DOI: https://doi.org/10.71317/kjard.2.8.2026.456

The Kashmir Journal of Academic Research and Development

Journal homepage: https://rjsaonline.org/index.php/KJARD

Effects of Ivermectin and Albendazole on Gastrointestinal Tract Nematode parasites of Domestic Pigeon (Columba Livia) in Faisalabad

Muhammad Tayyib Khan
Department of Clinical Medicine and Surgery, Faculty of Veterinary and Animal sciences, University of agriculture Faisalabad, Pakistan
Email: tayyibvet@gmail.com

Ashar Mahfooz
Department of Clinical Medicine and Surgery, Faculty of Veterinary and Animal sciences, University of agriculture Faisalabad, Pakistan

Mudasir Nazar
Department of Livestock Production and Management (DLPM), Faculty of Veterinary Sciences, The University of Veterinary and Animal Sciences, Swat, Pakistan

Muhammad Shahid
Faculty of Veterinary and Animal Sciences (FVAS), Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

Kashif Hussain
Faculty of Veterinary and Animal Sciences (FVAS), Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

Asghar Abbas
Faculty of Veterinary and Animal Sciences (FVAS), Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

Murtaz ul Hasan
Department of Parasitology and Microbiology, PMAS-Arid Agriculture University, Rawalpindi

Naheed Bano
Faculty of Veterinary and Animal Sciences (FVAS), Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

Muhammad Mustfa Jafar
Department of Clinical Medicine and Surgery, Faculty of Veterinary and Animal sciences, University of Agriculture, Faisalabad, Pakistan

Shafique Ahmad
Department of Therieogenology, Faculty of veterinary and animal sciences, University of Agriculture, Faisalabad, Pakistan

Kasim Sakran Abass
Department of Physiology, Biochemistry, and Pharmacology, College of Veterinary Medicine, University of Kirkuk, Kirkuk 36001, Iraq

Muhammad Usman
Department of Biosciences, Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan- 60800, Pakistan.

Muhammad Nadeeem
Department of Pathology, PMAS-Arid Agriculture University Rawalpindi, Sub-Campus Khushab

ARTICLE INFO

Received:
July 09, 2026
Revised:
July 23, 2026
Accepted:
August 07, 2026
Available Online:
August 20, 2026

Keywords:
Columba Livia, Gastrointestinal Nematodes, McMaster Technique, Drug Efficacy, Parasite Control

Corresponding Author:
Muhammad Tayyib Khan
Email: tayyibvet@gmail.com

ABSTRACT

Gastrointestinal nematode infections are a major health constraint in domestic pigeons (Columba livia), reducing their productivity and overall well-being. This study was evaluated the comparative anthelmintic efficacy of ivermectin and albendazole, administered individually and in combination, against naturally occurring gastrointestinal nematodes parasite in domestic pigeons from Faisalabad, Pakistan. A total of 140 pigeons (80 males and 60 females) were selected for this study. These infected bird were observed using standard fecal flotation and microscopic techniques to determine the prevalence of nematode infections. Total, 74.4% of the birds were infected, with infection rates of 73.75% in males and 75.0% in females. The predominant parasites were detected Capillaria spp. and Ascaridia columbae, whereas no eggs of Dispharynx spp. were identified in the examined fecal samples. We were randomly allocated 104 infected birds and its divided into four equal groups (A, B, C, and D), each group has 26 birds in this experiment for further process. Group A received ivermectin (0.1 mL/kg body weight), Group B received albendazole (1 mL/3 kg body weight), Group C received a combination of both drugs at the same dosages, and Group D remained untreated as the control. The treatments were administered for three consecutive days. Fecal samples were collected before treatment and on days 0, 4, 7, 14, 21, and 30 after treatment. Anthelmintic efficacy was assessed using the McMaster egg counting technique. Both ivermectin and albendazole significantly reduced fecal egg counts compared with the untreated control ($P < 0.05$). Ivermectin achieved a higher mean efficacy (90.37%) than albendazole (87.97%), while the combined treatment produced the greatest reduction in parasite burden, with an efficacy of 93.43% ($P < 0.05$). These findings indicate that ivermectin is more effective than albendazole when used alone, whereas combined therapy provides the highest level of control against gastrointestinal nematode parasites in domestic pigeons. The results support the strategic use of combined anthelmintic treatment to improve parasite management in pigeon production systems.

Introduction

Production of domestic pigeon (Columba livia) has increased in importance globally as pigeons are raised for meat, racing, ornamental use and for recreational purposes (Adawy et al., 2023). The pigeon farming also provides income to the family and is an important part of the small livestock farming, in many developing countries, including Pakistan (Ahmed et al., 2021). Pigeons are vulnerable to many infectious and parasitic diseases, which have a negative effect on their health, reproduction, growth performance and survival, particularly due to their economic and cultural value (Mia et al., 2022). These health issues include gastrointestinal helminth infections, which are one of the most prevalent causes of decreased flock performance and productivity (Saleem et al., 2022; Höglund et al., 2023). The gastrointestinal nematodes are common in domestic and wild pigeons all over the tropical and subtropical parts of the world (Bibi et al., 2025; Ayesha et al., 2023). These parasites inhabit various parts of the digestive system, compromising nutrient breakdown, gut barrier integrity, and immune responses (Ali et al., 2025). High infection rates can lead to poor feed efficiency, decreased production, anemia, diarrhea, anorexia, weight loss, delayed growth, and susceptibility to secondary infections such as bacterial and viral infections (Varanasi, 2024). The clinical disease varies with many factors such as species of parasites, level of infection, host age, nutrition, environmental hygiene, and management practices (Sadek et al., 2025). The nematodes of pigeons include Ascaridia columbae, Capillaria spp. and Dispharynx spp., which are regarded as the most economically important nematodes (Saleem et al., 2022). Ascaridia columbae is found in the small intestine and has been associated with intestinal obstruction, enteritis and poor growth; while Capillaria species invade the mucosa of the crop and intestinal tract, and cause chronic inflammation, poor growth and emaciation. Dispharynx spp. are mainly parasites of the proventriculus and can cause acute inflammatory lesions in heavily infected birds (Qureshi et al., 2023). As of now, recent epidemiological studies in Asia, the Middle East, and Africa have remained the most common gastrointestinal nematodes infecting domestic pigeons (Höglund et al., 2023; Saleh et al., 2025), stressing the importance of good surveillance and control programmes. The gastrointestinal nematodes are primarily transmitted via ingestion of infective eggs or intermediate hosts found in contaminated feed, water, litter, and environment (Bibi et al., 2025). Parasite infections can be maintained and spread in pigeon flocks because of the poor sanitation, high flock density, free ranging and improper deworming practices (Saha et al., 2026). Repeated exposure often results in reinfection and continued transmission of the parasites since nematode eggs are highly resistant to the environment (Qureshi et al., 2023). Therefore, a combination of improved management practices, regular monitoring, and judicious use of chemotherapy is crucial to maintaining pigeon health and productivity (Geurden et al., 2022; Samue eta al., 2025). Microscopic examination of the fecal sample by flotation and quantitative faecal egg count (QFEC) techniques (Hanny et al., 2020) are commonly used for diagnosis of gastrointestinal nematodes. The McMaster technique is one of the most popular techniques used to determine eggs per gram (EPG) of feces and to assess the efficacy of anthelmintics in the field (Hanny et al., 2020). The countries of the world recommend the use of fecal egg count reduction testing (FECRT) to determine the efficacy of treatment and to monitor anthelmintic resistance in flocks or herds of livestock and poultry (Singh et al., 2025; Coroian et al., 2026). The control of gastrointestinal nematodes (GIN) in avian species is still based on anthelmintic therapy (Rodríguez–Vivas et al., 2020). Ivermectin is a macrocyclic lactone that works by binding to glutamate-gated chloride channels in nerve and muscle cells of susceptible nematodes causing paralysis and death (Pollock et al., 2025). Albendazole, a benzimidazole derivative, acts as an antiparasitic agent by blocking β-tubulin polymerization and inhibiting glucose uptake and disrupting energy metabolism in the cells of parasites (Tahlan et al., 2025). Both drugs have been shown to have wide-spectrum activity against gastrointestinal nematodes in poultry and other domestic animals, but there may be differences in efficacy depending on the species of nematode, the level of the infection, the dosage, and management conditions (Halma et al., 2026). Ivermectin has been known to be effective against gastrointestinal nematodes in captive birds and poultry (Yazwinski et al., 2022). Albendazole has also exhibited a wide spectrum of activity against nematodes in domestic birds (Adnan et al., 2026). But, it has been reported that efficacy of treatment varies among different parasite species and production systems (Geurden et al., 2022). With the growing awareness of decreasing efficacy and the possibility of drug resistance, interest has grown in combination therapy with drugs with different modes of action (Kerek et al., 2025). Administration of ivermectin along with albendazole could potentially lead to greater elimination of parasites by attacking multiple physiological pathways, and also decrease the pressure for selection of repeated administration of a single drug (Malik et al., 2025). All this has pointed to the need for evidence-based anthelmintic strategies and for integrated parasite management, in order to ensure the long-term efficacy of the drugs available (Pérez Gaudio et al., 2025). Little is known about the comparative effectiveness of ivermectin and albendazole against gastrointestinal nematodes in naturally infected domestic pigeons in Pakistani production system. Thus, the present study was conducted to find the prevalence of GIT nematodes in domestic pigeons of Faisalabad, Pakistan and to compare the efficacy of ivermectin, albendazole and their combination treatment based on fecal egg count reduction (FECR) as an important parameter of response to treatment. The results obtained from this research can be useful to develop better control strategies for parasites and sustainable health management practices in the local production of pigeons.

Methodology

Study Area for Sampling Sites

The study was carried out in the city of Faisalabad, Punjab, Pakistan at 31°24' N latitude and 73°05' E longitude and at an elevation of about 183 m above the mean sea level. The climate of Faisalabad is semi-arid with significant difference in temperature and rainfall between different seasons. Precipitation is irregular and has large internal variations with the seasonal western disturbances being the main influence during the winter season when the ambient temperature is comparatively low ranging from 19.4°C to 33.9°C with a rare minimum of −2.0°C. The gastrointestinal parasites tend to survive and spread in these weather conditions in free ranging and domestically raised pigeons (Pakistan Meteorological Department, 2004).

Experimental Birds and Treatments

The experimental birds and treatments employed were: Apparently normal domestic pigeons Columba livia, 140 birds, 80 males and 60 females were collected from local bird markets of Faisalabad. All the birds were represented by birds of different ages and body weights, which are naturally reared pigeons. All birds were subjected to a general clinical examination prior to their enrolment, to determine their overall health status. Fecal samples were individually collected and processed microscopically to look for gastrointestinal nematode eggs. Birds which tested positive for one or more nematode species were deemed to be eligible for the treatment trial. Four groups of experimental birds were designed in this groups A, B, C and D, with the birds of each group being naturally infected pigeons, among which 104 birds have been screened. Each groups were contained at 26 birds in this experiment. Three-day intermittent treatment was given once a day. The birds were kept in separate cages during the entire experiment, and fed and watered freely. Treatments were administered once daily for three consecutive days. These birds were maintained in separate pens throughout the study to avoid cross-contamination and were provided feed and drinking water ad libitum.

Table 1. Experimental Design and Anthelmintic Treatment Regimens Administered to Domestic Pigeons

Group	Treatment	Dose	Route
A	Ivermectin	0.1 mL kg^{-1} body weight	Oral
B	Albendazole	1 mL per 3 kg body weight	Oral
C	Ivermectin + Albendazole	Same individual doses	Oral
D	Untreated control	—	—

Collection of Fecal Samples

The fresh fecal droppings were collected as soon as they were excreted to reduce environmental contamination. Samples were collected at 4, 7, 14, 21 and 30. All samples were collected and then transferred to sterile labeled containers and taken to the laboratory immediately for parasitological examination.

Parasitological Analysis

Gastrointestinal nematodes were qualitatively detected from the feces using the standard flotation method. The eggs were identified based on their morphological features such as egg size, shape, egg shell appearance, bipolar plugs and internal embryonic structures of the eggs. Identification was made with the aid of veterinary parasitology keys.

Quantification of Fecal Egg Counts

The intensity of nematode infection was determined using the McMaster egg-counting technique. About 2g of feces was thoroughly mixed with flotation solution and filtered and then placed into both compartments of a McMaster counting slide. The eggs were floated and eggs in the calibrated grid were counted using a light microscope at ×100 magnification. Egg counts were expressed as;

$$\text{EPG} = \frac{\text{Number of Eggs Counted} \times \text{Dilution Factor}}{\text{Weight of Feces}}$$

where:

EPG = eggs per gram of feces.

Drug Efficacy

Fecal egg counts were taken before and after treatment to assess the efficacy of the drugs. The formula used to calculate percentage reduction in the fecal egg count (FECR) was: Parasite Prevalence Determination The prevalence was determined overall based on the number of infected birds. Which one of the following is given below according to formula?

$$\text{EFCR\%} = \frac{\text{EPG0} - \text{EPGt}}{\text{EPG0}} \times 100$$

where

EPGo= Pre-treatment fecal egg count

EPGt=post-treatment fecal egg count

Determination of Parasite Prevalence

The total prevalence was calculated on the basis of number of infected birds. Which are given below according to formula.

$$\text{Prevalence\%} = \frac{\text{Number of Infected Birds}}{\text{Total Bird Examind}} \times 100$$

Similarly,

Species-specific prevalence was calculated using

$$\text{Species Prevalence\%} = \frac{\text{Birds Infected with a Particular Parasite}}{\text{Total Bird Examind}} \times 100$$

Statistical Analysis

Data were entered into a spreadsheet (Microsoft Excel) and then analyzed using IBM SPSS Statistics (IBM, 2026). Data are expressed as mean ± SE. One-way analysis of variance (ANOVA) was used to determine the difference among treatment groups and an appropriate post hoc multiple comparison procedure was used when significant differences were found. Fisher's exact test or the Chi-square test was used to determine differences in the prevalence of parasites between sex and group. A p value of < 0.05 was considered to be statistically significant.

Results

Prevalence of Gastrointestinal Nematodes Parasites (Columba Livia) in Domestic Pigeons

Gastrointestinal nematode (GIN) infection was detected in 104 (74.3%) of the 140 domestic pigeons and 36 birds (25.7%) were negative for the presence of nematode eggs in the feces. The infection was similar in both sexes, 73.75% (59/80) of males and 75.0% (45/60) of females were infected, with no statistically significant difference in infection rates between the sexes. In the fecal exam, two nematode taxa were identified (Ascaridia columbae, and Capillaria spp). In all samples examined, no eggs were found that were morphologically consistent with those of Dispharynx nausta.

Figure 1. Prevalence of Gastrointestinal nematode parasites in domestic pigeon

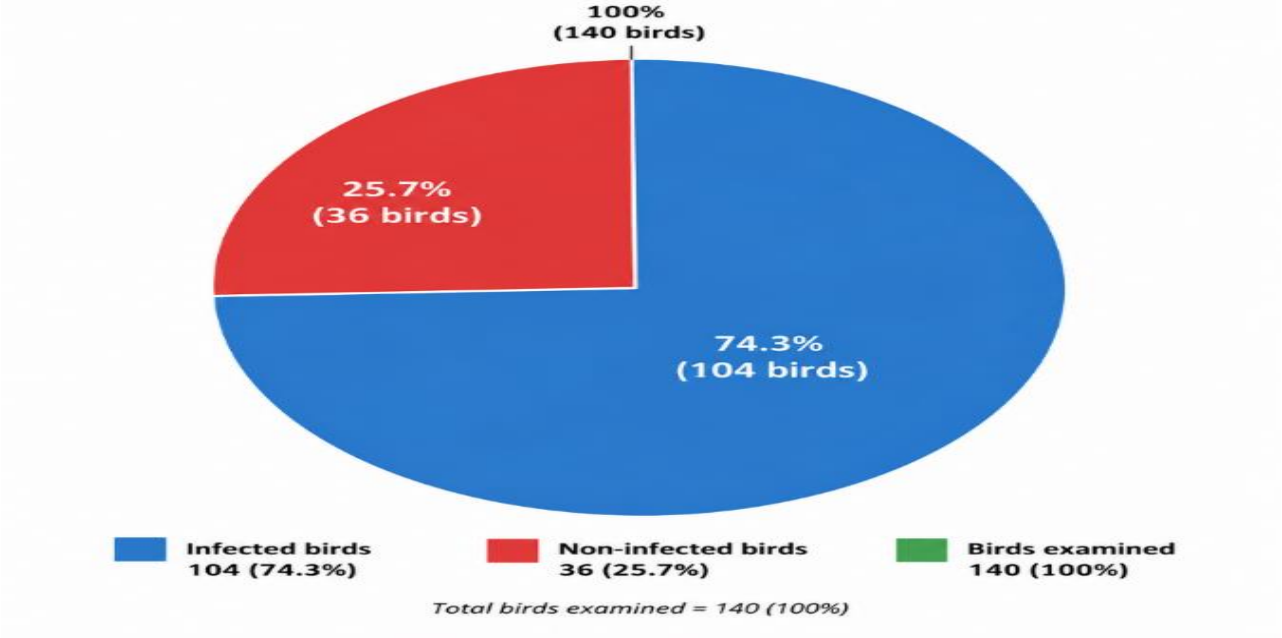

Table 2. Sex-Wise Prevalence of Gastrointestinal Nematodes

Sex	Examined	Positive	Prevalence%
Male	80	59	73.75
Female	60	45	75
Total	140	104	74.3

Distribution of Parasite Species

Ascaridia columbae, the most prevalent parasite, and Capillaria spp. were the other parasites identified. No eggs of Dispharynx nausta were seen during the study. Ascaridia columbae was found to be more common which suggests that this species was the most important gastrointestinal nematode of domestic pigeons in the study area.

Table 3. Identification of Gastrointestinal Nematodes in Domestic Pigeon

Parasite	Status
Ascaridia columbae	Present
Capillaria spp.	Present
Dispharynx nausta	Not detected

Representative Photomicrographs of Parasite Eggs

Samples were analysed by flotation and light microscopy of feces. Images were taken at x400 magnification and the scale bar is 50 µm. (A) Bipolar plugs at each end of capillaria spp. egg, elongated, barrel shaped with smooth shell. The eggs of Capillaria are characterized by these morphological characteristics which were used in the microscopic identification in the course of fecal examination. Ascaridia columbae (B) egg is nearly spherical to oval and has thick, smooth, multi-layered shell with a dense unsegmented embryo. A. columbae can be differentiated from other gastrointestinal nematodes of pigeons on the basis of its characteristic morphology.

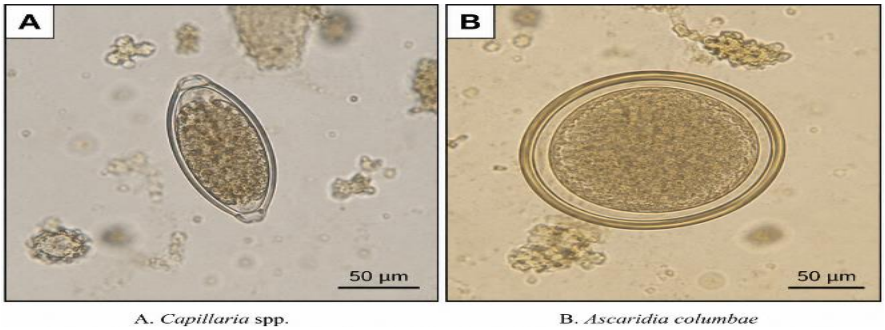

Figure 2. Representative photomicrographs of gastrointestinal nematode eggs identified in fecal samples of domestic pigeons (Columba livia). (A) Capillaria spp. egg showing a barrel-shaped structure with bipolar plugs. (B) Ascaridia columbae egg showing a thick, smooth shell and unsegmented embryo. Images were obtained by light microscopy at ×400 magnification. Scale bar show 50 µm.

Baseline Egg Counts

The numbers of eggs per gram of feces (EPG) were not significantly different between experimental groups before treatment, confirming that the groups were comparable before the anthelmintic treatments were given. Groups in the study had a range of mean baseline EPG values from about 257 to 275. Similarly, there was no significant difference in mean EPG values between male and female pigeons.

Table 4. Descriptive Analysis of Baseline Egg Counts (Mean (±SE) Pretreatment EPG)

Group	Mean EPG ± SE
Ivermectin	265.0 ± 28.16
Albendazole	274.7 ± 27.38
Combination	264.9 ± 28.26
Control	257.4 ± 27.61

Effect of Anthelmintic Treatments on Fecal Egg Counts

All medicated groups showed significant decrease in fecal egg count after treatment when compared to their pre-treatment counts while the untreated control group continued to have high counts of EPG throughout the observation period. This decrease was observed by Day 4 and remained until Day 30. The combination therapy group always had the lowest EPG value after therapy when compared to all other treatment groups.

Table 5. Mean fecal egg counts (EPG) of anthelmintic treatments

Day	Ivermectin	Albendazole	Combination	Control
0	270	275	264.58	258
4	18.75	26.92	16.0	276
7	20.0	25.0	14.6	272
14	18.0	25.0	14.58	274
21	14.0	21.5	14.58	270
30	26.0	32.0	18.0	272

Comparative Drug Efficacy

The results of the fecal egg count reduction calculation showed that ivermectin was more effective than albendazole alone. Ivermectin and albendazole (both given simultaneously) gave the biggest reduction in parasite counts or the highest overall efficacy throughout the experimental period. The mean efficacy rates were 90.37% with ivermectin, 87.97% with albendazole and 93.43% with both drugs together. There were significant differences between treatment regimens as shown by statistical analysis.

Table 6. Comparative of drug efficacy

Treatment	Mean efficacy (%)
Albendazole	87.97
Ivermectin	90.37
Combination	93.43

Discussion

Gastrointestinal nematodes are still one of the most significant parasitic problems of domestic pigeons. In the present study, the overall prevalence was 74.3%, which shows that gastrointestinal helminth infection in pigeons is prevalent in the local management system in Faisalabad, Pakistan. High prevalence could be linked to poor sanitation, constant contact with unclean surroundings, free access to waste, overcrowding, and the lack of control programs on parasites. It is important to note that gastrointestinal helminth infections (58%) were reported in domestic pigeons from various countries, with different climatic conditions, management practices, and diagnostic methods reported, which are comparable (Devulder et al., 2025). Continuous environmental contamination and poor hygiene are also significant risk factors for persistent helminth infections in domestic pigeons (Kovács et al., 2025). The infection rates observed in male (63.1.8%) and female (79.2.0%) pigeons were similar, indicating that there is no significant sex difference in susceptibility to gastrointestinal nematode infection (Saleem et al., 2022). The same was noted by Nabegu et al. (2025) who reported no difference in prevalence of helminths between male and female pigeons. Tayyub et al. (2025) also found that environmental exposure and management conditions were more important to consider in the spread of parasites than host sex. Ascaridia columbae and Capillaria spp. were the predominant nematodes found in the present study, and no eggs of Dispharynx spp. were found. The results are similar to those reported by other studies showing that the main gastrointestinal nematodes of domestic pigeons are Ascaridia spp. and Capillaria spp. (Saleem et al., 2022). Ascaridia spp. have a direct life cycle and are known to be fast spreaders within closed flocks, while Capillaria spp. can survive for a long time in contaminated environment, thereby causing long-lasting infections (Azam et al., 2025). In both ivermectin and albendazole groups, the mean difference in FEC was significant from the untreated group ($P < 0.05$) indicating efficacy against natural gastrointestinal nematode infections. But when alone, ivermectin was more effective in reducing faecal egg counts than albendazole. The same has been observed in poultry and captivity birds, where ivermectin has been found to be effective against gastrointestinal nematodes due to its quick neuromuscular effect (Yazwinski et al., 2022). Albendazole has also been claimed to be effective against a wide range of helminths, but the effectiveness has been found to be different for different helminths, intensity of infection, and dose regimens (Desta et al., 2025). When administered in combination, ivermectin and albendazole were the most effective (93.43%) when compared to ivermectin alone (89.76%), or albendazole alone (80.00%). The same has been observed after combination therapy in poultry and livestock, with anthelmintics with different modes of action improving parasite control and resistance management (Geurden et al., 2022). In addition, Höglund et al. (2023) recommended that using multiple anthelmintics, such as different classes, could yield better treatment results, including in cases of mixed-species infections. Fecal egg count reduction testing after treatment showed the marked decrease in the eggs and it was useful in assessing therapeutic response. The McMaster technique continues to be one of the most commonly used techniques for quantitative estimation of parasite burden in poultry and determining anthelmintic effectiveness (Yazwinski et al., 2022). Fecal egg count reduction is interpreted in the present study according to the recommendations of the World Association for the Advancement of Veterinary Parasitology (WAAVP) where they recommend the use of fecal egg count reduction as the standard method for determining the efficacy of the anthelmintic for birds (Geurden et al. 2022). Although the response to treatment was good, parasites could not be eliminated from every treated bird, and it is possible that reinfection or survival of a small proportion of parasites was experienced during the time that birds were observed. Previous studies also reported similar findings that environmental contamination and infective eggs' persistence affect the long-term efficacy of anthelmintic treatment (Jeantet et al., 2024). Additionally, recent WAAVP recommendations highlight the importance of strategic deworming in conjunction with improving sanitation and performing routine fecal monitoring to prevent reinfections and further development of anthelmintic resistance (Yazwinski et al., 2022). One limitation of the present study is that identification of parasites was done only at the egg level, not at the molecular level. These methodological shortcomings have also been recognised in earlier epidemiological studies on helminths of birds (Yazwinski et al., 2022). The use of molecular identification, seasonality epidemiological surveys and long-term monitoring of anthelmintic efficacy in future investigations would help optimize the strategies to control parasites. Overall, these results suggest that ivermectin was more effective than albendazole alone, and that the most effective treatment was a combination of the two drugs, which resulted in the highest reduction of gastrointestinal nematode burden. This is consistent with previous reports showing that combination anthelmintic (anti-worm) treatment can help with parasite control and should be combined with good management and biosecurity to ensure sustainable control of parasites (Geurden et al., 2022; Höglund et al., 2023).

Conclusion

Domestic pigeons (Columba livia) were infected with gastrointestinal nematode parasite (GINs) commonly found in their guts, with the most common parasites being identified as Ascaridia columbae and Capillaria spp. The anti-parasitic drugs ivermectin and albendazole both had a significant effect on reducing the number of eggs in the faeces; ivermectin was more effective than albendazole at reducing the eggs in the feces when used alone. Ivermectin plus albendazole appeared to give the best therapeutic response, suggesting that a combination treatment is a more effective way of controlling gastrointestinal nematode infections in domestic pigeons. Strategic treatment with anthelmintics, regular parasitological monitoring and better flock management

are recommended for the improved health and reduced transmission of parasites. The long-term efficacy needs to be assessed, and the possibility of anthelmintic resistance in the field needs to be monitored in further studies.

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