Prevalence Rate and Infection Degree of Helminthiasis on Pigeon (*Columbia Livia Domestica*) in North Surabaya

[1)]Khurun'In Fadia Ihda Hanny, [2)]Djoko Legowo, [3)]Mufasirin, [3)]Kusnoto, [4)]Dian Ayu Permatasari, [3)]Poedji Hastutiek

[1)]Student, Faculty of Veterinary Medicine, Universitas Airlangga
[2)]Division of Veterinary Pathology, Faculty of Veterinary Medicine, Universitas Airlangga
[3)]Division of Veterinary Parasitology, Faculty of Veterinary Medicine, Universitas Airlangga
[4)]Division of Veterinary Public Health, Faculty of Veterinary Medicine, Universitas Airlangga
***Corresponding author:** khurunin.fadia.ihda-2017@fkh.unair.ac.id

Abstract

Pigeon meat is an alternative option to other poultry meat such as chickens. As pigeons are easy to keep and quickly reproduce. Improper hygiene practices are a strong factor in helminthiasis transmission. This study aims to know the prevalence and degree of infection of helminthiasis in North Surabaya. Seventy samples taken from pigeon butchers in North Surabaya from September to November 2022. Dissection of pigeon done for prevalence rate count and modified McMaster method used to count degree of infection. The result shown that 70% of samples had positive worm infection. Types of worms found were *R. cesticillus* (55.7%), *Ascaridia* sp. (25.7%), *Capillaria* sp. (14.2%), *Echinostoma* sp. (2.8%) and *Heterakis* sp. (1.4%). Qualitative examination shown helminthiasis was more prevalent in adult pigeon than in squab, but analysis with *Chi-square* test shown no significant association between helminthiasis infection and age of the pigeons (P>0.05). Likely because of direct contact and interaction between squab and adult. Quantitative examination with McMaster method shown degree of infection of single *Ascaridia* infection in adult pigeons was 340 EPG while in *Capillaria sp.* was 287.5 EPG and 150 EPG in *Heterakis*. All of them considered mild infection according to Soulsby (1986). Thus, proper loft and feed hygiene should applied to prevent more transmission.

Keywords: Pigeons, Helminthiasis, Prevalence, Degree of infection

Introduction

Pigeon is one of the most common bird found in Indonesia, either for consumption or race bird. Young pigeon meat, also known as squab, has a striking appearance compared to other poultry meat. The red colour with soft meat fibre gives a unique taste (Samudera *et al.*, 2016). Generally, pigeon breeder use traditional method (extensive method), in which the birds are kept using traditional lofts. In Java, Pigeon lofts called "Pagupon" and birds fed with grains, leftover rice and rice or corn bran. To meet nutritional needs, the birds will forage around the environment. With Intensive farming method, the pigeons kept in standard lofts with all nutritional needs provided by the breeder (Hamid *et al.*, 2015).

Helminths infections often lead to reduced egg production and development, growth retardation, emaciation, lethargy and diarrhea (Rahman *et al.*, 2019; Al-Quraishy *et al.*, 2019; Aldamigh *et al.*, 2022). The infection of domestic pigeons with helminth parasites can lead to an increase in mortality and has severe economic consequences (Aldamigh *et al.*, 2022). Helminthiasis reports on North Surabaya is important, as many restaurants and food vendors in Surabaya butcher and purchase pigeons from this area. As many helminths in pigeons also infect other poultry and sometimes humans (Winarti and Widyastuti, 2015).

To obtain accurate information in regard to the severity of an infection, egg-counting methods have been devised in order to determine the number of eggs per gram of faeces (Soulsby, 1986). It could be used to determine the efficacy of drug treatment (Zajac and Conboy, 2012)

This research aims to identify and determine prevalence rate and degree of infection of helminthiasis in meat pigeons in North Surabaya. The results of this research could be used as reference for disease control and husbandry standard evaluation in meat pigeon.

Research Methods

Sample and Sample Size

Sample intestine examination was conducted in Veterinary Parasitology Laboratory, Faculty of Veterinary Medicine, Universitas Airlangga from September to November of 2022. Seventy pigeon intestines taken from pigeon butchers who collected them from traditional breeders around

This work is licensed under a Creative Commons Attribution-NonCommercial-Share Alike 4.0 International License

Kenjeran, Pabean and Petekan sub-districts in North Surabaya.

Intestine Dissection

Pigeon intestine taken and separated from other organs into a petri dish. Longitudinal incision then made along the intestine and the content exposed. Worms found in the lumen then extracted and moved to separate Petri dish filled with NaCl solution to clean the worm off of debris. Worms then counted and identified through magnifying glass. Smaller worms found in intestine petri dish extracted under dissecting microscope. The identification based on the identification key by Soulsby (1982), Koesdarto *et al*. (2017) and Mumpuni *et al*. (2017). Helminths then preserved in alcohol glycerine 5% to be stained with carmine. Sample was determined as positive when there is at least one organism of a species detected in the intestinal lumen. The result from this exam used to determine prevalence rate.

Two grams of faeces from the intestinal lumen then collected in a plastic container for floatation and Mc Master examination.

Native Faecal Exam

Two drops of aquadest dripped on object glass. Faecal sample taken and homogenized with the aquadest using sticks. Sample then covered with cover glass and examined under microscope with 40-100x magnifications. Egg identification based on Foreyt (2001), Mumpuni *et al.* (2017) and Soulsby (1986).

McMaster Exam

The faeces mixed with 28 ml of aquadest, mixed and homogenized well. The mixture then filtered using sieve and poured into 15 ml centrifuge tube and run through centrifuge with speed of 1500 rpm for 5 minutes. Supernatant then discarded. Flotation solution added until half of the tube, then homogenized well. More flotation fluid then added until 15 ml and homogenized further. The suspension then shaken and taken through a pipette to fill the camera of McMaster slide, being careful not to form air bubbles. Take another aliquot for the other camera and the rest of suspension will be used for flotation examination (Zajac and Conboy, 2012; Permatasari et al., 2020; RCV, 2021).

The filled McMaster slide then left undisturbed on microscope for 5 minutes to allow parasite eggs to float into the surface. Then the slide is examined through microscope with 40x magnifier, focusing on the top layer (Bizhga et. al., 2011; Zajac and Conboy, 2012).

Flotation Exam

The remained suspension then used for flotation method. More flotation solution then added with pipette until there was a reverse meniscus on top of the vial and place a coverslip on top of the fluid. The flotation then left standing for 5-10 minutes to allow the eggs to float, the coverslip then removed and placed on object glass to be examined under microscope with 40-100x magnifier (Zajac and Conboy, 2012; Permatasari *et al.*, 2020).

Acetic-Carmine Staining

The worm submerged in alcohol glycerine 5% for 24 hours to preserve and soften the cuticle. The worm then submerged into alcohol 70% for 5 minutes. The worm then moved into diluted Carmine solution and submerged for more or less 8 hours. The worm then moved to acid alcohol (alcohol 70% + HCl) for 2 minutes and then submerged in basic alcohol (alcohol 70% + $NaHCO_3$) for 20 minutes. The worm then put into gradual dehydration through alcohol 70%, alcohol 85% and alcohol 95% for 5 minutes each. Next process is mounting the worm in Hung I solution for 20 minutes then glued with Hung II solution to keep object glass, sample and cover glass together. The sample dried in incubator in 37°C for one hour or more.

Data Analysis

Calculation for Prevalence rate and Degree of Infection based on McMaster method and research data presented descriptively in the form of tables and graph. *Chi-square* test used to analyse the association between helminthiasis infection and age of the pigeon. The computer program used is IB SPSS Statistic v22.

Results and Discussion

Intestine examination of 70 pigeons revealed 49 positive samples or 70% helminthiasis infection. 24 out of 33 (72.7%) of samples of adult pigeons were infected with helminthiasis while 25 out of 37 (67.5%) squab samples were infected with helminthiasis (Table 1). Statistical analysis showed that there is no significant association found between helminthiasis infection and age of the pigeons ($p > 0.05$). This is likely because squab and adult pigeons are often in direct contact and interaction with each other, especially when adults are feeding or brooding nestlings, thus infective eggs transmit easily between them. This result was in accordance with the study done by Sivajothi and Sudhakara (2015).

Table 1. Prevalence of Helminthiasis

Age	Helminthiasis		Total
	Positive	Negative	
Squab	25	12	37
Adult	24	9	33
Total	49	21	70

Table 2. Positive Samples in Different Age Group for Each Parasite Found

Single Infection	frequency of positive samples in different age		Total	Percentage (%)
	Squab	Adult		
Ascaridia sp.	6	0	6	8.5%
R. cesticillus	12	13	25	35.7%
Capillaria sp.	0	1	1	1.4%
Echinostoma sp.	1	1	2	2.8%
Mixed infection				
Ascaridia, R. cesticillus and *Capillaria*	0	5	5	7.1%
Ascaridia and *Raillietina*	4	1	5	7.1%
R. cesticillus and *Capillaria*	0	3	3	4.2%
Ascaridia and *Capillaria*	1	0	1	1.4%
Ascaridia, R. cesticillus and *H. gallinarum*	1	0	1	1.4%

Types of worms found were *Raillietina cesticillus* (55.7%), *Ascaridia* sp. (25.7%), *Capillaria* sp. (14.2%), *Echinostoma* sp. (2.8%) and *Heterakis gallinarum* (1.4%). Single infection of *Ascaridia* sp. is 8.5%, while *R. cesticillus* is 35.7%. Mixed infection with different combination of worm species made up 30.6% of positive samples. Multiple infection recorded, were *R. cesticillus, Ascaridia* sp. and *Capillaria* sp. (7.1%); *R. cesticillus, Ascaridia* sp. and *H. gallinarum* (1.4%); *R. cesticillus* and *Capillaria* sp. (4.2%); *R. cesticillus* and *Ascaridia* sp. (7.1%); *Ascaridia* sp. and *Capillaria* sp. (1.4%). List of helminthiasis infection could be seen in Table 2.

In this research, the prevalence rate of helminthiasis in pigeon is 70% which higher than previous research result by Muqorobin *et al.* (2017), but lower than result by Ashfiyah *et al.* (2022) in Tuban. In comparison, report by Sivajothi and Sudhakara (2015) in Adhra Pradesh, India and Umaru *et al.* (2017) in Taraba State, Nigeria shown similar result of 72.7% and 78.3% respectively. Despite the similarity of overall high helminth prevalence, distribution of helminth species was different. The reason for this difference most likely influenced by geographic and environmental condition, number of pigeons examined and season during research, management practices as well as intermediate hosts availability and distribution.

High prevalence rate of worms can be attributed to the lack of hygiene management in pigeon rearing which raised the chance of infested droppings to be ingested and transmitted (Al-Quraishy *et al.*, 2019). As many farmers in North Surabaya likely neglected loft cleaning and medical treatment to save money. Other contributing factors are the distribution and reproduction pattern of intermediate hosts. Main factor that makes this research result higher than report by Muqorobin *et al.* (2017) was that our research samples were mainly taken from pigeons reared with extensive and semi-intensive method which allows them to search for more food in farther area and predispose them to more infective stage of helminths (Umaru *et al.*, 2017). While sample research by Muqorobin *et al.* (2017) was taken from farms using intensive and extensive method.

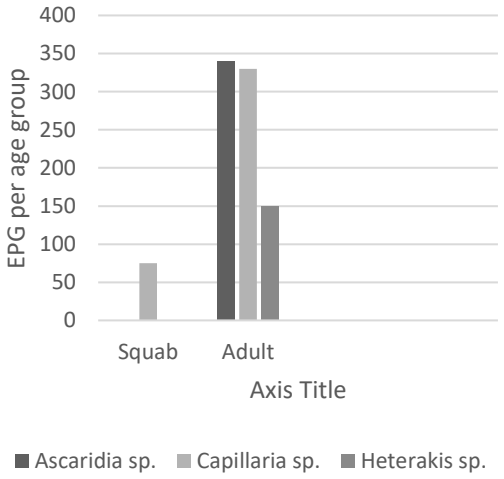

Figure 1. The graph of degree of infection based on sample's age group

Out of 70 samples, 13 samples have positive egg count. Egg found are from *Ascaridia, Capillaria* and *Heterakis* species. Figure 1 is a graph showing infection degree per age group. Infection degree from squab age group shown lowest value on all worm species observed with EPG of 75 for *Capillaria* sp.. Highest infection degree in adult pigeons is from *Ascaridia* sp. with 340 EPG, followed with *Capillaria* sp. (330 EPG) and *Heterakis* sp. (150 EPG). However, all of them still

considered mild infection by Soulsby (1986) as they are below 500 EPG. Nematode parasite can cause intestinal hemmorhage, mortality, weight depression, retard-ed growth and decrease in egg production (Yabsley, 2009; Qamar *et al.*, 2017; Rahman *et al*., 2019) To prevent reinfection, loft should be cleaned regularly and dried under direct sun. The feed hygiene should be checked and evaluated and the water should be replaced daily. Formalin, povidone iodide and TH4 are effective disinfectant to inhibit embryonic development of *Ascaridia* eggs (Bessat and Amira, 2019).

As noticed, Cestode infection still have higher prevalence compared to Nematode infection, despite nematode worms not needing intermediate hosts (Al-Quraishy *et al.*, 2019). Similar result reported by Muqorobin *et al.* (2017) in Surabaya. In contrast, prevalence of cestode infection were lower in study by Khezerpour and Naem (2013), Sivajothi and Sudhakara (2015), Umaru *et al.* (2017) and Ashfiyah *et al.* (2022). This result indicate possible feed contamination with insects such as ants, beetles or *Musca domestica* as the intermediate host of *Raillietina* spp. Damp and rarely cleaned lofts or nest boxes attracting flies and other cestode intermediate hosts like *Musca domestica,* termites, mini-wasps and beetles which can bring cestode eggs from other areas (Butboonchoo *et al.*, 2016; Koesdarto *et al.*, 2017). Warm temperature of North Surabaya and dry season also attracted these insects. Furthermore, nest boxes are also likely to swarmed by insects if they did not cleaned regularly (Ibrahim *et al.*, 2018). As this research done during dry season, high temperature and low humidity might have affected survivability of worm eggs. According to Soulsby (1986) and Kusnoto *et al.* (2011) (in Ashfiyah *et al.,* 2022), that eggs containing stage 2 larvae, are able to survive more than 3 months in a shady or protected place, but will die soon if the conditions are and weather is dry and hot.

In many samples found during examination, *Raillietina* parasites almost completely obstructing intestinal lumen. Small intestine being the site with severe infestation, causing severe enteritis, intestinal obstruction and watery feces. These pathological changes were in line with research result by Kamal *et al.* (2020). However, *Raillietina* eggs could not be reliably detected by flotation faecal exam (Zajac and Conboy, 2012; Mumpuni *et al.*, 2017), thus the lack of *Raillietina* degree of infection data in this research as many *Raillietina* eggs were likely damaged or not reaching full maturity yet.

Echinostoma sp. only found in two samples. While *Echinostoma* known to be zoonotic, viable *Echinostoma* metacercariae infects aquatic animals, such as freshwater fish and snails as zoonotic second intermediate hosts. These metacercariae on secondary host will infect definitive host (such as humans and birds) when the secondary hosts are eaten raw (Sah *et al.*, 2018; CDC, 2019). While pigeons rarely eat invertebrates, smaller snail host might ingested by accident while the pigeons were feeding near or around water bodies, such as ponds. Pigeons infected with Echinostomiasis should be treated with appropriate dose of praziquantel orally (De Herdt and Pasmans, 2009; Motarjemi *et al.*, 2014).

Conclusion

Prevalence of helminthiasis in North Surabaya is 70%. *R. cesticillus* has the highest prevalence rate in pigeons compared to other species with the percentage of 55.7%. In comparison, *Ascaridia* sp., *Capillaria* sp., *Echinostoma* sp. and *H. gallinarum* have prevalence rate of 25.7%, 14.2, 2.8% and 1.4% respectively. There was no significant association between helminthiasis infection and pigeon's age.

Degree of infection for *Ascaridia* sp. and *Capillaria* sp. were 340 and 287.5 EPG respectively. They are considered mild infection.

References

Al-Quraishy, S., R. Abdel-Gaber, D. A. Mohamed, and A. Khulud. 2019. Morphological and Molecular Characteristics of the Gastro-Intestinal Nematode Parasite *Ascaridia columbae* Infecting the Domestic Pigeon *Columba livia* domestica in Saudi Arabia. Acta Parasitologica. 65(1): 208–224.

Aldamigh, M.A., A.H. Hassan, and A. A. Alahmadi. 2022 Histopathological Changes in the Intestine of Infected Pigeons (*Columba livia domestica*) by Helminth Parasites from Al-Qassim, Saudi Arabia. Open Access Library Journal. 9: 1-9.

Ashfiyah, M. A., S. Koesdarto, H. Eliyani, Mufasirin and E. K. Sabdoningrum. 2022. Prevalence of Digestive Endoparasites (Helminth and Protozoa) in Pigeon Domestic (Columba livia) Male and Female in Tuban. Journal of Parasite Science. 6(1): 13-18.

Bessat, M. and D. Amira. 2019. Assessment of the inhibitory effects of disinfectants on the embryonation of *Ascaridia columbae* eggs. Alexandria University. Egypt. 14(5): 1 – 10.

Bizhga, B., E. Sotiri, A. Boçari and D. Kolleshi. 2011. *Ascaridia columbae* In *Columbia livia domestica*. Faculty of Veterinary Medicine Agricultural University of Tirana. Albania. 10(2):1 – 12.

Butboonchoo, P., C. Wongsawad, A. Rojanapaibul and J. Chai. 2016. Morphology and Molecular Phylogeny of *Raillietina* spp. (Cestoda: Cyclophyllidea: Davaineidae) from Domestic Chickens in Thailand. Korean J Parasitol. 54(6): 777 – 786.

Centers for Disease Control and Prevention (CDC). 2019. Echinostomiasis. https://www.cdc.gov/dpdx/echinostomiasis/index.html [accessed 27 May 2023].

De Herdt, P. and F. Pasmans. 2009. Pigeon. In: Tully, T. N., Dorrestein, G. M., and C., L. M. P. (2009). Handbook of avian medicine. Butterworth-Heinemann. 350 – 376.

Foreyt, W. J.. 2001. Veterinary Parasitology Reference Manual. 5th ed.. Blackwell Publishing. State Avenue. Ames. Iowa. 153 – 165.

Hamid, A., E.J. Saleh dan S. Fathan. 2015. Pola Tingkah Laku Makan Burung Merpati (*Columba livia*) Jantan yang Dipelihara secara Intensif. Gorontalo: Universitas Negeri Gorontalo. Gorontalo.

Ibrahim, N. A., E. A. Hassan, T. I. Moawad and M. A. Ghobashy. 2018. Pathological and Physiological Alterations Induced by Intestinal Helminths Infecting Domestic Pigeon *Columbia livia domestica.* International Journal of Zoology and Applied Biosciences. 3(2): 212 - 219.

Kamal, M., W. Khan, N. U. Nisa, G. Yasmeen, H. U. Hassan, Ihsanullah. 2020. Acute raillietiniasis in domestic pigeon (*Columba livia domestica*). Adv. Anim. Vet. Sci. 8(11): 1180-1183.

Khezerpour, A. and S. Naem. 2013. Investigation on Parasitic Helminthes of Gastrointestinal, Liver and Lung of Domestic Pigeons (*Columba livia*) in Urmia, Iran. International Journal of Livestock Research. 3(3): 35–41.

Koesdarto, S., S. Mumpuni and Kusnoto. 2017. Penuntun Praktikum Helmintologi Veteriner. Departemen Parasitologi. Fakultas Kedokteran Hewan. Universitas Airlangga. Surabaya. 16 – 32.

Muqorobin, A., M. Yunus and S. M. Sosiawati. 2017. Prevalensi Helminthiasis pada Burung Merpati (*Columba livia*) Melalui Bedah Saluran Pencernaan. Surabaya: Journal of Basic Medicine Veterinary, Fakultas Kedokteran Hewan Universitas Airlangga. Surabaya. 6(1): 44 – 50.

Mumpuni S, S. Subekti, S. Koesdarto, H. Puspitawati dan Kusnoto. 2017. Penuntun Praktikum Ilmu Penyakit Helminth Veteriner. Departemen Pendidikan Nasional. Fakultas Kedokteran Hewan. Universitas Airlangga. Surabaya. 5 – 49.

Permatasari, D. A., R. Kusriningrum, R. T. Imam, S. Mumpuni, S. Endang, H. E. Mustofa. 2020. Prevalensi dan Derajat Infeksi Cacing Saluran Pencernaan pada Itik Jawa (*Anas javanica*) di Dua Daerah Geografis Berbeda. Journal of Parasite Science. 4(1): 22 – 24.

Qamar, M. F., A. Butt, S. Ehtisham-ul-Haque and M.A. Zaman. 2017. Attributable risk of *Capillaria* species in domestic pigeons (*Columba livia domestica*). Veterinary Medicine. Arq. Bras. Med. Vet. Zootec. 69 (05).

Rahman, M.M.I.A., H. M. N. Tolba and H. M. Abdel-Ghany. 2019. Ultrastructure, morphological differentiation and pathological changes of Ascaridia species in pigeons. Advances in Animal and Veterinary Science. 7(2): 66-72.

RCV/FAO Guide to Veterinary Diagnostic Parasitology. 2021. McMaster Egg Counting Tehnique: Purpose. https://www.rvc.ac.uk/review/parasitology/eggcount/Purpose.htm [accessed in 8 December 2021].

Sah, R., S. Khadka, R. Hamal and S. Poudyal. 2018. Human Echinostomiasis: A Case Report. BMC Research Notes. 11(17): 1 – 6.

Samudera, R., S. Dharmawati dan S. Prasetiyo. 2016. Kadar Lemak dan Protein Daging Burung Merpati Lokal (*Columba livia*) yang Dipelihara Secara Intensif dan Dipotong pada Umur Berbeda. Al Ulum Sains dan Teknologi. Program Studi Peternakan Fakultas Pertanian. Universitas Islam Kalimantan Banjarmasin. 2(1): 6 – 9.

Sivajothi, S. and R. B. Sudhakara. 2015. A study on the gastro intestinal parasites of domestic pigeons in YSR Kadapa district in Andhra Pradesh, India. Journal of Dairy Veterinary and Animal Research. 2(6): 216–218.

Soulsby EJL. 1986. Helminth, Arthropods and Protozoa of Domesticated Animal. 7th Ed. Bailliere Tindall. London. 164.

Motarjemi, Y., Moy, G. G., and Todd, E. C. D. 2014. Encyclopedia of Food Safety. 2nd Ed. Elsevier, Academic Press. 134 – 139.

Umaru, G. A., O A Bello, Y. U. Abubakar, Y. A. Umar, N. B. Adamu and S. G. Adamu. 2017. Prevalence of helminth parasites of domestic pigeons (*Columba livia*) in Jalingo Metropolis, Taraba State. Nigerian Journal of Parasitology. 38(1): 43-47.

Winarti, E. dan A. Widyastuti. 2015. Potensi Merpati (*Columba livia*) sebagai Sumber Protein Hewani di Indonesia. Balai

Pengkajian Teknologi Pertanian Yogyakarta. 467 – 471.

Yabsley, M. J.. 2009. Capillarid Nematodes. In:Atkinson, C. T., N. J. Thomas and D. B. Hunter. Parasitic Diseases of Wild Birds. 1st ed. Wiley-Blackwell. Singapore. 463 – 491.

Zajac, A. M. and G. A. Conboy. 2012. Veterinary Clinical Parasitology. 8th ed. Hoboken, NJ: Wiley-Blackwell. 3 – 21.