

Gastrointestinal helminth parasites of *Gallus gallus* raised in extensive system in the city of Viçosa, Minas Gerais, Brazil

Helminthos parasitos gastrintestinais de *Gallus gallus* criados em sistema extensivo no município de Viçosa, Minas Gerais, Brasil

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Abstract

Extensive rearing systems enable higher occurrence of helminths, which is a hindrance in poultry farming, significantly affecting productivity. A survey was conducted to determine the prevalence of gastrointestinal helminths in chickens reared in extensive system in the city of Viçosa, Minas Gerais, Brazil between December 2017 to September 2018. A total of 5579 specimens were recovered from the gastrointestinal tracts of most animals (81.55% of prevalence). Of the positive poultries, only 41.67% had mixed infections, and of these, more than 90% were nematodes and cestodes co-infections. Three nematodes (*Ascaridia galli*, *Heterakis gallinarum*, *Capillaria* sp.), seven cestodes (*Raillietina tetragona*, *R. echinobothrida*, *R. cesticillus*, *Choanotaenia infundibulum*, *Hymenolepis cantianiana*, *H. carioca* and *Davainea proglottina*) and two trematodes (*Postharmostomum commutatum* and *Echinostoma* sp.) species were identified. The most dominant helminth species was *H. gallinarum* (60.19%), which also presented higher average intensity (35.46 ± 0.65) and abundance (21.34 ± 3.01) among all recovered species. The tapeworm species correspond to 42.23% of prevalence and the trematodes correspond to only 3.40%. Despite the scarcity of data in the Brazilian literature on poultry helminths reared in extensive systems, regional parasitological surveys are important. It is expected that these results will contribute to the adoption of prophylactic measures and alternative control strategies in order to reduce the risk of helminth infection in poultry.

Keywords: poultry, extensive breeding, helminths.

Resumo

Os sistemas de criação extensivos permitem maior ocorrência de helmintos, o que é um entrave na avicultura, afetando significativamente a produtividade. Um levantamento foi realizado para determinar a prevalência de helmintos gastrintestinais em frangos criados em sistema extensivo na cidade de Viçosa, Minas Gerais, Brasil, entre dezembro de 2017 a setembro de 2018. Um total de 5.579 espécimes foram recuperados do trato gastrointestinal da maioria dos animais (81,55% de prevalência). Das aves positivas, apenas 41,67% tiveram infecções mistas e, destas, mais de 90% foram coinfeções por nematóides e cestóides. Três espécies de nematóides (*Ascaridia galli*, *Heterakis gallinarum*, *Capillaria* sp.), sete de cestóides (*Raillietina tetragona*, *R. echinobothrida*, *R. cesticillus*, *Choanotaenia infundibulum*, *Hymenolepis cantianiana*, *H. carioca* and *Davainea proglottina*) e dois trematódeos (*Postharmostomum commutatum* and *Echinostoma* sp.) foram identificadas. A espécie de helmintos mais dominante foi *H. gallinarum* (60,19%), que também apresentou maior intensidade média ($35,46 \pm 0,65$) e abundância ($21,34 \pm 3,01$) entre todas as espécies recuperadas. As espécies de tênia correspondem a 42,23% da prevalência e os trematódeos correspondem a apenas 3,40%. Apesar da escassez de dados na literatura brasileira sobre helmintos avícolas criados em sistemas extensivos, levantamentos parasitológicos regionais são importantes. Espera-se que esses resultados contribuam para a adoção de medidas profiláticas e estratégias alternativas de controle, a fim de reduzir o risco de infecção por helmintos em aves.

Palavras-chave: avicultura, criação extensiva, helmintos.




How to cite: Valadão, M. C., Vieira, I. S., Carvalho, L. M., Neves, P. H., Magalhães, R. T., Campos, A. K., & Araújo, J. V. (2021). Gastrointestinal helminth parasites of *Gallus gallus* raised in extensive system in the city of Viçosa, Minas Gerais, Brazil. *Brazilian Journal of Veterinary Medicine*, 43, e002121. <https://doi.org/10.29374/2527-2179.bjvm002121>

Received: June 15, 2021.

Accepted: September 16, 2021.

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Introduction

Extensive poultry production systems are intended to promote the natural behavior of animals, and consumers play a considerable role in their recent preference for healthier and more natural food sources (Lozano et al., 2019). However, these systems are characterized by high levels of helminth infections, usually accompanied by reduced production performance and behavioral changes which could indicate reduced animal welfare in chickens (Tamara et al., 2019; Thapa et al., 2015).

The feeding habits of domestic chickens predispose them to parasitic infections, either due to continuous ingestion of infective parasitic stages present in soil and/or by eating infected intermediate hosts (Kaufmann et al., 2011; Ogbaje et al., 2012). Although rarely fatal, parasitic infections of poultry may also increase the risk of animals becoming infected with secondary pathogens or other opportunistic infections that can cause immunosuppression, which can interfere with vaccination response against diseases of other etiology (Cardozo & Yamamura, 2004; Katoch et al., 2012; Silva et al., 2018; Thapa et al., 2015).

Variations in the occurrence of gastrointestinal helminths in *Gallus gallus* Linnaeus, 1758 are due in large part to geographic factors and regional climatic conditions, which influence the biological cycle of helminths (Gomes et al., 2009; Silva et al., 2018; Vieira et al., 2015). Studies on the occurrence and intensity of infection of *G. gallus* gastrointestinal helminths are scarce in the Brazilian literature, and studies from different regions may help to better understand the host-parasite relationship in poultry (Gomes et al., 2009; Silva et al., 2016, 2018; Vieira et al., 2015).

Nematodes constitute the most important group of gastrointestinal helminths in poultry in terms of number of species and pathogeny, and are frequently reported in tropical climates, which are favorable to the propagation and development of larval stages (Brandão-Simões et al., 2020; Katoch et al., 2012; Silva et al., 2018; Thapa et al., 2018). Many gastrointestinal parasites that have indirect cycles, such as cestodes and trematodes, and that have varying degrees of pathogenicity, with some aspects of etiopathogenicity and zoonotic potential, have not yet been fully elucidated (Ogbaje et al., 2012).

The control of endoparasites in various species is carried out using anthelmintic drugs. However, it represents a great challenge for rearing systems, due to its limited use due to economic and environmental issues, the concern with chemical residues in animal products, as well as the development of anthelmintic resistant strains (Kaufmann et al., 2011; Lozano et al., 2019). Regional parasitological surveys are essential to determine appropriate therapies and prophylactic measures in poultry production (Kaufmann et al., 2011; Lozano et al., 2019; Tamara et al., 2019). The aim of this study was to determine the occurrence and intensity of gastrointestinal helminths in poultry reared in an extensive system in Viçosa, Minas Gerais, Brazil, in order to contribute to the search for new control strategies for the main parasitosis.

Material and methods

From December 2017 to September 2018, 191 birds raised in an extensive system were slaughtered by producers in the city of Viçosa, Minas Gerais, and their digestive tract was donated to carry out this work. The city of Viçosa is located in the Zona da Mata region, between latitude 20°45'14" south and longitude 42°52'55" west, comprising an area of approximately 300km² with small and medium rural properties, mostly composed of family farmers.

The small and large intestines were examined for the presence and intensity of helminth infections using standard parasitological methods (Amato & Amato, 2009; Permin & Hansen, 1998). The small intestine was divided into 3 parts, using Meckel's diverticulum (vestibule of the yolk sac) as a reference to mark the middle third, since the anatomical divisions (duodenum, jejunum and ileum) are not as well demarcated as in mammals (Berchieri-Júnior et al., 2009). Then, the caeca and rectum were analyzed.

Each segment of the gastrointestinal tract examined was individually opened with scissors in longitudinal sections and washed with tap water over a 100µm aperture sieve to allow removal of helminths adhered to the mucosa. The helminths found were separated in 9-cm diameter Petri dishes containing 0.9% sodium chloride solution according to their morphological characteristics and counted separately by animal. The identification of adult helminths was performed through

stereoscopic and optical microscope visualization and using the taxonomic keys proposed by Vicente et al. (1995), Anderson et al. (2009), Khalil et al. (1994) and Pojmańska (2002). Prevalences were determined by calculating the percentage of the infected population and each group and species of helminths recovered. The mean values of intensity and abundance for each species and group were calculated according to Bush et al. (1997).

Results

The results obtained show that out of the 260 digestive tracts assessed, 168 (81.55%) harbored at least one worm of one helminth species. In total, 5579 helminths were found and classified into 12 species of Nematoda (5001 worms), Cestoda (528 worms) and Trematoda (50 worms). The prevalence, mean intensity, mean abundance and standard errors (\pm SE) of helminths recovered from the gastrointestinal tracts assessed in this study are shown in Table 1.

Table 1. Prevalence, mean and standard error (\pm SE) of the intensity and abundance of helminths recovered in the *post-mortem* analysis of the intestinal contents of 206 birds slaughtered in the municipality of Viçosa, Minas Gerais, from December 2017 to September 2018.

Helminth	Prevalence (%)	Mean intensity (cSE)	Mean abundance (\pm SE)
<i>Ascaridia galli</i>	28.64	8.95 \pm 0.66	2.56 \pm 0.63
<i>Heterakis gallinarum</i>	60.19	35.46 \pm 0.65	21.34 \pm 3.01
<i>Capillaria</i> sp.	11.17	3.3 \pm 0.21	0.37 \pm 0.13
Nematodes	72.33	33.56 \pm 0.64	24.28 \pm 3.14
<i>Raillietina tetragona</i>	13.59	3.54 \pm 0.26	0.48 \pm 0.18
<i>Raillietina echinobothrida</i>	33.50	5.22 \pm 0.22	1.75 \pm 0.29
<i>Raillietina cesticillus</i>	3.88	4.25 \pm 0.17	0.17 \pm 0.07
<i>Choanotaenia infundibulum</i>	3.4	2.29 \pm 0.15	0.08 \pm 0.04
<i>Hymenolepis cantaniana</i>	2.91	2.33 \pm 0.11	0.07 \pm 0.03
<i>Hymenolepis carioca</i>	0.97	1 \pm 0.07	0.01 \pm 0.01
<i>Davainea proglottina</i>	0.49	3 \pm 0.12	0.01 \pm 0.01
Cestodes	42.23	6.07 \pm 0.25	2.56 \pm 0.40
<i>Postharmostomum commutatum</i>	2.91	7.83 \pm 0.26	0.23 \pm 0.12
<i>Echinostoma</i> sp.	0.49	3 \pm 0.12	0.01 \pm 0.01
Trematodes	3.40	7.14 \pm 0.25	0.24 \pm 0.13
TOTAL	81.55	33.21 \pm 0.61	–

The most prevalent species was the nematode *Heterakis gallinarum* (60.19%), which presented higher average intensity (35.46 \pm 0.65) and abundance (21.34 \pm 3.01) among all recovered helminths, corresponding to 4397 specimens found. Within the cestodes (42.23% of prevalence), 7 species of the genera *Raillietina*, *Choanotaenia*, *Hymenolepis* and *Davainea* were identified, ranging between 0.49 and 33.50% of prevalence, being *Raillietina echinobothrida* Mégnin (1880) predominant over the other species of the group (5.22 \pm 0.22 and 1.75 \pm 0.29 of mean intensity and abundance, respectively). The most relevant distinguishing feature that determines the species *R. echinobothrida* among other species of the genus *Raillietina* is the rostelo, which has double layers, not just rows of hooks (Lalchhandama, 2009). Of 50 trematodes collected in the cecum of 87 positive animals, with 3.40% of prevalence, it was possible to identify two species,

Postharmostomum commutatum (Dietz, 1858) (2.91%), and three specimens belonging to the genus *Echinostoma* Rudolphi, 1809 (0.49%).

Discussion

The high prevalence of gastrointestinal helminths (81.55%) associated with the diversity of species observed in this study can be attributed to the environmental and management conditions in which the chickens were raised, which favor contact with infectious stages of parasites and intermediate hosts. These results are comparable to those reported by Silva et al. (2016, 2018), who found 12 and 15 species of helminths distributed among cestodes, nematodes and trematodes, parasitizing poultry in different poultry production systems also in southeastern Brazil. The various helminth species found in this study negatively affect animal productivity and welfare. High-intensity infections with different helminths species can cause intestinal obstruction, wasting and even death in infected birds (Katoch et al., 2012; Tamara et al., 2019).

Interestingly, the most intestines examined (58.33%) were infected with only one morphotype of the helminth groups, while only 41.67% harboring more than one type of the Nematoda, Cestoda or Trematoda group. In these mixed infections, it was more frequently observed that more than 90% of them had nematode and cestode species together. Several authors still seek to establish a correlation between the prevalence of helminths and some climatic variables, such as temperature, humidity and precipitation (Lozano et al., 2019). The climatic conditions of the city of Viçosa (average temperature 20.6 °C and 1229mm average annual rainfall) associated with the extensive breeding system, favorably influence the maintenance of direct biological cycle parasites, as well as the ubiquitous distribution of intermediate hosts of cestodes and trematodes (Permin et al., 1999; Ruff, 1999; Silva et al., 2018; Thapa et al., 2015; Vieira et al., 2015).

Heterakis gallinarum is a highly prevalent nematode that develops in the cecum of several gallinaceous species. Direct pathogenic effect of *H. gallinarum* can cause typhlitis and ulcerations. This species is recognized as resulting in negative economic impact due to its ability to transport the microorganism responsible for histomonosis (Brandão-Simões et al., 2020; Cupo & Beckstead, 2019; Lozano et al., 2019; Tamara et al., 2019). The results obtained in the present study are in agreement with the results of Vieira et al. (2015) in which 262 birds were evaluated (85.9% positive), most of which were infected with *H. gallinarum* (71.4% prevalence). The high prevalence, intensity and mean abundance of *H. gallinarum* may be closely related to its direct biological cycle, e.g., the continuous exposure of animals to helminth eggs distributed in the environment.

Reports in other countries also highlight the high occurrence of cestode infections in extensive poultry farming systems. Similar to studies carried out in Algeria (Yousfi et al., 2013), Bangladesh (Ferdushy et al., 2016) and Nigeria (Imam et al., 2017), we found a prevalence of 42.23% of cestodes in our analyses. Discrepant data on the prevalence of cestodes in poultry can be observed due to proglottic fragmentation or loss of scolex in the intestinal mucosa, causing inaccurate results in some studies.

Although they had the lowest prevalence (3.40%) in this study, two species of digenetic trematodes were identified, *P. commutatum* and *Echinostoma* sp. However, the accurate identification of these parasites requires more studies than just the morphological characterization of adult specimens.

When these diseases are enzootic, the correct diagnosis associated with management factors can contribute to the control of gastrointestinal parasites in birds in extensive systems (Tamara et al., 2019; Thapa et al., 2015). The high prevalence and mixed infections by helminths observed in this study suggest the adoption of strategic prophylactic measures that consider the biology of the parasite and regional climatic conditions, in order to reduce the risk of these diseases in the long term. These aspects highlight the need for greater awareness of health aspects.

Acknowledgements

The authors are grateful to the Coordination of Improvement of Higher Education Personnel (CAPES), the National Council for Scientific and Technological Development (CNPq) and the Foundation for Research Support of the State of Minas Gerais (FAPEMIG) for the financial support of this study and the teacher Hudson Alves Pinto and students of the Laboratory of Biology of

Trematoda of the Department of Parasitology of the Federal University of Minas Gerais (UFMG) for help in identifying the trematodes found in the study.

Ethics statement

This study was previously approved by the Commission of Animal Experimentation of the Federal University of Viçosa, under protocol number 69/2017, and the donations of the intestines of the birds created in extensive system and slaughtered by breeders were done by means of a Consent Form and duly signed by the donor.

Financial support

MCV - received scholarship from CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior);

ISV -

LMC - received scholarship from CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior);

PHN and RTM - received scholarship from FAPEMIG

AKC - none

JVA - Acquisition of the financial support for the project leading to this publication

Conflict of interests

The authors declare no conflicts of interest.

Authors' contributions

MCV, PHN, RTM - Development of methodology; preparation and writing the initial draft. ISV - Application of statistical study data, Review and Editing manuscript. MCV, LMC and AKC - Writing, Review and Editing manuscript. JVA - Acquisition of the financial support for the project leading to this publication.

Availability of complementary results

The authors must identify where readers can access any complementary information available, such as in an online repository or from the authors on request. We suggest consulting https://wp.scielo.org/wp-content/uploads/Lista-de-Repositorios-Recomendados_pt.pdf

The study was carried out at Laboratório de Parasitologia Veterinária e Doenças Parasitárias, Departamento de Medicina Veterinária da Universidade Federal de Viçosa - UFV, Viçosa, MG, Brasil.

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