Open Veterinary Journal, (2024), Vol. 14(12): 3232-3240
ISSN: 2226-4485 (Print)
ISSN: 2218-6050 (Online)
Research Article
DOI: *10.5455/OVJ.2024.v14.i12.8*

Submitted: 01/08/2024 Accepted: 21/11/2024 Published: 31/12/2024

Prevalence of gastrointestinal parasites in chickens (*Gallus gallus domesticus*) and associated risk factors in M'passa department, Southeast Gabon

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ABSTRACT

Background: Gastrointestinal parasites (GIPs) pose a significant global challenge to the poultry industry, affecting health, welfare, and production performance. Few studies have been conducted in Gabon on the prevalence of these infections in chickens.
Aim: This cross-sectional survey aims to assess the presence and diversity of GIP among chickens in the M'passa department.
Methods: Between April and October 2022, we randomly collected 402 fecal samples from local and exotic chicken breeds from four semi-intensive poultry farms and 11 free-range chicken sites in the M'passa department, southeast Gabon. These samples were analyzed for GIP using flotation and sedimentation methods.
Results: This study found 14 GIP eggs and oocytes in 72.9% (293/402) of examined chickens. *Capillaria* spp. (39.5%) and *Ascaridia* (31.1%) species were the most frequently identified parasites. Other identified parasites included *Eimeria* spp. (20.1%), *Strongyloides avium* (16.9%), *Choanotaenia infundibulum* (13.4%), *Hymenolepis* spp. (10.4%), *Chilomastix gallinarum* (7.7%), and *Entamoaba*. (1.7%). Single infections occurred in 39.3% (115/293, 95% IC: 33.7–44.9) of cases, while mixed infections were recorded in 60.7% (178/293, 95% IC: 55.1–66.3). The study also identified significant differences in prevalence among local and exotic breeds, genders, and age groups.
Conclusion: This study revealed a high prevalence of GIP in Gabon chickens, potentially harming their health and productivity. We recommend implementing effective control measures against these infections to enhance the health and productivity of chickens in the region.
Keywords: Chickens, Gastrointestinal parasites, Gabon, Prevalence, Risk factors.

Introduction

Domesticated birds, known as poultry, are reared by humans for meat, eggs, and occasionally feathers to support livelihoods. This group includes chickens, ducks, geese, and turkeys. Poultry is a vital source of protein and farm fertilizer (Jegede *et al.*, 2015). The most commonly raised poultry is domestic chicken (*Gallus gallus domesticus*) (Asumang *et al.*, 2019; Lawal *et al.*, 2020). Over the past few decades, poultry production has steadily risen globally (Mottet and Tempio, 2017). According to the Food and Agriculture Organization, developing countries account for approximately 75% of the existing 15 billion chickens (Ferdushy *et al.*, 2016). This sector is recognized as an important mechanism for alleviating problems associated with poverty in developing countries in terms of food security and malnutrition (Ola-Fadunsin, 2017; Ola-Fadunsin *et al.*, 2019b).

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Gastrointestinal parasites (GIPs) significantly hinder poultry production, leading to economic losses from reduced productivity, poorer feed conversion rates, and inadequate weight gain. They cause issues such as decreased egg production, catarrh, anorexia, diarrhea, intestinal obstruction, emaciation, anemia, weakness, paralysis, poor feathering, and even death (Jegede *et al.*, 2015; Shifaw *et al.*, 2021). Additionally, GIP can increase disease susceptibility and weaken the immune response to vaccinations (Pleidrup *et al.*, 2014; Saadoon Ibadi Al-Alwani and Hamle Abid, 2023). Gastrointestinal helminths can also transmit pathogens like *Histomonas meleagridis*, resulting in high morbidity and up to 20% mortality in chicken flocks (McDougald, 2005; Clark and Kimminau, 2017). GIP that infects poultry include; cestodes, nematodes, trematodes, and protozoans (Nnadi and George, 2010; Shifaw *et al.*, 2021). Nematodes are the most significant intestinal worms in the poultry industry due to their species diversity and the diseases they cause (Hafiz *et al.*, 2015; Ola-Fadunsin *et al.*, 2019a,b).

In Gabon, animal husbandry plays a marginal role in the economy, representing less than 1% of the GDP (Maganga *et al.*, 2019). Poultry and pig farming constitutes 80% of peri-urban rearing activities in Libreville, Gabon's capital, with laying hens being the most commonly raised (Maganga *et al.*, 2019). Reports from Libongui indicate the presence of farms with over 11,000 chickens (Libongui, 2022). Gabon's national production shows an estimated 3 million eggs in 2019, and 3,920 tons of chicken meat in 2013 (Lacroix, 2014; Direct, 2020).

Semi-intensive and backyard poultry farming is expanding in Haut-Ogooué Province, Gabon; however, there are no reports on the GIP of chickens in this region. This study aims to determine the prevalence and species diversity of GIP in chickens in southeastern Gabon, filling a critical knowledge gap in the region.

Materials and Methods

Study area

The study took place in the M'passa departments of Haut-Ogooué province in southeastern Gabon (Coordinates 13°8′S and 13°35′E) (Fig. 1). This region features an equatorial climate with four alternating seasons of rainy and dry weather. Average temperatures range from 24.4°C to 26.8°C, and annual rainfall typically falls between 2000 and 2250 mm. There is currently no information available on chicken husbandry in this province.

Sample size determination

The study's sample size was calculated using Thrusfield's formula (Thrusfield, 2018) with 5%

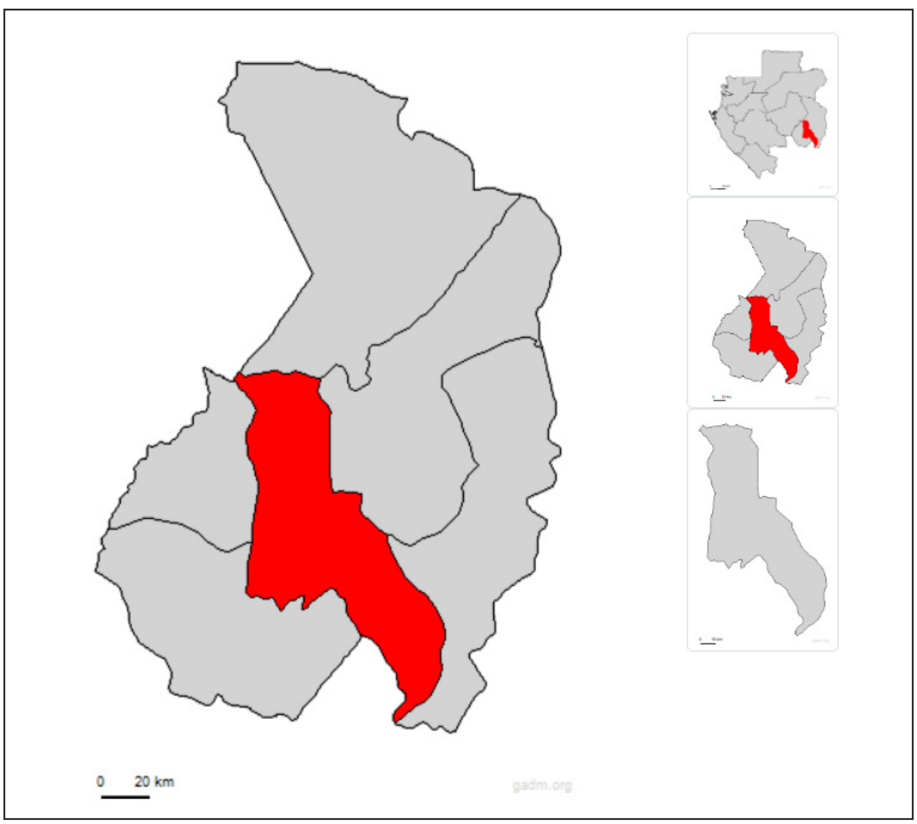

Fig. 1. Location of the sampling zone.

precision and a predicted prevalence of 25.0%, as reported by Makouloutou-Nzassi *et al.* (2024).

$$N = \frac{1.96^2 * Pexp(1-exp)}{d^2}$$

where: N = required sample
Pexp = Expected prevalence
D = desired absolute precision

$$N = \frac{1.96^2 * 0.25\ (1-0.25)}{0.05^2}$$

$$N = \frac{3.8416 * 0.25\ (0.75)}{0.0025} = 288$$

The study's sample size was set at 288, but to minimize sampling errors, it was increased to 402 chickens.

Sampling

This study utilized a simple random sampling technique from April to October 2022, investigating four semi-intensive poultry farms and 11 free-range chicken sites. The selection of the farms and sites was based on an agreement with the managers and owners after discussing the study's objectives. Domestic poultry were chosen for their availability, regardless of age and sex. A total of 402 fecal samples were collected from individual domestic poultry (201 from local and 201 from exotic breeds) using swabs from the rectum or directly from the ground after defecation. The samples were placed in sterile, labeled Falcon tubes with physiological serum and kept on ice for transport to the Ecological Health Research Unit at the Interdisciplinary Center for Medical Research of Franceville (CIRMF) for processing and testing. Data on breeding system, breed, sex, and age were recorded via a survey questionnaire.

Sample examination

Parasite eggs, cysts, oocysts, and larvae in fecal samples were identified using two qualitative techniques: flotation with a saturated salt solution and sedimentation with physiological saline (Chauhan, 2007). These parasitic forms were examined at X40 and X100 magnification using an optical microscope with a camera (Realux France, ToupcamTM). Identification was based on the morphology of the shell, egg nucleus, oocysts, cysts, and the head and tail of the larva (Ashford and Crewe, 2003; Boundenga *et al.*, 2018; Maganga *et al.*, 2019). Gastrointestinal parasitic species were identified using keys by Soulsby (1968).

Statistical analysis

The data obtained from parasitological analyses and questionnaires were entered into Microsoft Office Excel 2016 (Microsoft Corp., Redmond, WA). The statistical tests were conducted using R Studio 4.3.2 software ("Posit," 2024). Host-related risk factors, such as breeding system, breed, sex, and age, were considered explanatory variables for GIP infection using chi-square and Fisher tests. The test results were considered significant at a 5% significance level.

Ethical approval

This study used non-experimental animals and conducted non-invasive sampling. The fecal samples collected were obtained through non-invasive and non-painful procedures following the protocols at Institut National Supérieur d'Agronomie et Biotechnologies. All poultry owners were adults and were informed about the nature of this study.

Results

Prevalence and diversity of GIP

This study aimed to determine the prevalence and diversity of GIP in domestic poultry in M'passa department of Gabon (Fig. 2). As shown in Table 1, the overall prevalence of infection with GIP in domestic

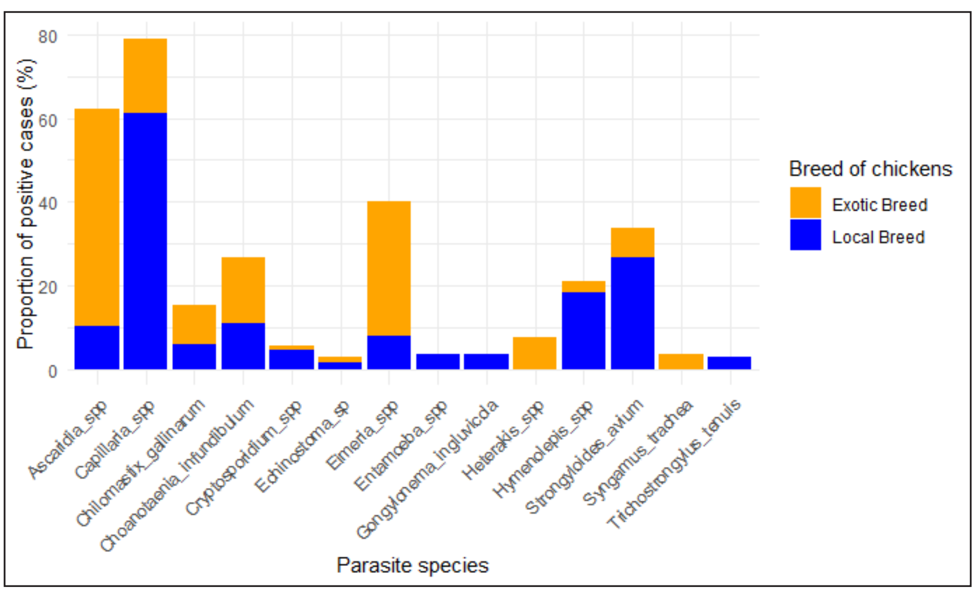

Fig. 2. Diversity of GIP with breed of chicken.

chickens (*Gallus gallus domesticus*) was 72.9% (293/402; 95% CI:68.6–77.2). Nematodes had the highest prevalence at 65.2% (or 262/402), followed by protozoans at 26.9% (or 108/402), cestodes at 21.9% (or 88/402), and trematodes had the lowest prevalence of 1.5% (6 cases) ($p < 0.05$).

Parasitic diversity included 14 genera: seven nematodes, two cestodes, one trematode, and four protozoa (Table 2). *Capillaria* spp. (39.5%) and *Ascaridia* spp. (31.1%) were the most prevalent nematodes, followed by *Strongyloides avium* (16.9%). *Trichostrongylus tenuis* (1.5%) was the least encountered. Among cestodes, *Choanotaenia infundibulum* had the highest prevalence at 13.4% (or 54/402), followed by *Hymenolepis* spp. (10.4% or 42/402). For protozoa, 20.1% (or 81/402) of chickens were infected with *Eimeria* spp., and 7.7% (or 31/402) with *Chilomastix gallinarum*; other protozoan prevalence ranged from 1% to 2.7% (Table 2). Helminths had a prevalence of 70.4% (283/402), while protozoa accounted for 26.9% (108/402). Single infection was recorded in 39.3% (115/293) of cases, while mixed infections included two species in 21.6% (or 87/293), three species in 14.7% (or 59/293), and four or more species in 10.9% (or 32/293).

Prevalence of GIP and host-related risk factors

The gastrointestinal parasitic infections showed a significant association ($p < 0.05$) with the sex, age, and breeding system of the chickens. Males had a higher prevalence (90.2%) than females (67.7%), adults (76.6%) were more affected than young chickens (66.2%), and extensive breeding systems exhibited a greater prevalence (80.1%) compared to semi-intensive systems (65.7%) (Table 3).

The extensive breeding system (p-value <2.2e-16) also strongly correlated with *Capillaria* spp. occurrence, while the semi-intensive system (p = 4.654e-5) was strongly linked to *Heterakis* spp. presence. For *Hymenolepis* spp., extensive management (p = 1.106e-7) and adults (p = 0.01687) were strongly associated with their frequency. Extensive system (p = 1.038e-7) and females (p = 5.791e-5) were risk factors for *S. avium* occurrence. The extensive system was the sole risk factor for *Gongylonema ingluvicola* (p = 0.01482) and *Entamoeba* spp. (p = 0.01482). For *T. tenuis*, the extensive system (p = 0.01482) and males (p = 0.02653) were associated risk factors. In this study, we found that adult individuals (p = 0.02615) showed a significant association with *Ascaridia* sp., while young individuals (p = 0.0007075) were strongly linked to *C. infundibulum*. Additionally, we observed a strong association of females (p = 6.338e-15) with *Capillaria* spp., and the semi-intensive farming system was significantly linked (p = 0.01482) to the occurrence of *Syngamus trachea*.

Discussion

Epidemiological studies are important for preventing and controlling parasitic poultry diseases (Györke *et al.*, 2013; Shifaw *et al.*, 2021). This study is the first of its kind to be conducted on poultry endoparasites in the country. We found that 72.9% of the sampled population was infected with one or more GIP species. In other studies, Asumang *et al.* (2019) reported a prevalence rate of 65.5% in Pankrono-Kumasi, Ghana, Sarba *et al.* (2019) reported 92.1% in West Shoa zone central, Ethiopia, and Idika *et al.* (2016) reported 96.8% in Nsukka region, Nigeria. The differences in prevalence rates among these studies may be due to factors such as sampling periods, sample size, study design, geographical area, and climatic conditions. The prevalence of GIP observed in our study may be attributed to agro-ecological conditions, exposure to specific intermediate hosts, and the poultry management system.

This study revealed that approximately 60.7% of the chickens in the study area were found to harbor multiple species of GIP, supporting the hypothesis that parasitic infestations tend to co-circulate in chickens (Ben Slimane, 2016; Coroian *et al.*, 2024). The combined detrimental effects of these infestations on the host's metabolism significantly contribute to early chick mortality and other production losses among adult chickens (Nnadi and George, 2010). Moreover, this finding aligned with the results reported in the Giwa Local Government Areas of Nigeria (Junaidu *et al.*, 2014), and in Mekelle town, Ethiopia (Berhe

Table 1. Overall prevalence of GIP of domestic poultry (*Gallus gallus domesticus*) (N = 402).

Parasites	Frequency (n)	Prevalence (%)	95% CI	p-value	Significance
Protozoa	108	26.9	[23.6–28.7]	2.2e-16	+
Nematodes	262	65.2	[60.6–69.8]		
Cestodes	88	21.9	[17.8–25.6]		
Trematodes	6	1.5	[1.4–1.7]		
Single infection	115	39.3	[33.7–44.9]	0.03567	+
Mixed infection	178	60.7	[55.1–66.3]		
Total	293	72.9	[68.6–77.2]	-	-

95% CI – 95% confidence interval.

Table 2. Species-specific prevalence of GIP of domestic chicken (*Gallus gallus domesticus*) ($N = 402$).

Species	Frequency (*n*)	Prevalence (%) [95% CI]
Trematodes		
Echinostoma sp.	6	1.5 [0.6–3.2]
Cestodes		
Choanotaenia Infundibulum	54	13.4 [10.4–17.1]
Hymenolepis spp.	42	10.4 [7.8–13.8]
Nematodes		
Capillaria spp.	159	39.5 [34.7–44.3]
Ascaridia spp.	125	31.1 [26.7–35.7]
Heterakis sp.	15	3.7 [2.3–6.0]
Strongyloïdes avium	68	16.9 [13.5–20.8]
Gongylonema ingluvicola	7	1.7 [0.8–3.5]
Trichostrongylus tenuis	6	1.5 [0.6–3.2]
Syngamus trachea	7	1.7 [0.8–3.5]
Protozoans		
Chilomastix gallinarum	31	7.7 [5.4–10.7]
Eimeria spp.	81	20.1 [16.5–24.3]
Cryptosporidium sp.	11	2.7 [1.5–4.8]
Entamoeba sp.	7	1.7 [0.8–3.5]

Table 3. Association of potential risk factors for GIP infection in chickens in the study area.

Factors	Category	No. examined	GIP infection			
			No. positive (%)	X^2	*p*-value	Significance
Sex	Male	92	83 (90.2)	17.015	3.709e-5	+
	Female	310	210 (67.7)			
Age	Adults	258	197 (76.3)	4.3209	0.03765	+
	Young	145	96 (66.2)			
Breeding system	Extensive	201	161 (80.1)	9.8684	0.001681	+
	Semi-intensive	201	132 (65.7)			

et al., 2019), which recorded a polyspecific parasitism rate of 60.5% and 87.7%, respectively.

The results of this study indicated that 14 species of GIP affect poultry in the study area. Like our findings, Poulsen *et al.* (2000) reported eighteen GIP species among chickens in the upper eastern region of Ghana, and sixteen species in the KwaZulu-Natal province of South Africa (Mukaratirwa and Khumalo, 2010). In contrast, Permin *et al.* (1997) reported 29 GIP species in rural scavenging poultry in Tanzania, while Magwisha *et al.* (2002) found 26 GIP species in free-range chickens in Morogoro, Tanzania. Outside of Africa, nine GIP species were reported in India (Kumar *et al.*, 2015), seven species in Trinidad (Baboolal *et al.*, 2012), six species in Bangladesh (Alam *et al.*, 2014), six species in Iran (Badparva *et al.*, 2015), and four species in Poland (Tomza-Marciniak *et al.*, 2014). The differences in the number of GIP species detected in this study compared to other studies may be attributed to environmental and climatic variations, mainly the temperature and moisture which support the development of these helminths. Our findings demonstrate the presence of diverse species of GIP affecting poultry in the M'passa Department.

This study found *Capillaria* spp. and *Ascaridia* sp. to be the most prevalent parasite species in the examined chickens, with a prevalence rate of 39.5% and 31.1%, respectively. This is consistent with Shifaw's systematic review of the prevalence of gastrointestinal nematodes in chickens which found that *A. galli*, *H. gallinarum*, and *Capillaria* spp. were the most common identified parasites (Shifaw *et al.*, 2021). *Ascaridia galli*'s direct transmission and resilient eggs allow them to survive long outside the host. The eggs, when excreted in feces, develop into an infective stage, contaminating feed and water sources. They can remain infective for years in deep litter systems, depending on environmental factors such as temperature, humidity, pH, and ammonium concentration (Thapa *et al.*, 2015; Shohana *et al.*, 2023; Singh *et al.*, 2023). Consequently, without proper management practices, feed and water can quickly become contaminated, especially as farm handlers may inadvertently transport these eggs from other locations (Sharma *et al.*, 2019).

A statistically significant difference was found in the prevalence of GIP among chickens in extensive versus semi-intensive management systems. This suggests that as the production system becomes more modernized and hygienic, the prevalence of the GIP decreases, a finding corroborated by studies from Mekelle Town, Ethiopia (Berhe *et al.*, 2019), and Akure, Nigeria (Afolabi *et al.*, 2016). The lower prevalence in semi-intensive farms may be attributed to better hygiene and feeding practices that inhibit helminth growth and transmission (Chauhan, 2007; Asumang *et al.*, 2019). Conversely, in the extensive system, chickens often ingest intermediate hosts while foraging, leading to higher parasite exposure. The differences observed in *Eimeria* spp., *Heterakis* spp., *Hymenolepis spp.*, *S. avium*, *Gongylonema ingluvicola*, *Entamoeba* spp., *T. tenuis*, and *Syngamus trachea* are likely due to their widespread presence in nature and their status as common digestive endoparasites in gastrointestinal parasitism (Kaingu *et al.*, 2010; Mwale and Masika, 2011; Lozano *et al.*, 2019; Coroian *et al.*, 2024).

Considering the sex parameter, a statistically significant difference in infection rate between male and female chickens is evident, with males showing higher susceptibility to parasites. This finding aligns with a study in Nigeria (Jegede *et al.*, 2015), that also reported higher infection levels in male chickens of both breeds. This difference may result from chance or dietary habits, as males typically have a more active diet, increasing their exposure to helminth infections (Ozougwu *et al.*, 2021). Additionally, their selective feeding may lead them to consume intermediate hosts like earthworms, which create a better environment for parasite development (Sonaiya, 1990; Ola-Fadunsin, *et al.*, 2019a,b).

This study found a significant difference ($p < 0.05$) among the age groups, with adult chickens showing the highest infection rate at 76.6%. This suggests that age influences GIP infection in chickens. Possible reasons include the presence of maternal immunity in chicks and older birds and increased exposure to helminth ova and coccidian oocysts in their environment (Jegede *et al.*, 2015). Additionally, adult poultry tend to be more social, resulting in a greater exposure rate, while younger individuals are less familiar with their surroundings and venture out less frequently (Nnadi and George, 2010).

Conclusion

This study recorded a high prevalence of GIP in chickens in southeastern Gabon, with nematodes and cestodes being the most common, including *Capillaria* spp, *Ascaridia* spp, *C. infundibulum*, and *Hymenolepis* spp. The occurrence of these parasites was influenced by the chickens' management system, sex, and age. We recommend enhancing producer awareness of GIP prevention and treatment, engaging veterinary extension agents in farm management, and offering support to safeguard poultry health, welfare, and public health. However, this study did not investigate the impact of gastrointestinal parasitic infections on chicken production parameters. Further research is needed to evaluate how these infections affect mortality, weight gain, and egg-laying.

Acknowledgments

The authors extend their gratitude to the poultry owners in the M'Passa department who participated in the study, and to the staff members of the Unité de Recherches en Écologie de la Santé, CIRMF, for their assistance during the laboratory work.

Conflict of interest

The authors declared that they have no conflict of interest.

Funding

This study receives no specific grant funding.

Authors' contribution

PMN: Conception, Data curation, Formal analysis, Writing original draft, Supervision, NMLP: Data acquisition, Data curation. LKAN: Data acquisition, Data curation SSL: Writing, review the manuscript. BB: Data acquisition. FB: Data acquisition, Data curation. GDM: Supervision, Conception, Validation. LB: Supervision, Conception, Validation.

Data availability

The data supporting this article's findings are available in the manuscript and from PMN upon reasonable request.

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