (Anderson et al., 2009). Trichomonas was identified by signs of mobility and the presence of flagella (Dovc et al., 2004).

To study intestinal parasites, a pathological examination was performed according to Fowler (1996), all helminths were collected in Petri dishes and counted under a dissecting microscope. The number of helminths obtained from one bird was determined and identified (Sepulveda & Kinsella, 2013).

Postmortem dissection of poultry carcasses by Scriabin (1928) and collection of helminths was performed. The isolated nematodes were preserved in Barbagalo liquid, and cestodes – in 70% ethyl alcohol. Determination of helminth species was carried out by morphology – nematodes after illumination in lactic acid with glycerol, and cestodes – after staining with lactic carmine. Differentiation of cestodes oncospheres (*Railletina*, *Davainea*) was performed by staining eggs with diamond green at a dilution of 1:10000 and then the capsules were analyzed in Petri dishes. Oncospheres of *Davainea proglottina* were stained light green in 3–5 minutes, and oncospheres of *Railletina* spp. during the time they were not painted (Ukrainian patent for utility model No. 78451).

Results

According to the results of studies of wet smears, it was found that all species of domestic and wild pigeons are carriers of *Trichomonas gallinae*. Out of 148 pigeons studied, 28 (18.9%) individuals had pathogens of trichomonosis. The highest rate of infection was recorded in the wood pigeon *Columba palambus* 9 (32.1%) and the domestic (feral) pigeon *C. livia domestica* 11 (27.5%). Also infected were 5 (12.5%) collared doves *Streptopelia decaocto* and 3 (7.5%) turtle doves *S. turtur* (Table 2). The infestation rate of pigeons of different species with the causative agent

of trichomonosis depends on sex. The total invasiveness of males was 21.1%, while that of females was 16.7%. Male *C. palambus* (38.5%) and *C. livia domestica* (30.0%) were the most infested, while females were infested at 26.7% and 25.0%, respectively (Table 3).

Table 1

Information about the studied pigeons in the south of Ukraine

Common name	Scientific name	Males	Females	Total
Domestic pigeon	<i>Columba livia domestica</i> (Gmelin, 1789)	20	20	40
Wood pigeon	<i>Columba palambus</i> (Linnaeus, 1758)	13	15	28
Common dove	<i>Streptopelia turtur</i> (Linnaeus, 1758)	22	18	40
Collared dove	<i>Streptopelia decaocto</i> (Frivaldsky, 1838)	21	19	40
Total:		76	72	148

Table 2

Infection of domestic and wild pigeons with trichomonosis in the south of Ukraine

Types of pigeons	Number of examined	Number of infested	% infested
<i>C. livia domestica</i>	40	11	27.5
<i>C. palambus</i>	28	9	32.1
<i>S. turtur</i>	40	3	7.5
<i>S. decaocto</i>	40	5	12.5
Total:	148	28	18.9

Table 3

Distribution of trichomonosis in domestic and wild pigeons depending

Types of pigeons	males			females		
	researched, heads	infested heads	%	researched, heads	infested heads	%
<i>C. livia domestica</i>	20	6	30.0	20	5	25.0
<i>C. palambus</i>	13	5	38.5	15	4	26.7
<i>S. turtur</i>	22	2	9.1	18	1	5.6
<i>S. decaocto</i>	21	3	14.3	19	2	10.5
Total:	76	16	21.1	72	12	16.7

According to the research results, the general level of infestation of pigeons with cestodes was 28.4%. *C. palambus* 17 (60.7%) and *C. livia domestica* 13 (32.5%) were the most infested with cestodes. The infestation of *S. turtur* and *S. decaocto* was 12.5% and 17.5%, respectively (Table 4).

Table 4

Infection of domestic and wild pigeons with cestodes in the south of Ukraine

Types of pigeons	Number of examined	Number of infested	% infested
<i>C. livia domestica</i>	40	13	32.5
<i>C. palambus</i>	28	17	60.7
<i>S. turtur</i>	40	5	12.5
<i>S. decaocto</i>	40	7	17.5
Total:	148	42	28.4

When determining the level of general infestation of pigeons with cestodes, no significant differences from sex were registered. Thus, the incidence of males was 30.3%, and females – 26.4% (Table 5).

Table 5

Distribution of cestodes in domestic and wild pigeons depending on sex

Types of pigeons	males			females		
	researched, heads	infested heads	%	researched, heads	infested heads	%
<i>C. livia domestica</i>	20	6	30.0	20	7	35.0
<i>C. palambus</i>	13	10	76.9	15	7	46.7
<i>S. turtur</i>	22	3	13.6	18	2	11.1
<i>S. decaocto</i>	21	4	19.1	19	3	15.8
Total:	76	23	30.3	72	19	26.4

In the studied 148 pigeons 34 (22.9%) were affected by nematodes. *C. livia domestica* 21 (52.5%) and *S. decaocto* 9 (22.5%) were the most infested and only one *S. turtur* (2.5%) was infected (Table 6).

In a study of the species composition of cestodes in pigeons, it was found that the most common species was *Railletina* spp. The highest

infestation was in *C. palambus* – 82.4% with an intensity of 2.6 specimens/bird, in *C. livia domestica* – 76.9% with a lesion intensity of 4.3 specimens/bird. Invasion of *S. decaocto* with *Raillietina* spp. was 71.4%, and *S. turtur* – 60.0%. The pathogen *Davainea proglottina* was registered only in two pigeons *C. livia domestica* (15.4%) and *S. decaocto* (28.6%). Three (17.6%) *C. palambus* and one *C. livia domestica* (7.7%) hosted the cestode *Echinolepis carioeca* (Table 7).

Table 6
Infection of domestic and wild pigeons by nematodes in the south of Ukraine

Types of pigeons	Number of examined	Number of infested	% infested
<i>C. livia domestica</i>	40	21	52.5
<i>C. palambus</i>	28	3	10.7
<i>S. turtur</i>	40	1	2.5
<i>S. decaocto</i>	40	9	22.5
Total:	148	34	22.9

Table 7
Species composition of cestodes in domestic and wild pigeons in the south of Ukraine

Cestodes	Number of infested pigeons / intensity of invasion (specimens/bird)				Total infested
	<i>C. livia domestica</i>	<i>C. palambus</i>	<i>S. turtur</i>	<i>S. decaocto</i>	
<i>Raillietina</i> spp.	10 (4.3)	14 (2.6)	5 (1.4)	5 (2.5)	34
<i>Davainea proglottina</i>	2 (6.2)	0	0	2 (3.0)	4
<i>Echinolepis carioeca</i>	1 (2.0)	3 (1.6)	0	0	4

Three species of nematodes were identified in pigeons: *Heterakis gallinarum*, *Ascaridia columbae* and *Capillaria* spp. The nematodes *H. gallinarum* most heavily infested *C. palambus* (66.7%) and *S. decaocto* (33.3%). The helminth *A. columbae* was most recorded in *C. livia domestica* (57.1%) and *S. decaocto* (44.4%) with an intensity of 5.1 specimens/bird and 3.7 specimens/bird, respectively. In *S. turtur*, nematodes *H. gallinarum* and *A. columbae* were not registered. Helminths *Capillaria* spp. were identified in all species of pigeons (Table 8).

Table 8
Species composition of nematodes in domestic and wild pigeons in the south of Ukraine

Nematodes	Number of infested pigeons / intensity of invasion (specimens/bird)				Total infested
	<i>C. livia domestica</i>	<i>C. palambus</i>	<i>S. turtur</i>	<i>S. decaocto</i>	
<i>H. gallinarum</i>	5 (9.1)	2 (6.2)	0	3 (4.3)	10
<i>A. columbae</i>	12 (5.1)	0	0	4 (3.7)	16
<i>Capillaria</i> spp.	4 (8.5)	1 (4.0)	1 (3.0)	2 (3.4)	8

Discussion

Monitoring for diseases of any etiology, among which the main place in this research is occupied by parasitoses of pigeons is and remains an important stage of control in scientific and practical terms, both from an epizootic and ecological point of view. The study of the species composition of parasites and their infection of birds is of great interest not only to parasitologists, zoologists and ecologists, but also to veterinary specialists. This provides an opportunity to create a modern information base for in-depth study of the helminthological situation in some parts of the country in order to develop concepts for controlling and managing the invasive process in groups of birds, ensuring parasitological safety of natural ecosystems and developing measures to combat parasitic diseases (Kumar et al., 2015; Maqbool et al., 2017).

Pigeon trichomonosis is a disease caused by flagellate protozoa (*T. gallinae*) commonly found in the upper digestive tract of pigeons and bird predators that feed on pigeons (Borji et al., 2011; Girard et al., 2014). Trichomonosis is a common disease worldwide. Researchers from Libya note that 55.0% of the studied pigeons are affected by *T. gallinae* (Alkharigy et al., 2018). According to the authors from the province of Babylon, Iraq, the highest level of *Trichomonas gallinae* infection was registered in

wood pigeon 16 (53.3%), followed by rock dove, domestic pigeon, collared dove and palm dove 12 (40.0%), 9 (30.0%), 4 (13.3%) and 2 (11.1%), respectively (Al-Rammahi et al., 2013). In the United Kingdom, trichomonosis was first detected in 86.0% of *Streptopelia turtur*, 86.0% of collared doves *S. decaocto*, 47.0% of wood pigeons *C. palambus* and 40.0% of stock doves *C. oenas* (Lennon et al., 2013). Similar data on the prevalence of trichomonosis in wild pigeons were obtained by researchers in Western and Southern Europe (Marx et al., 2017). It is noted that in a small flock of *S. decaocto* and *S. risoria* numbering 200 head, mortality from trichomoniasis can reach 15–20%. Ninety-four percent (17/18) of affected birds had multiple lesions. Oral lesions spread by 33.0% (6/18) to the orbit of the eye and 11.0% (2/18) to the entire head area (Stimmelmayer et al., 2012). The prevalence of trichomonosis among common pigeons in Spain was found to be 34.2% (Villanua et al., 2006), in southern Khorasan in Iran – 57.8% (Radfar et al., 2011), in Iraq – 39.2% (Al-Barwari et al., 2012), in the province of Kvaliobia, Egypt – 68.9% (Abd El-Rahman et al., 2008), and in Colombia – 40.0% (Pérez-García et al., 2015). Adult birds can remain infected for a year or more and are a constant source of infection for their squabs (Jayentakumar Singh & Mohilal, 2017).

Both domestic and wild pigeons feed mainly on grain, but consume beetles, snails, earthworms, and ants, which can be carriers of invasive stages of helminths (Bogach et al., 2020). The prevalence and level of infestation of birds varies depending on the type of parasite, the physiological condition of the individual, as well as the geographical location of the natural-climatic zone (Oniye et al., 2000). Endoparasites are represented by nematodes *Ascaridia columbae* (30.0%), *Dispharynx spiralis* (10.0%) and cestodes *Raillietina* spp. (80.0%) found in clinically healthy pigeons (Mushi et al., 2000). Domestic pigeons in northwestern Nigeria are infected with intestinal parasites: cestodes – *Raillietina tetragona* 20 (13.8%), *R. echinobothrida* 11 (7.6%), *Davainea proglottina* 10 (6.9%) and *Amoebotaenia cuneata* 5 (3.5%), as well as nematodes *Capillaria* spp. 10 (6.9%) (Mohammed et al., 2019). In the Zaria region of northern Nigeria, 116 (48.3%) of the pigeons surveyed were infected with 9 species of helminths, including 6 species of cestodes and 3 species of nematodes. The species composition of cestodes is represented by *Raillietina tetragona* 65 (27.1%), *R. echinobothrida* 26 (10.6%), *Hymenolepis cantaniana* 4 (1.7%), *H. carioeca* 3 (1.3%), *R. cesticillus* 1 (0.5%) and *Amoebotaenia cuneata* 2 (0.8%), and nematodes – *Ascaridia columbae* 27 (11.3%), *A. galli* 8 (3.3%) and *Heterakis gallinarum* 8 (3.3%) (Adang et al., 2008). The most common helminths in *S. decaocto* from Florida were *Ascaridia columbae* (73.0%), *Fuhrmannetta crassula* (28.6%), *Ornithostrongylus quadriradiatus* (12.7%) and *Bruscapillaria obsignata* (11.1%) (Bean et al., 2005). In Bristol Zoo endoparasites in domestic and wild pigeons were represented by cestodes and nematodes (Carrera-Játiva et al., 2018). In Southern Texas 12 species of helminths were found in domestic and wild pigeons (9 nematodes and 3 cestodes). In general the distribution of helminths was similar regardless of pigeons' sex (Smith et al., 2012). Also, domestic pigeons in Turkey were observed to have no significant differences in the distribution of helminths depending on age and sex of the birds (Smith et al., 2012).

Cestodes parasitize in the small intestine (duodenum and ileum) – an area rich in half-digested food and which promotes the absorption of nutrients through the surface of the body. The presence of several cestodes in the intestine causes its obstruction, which leads to high levels of depletion, weight loss and even death of the bird (Radfar et al., 2012).

Conclusion

It has been proved that in the south of Ukraine endoparasitoses of domestic and wild pigeons is a fairly common invasive disease caused by *Trichomonas gallinae*, *Raillietina* spp., *Davainea proglottina*, *Echinolepis carioeca*, *H. gallinarum*, *A. columbae*, *Capillaria* spp. *Columba livia domestica* pigeons are infected with trichomonosis and nematodes (*A. columbae*), *C. palambus* pigeons are diagnosed with trichomonosis and cestodes (*Raillietina* spp.). *Streptopelia turtur* pigeons are affected by cestodes (*Raillietina* spp.) and *S. decaocto* are infested with cestodes (*Raillietina* spp.) and nematodes (*H. gallinarum*, *A. columbae*). Monitoring of pigeon parasitosis should be continuous, as pigeons, in most cases, come

into contact with other species of poultry and can be carriers of invasive pathogens.

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