



Revista Brasileira de Ciência Avícola

ISSN: 1516-635X

revista@facta.org.br

Fundação APINCO de Ciência e
Tecnologia Avícolas
Brasil

da Silva, GS; Romera, DM; Fonseca, LEC; Meireles, MV
Helminthic Parasites of Chickens (*Gallus Domesticus*) in Different Regions of São Paulo
State, Brazil

Revista Brasileira de Ciência Avícola, vol. 18, núm. 1, enero-marzo, 2016, pp. 163-168
Fundação APINCO de Ciência e Tecnologia Avícolas
Campinas, Brasil

Available in: <http://www.redalyc.org/articulo.oa?id=179745391021>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative



Helminthic Parasites of Chickens (*Gallus Domesticus*) in Different Regions of São Paulo State, Brazil

■ Author(s)

Silva GS da^I
Romera DM^{II}
Fonseca LEC^{III}
Meireles MV^{IV}

^I Laboratório de Parasitologia Animal/Instituto Biológico - IB/APTA/SAA. Votuporanga, SP, Brazil

^{II} Instituto Agrônomo de Campinas - IAC/APTA/SAA. Votuporanga, SP, Brazil

^{III} Departamento de Apoio, Produção e Saúde Animal/Faculdade de Medicina Veterinária/UNESP. Araçatuba, SP, Brazil

^{IV} Departamento de Clínica, Cirurgia e Reprodução Animal/Faculdade de Medicina Veterinária/UNESP. Araçatuba, SP, Brazil

■ Mail Address

Corresponding author e-mail address
Giane Serafim da Silva
Caixa Postal 61 – Votuporanga – SP – Brazil
– CEP 15500-970
Phone: +51(17)34222423 Ramal 207
Email: giane@biologico.sp.gov.br

■ Keywords

Helminths, cestodes, nematodes, trematodes, chicken.

ABSTRACT

The Brazilian poultry industry is an outstanding national and international agribusiness sector. Among the Brazilian states, São Paulo is the largest producer of commercial eggs and the fourth largest producer and exporter of chicken meat. Alternatively, semi-intensive and/or organic poultry production have also obtained a significant share of the domestic market as a result of consumer demand. Helminths affect the performance of the birds, causing significant direct or indirect losses. The objective of the present study was to identify the main helminth species present in chickens reared in 17 municipalities of the state of São Paulo. In total, 359 adult birds were investigated. The birds were reared in different housing systems and were obtained from 69 farms in the selected regions. The birds were submitted to procedures for the detection and identification of helminth parasites, following international standards. The evaluation of the small intestine employed the Mello-Campos method (Mello & Campos, 1974), which allows better recovery of cestode scolices attached to the intestinal mucosa. Stereomicroscopy was used to evaluate the collected materials, and light microscopy was used to identify the species based on their morphological characteristics. The following helminth species were diagnosed in chickens reared in 17 municipalities of the state of São Paulo: nematodes (*Ascaridia galli*, *Capillaria* sp., *Cheilospirura hamulosa*, *Heterakis gallinarum*, *Oxyspirura mansoni*, and *Strongyloides* sp.), cestodes (*Amoebotaenia cuneata*, *Choanotaenia infundibulum*, *Hymenolepis* sp., *Railletina cesticillus*, *Railletina echinobothrida*, and *Railletina tetragona*), and trematodes (*Zygocotyle lunata* and *Postharmostomum commutatum*).

INTRODUCTION

The Brazilian poultry industry is an important national and international agribusiness sector. Among Brazilian states, São Paulo is the largest producer of commercial eggs and the fourth largest producer and exporter of chicken meat (UBA, 2014). According to the Brazilian Institute of Geography and Statistics (IBGE in Portuguese; Brasil, 2011), the Bastos and Amparo municipalities are the largest producers of commercial eggs and broilers, respectively.

However, alternative, semi-intensive and/or organic poultry production has conquered a significant share of the domestic market (Madeira *et al.*, 2010) as a result of consumers' demand. These production systems are regulated in Brazil by the Ministry of Agriculture and Food Supply (Brasil, 1999).

Helminths, when present, affect poultry performance, causing significant direct or indirect losses (Reid & McDougald, 1997; Silva, 2009). São Paulo chicken farmers that use semi-intensive systems



report that helminth control is one of the key obstacles to successful production.

Nematodes are an important group of bird parasites both in terms of the number of species and the damage caused (Ruff & Norton, 1997). Out of the 25 families of nematodes, 13 infect birds: Strongyloididae, Trichuridae, Syngamidae, Trichostrongylidae, Subuluridae, Heterakidae, Ascarididae, Spiruridae, Thelaziidae, Gnathostomatidae, Physaloptera, Acuariidae, and Dipetalonematidae.

Approximately 1400 species of cestodes that parasitize domestic and wild birds have been described. Three families (Davainidae, Dilepididae, and Hymenolepidae) and ten genera (*Amoebotaenia*, *Choanotaenia*, *Davainea*, *Diorchis*, *Drepanidotaenia*, *Imparmargo*, *Metroliasthes*, *Raillietina*, *Hymenolepis*, and *Fimbriaria*) were identified in a survey performed in the United States (Reid & McDougald, 1997).

The class Trematoda includes 27 families, 125 genera, and approximately 500 species that are found in birds. Flukes are less host-specific than tapeworms, so wild birds often introduce infection in areas where domestic poultry is reared (Reid & McDougald, 1997).

Extensive studies on helminth parasites of poultry have been conducted, and new species have been described (Kolluri *et al.*, 1985; Permin *et al.*, 1999; Malhotra & Capoor, 1984; Dixit & Capoor, 1990). International studies examining poultry under different management conditions (Maqbool *et al.* (1998) in Pakistan; Permin *et al.* (1999) in Denmark; Hernández *et al.* (2002) in Cuba; Komba (2013) in Tanzania; Adang *et al.* (2014) in Nigeria; Alam *et al.* (2014) in Bangladesh and Butt *et al.* (2014) in Pakistan) have diagnosed an increasing prevalence of helminths, including *Acuaria hamulosa*, *Amoebotaenia cuneata*, *Ascaridia galli*, *Capillaria sp.*, *Choanotaenia infundibulum*, *Cotugnia digonopora*, *Dispharinx spiralis*, *Heterakis spp.*, *Heterakis gallinarum*, *Heterakis isolonche*, *Hymenolepis cantaniana*, *Hymenolepis carioca*, *Raillietina spp.*, *Raillietina cesticillus*, *Raillietina echinobothrida*, *Raillietina magninumida*, *Raillietina tetragona*, and *Subulura suctoria*.

In Brazil, Costa *et al.* (1986) conducted a literature review and described 50 species of helminthic parasites of chickens based on their occurrences in Brazilian states and territories. The literature review mentions 29 parasites belonging to the class Nematoda, 12 belonging to the class Cestoda, eight belonging to the class Trematoda, and one belonging to the class Acanthocephala, with 19 nematode species, 10

cestode species, and two flukes present in poultry in São Paulo State.

An increasing occurrence of *Ascaridia sp.*, *Capillaria sp.*, *Heterakis sp.*, and *Raillietina sp.* was determined in poultry in Rio de Janeiro State, Brazil, (D'Avila *et al.*, 2004 and Gomes *et al.*, 2009). In Northern Paraná State, Brazil, Vieira (2010) described the occurrence of *Ascaridia galli*, *Capillaria spp.*, *Capillaria annatis*, *Capillaria annulata*, *Capillaria collaris*, *Capillaria contorta*, *Capillaria obsignata*, *Choanotaenia infundibulum*, *Dispharinx spiralis*, *Heterakis gallinarum*, *Hymenolepis carioca*, *Oxyspirura mansoni*, *Physaloptera truncata*, *Postharmostomum commutatum*, *Raillietina spp.*, *Raillietina cesticillus*, *Raillietina echinobothrida*, *Raillietina tetragona*, *Strongyloides oswaldoi*, *Subulura brumpti*, *Syngamus trachea*, *Tropisurus americanus* and *Tropisurus fissispinus* in birds. The helminths *Ascaridia galli*, *Heterakis gallinarum*, and *Raillietina cesticillus* showed a greater intensity of infection.

In a study evaluating antihelminthic drugs for poultry in Northwestern and Northeastern São Paulo State, Brazil, Silva *et al.* (1999) recorded the occurrence of the following species: *Amoebotaenia cuneata*, *Davainea proglottina*, *Choanotaenia infundibulum*, *Hymenolepis cantaniana*, *Raillietina echinobothrida*, *R. cesticillus*, and *R. tetragona*.

Literature describing helminthological surveys with domestic chickens (*Gallus domesticus*) in São Paulo State is scarce; the most important study, published in 1986 by Costa *et al.*, compiled the distribution of helminthic parasites of domestic animals in Brazil.

The objective of the present study was to determine the occurrence of the main helminth species present in domestic chickens (*Gallus domesticus*) reared in different municipalities of São Paulo State.

MATERIAL AND METHODS

The surveyed region included 17 municipalities (Amparo, Araçatuba, Bastos, Cedral, Fernandópolis, Guararapes, Guataparã, João Ramalho, Monte Alegre do Sul, Nhandeara, Panorama, Pereira Barreto, Presidente Prudente, Rancheira, Regente Feijó, Valentim Gentil and Votuporanga), according to divisions determined by the IBGE (Brazil, 2011). The municipalities included in the research represent 10 microregions (Andradina, Araçatuba, Amparo, Tupã, Presidente Prudente, Ribeirão Preto, São José do Rio Preto, Fernandópolis, Nhandeara, and



Votuporanga) and, consequently, six mesoregions of São Paulo State.

In total, 359 adult chickens were investigated. The chickens were reared under different housing systems (extensive, intensive, and semi-intensive) and were obtained from 69 farms. The birds were submitted procedures for the detection and identification of helminthic parasites, following international criteria (Vich Topic GL21, 2001; Yazwinski *et al.*, 2003).

During necropsy, the gastrointestinal organs of each chicken were separated, and their contents were collected to form a pool (five birds per farm) of each organ and was subsequently fixed in 70% ethanol. The remaining systems and organs were also assessed individually with respect to the helminthological study.

The evaluation of the small intestine employed the Mello-Campos method (Mello & Campos, 1974),

which allows better recovery of cestode scolices attached to the intestinal mucosa. Stereomicroscopy was used to evaluate the collected materials, and light microscopy was used to identify the species according to their morphological characteristics (Yamaguchi, 1959; Schmidt, 1970; Reid & McDougald, 1987 and Ruff & Norton, 1987).

RESULTS AND DISCUSSION

The results showed the presence of parasitic nematodes, cestodes, and trematodes in domestic chickens in the investigated regions of São Paulo (Tables 1 and 2).

Nematodes were found in the small intestine (*Ascaridia galli*, *Capillaria* spp., and *Strongyloides* sp.), cecum (*Heterakis gallinarum* (Figure 1) and *Capillaria* sp.), gizzard (*Cheylospirura hamulosa*) (Figure 1), crop

Table 1 – Helminths diagnosed in the regions of São Paulo State addressed in this study (17 municipalities/10 microregions/6 mesoregions).

| REGIONS | | | | HELMINTHS | | | | | | | | | | | | | |
|-----------------------|---------------------|---------------------|----------|--------------------------|-------------------------|------------------------|-----------------------|-----------------------------|--------------------------|------------------------------|----------------------------------|------------------------|--------------------|-----------------------|------------------|-----------------------------------|--------------------------|
| Mesoregions | Microregions | Municipalities | N. BIRDS | Nematodes | | | | | | Cestodes | | | | | | Trematodes | |
| | | | | <i>Oxspirura mansoni</i> | <i>Acuaria hamulosa</i> | <i>Ascaridia galli</i> | <i>Capillaria</i> sp. | <i>Heterakis gallinarum</i> | <i>Strongyloides</i> sp. | Raillietina | | | | | | <i>Postharmostomum commutatum</i> | <i>Zygocotyle lunata</i> |
| | | | | | | | | | | <i>Amoeba taenia cuneata</i> | <i>Choanotaenia infundibulum</i> | <i>Hymenolepis</i> sp. | <i>cesticillus</i> | <i>echinobothrida</i> | <i>tetragona</i> | | |
| Araçatuba | Andradina | Pereira Barreto | 20 | - | - | - | - | - | - | - | + | - | + | - | - | - | - |
| | Araçatuba | Araçatuba | 5 | + | - | + | + | + | - | + | + | + | + | + | + | - | - |
| | | Guararapes | 5 | - | - | - | - | + | - | + | + | + | + | - | - | - | - |
| Campinas | Amparo | Amparo | 20 | + | - | + | + | + | + | + | + | + | + | + | + | - | - |
| | | Monte Alegre do Sul | 10 | + | - | + | - | + | - | + | - | - | + | - | - | - | - |
| Marília | Tupã | Bastos | 135 | - | - | + | - | + | - | - | + | - | + | - | - | - | - |
| Presidente Prudente | Presidente Prudente | Rancharia | 10 | - | - | - | - | - | - | - | + | - | - | - | - | - | - |
| | | João Ramalho | 10 | - | - | - | - | - | - | - | - | + | - | + | - | - | - |
| | | Regente Feijó | 10 | - | - | - | - | - | - | - | - | + | - | - | - | - | - |
| | | Presidente Prudente | 10 | + | - | + | - | + | - | - | + | + | - | + | + | - | - |
| | | Panorama | 5 | - | - | + | + | + | - | + | + | + | + | + | + | + | - |
| Ribeirão Preto | Ribeirão Preto | Guataparã | 50 | - | - | + | + | + | - | + | + | + | + | + | - | + | |
| São José do Rio Preto | S. J. Rio Preto | Cedral | 10 | + | - | + | + | + | - | + | + | + | + | + | + | - | - |
| | Fernandópolis | Fernandópolis | 10 | - | - | + | + | + | - | + | + | + | - | + | + | - | - |
| | Nhandeara | Nhandeara | 10 | - | - | + | + | + | - | - | - | - | - | - | + | - | |
| | Votuporanga | Votuporanga | 34 | + | + | + | + | + | - | + | + | + | + | + | - | - | - |
| | | Valentim Gentil | 5 | + | - | + | - | + | - | + | + | + | - | + | + | 4 | - |



Table 2 – Occurrence (%) of helminth species diagnosed in the regions of São Paulo State addressed in this study
(17 municipalities/10 microrregions/6 mesoregions).

| CLASS | HELMINTHS | | OCCURRENCE (%) | | |
|------------|-----------------------------------|----------------------|----------------------|-------------------|--|
| | SPECIES | MUNICIPALITIES (17*) | MICRORREGIONS (10**) | MESOREGIONS(6***) | |
| NEMATODES | <i>Oxyspirura mansoni</i> | 41 | 50 | 67 | |
| | <i>Acuaria hamulosa</i> | 6 | 10 | 17 | |
| | <i>Ascaridia galli</i> | 71 | 90 | 100 | |
| | <i>Capillaria sp.</i> | 59 | 80 | 83 | |
| | <i>Heterakis gallinarum</i> | 76 | 90 | 100 | |
| | <i>Strongyloides sp.</i> | 6 | 10 | 17 | |
| CESTODES | <i>Amoebotaenia cuneata</i> | 59 | 70 | 83 | |
| | <i>Choanotaenia infundibulum</i> | 88 | 90 | 100 | |
| | <i>Hymenolepis sp.</i> | 59 | 70 | 83 | |
| | <i>Raillietina echinobothrida</i> | 53 | 70 | 83 | |
| | <i>Raillietina cesticillus</i> | 65 | 80 | 100 | |
| | <i>Raillietina tetragona</i> | 47 | 70 | 67 | |
| TREMATODES | <i>Zygoctyle lunata</i> | 6 | 10 | 17 | |
| | <i>Postharmostomum commutatum</i> | 6 | 10 | 17 | |

*Municipalities: Amparo, Araçatuba, Bastos, Cedral, Fernandópolis, Guararapes, Guataparã, João Ramalho, Monte Alegre do Sul, Nhandeara, Panorama, Pereira Barreto, Presidente Prudente, Rancheira, Regente Feijó, Valentim Gentil, Votuporanga

**Microregions: Andradina, Araçatuba, Amparo, Tupã, Presidente Prudente, Ribeirão Preto, São José do Rio Preto, Fernandópolis, Nhandeara, Votuporanga

***Mesoregions: Araçatuba, Campinas, Marília, Presidente Prudente, Ribeirão Preto e São José do Rio Preto

(*Capillaria sp.*) and eye (*Oxyspirura mansoni* (Figure 1), which supports the results of Costa *et al.* (1986). *Ascaridia galli* and *Heterakis gallinarum* were the most frequently observed nematodes. Similar results were observed in São Paulo (Costa *et al.*, 1986) and in a study performed in Rio de Janeiro (Gomes *et al.*, 2009), where *Ascaridia*, *Capillaria* and *Heterakis* were the most commonly diagnosed nematodes in domestic chickens.

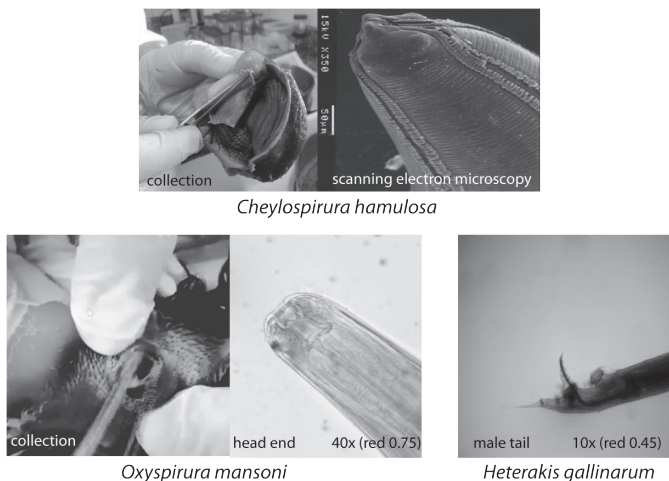


Figure 1 – Nematodes (*Cheylospirura hamulosa*, *Heterakis gallinarum* and *Oxyspirura mansoni*) present in chickens originating from state of São Paulo.

Oxyspirura mansoni was found only in municipalities that belonged to the mesoregions of São José do Rio Preto and Presidente Prudente. Parasitism by *Cheylospirura hamulosa* was observed in only one chicken from the mesoregion of São José do Rio Preto, and *Strongyloides sp.* was observed in the municipality of Amparo. According to Costa *et al.* (1986), these species occur in São Paulo State and have been reported in the northern region of the state.

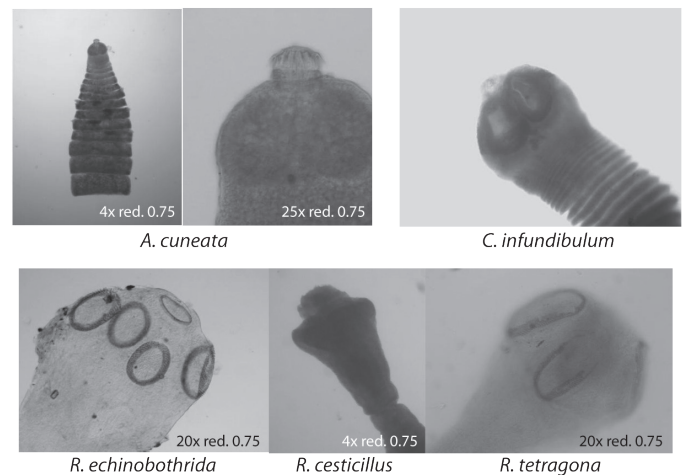
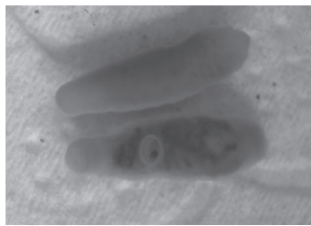


Figure 2 – Cestodes (*Amoebotaenia cuneata*, *Choanotaenia infundibulum*, *Raillietina echinobothrida*, *Raillietina cesticillus* and *Raillietina tetragona*) present in chickens originating from state of São Paulo.

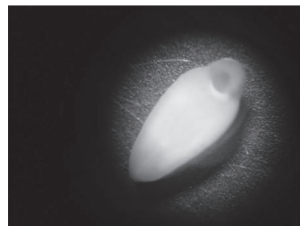


Six cestode species were diagnosed (*Amoebotaenia cuneata*, *Choanotaenia infundibulum*, *Hymenolepis* sp., *Raillietina cesticillus*, *Raillietina echinobothrida*, and *Raillietina tetragona* - Figure 2). Out of these species, the occurrence of *Hymenolepis* sp. in São Paulo state had not been reported by Costa *et al.* (1986). The results showed the absence of parasitism by *Davainea proglottina*, one of the species considered most pathogenic for young chickens (Reid & McDougald, 1997); its occurrence was previously reported in São Paulo state (Costa *et al.*, 1986). *Choanotaenia infundibulum* and *Raillietina cesticillus* were the most common cestodes.

Two species of trematodes were recovered from the cecum, *Postharmostomum commutatum* and *Zygocotyle lunata* (Figure 3), of chickens reared in the municipalities of Guatapar and Valentim Gentil, respectively. *Postharmostomum commutatum* was previously reported in Northern So Paulo State by Costa *et al.* (1986).



Postharmostomum commutatum



Zygocotyle lunata

Figure 3 – Trematodes (*Postharmostomum commutatum* and *Zygocotyle lunata* - stereomicroscopy) present in chickens originating from state of So Paulo.

Parasitological surveys at different locations and times are important for the epidemiological tracking of parasites because changes in animal husbandry due to advances in facilities, management, and preventive measures can lead to changes in the parasitic fauna of a particular location/region over time. Although most of the species diagnosed in the present study are consistent with those reported by Costa *et al.* (1996) with regard to their occurrence in So Paulo State, the number of species recovered was smaller than that compiled by those authors. However, this study detected the presence of *Hymenolepis* sp. and *Zygocotyle lunata*, which were not mentioned in the cited review.

Thus, further studies including additional municipalities and time periods are recommended for the constant tracking of the distribution of helminthic parasites in domestic poultry in So Paulo State and Brazil.

CONCLUSIONS

The following helminth species were diagnosed in chickens reared in the regions sampled in the present study:

- nematodes: *A. galli*, *Capillaria* sp., *C. hamulosa*, *H. gallinarum*, *O. mansoni*, and *Strongyloides* sp.;
- cestodes: *C. infundibulum*, *R. cesticillus*, *A. cuneata*, *Hymenolepis* sp., *R. echinobothrida*, and *R. tetragona*;
- trematodes: *P. commutatum* and *Z. lunata*.

ACKNOWLEDGEMENTS

The authors thank the *Fundao de Amparo  Pesquisa do Estado de So Paulo* (FAPESP) for the financial support (Proc. 2012/18929-3) and the technical support scholarships (Proc. 2013/03599-0 and Proc. 2014/04097-1), as well as the technicians at CATI and the researchers at APTA for their valuable contributions in contacting farmers to make birds available for sampling.

REFERENCES

- Adang KL, Asher R, Abba R. Gastro-intestinal helminths of domestic chickens *Gallus gallus domestica* and ducks *Anas platyrhynchos* slaughtered at Gombe mai market, Gombe State, Nigeria. *Asian Journal of Poultry Science* 2014;8(2):32-40.
- Alam MN, Mostofa M, Khan MAHNA, Alim MA, Rahman AKMA Trisha AA. Prevalence of gastrointestinal helminth infections in indigenous chickens of selected areas of Barisal district, Bangladesh. *Bangladesh Journal of Veterinary Medicine* 2014;12(2):135-139.
- IBGE - Instituto Brasileiro de Geografia e Estatstica. Produo da pecuria municipal [cited 2015 abr 20]. 2011. v.39. Available from: http://www.ibge.gov.br/home/estatistica/economia/ppm/2011/default_pdf.shtm.
- Brasil. Ministrio da Agricultura e do Abastecimento. Ofcio Circular DOI/ DIPOA No007/99, de 19 de maio de 1999. Braslia, DF; 1999.
- Butt Z, Shaikh AA, Memon SA, Mal B. Prevalence of Cestode parasites in the intestine of local chicken (*Gallus Domesticus*) from Hyderabad, Sindh, Pakistan. *Journal of Entomology and Zoology Studies* 2014;2(6):301-303.
- Costa HMA, Leite ACR, Guimares MP, Lima AS. Distribuio de helmintos parasitos de animais domsticos no Brasil. *Arquivo Brasileiro de Medicina Veterinria e Zootecnia* 1986;38(4):465-579.
- D'vila S. Dias RJP, Bessa ECA, Rodrigues MLA. Exame parasitolgico de fezes para o diagnstico de helmintoses de galinhas (*Gallus gallus* Linnaeus, 1758) criadas em sistema semi-extensivo: avaliao das tcnicas de sedimentao e de flutuao simples. *Revista Brasileira de Parasitologia Veterinria* 2004;13(Suppl):263.
- Dixit GR, Capoor VN. Studies on cestodes from a sub-humid region: a new dilepid from Coraciformes birds. *Indian Journal of Parasitology* 1990;14(2):179-182.
- Gomes FF, Machado HHS, Lemos LS, Almeida LG, Daher RF. Principais parasitos intestinais diagnosticados em galinhas domsticas criadas em regime extensivo na municipalidade de Campos dos Goytacazes, RJ. *Cincia Animal Brasileira* 2009;10(3):818-822.



- Hernández M, LarramendyR, Szczypel B. Incidencia de parásitos en aves de producción alternativa y recomendaciones para su control. *Revista Cubana de Ciencia Avícola* 2002;26:141-44.
- Kolluri SR, Lakshmi CV, Rao KH. Studies on cestodes of birds, with description of a new species of *Raillietina* (*Raillietina*). *Revista Iberica de Parasitologia* 1985;45(3):195-201.
- Komba EVG, Mkupasi EM, Mwesiga GK, Mbyuzi AO, Busagwe Z, Mzula A, Lupindu AM, Nzalawahe J. Occurrence of helminths and coccidia in apparently healthy free range local chickens slaughtered at Morogoro live bird market. *Tanzania Veterinary Journal* 2013;28(2):55-61.
- Madeira LA, Sartori JR, Araujo PC, Pizzolante CC, Saldanha, ESPB., Pezzato AC. Avaliação do desempenho e do rendimento de carcaça de quatro linhagens de frangos de corte em dois sistemas de criação. *Revista Brasileira de Zootecnia* 2010;39(10):2214-2221.
- Maqboo IA, Ahmad M, Raza A. Prevalence of helminth parasites of poultry under different management conditions. *Journal of the Faculty of Veterinary Medicine*, 1998;53(1-2):102-103.
- Malhotra SK, Capoor, VN. A new cestode *Raillietina* (*Skrjabinia*) *doggaddaensis* n. sp. from *Gallus gallus domesticus* (L) from India. *Korean Journal of Parasitology* 1984;22(1):96-98.
- Mello EBF, Campos MS. Nova técnica de coleta de helmintos parasitos intestinais. *Arquivo do Instituto Biológico de São Paulo* 1974;41:201-206.
- Permin A, Bisgaard M, Frandsen F, Pearman M, Kold J., Nansen, P. Prevalence of gastrointestinal helminths in different poultry production systems. *British Poultry Science* 1999;40(4):439-443.
- Reid WM, Mcdougald LR. Internal parasites. Cestodes and trematodes. In: Calnek BW, *et al.* *Diseases of poultry*. 10th ed. Ames: Iowa State University Press; 1997. p.850-864.
- Ruff MD, Nortton RA. Internal parasites. Nematodes and acanthocephalans. In: Calnek BW, *et al.* *Diseases of poultry*. 10th ed. Ames: Iowa State University Press; 1997. p.815-850.
- Schmidt GD. How to know the tapeworms. St Louis: WM. C. Brown Comp. Publishers; 1970.
- Silva GS, Costa AJ, Soares VE, Meireles MV, Paulillo AC. Atividade anti-helmíntica do albendazole e do praziquantel em aves (*Gallus gallus domesticus*) naturalmente infectadas. *ARS Veterinária* 1999;15(Suppl):18-22.
- Silva GS, Zoche AT. Endoparasitoses em aves de produção industrial In: Berchieri Júnior A, *et al.* ed. *Doença das aves*. 2^a ed. Campinas: FACTA; 2009.
- União Brasileira de Avicultura. Relatório anual 2014. 2014. 55p. [cited 2015 Apr 24]. Available from: <http://www.ubabef.com.br>.
- Vich Topic GL21. Efficacy of anthelmintics: Specific recommendations for poultry. London: The European agency for the evaluation of medicinal products; 2001. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004587.pdf
- Vieira FEG. Helmintofauna em frangos (*Gallus gallus domesticus* LINNAEUS, 1758) criados em sistema colonial/caipira na região norte do Estado do Paraná [mestrado]. 2010. Londrina (PR): Universidade Estadual de Londrina; 2010.
- Yamaguti S. *Systema helminthum*. New York: Interscience Publishers; 1959. v.2.
- Yazwinski TA, Chapman HD, Davis RB, Letonja T, Pote L, Maes L, *et al.* World Association for the Advancement of Veterinary Parasitology (WAAVP) guidelines for evaluating the effectiveness of anthelmintics in chickens and turkeys. *Veterinary Parasitology* 2003;116:159-73.