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Original Article

The Study on Prevalence of Gastrointestinal Helminths (Cestodes, Nematodes, and Trematodes) in Chickens, Dalomana District, Bale Zone, Southeast Ethiopia

Sufian Abdo Jilo[1,*], Sadik Zakir Abadura[1], and Sureshkumar P. Nair[2]

[1] School of Veterinary Medicine, Jimma University College of Agriculture and Veterinary Medicine, Ethiopia
[2] Department of Biomedical Sciences, Institute of Health, Jimma University, Ethiopia

*** *Corresponding author:*** Sufian Abdo Jilo, School of Veterinary Medicine, Jimma University College of Agriculture and Veterinary Medicine, Ethiopia.
Email: sufianabdojilo@gmail.com

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ABSTRACT

Introduction: Gastrointestinal tract helminthiasis of poultry is a parasitic infection of gastrointestinal parts of poultry by macroparasite which is classified as a tapeworm (cestodes), roundworm (nematodes), and flukeworm (trematodes). Cestodes and nematodes are the common intestinal helminthic infections in local chickens leading to high nutritional and economic loss to the poor farmers of rural areas. Thus, the current study aimed to determine the prevalence of gastrointestinal helminth parasites and identify the parasite species that infect local breed chickens in the study area.
Materials and methods: This cross-sectional study on gastrointestinal helminths was conducted on 144 local breeds of chickens raised under a traditional management system in seven kebeles located around Dalomana town of Bale zone, Ethiopia.
Results: Of these chickens, 131 (91%) were infected with one of the five different helminth parasites, and 13 (9%) were free of helminth parasites. The results of the current study indicated that 131 (91%) and 107 (74.3%) of the examined chickens were invariably infected by diverse species of cestodes and nematodes species, respectively. The major cestode species recovered from chickens were *Raillietina echinobothrida* (75.5%), *Raillietina tetragona* (73.6%), *Davainea proglottina* (11.1%). The major nematode species encountered were *Heterakis gallinarum* (37.5%), *Ascaridia galli* (35.4%), *Capillaria anatis* (6.9%), *Capillaria obsignata* (5.6%), and *Capillaria annulata* (4.9%). Regarding the prevalence of these parasites in relation to age, sex, and kebele, no significant difference was indicated.
Conclusion: The findings of the current study strongly suggested that helminthiasis is a serious problem of backyard chickens in Dalomana district, Bale zone of Oromia, and appropriate control strategies need to be devised.

1. Introduction

Poultry includes all domestic birds kept for human food production (meat and eggs), such as chickens, turkeys, ducks, geese, ostrich, guinea fowl, and doves and pigeons. In Ethiopia, ostrich, ducks, guinea fowls, doves, and pigeons are found in their natural habitat (wild), whereas geese and turkey are exceptionally not common in the country. Lack of access to productive and adaptable chicken breeds still remains one of the most critical challenges to increasing the economic contribution of the poultry production sector. Most chickens kept by smallholder farmers are unimproved indigenous flocks, well-adapted to the local environments, with slow growth rates and very poor egg productivity[1].

In Ethiopia, the total poultry population is estimated to be about 44.89 million. By the report, poultry entails cocks, cockerels, pullets, laying hens, non-laying hens, and chicks. With regard to breed, 96.46%, 0.57%, and 2.97% of the total poultry were reported to be indigenous, hybrid, and exotic, respectively[2].

The poultry industry occupies a crucial position in the provision of animal protein (meat and egg) to man and generally plays a vital role in the national economy as a

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revenue provider. Poultry production in Africa and parts of Asia is still distinctively divided into commercialized and village enterprise subsector[3]. The poultry production system in Ethiopia is an indigenous and integral part of the farming system that ranges from nil-input traditional free ranges to modern production systems using relatively advanced technology. There is also a small-scale intensive system with a small number of birds (from 50 to 500) as an urban and peri-urban small-scale commercial system using exotic birds and relatively improved feeding, housing, and health care[4].

Backyard poultry usually carry high levels of worms in their digestive systems, putting increased stress on the animal and its ability to convert feed into proteins. Anthelmintic medications (de-wormers) are cheap and effective and are beneficial even at this level of poultry production as they improve the bird's appetite: the better the bird eats, the better its health and the greater its resilience to other diseases. Combined with vaccinations, this level of intervention can have profound impacts on family nutrition for backyard 'hanging in' farming households[3].

Parasites are among the infectious agents that cause an alarming problem to the industry, posing adverse economic effects. Gastrointestinal parasitism leads to significant economic losses in poultry, especially in backyard poultry production[4]. Nematodes cause more serious problems in backyard flocks, in developing countries such as Ethiopia. The backyard scavenging production system exposes chickens to certain eggs and larvae of parasites from ingested soils and insects[5]. Helminth infections in rural free-range chickens are ubiquitous and may result in subclinical diseases even when they occur in lower numbers[6].

Recently, there has been a dramatic increase in Ethiopian poultry farms. Research findings conducted in different parts of the country incriminated helminths as major causes of ill health and loss of productivity in local chickens[7].

Helminth's parasites involving nematodes (roundworms), trematodes (flatworms), and cestodes (tapeworms) affecting scavenging chickens have been widely reported, with mixed infection being very common[8]. In Africa, prevalence (usually of multiple infections) of up to 99% has been reported[9].

There are currently a few formations in Ethiopia that show the prevalence and distribution of gastrointestinal tract (GIT) helminths. According to reports, the prevalence of GIT helminths in Ethiopia ranges from 44.5%[10] to 91.01%[11,12]. However, it is limited by its coverage (region) of Ethiopia, so that does not indicate the whole picture of the prevalence in Ethiopia. There are only a few studies conducted in central[12] and northern parts of the country. A study by Mebrahtu in 2019 indicated that the prevalence of GIT helminths is 90.6% in Mekele Ethiopia[7]. Hence, the current study intended to estimate the prevalence and potential risk factors for the occurrence of GIT helminths in scavenging chickens in selected rural villages around Dalomana town. In order to design effective preventive and control strategies, it is essential to know about the available helminth parasite species and their burden on chickens in the study area. Therefore, the present study was conducted under backyard management systems, to determine the prevalence of gastrointestinal helminth parasites and identify the parasite species that infect local breed chickens in the study area.

2. Materials and Methods

2.1. Ethical consideration

Ethical clearance was obtained from the Institutional Review Board of Jimma University, College of Agriculture and Veterinary Medicine. Furthermore, verbal informed consent was obtained from restaurant owners and household individuals who participated in the study after explaining the purpose of the study in their local language (Afan Oromo).

2.2. Study area

The study was conducted in Dalomana district, Bale Zone, Southeastern Oromia, Ethiopia. The altitude of the study area ranges from 850 to 2800 m.a.s.l, where the lowland area predominates with a narrow strip of highland area in the Northern part of the Dello-Mena district. The area experiences a bimodal rainfall occurring from September to November and March to June. Annual rainfall ranges from 700 to 1200 mm. The mean annual temperature is 29.5˚C while the annual minimum temperature is 21˚C and maximum is 38˚C and the mean annual rainfall is 986.2 mm[13].

2.3. Study design

A cross-sectional survey was conducted from November 2020 to March 2021 to provide baseline information on the prevalence and distribution of GIT helminths of scavenging chicken rearing under the traditional system in Dalomana district, southeast Ethiopia.

2.4. Study population and management

The local breed of chickens under backyard production systems in and around Dalomana town was considered during the study. The chickens used in this study were those slaughtered in volunteer restaurants and households with backyard management. For postmortem examination, chickens within the age range of 6-12 months were taken as young and those older than 1 year were considered as adults following the method used by Magwisha et al[6] with some modifications.

2.5. Sample size and sampling methods

The sample size was calculated according to Thrusfield[14]. The previous study by Eshetu et al.[11] indicated a 91.01% prevalence with comparable agroecology and this was taken as the expected prevalence. With a desired

absolute precision of 5 and a 95% level of confidence, sample sizes of at least 120 chickens were required. About 144 chickens were obtained from Mena 01, Mena 02, Wabaro, Chiri, Nanigadera, Hayaoda, and Irba village in a different hotel and from the individual houses during the festival.

2.6. Examination of chickens for the type of worms

The chickens were slaughtered at a different hotel and the GIT was obtained. The GIT was then separated into the esophagus, crop, proventriculus, gizzard, small intestine, and caeca. Each part was opened and its contents were emptied separately into labeled beakers. The contents were washed into a Petri dish and examined under a binocular stereo turret microscope with a Halogen bulb (Olympus, Japan). The larger helminths were collected directly and smaller ones were isolated under the stereo turret microscope. Worms were grouped and counted before being stored in plastic bottles containing 70% alcohol according to a method described by Ashenafi and Eshetu[12].

2.7. Identification of worms

Identification of collected helminths was done at the Laboratory of Dalomana veterinary clinic. All helminths were identified by hand lens and under a stereo, turret microscope using helminthological keys of Calneket al.[15] and Ashenafi and Eshetu[12].

In this regard, The gastrointestinal tracts (GITs) were collected and placed in plastic bags for transport to the diagnostic and examination laboratory. Upon proper labeling and dating, they were promptly sent to the processing laboratory. Any samples that could not be immediately analyzed were stored in a refrigerator. Subsequently, the GITs were divided into distinct sections of gizzard, crop, small intestine, large intestine, and caecum.

Each of these regions was opened via a longitudinal incision. The process involved intestinal scrapping, during which any visible parasites were extracted using forceps, followed by a saline wash and identification. Visible worms were carefully removed using thumb forceps, while adult worms were directly identified under a stereo turret microscope.

Scrapings were obtained from the mucosae of the upper, middle, and lower intestine, as well as the caecum. These scrapings were examined under the stereo turret microscope. Mucous exudate and deep mucosal scrapings were collected and placed between two glass plates to form a thin layer. This preparation was scrutinized under the stereo turret microscope, particularly searching for parasites like *Capillaria* eggs. Distinctive features of tapeworms, such as bipolar, lemon-shaped eggs in female capillaries, were observed. Additionally, the scolex, eggs, and individual proglottids of recently shed tapeworms, along with whole live specimens, were examined for characteristic traits.

General morphology used in the identification of the nematodes involved a body covering, mouth, sex organ, and others. *Ascaridia galli* types of nematodes are large, thick, yellowish-white worms; their head has three large lips. The male is 50–76 mm long and 1.21 mm wide; the perianal sucker is oval or circular, with a strong chitinous wall with a papilliform interruption on its posterior rim; the tail has narrow caudal alae or membranes and 10 pairs of papillae; the first pair of ventral caudal papillae is anterior to the perianal sucker; the fourth pair are widely separated, compare with *Ascaridia dissimilis*; and spicules are nearly equal and narrow, with blunt ends and slight indentations. The larger female is 60–116 mm long and 1.8 mm wide; the vulva is in the anterior part of the body, and the eggs are elliptical, thick-shelled, and not embryonated at the time of deposition.

2.8. Statistical analysis

The data obtained from postmortem examinations were entered into a Microsoft Excel spreadsheet. Raw data were coded and then analyzed using SPSS (version 23). Descriptive analysis was used to determine the frequency and percentage of the parasite infections. Age, sex, and origin were examined with the prevalence of GIT helminths, by the Chi-square. The Duncan test was chosen to find the significant differences between the results. P value less than 0.05 was considered as a significant level.

3. Results

3.1. Overall helminth prevalence

Out of 144 examined chickens, 91% (131/144) were found to be infected or infested with GIT helminths of many species. Analysis of data for the prevalence of the different species of helminth parasite out of the total number of affected chickens examined indicated the highest proportion for *Railathenia echinobothrida* (75.5%) followed by *Railathinia tetragona* (73.6%), *Heterakis gallinrum* (37.5%), *Ascarid galli* (35.4%), *Cappilaria anatis* (6.9%), *Cappilaria obsignata* (5.6%) and *Capillaria annulata* (4.9%, Table 1).

3.2. Prevalence of cestode and nematode of examined chicken

A total of 144 chickens were examined, out of which 70 (64%) were females and 74 (67%) were males. The results indicated that 131 (91%) of the chickens were infected by helminth parasites, and 8 helminths species including 5 nematodes and 3 cestodes, were recorded. Of the 144 chickens slaughtered and examined, 90 (62.5%) and 17 (11.8%) had single and mixed nematode infections, and 38 (26.4%) and 93 (64.6%) had a single and mixed cestode infection, respectively. The sites with double or triple nematode infections were the intestinal tracts, proventriculus, and Caeca (Table 2).

Table 1. Prevalence of chicken Helminths and their predilection site

Helminth	Predilection site	Frequency	Percentage
Nematode			
Ascaridia galli	small intestine	51	35.4
Heterakis gallinarum	Cecum	54	37.5
Capillaria anatis	Cecum	10	6.9
Capillaria obsignata	Small intestine	8	5.6
Capillaria annulata	Crop and esophagus	7	4.9
Cestode			
Raillietina echinobothrida	Small intestine	109	75.5
Raillietina tetragona	Small intestine	106	73.6
Davainea proglottina	Small intestine	16	11.1
Total		131	91

Table 2. Prevalence of cestode and nematode of examined Local breeds of chickens

	Number of infected chickens	Prevalence (%)
Nematode single infection	90	62.5
Mixed infection	17	11.8
Total	107	74.3
Cestode single infection	38	26.4
Mixed infection	93	64.6
Total	131	91

3.3. Sex, age, and origins a risk factor

Although helminth infection was more prevalent in males (46.5%) than females (44.4%), and in adults (72.2%), followed by young chicks (18.8%), there was no significant difference in the prevalence of helminth parasites among sexes and age groups of chickens ($p > 0.05$). In the present study, the association between the prevalence of helminth parasites and various explanatory variables, such as age, sex, and origin, was observed. The prevalence of helminth was not significantly different ($p > 0.05$) in the different villages of the district (Table 3).

Table 3. Prevalence of helminth parasites based on sex, age, and origin of local breeds of chickens

Variable		Number of examined	Number of infected	Percentage	p-value
Age	Young (6-12 months)	29	67	18.8	0.654
	Adult (> 12 months)	115	104	72.2	
Sex	Female	70	64	44.4	0.853
	Male	74	67	46.5	
Origin	Mena 01	16	13	9	0.3337
	Mena 02	27	23	16	
	Wabaro	20	19	13.2	
	Chiri	21	18	12.5	
	Nanigader	20	20	13.5	
	Hayaoda	18	17	11.8	
	Irba	22	21	14.6	

4. Discussion

The study disclosed an overall prevalence of 131 (91%) of gastrointestinal helminths. This finding is generally comparable with the previous report of 91.01% in Ethiopia[11], 90.6% in Mekele town Ethiopia[7], 89.5% prevalence in Ethiopia[16] 88.5% in Hawasa town Ethiopia[17] and 164 (86.32%) of Cestodes and 144 (75.79%) of nematodes in Ethiopia[12] However, slightly lower than the prevalence rate of gastrointestinal parasites of scavenging chickens which was reported to be 100% in Zimbabwe[18] and 99% of prevalence reported by Mwale and Patrick in South africa[9]. The present prevalence finding was somewhat higher than the reports of gastrointestinal parasites in different areas of Ethiopia, including Gondar (44.5%)[10], in and around Hawassa town (20.1%)[19], and Haromaya (51.8%)[20] as well as Nigeria (20.5%)[21] and Kenya (20.6%)[22]. Furthermore, the number of identified helminth species varied from 10 (6 nematodes, 4 cestodes) in Cameroon to 15 (8 nematodes, 7 cestodes). In the current study, trematodes were not observed, and this observation is concurrent with previous findings where few or not all trematodes were found in local chickens[23].

The absence of trematode parasites during the current study was also in agreement with findings reported from Ethiopia[7], Giwa local government, Nigeria[24,] and Mbeere sub-county, Kenya[25]. However, trematodes were recorded from Kiambu and Nairobi counties, Kenya[26]. This difference could be due to the absence or less occurrence of the snail intermediate hosts responsible for their transmission[7]. In most cases, the prevailing environmental conditions might not be conducive to the perpetuation of the intermediate hosts[27, 28]. Thus, the life cycle of the parasites is rarely completed. In addition, trematodes are more crucial parasites of wild waterfowl, domesticated ducks, geese, and not chickens[29].

Generally, a high prevalence of gastrointestinal helminths in local domestic chickens in the Dalomana district, and the chickens were infected with many different species. It might be a result of continuous exposure of chickens to the range conditions that

facilitate infection. Local chickens satisfy their nutrient requirements by roaming from place to place. They usually seek their food in the superficial layers of the soil which is often contaminated with various insects that serve as intermediate hosts for helminths parasites. This indicates the importance of gastrointestinal helminths in backyard poultry farming[30].

Raillietina echinobothrida and *Raillietina tetragona* are considered to be studied harmful to chicken[12]. *Raillietina echinobothrida* induces the formation of nodules in the intestinal wall, which can lead to confusion with lesions of avian tuberculosis[15,31]. Of 144 examined chickens, 109 (75.7%) prevalence was obtained. *Raillietina echinobothrida* was the most prevalent 109 (75.7%) cestode species in the chickens. Its prevalence was within the range of the prevalence (25-84%) reported in Ethiopia[11]. Other researchers also reported a similar prevalence rate range of 34-81% for the same parasite[7,8,]

Raillietina tetragona was recorded in 106 (73.6%) cases which is similar to another study by Mebratu et al[7] (73.9%) and higher than other studies as reported 10.75%[32], 20.5%[17], 0.8%[20], and 0.8%[33] in Vietnam. The relatively higher prevalence of *Raillietina* species can be attributed to the widespread and easy accessibility of intermediate hosts (dung beetles, ants) to the local scavenging chickens.

The prevalence of *Heterakis gallinarum* in the current study was 54 (37.5%). This was in line with the work of Solomon and Yobsan [32], who recorded 33.43%, and Nguyen et al[33] who reported 43.3%. It was lower than the reported rates of 83.3%[7] and 51.6% in Ethiopia[17], and higher than the previous study in Jimma Ethiopia 9.4%[20]. *Heterakis gallinarum* has a major effect on the health of chickens by sharing feed, thus causing stunted growth and low productivity, which may be related to damage to the intestinal mucosa[33]. The parasite sometimes causes major irritation and inflammation to the mucosa, thus interfering with the absorption of food and showing on the caeca marked inflammation and thickening of the mucosa with petechial hemorrhages. *Heterakis gallinarum* may produce nodular diarrhea, emaciation, and death[34]. *Ascaridia galli* was identified with a prevalence of 35.4% amongst the intestinal nematodes identified in studied chickens. This was comparable with other studies reporting 35.58%[11] and 32.3%[16] in Ethiopia and a lower prevalence of 25.5% by Solomon and Yobsan[32] and a higher prevalence of 79%[7]. In other African countries, the prevalence of *Ascaridia galli* was comparable to the current estimate, ranging from 24 to 36%[6,8]. Reasons might be the geographical differences in the distribution of the parasites or intermediate hosts of worms.

In the present study, no significant difference was observed in parasitic infection due to the differences in host sex, age, and villages. In all villages, all parasitized chickens suffered from 1 to 4 helminths. The present result of mixed-species infection is slightly lower than the previous results reported up to 6 and 7 species of gastrointestinal helminths were Jimma[20] and Mekele[7], respectively.

Finally, the present finding focused on the prevalence of helminthiasis in backyard chickens and excluded the prevalence of coccidiosis similar to previous studies in Ethiopia[20] and Vietnam[33] that reported the prevalence of helminthiasis in backyard chickens. Coccidiosis is a protozoal disease, and the prevalence of coccidiosis is not reported in this study and does not indicate that the coccidiosis has not occurred in the study area.

5. Conclusion

The most commonly isolated nematode and cestode species in chickens in the current study were *Raillietina echinobothrida* (75.5%), *Raillietina tetragona* (73.6%), *Heterakis gallinarum* (37.5%), and *Ascaridia galli* (35.4%). In the current study, sex and age had no significant effect on the prevalence of poultry helminths. Of note, Chicken coccidiosis was not included in this study and the findings were limited to a helminthic parasite which can be classified as roundworms (nematode), tapeworm (cestodes), and flukeworm (trematodes) in GIT chickens. The present study suggests that cestode and nematode are highly significant helminth problems of local chickens in Dalomana district, Ethiopia.

Declarations

Competing interest

The authors declare that they have no conflicts of interest.

Authors' contribution

Sufian A generated the idea, proposal, and paper outline, completed the paper, and analyzed data. Both Sadik Z and Suresh PN took part in the paper write-up, data analysis, and revision of the manuscript. All authors read and approved the final version of the manuscript and conceived the study.

Availability of data and materials

The raw data used to support the findings of this study have been documented in the Dalomana Agriculture Office annual reports of 2020.

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