Indian J. Anim. Res., 52 (7) 2018 : 1063-1067
Print ISSN:0367-6722 / Online ISSN:0976-0555

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.ijaronline.in

Morpho-pathological description of first record of fatal concurrent intestinal and renal parasitism in *Columba livia domestica* in India

Aman D. Moudgil*, L.D. Singla[1] and K. Gupta

College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana-141 004, Punjab, India.

Received: 28-09-2016 Accepted: 09-03-2017 DOI: 10.18805/ijar.v0iOF.9140

ABSTRACT

Out of around 200 pigeons (housed at Mahendra Chaudhury Zoological Park, Chhatbir, Punjab), two pigeons exhibiting signs of depression, lethargy, droopiness and blood tinged greenish diarrhoea were quarantined for detailed examination. The faecal examination revealed a concurrent parasitic egg load of capillarid, ascarid and strongyle eggs. Morphological observations after clearing of retrieved parasites from the deceased pigeons revealed the presence of *Ascaridia columbae*, *Capillaria obsignata*, and *Ornithostrongylus quadriradiatus*. Histopathological studies of the intestines revealed sloughing and hyperplasia of the lining epithelium; whereas kidneys of one of the pigeon exhibited the extensive tubular damage and marked haemorrhages with cut sections of the parasite, *Paratanaisia bragai*. The other vital organs showed no signs of any significant lesions in both pigeons. This seems to be the first report of fatal concurrent gastrointestinal and renal pathology due to *A. columbae*, *C. obsignata*, *O. quadriradiatus* and *P. bragai* in pigeons kept at zoological park in India.

Key words: *Ascaridia columbae*, *Capillaria obsignata*, *Columba livia domestica*, *Ornithostrongylus quadriradiatus*, *Paratanaisia bragai*.

INTRODUCTION

Pigeons, members of the order Columbiformes are distributed throughout the world (Marques *et al*., 2007). These fascinating birds reside in close vicinity to human dwellings as they have adapted themselves to rural, urban and suburban life styles (Khezerpour and Naem, 2013). Parasitism is an intricate problem in companion birds and animals and is generally overlooked unless it exhibits serious clinical disorders (Tsai *et al*., 1992). The parasitism affects the birds (especially pigeons) severely, leading to retarded growth, depression, less egg production, immunosuppression and further renders them susceptible to other infections (Dranzoa, 1999). The feeding habits of pigeons include consumption of grains, earthworms, slugs and insects, which make them more susceptible for the invasion of nematode, trematode and cestodes (Adang *et al*., 2009).

Ascaridia columbae is one of the most pathogenic parasites of pigeons (Kajerova *et al*., 2004). The target organ of the parasite is mainly small intestines, where it localizes for almost one year. The symptoms in heavily infected birds are diarrhoea, reduction in growth and production, lethargy and depression (Kulisic, 1989). On the other hand, out of the six species of the capillarid nematodes described in the wild and domesticated birds, only two most common species *viz. Capillaria obsignata* and *C. caudinflata* have been incriminated to cause pathogenesis in pigeons (Park and Shin, 2010). Heavy infestations of *Ornithostrongylus quadriradiatus* has been attributed to exhibit acute symptoms rather than characteristic helminthic chronic disease conditions. Diseased birds lack strength, become lethargic and pass pronounced greenish diarrhoea (Cuvillier, 1937). The trematodes of various genera of the families Eucotylidae and Renicolidae infect the kidneys of the birds and prove detrimental by affecting renal pelvis and proximal ureters (Kanev *et al*., 2002). *Paratanaisia bragai*, member of the family Eucotylidae had been found involved in infections of kidneys of various bird species, which had proved fatal (Unwin *et al*., 2013). The prime objectives of present study were morphological identification of the parasites retrieved from the intestines of the pigeons at necropsy and histopathological evaluation of extent of damage caused by them in different organs.

MATERIALS AND METHODS

Faecal sample collection: Amongst the lot of around 200 domestic pigeons, two adults exhibited signs of depression, lethargy, droopiness and blood tinged greenish diarrhoea. Both birds were quarantined for detailed examination. The faecal samples were collected from the infected pigeons as well as from twenty other birds of susceptible population (random sampling) and were kept in polythene bags at 4°C (with the help of ice packs) and then transferred to Department of Veterinary Parasitology, COVS, GADVASU, Ludhiana (India) for further processing. The qualitative analysis was carried out by direct smear method, floatation

*Corresponding author's e-mail: moudgil.aman@gmail.com

concentration technique using Sheather's sugar solution as well as by sedimentation technique (Soulsby, 1982). Whereas, the quantitative analysis was performed by McMaster egg counting technique to approximate relative parasitic intensity, which was expressed as eggs per gram (EPG) values (Soulsby, 1982).

Gross specimen collection and processing: Despite of immediate therapeutic intervention with albendazole (Albomar®, Virbac India), both pigeons succumbed one after another on consecutive days. At necropsy, markedly dilated intestinal tract stuffed completely with adult parasites and catarrhal exudate was observed. The adult parasites were collected, washed with normal saline and then cleared with lactophenol containing glycerine, lactic acid, phenol and double distilled water (1:1:1:1) for detailed observation and identification. All organs suspected to be affected by the parasitic stages including the intestine, gizzard, liver, lungs, heart and kidneys were collected and fixed in 10% neutral buffered formalin.

Morphological studies: Morphological examination and identification involved morphometry of the eggs as well as dimensional study of the adult parasites. The length and breadth of the eggs (n=20) was depicted in micrometers (µm) and was expressed as mean ± standard deviation. Similarly, the length of the parasites (n=10 male and female each) was expressed in millimetres (mm) and width in micrometers (µm) and was expressed as mean ± standard deviation.

Histo-pathological examination: Tissue samples from the intestine, gizzard, liver, lungs, heart and kidneys were collected and processed for histo-pathological studies as per the method of Luna and Lee (1968). Five micron thick sections were cut and stained with routine haematoxylin and eosin stain for the histopathological studies.

Statistical analysis: Data related to morphometric studies was analysed and expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

Faecal sample examination with direct smear and floatation concentration technique revealed the presence of capillarid, ascarid and strongyle eggs in the faecal samples of both the birds. The quantitative analysis depicted 1200, 2100, 700 and 1600, 1900, 1300 eggs per gram (EPG) values for *Capillaria* and *Ascaridia* species and for Strongyles in the first and second pigeon, respectively. The sedimentation technique carried out for both the faecal samples were observed negative for the presence of any egg. The egg per gram values for other representative pigeons (n=20) of the flock were found to be 710 ± 347.77, 905 ± 409.72 and 155 ± 131.69 for *Capillaria* species, *Ascaridia* species and for Strongyles, respectively.

The concurrent, heavy gastrointestinal parasitism could be fatal for birds due to the infliction caused by the worms as well as occlusion of the tract (Nghonjuyi *et al*., 2014). The results of the present study depicted the presence of concurrent gastrointestinal parasitism in domestic pigeons which could have resulted in their mortality. The similar clinical signs observed in the present study were earlier reported by Cuvillier (1937) and Kulisic (1989).

The intestines of both pigeons were completely crowded with roundworms especially ascarids and the findings were in agreement with the results of the earlier studies carried out by Ashrafihelan *et al*. (2010) and Khezerpour and Naem (2013). However, they also reported concurrent presence of cestodes, which was not observed in present study.

The morphological studies targeting the micrometry of the eggs and detailed study of the characteristics features of the adult worms was carried out so as to determine the species of encountered parasites. The average ascarid, capillarid and strongyle eggs (n=10) sizes (length × breadth) were 80.5 ± 21.9 µm (79.9 – 94 µm) × 44.6 ± 4.6 µm (37.6 – 51.7 µm), 51.4 ± 3.3 µm (47.5 – 56.4 µm) × 22.1 ± 3.2 µm (18.8 – 28.2 µm) and 72.4 ± 3.3 µm (70.5 – 79.9 µm) × 39.9 ± 2.5 µm (37.6 – 42.3 µm), respectively.

The adult ascarid, capillarid and strongyle worms were identified on the basis of gross and microscopic morphological examination. Grossly, the length of the ascarid, capillarid and strongyle male and female worms (n = 5 each) were measured 63.2 ± 4.7 mm (56 – 68 mm) and 70.9 ± 4.9 mm (65 – 76 mm), 10.1 ± 0.5 mm (9.4 – 10.8 mm) and 12.6 ± 0.2 mm (10.8 – 15.0 mm) and 11.8 ± 1.9 mm (9 – 14 mm) and 20 ± 2.1 mm (18 – 23 mm), respectively.

The distinctive morphological features observed in case of ascarid worms were developed triradiate lips (one dorsal and two subventral) with wide cephalic alae extending on both the lateral sides and filariform oesophagus (Fig. 1). Spicules in case of males were almost equal and there was presence of precloacal chitinous-rimmed sucker (Fig. 2).

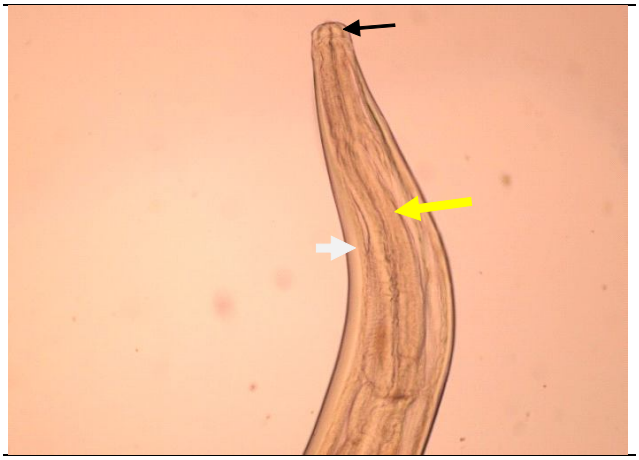

Fig 1: Anterior end of adult *Ascaridia columbae* with triradiate lips (black arrow), filariform oesophagus (yellow arrow) and wide cephalic alae (white arrow) (4X)

Fig 2: Posterior end of adult male *Ascaridia columbae* with precloacal sucker (white arrow) and spicules (black ar row) (4X)

The male of the *Capillaria* species was possessing oesophagus more than the half of the whole length of the parasite, whereas female possessed shorter oesophagus than males. The vulva was slightly prominent in case of females and was observed slightly posterior to the intestinal - oesophageal union (Fig. 3).

In case of the strongyle worms, the cuticle at the anterior end was inflated forming a vesicular enlargement of about 94.9 ± 6.1 µm (89 -103 µm). The mouth was lacking any visible papillae and was simple and unarmed (Fig. 4). The male parasites were comparatively smaller than the female counterparts. The vulva was situated at an average 4.6 ± 0.9 mm (4 -6 mm) from posterior end in female parasites and the body tapered to a blunt, narrow end with a short spine. The eggs were segmented when laid.

The morphological characters of the ascarid worms and eggs, depicting them to be *A. columbae* were in corroboration with the studies of Wehr and Hwang (1964) and Kajerova *et al*. (2004). Whereas, the morphological criteria about the adult worms and the eggs of capillarid parasite in the present study were in agreement with the studies of Wakelin (1965), Soulsby (1982) and Park and Shin (2010), suggesting it to be *C. obsignata*. The characteristics features noticed about the adult strongyle worms and the eggs were consistent with Cuvillier (1937), who reported that *O. quadriradiatus* was pathogenic for domestic pigeons. The morphology of female adult worms was distinguishably clear and could easily be differentiated on the basis of presence of spine at the posterior end. Thus, *A. columbae*, *C. obsignata* and *O. quadriradiatus* were three helminthic species observed in the intestinal tract of both pigeons in the present investigation.

A detailed microscopic examination of the tissues retrieved from the intestines, gizzard, liver, lungs, heart and kidneys was carried out, where marked lesions along with cut section of parasites were observed in intestines and kidneys. Although, no parasites were detected in the heart, lungs, liver and gizzard, but certain microscopic alterations were observed in some organs *viz.* hyperplasia of the lining epithelium with sloughing at places was observed in the gizzard. Most of the lesion in case of intestine was observed in the anterior part of the small intestine *i.e.* duodenum, from where most of the parasites were recovered. At places, cut sections of adult *C. obsignata*, larvae of *A. columbae* and adult of *O. quadriradiatus* with sloughing and hyperplasia of lining epithelium was observed (Fig. 5). Concurrent inflictions to the intestinal tract were in agreement with the findings of Adang *et al*. (2010) and Park and Shin (2010), who observed the adverse effect of *A. galli*, *H. gallinarum* and *C. obsignata* in domestic pigeons and rock partridges, respectively.

The histopathological examination of the kidneys revealed the presence of a digenetic trematode parasite,

Fig 3: Female *Capillaria obsignata* characterized by slightly prominent vulva (white arrow), just posterior to the union of the oesophagus and the intestine (black arrow) (40X)

Fig 4: Anterior end of *Ornithostrongylus quadriradiatus* with vesicular enlargement (white arrow) (40X

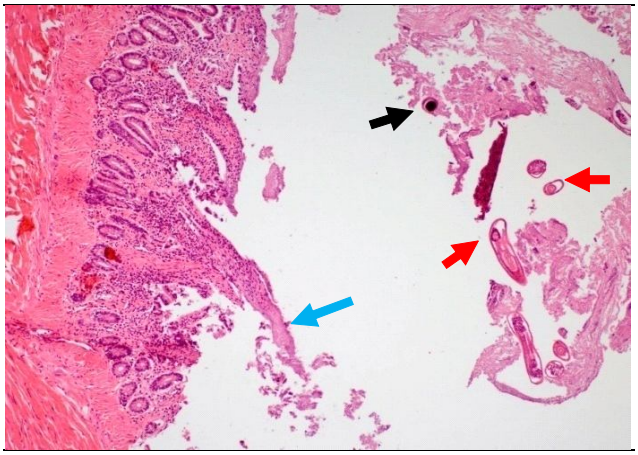

Fig 5: Cut sections of *Capillaria obsignata* (red arrows) and *Ornithostrongylus quadriradiatus* (black arrow) in the lu men of the intestine along with sloughing and hyperplasia of lining epithelium (blue arrow) (10X)

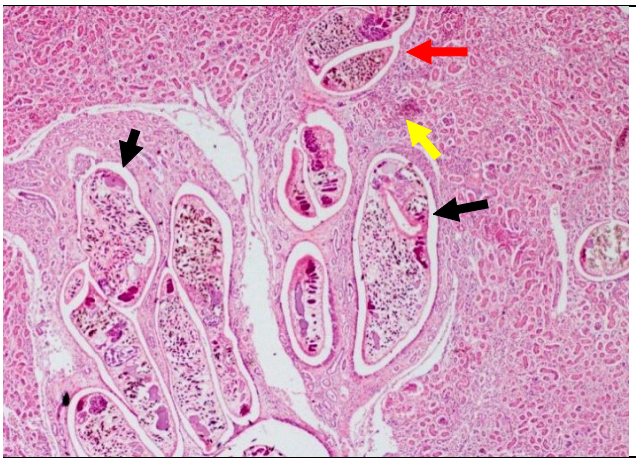

Fig 6: Cut sections of the parasites trapped in renal glomeruli (red arrow), damaging renal tubules (black arrows) and causing marked haemorrhages and infiltration of mono nuclear inflammatory cells (yellow arrow) (4X)

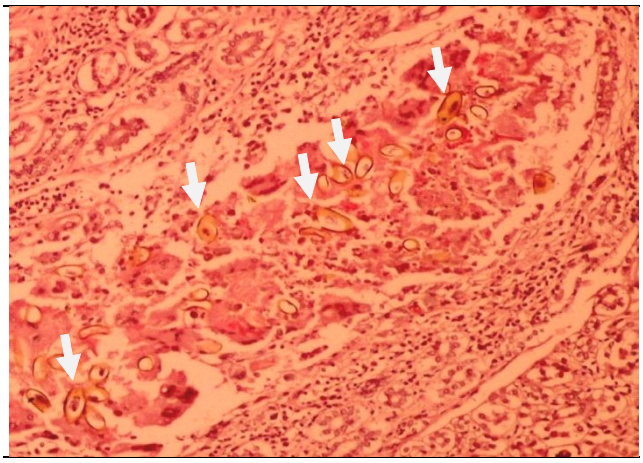

Fig 7: Kidney showing presence of brownish parasitic eggs (white arrows) with tubular damage (10X)

consistent with *Paratanaisia bragai*. The brown coloured eggs, some of which containing fully developed embryos were also observed. Some of the parasites and their eggs were found trapped in the glomeruli, resulting in their destruction (Fig. 6). The major lesions were characterized by haemorrhages and infiltration of mononuclear inflammatory cells around the cut sections of the parasites in the collecting tubules (Fig. 6). The renal tubules exhibited degeneration and presence of brown hemosiderin pigment within the lining epithelial cells. Some of the eggs and hatched miracidium were found free within the parenchyma thereby causing damage to the glomeruli tubules along with infiltration of inflammatory cells (Fig. 7).

P. bragai had previously been reported to parasitize the kidneys of domestic pigeons (Borah *et al.*, 2009), cattle egret (Abdo and Sultan, 2013), guinea fowl (Menezes *et al.*, 2001), whistling ducks (Fedynich *et al.*, 1996), red bird of paradise (Unwin *et al.*, 2013), ruddy ground dove (Pinto *et al.*, 2004), turkey (Brener *et al.*, 2006) and ring- necked pheasant (Gomes *et al.*, 2005) and the parasite had been incriminated as a cause of death of the heavily infected birds (Arnizaut *et al.*, 1992). The detailed examination revealed that tubular and glomerular damage was primarily due to the parasites as well as by the invading eggs. However, Abdo and Sultan (2013) incriminated the renal damage primarily due to the invading eggs. All other observations in the present study were in corroboration with the findings of Abdo and Sultan (2013), who reported the presence of *P. bragai* in cattle egret. The microscopic changes were also in agreement with the observations of Pinto *et al.* (2004) and Gomes *et al.* (2005).

CONCLUSION

Based on the gross and microscopic findings, authors believe that concurrent intestinal and renal parasitism with the pathogenic parasites resulted in substantial pathology of the organs concerned, which ultimately proved fatal for the hosts. The present study also reflects and supports the fact that concurrent intestinal parasitism leads to depression, diarrhoea, decreased egg production and immunosuppression in domestic pigeons, which further rendered them susceptible to other infections. Based on thorough literature search and available information, this appears to be the first such report of fatal concurrent gastrointestinal and renal parasitism due to *A. columbae*, *C. obsignata*, *O. quadriradiatus* and *P. bragai* in domestic pigeons of Punjab state in India.

ACKNOWLEDGEMENT

Authors are thankful to the Dean, Post Graduate Studies, GADVASU, Ludhiana for providing all available helps to undertake this investigation. Thanks are also due to DST for providing INSPIRE fellowship to the first author for his doctoral programme. Authors declare no conflict of interest.

REFERENCES

Abdo, W. and Sultan, K. (2013). Histopathological findings of the kidney trematoda *Paratanaisia* spp. (Digenea: Eucotylidae) in cattle egret (*Bubulcus ibis*). *Rev. Bras. Parasitol. Vet.* **22**: 312-313.

Adang, K.L., Abdu, P.A., Ajanusi, J.O., Oniye, S.J. and Ezealor, A.U. (2010). Histopathology of *Ascaridia galli* infection on the liver, lungs, intestines, heart and kidneys of experimentally infected domestic pigeons (*C. l. domestica*) in Zaria, Nigeria. *The Pac. J. Sci. Tech.* **11**: 511- 515.

Adang, K.L., Oniye, S.J., Ezealor, A.U., Abdu, P.A., Ajanusi, O.J. and Yoriyo, K.P. (2009). Ectoparasites and intestinal helminths of speckled pigeon (*Columba guinea* Hartlaub and Finsch 1870) in Zaria, Nigeria. *Sci. World J.* **4**: 1-5.

Arnizaut, A.B., Hayes, G.D., Olsen, H., Torres, J.S., Ruiz, C. and Pérez- Rivera, R. (1992). An epizootic of *Tanaisia bragai* in a captive population of Puerto Rican plain pigeon (*Columba inornata wetmorei*). *Ann. N. Y. Acad. Sci.* **653**: 202 205.

Ashrafihelan, G., Norozi, R., Seyed-Hosein, N. and Mehpeikar, H. (2010). An identification of helminth parasites and gastrointestinal infection domestic pigeon in Tabriz, Iran. *Iran. J. Vet. Res.* **6**: 52-57.

Borah, M.K., Rahman, T., Goswami, S. and Islam, S. (2009). On the incidence and pathology of *Paratanaisia bragai* dos Santos, 1934 (Freitas, 1959) infection in domestic pigeon (*Columba livia*). *J. Vet. Parasitol.* **23**: 159-161.

Brener, B., Tortelly, R., Menezes, R.C., Muniz-Pereira, L.C. and Pinto, R.M. (2006). Prevalence and pathology of the nematode *Heterakis gallinarum*, the trematode *Paratanaisia bragai*, and the protozoan *Histomonas meleagridis* in the turkey *Meleagris gallopavo*. *Mem. Inst. Oswaldo Cruz* **101**: 677– 681.

Cuvillier, E. (1937). The nematode, *Ornithostrongylus quadriradiatus*, a parasite of the domesticated pigeon. U. S. Dept. of Agriculture, Technical bulletin.

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

Fedynich, A.M., Pence, D.B. and Bergan, J.F. (1996). Helminth community structure and pattern in sympatric populations of black-bellied and fulvous whistling-ducks. *Can. J. Zool.* **74**: 2219-2225.

Gomes, D.C., Menzel, R.F.C., Tortelly, R. and Pinto, R.M. (2005). Pathology and first occurrence of the kidney trematode *Paratanaisia bragai* (Santos, 1934) Freitas, 1959 (Digenea: Eucotylidae) in *Phasianus colchicus* L. 1758, from Brazil. *Mem. Inst. Oswaldo Cruz* **100**: 285-288.

Kajerova, V., Barus, V. and Literak, I. (2004). Nematodes from the genus *Ascaridia* parasitizing psittaciform birds: a review and determination key. *Vet. Med*. **49**: 217-223.

Kanev, I., Radev, V. and Fried, B. (2002). Family Eucotylidae. In: D.I. Gibson, A. Jones, R.A. Bray (eds.), Keys to the Trematoda. Volume 1. CABI, CAB International, Wallingford. p. 147-153.

Khezerpour, A. and Naem, S. (2013). Investigation on parasitic helminthes of gastrointestinal, liver and lung of domestic pigeons (*Columba livia*) in Urmia, Iran. *Int. J. Livest. Res.* **3**: 35-41.

Kulisic, Z. (1989). Parasite fauna of pigeons (*Columba livia*) in the Belgrade area. *Vet. Glasnik* **43**: 847-852.

Luna, H.T. and Lee, G. (1968). *Manual of Histological Staining Methods of the Armed forces*. 3rd Edition, Plackiston Division McGraw Hill Book co. New York Toronto, London and Sydney.

Marques, S.M., Quadros, R.M., Da-Silva, C.J. and Baldo, M. (2007). Parasites of pigeons (*Columba livia*) in urban areas of langes, Southern Brazil. *Parasitol. Latinoam.* **62**: 183-187.

Menezes, R.C., Mattos, D.G. Jr., Tortelly, R., Muniz-Pereira, L.C., Pinto, R.M. and Gomes, D.C. (2001). Trematodes of free range reared guinea fowls (*Numida meleagris* Linnaeus, 1758) in the state of Rio de Janeiro, Brazil: morphology and pathology. *Avian Pathol.* **30**: 209-214.

Nghonjuyi, N.W., Kimbi, H.K. and Tiambo, C.K. (2014). Study of gastro–intestinal parasites of scavenging chickens in Fako Division, Southwest Cameroon. *J. Adv. Parasitol.* **1**: 30-34.

Park, S.I. and Shin, S.S. (2010). Concurrent *Capillaria* and *Heterakis* Infections in Zoo Rock Partridges, *Alectoris graeca*. *Korean J. Parasitol.* **48**: 253- 257.

Pinto, P.M., Menezes, R.C. and Tortelly, R. (2004). Systematic and pathologic study of *Paratanaisia bragai* (Santos, 1934) Freitas, 1959 (Digenea, Eucotylidea) in a ruddy ground dove *Columba talpacoti* (Temminck, 1811). *Arq. Bras. Med. Vet. Zootec.* **56**: 472-479.

Soulsby, E.J.L. (1982). Helminths, Arthropods and Protozoa of Domesticated Animals. 7th Edition, ELBS, Bailliere Tindall, London.

Tsai, S.S., Hirai, K. and Itakura, C. (1992). Histopathological survey of protozoa, helminths and ascarids of imported and passerine local Psittacine and Birds in Japan. *Japanese J. Vet. Res.* **40**: 161- 174.

Unwin, S., Chantrey, J., Chatterton, J., Aldhoun, J.A. and Littlewood, T.J. (2013). Renal trematode infection due to *Paratanaisia bragai* in zoo housed Columbiformes and a red bird-of-paradise (*Paradisaea rubra*). *Int. J. Parasitol. Parasites Wildl.* **2**: 32-41.

Wakelin, D. (1965). Experimental studies on the biology of *Capillaria obsignata* Madsen 1945 a nematode parasite of the domestic fowl. *J. Helminthol.* **39**: 399-412.

Wehr, E.E. and Hwang, J.C. (1964). The life cycle and morphology of *Ascaridia columbae* (Gmelin, 1790) Travassos, 1913 (Nematoda: Ascarididae) in the domestic pigeon (*Columba livia domestica*). *J. Parasitol.* **50**: 131-137.