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Investigation of Chicken Ascaridia galli, Associated Risk Factors, and Assessment of Farmers' Anthelmintic Drug Use for Chicken

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A B S T R A C T

Chickens play a vital role in supplying eggs and meat. Chicken production is expanding rapidly to meet the growing demand for human nutritional needs. Nevertheless, backyard husbandry chickens are susceptible to nematode parasites and continue to sustain substantial populations. A cross-sectional study was conducted from March 2023 to February 2024 to determine the prevalence of ascaridiasis and assess the availability of anthelmintic drugs for managing chicken health. Fresh fecal samples from 380 chickens were directly collected from the cloaca using gloves and preserved in 10% formalin to conduct the flotation technique. In addition, postmortem examinations were done on 30 chickens, and adult parasites were collected to evaluate the parasite load of the chickens. Additionally, 120 farmers were interviewed to analyze the use of anthelmintic drugs for parasitic infections in their chickens. Data analysis was performed using SPSS to explore the risk factors involved. The results revealed that the prevalence of chicken ascaridiasis was 41.07% (N=115/380). Sex was identified as a significant factor, with a prevalence of 34.03% in females compared to males (χ^2 = 4.29, p = 0.038). Local breeds showed a higher prevalence (45.63%) compared to exotic breeds (24.55%) (χ^2 = 15.81, p < 0.001). Regarding management practices, the prevalence was 35.3% under extensive, 33.45% under semi-intensive, and 19.84% under intensive systems (χ^2 = 4.994, p = 0.025). Multivariate logistic regression analysis indicated that age (χ^2 = 9.915, p = 0.002), sex (χ^2 = 4.29, p = 0.038), breed (χ^2 = 15.81, p < 0.001), and management type (χ^2 = 4.994, p =

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0.025) (OR = 1.521, 95% CI: 0.85–2.7) were significantly associated with the prevalence. Among the 30 chickens necropsied, intestinal parasite counts varied: 50% (15/30) had 1–5 parasites, 36.67% (11/30) had 6–10, and 13.33% (4/30) had 11–15 parasites in their intestines. Adult parasites were found in the small intestine, and notably, pathological lesions of varying degrees, including mild ulcerations, were present in 50% of the chickens (N = 15/30). Herbal remedies were commonly used by farmers for poultry health management, with full reliance on backyard systems (100%), followed by 90% in semi-intensive and 80% in intensive systems. These findings emphasize the importance of anthelmintic drugs for chickens' seasonal deworming programs for the effective management of *Ascaridia galli.*

Keywords: *Antihelminthic, Ascaridia galli, Chicken, Herbal Drug, Necropsy*

1 Introduction

Nematode parasites are significant parasites affecting poultry health, as they severely affect the chicken intestine, leading to increased susceptibility to secondary diseases, both directly and indirectly (1). From the nematode parasite *Ascaridia galli*, intestinal parasitic infection results in reduced production performance, manifested by weight loss, reduced egg production, and even mortality due to intestinal obstruction. The *prevalence of Ascaridia galli* in chickens globally is leading to significant health and economic impacts. The prevalence may vary from region to region due to epidemiological factors (2, 3).

The impact of *A. galli* is exacerbated when concurrent infections occur, particularly with Eimeria, which can lead to declines in health status and production of chickens (4, 5). The egg of this parasite is resilient and can survive in the environment, leading to direct transmission from chicken to chicken. Eggs of the parasite are excreted in the feces, where they undergo embryonation in the environment (6). Contaminated feed, water, and farm equipment may be ways of transmission to chicken *A. galli* (7).

Deworming practice in chicken husbandry is crucial for chicken health and productivity. Particularly in free-range chicken, helminth parasite infections are prevalent. Fenbendazole (5 mg/kg BW) has an efficacy of 83.7%, while levamisole (16 mg/kg BW) showed 71.8% efficacy against gastrointestinal nematodes (8). Additionally, tetramisole is 100% effective against *Ascaridia galli* at a dose of 25 mg/kg, demonstrating its potential for treating common poultry parasites (9).

Ethnobotanical research indicated that a combination of Ipil-ipil and Betel nut was effective against roundworms in chickens, offering a cost-effective alternative to commercial chicken deworming (10). Targeted treatment strategies can be implemented to reduce barn contamination and worm burdens more effectively than single late treatments. While conventional anthelmintics are effective, there is a growing interest in ethnobotanical alternatives due to their lower cost and potential sustainability benefits. However, the efficacy and safety of these alternatives require further investigation to ensure they replace or complement traditional methods effectively (11).

The problem statement of the study was that a significant portion of the chicken population in Ethiopia is managed within backyard production systems. Nevertheless, these backyard chickens do not implement deworming practices to prevent parasite diseases. Ascaridia galli is a major parasitic disease of chickens in backyard production systems and poses a significant threat to chicken health and productivity. Ethiopia's chicken population is large and experiencing rapid growth. Nevertheless, access to drugs for parasitic diseases in chickens is considerably limited compared to other livestock. Therefore, the objective of this study was to investigate the prevalence of *Ascaridia galli* parasites in chickens and to analyze the availability of commercial and herbal anthelmintic drugs for these birds.

2 Methods and Materials

2.1 Study Area

The study was carried out in the central Gondar zone of the Amhara Regional State, Ethiopia, between March 2023 and February 2024. The coordinates are 12°36′N, 37°28′E. Gondar is exactly 742 kilometers away from Addis Ababa, the capital of Ethiopia. The rainfall pattern is bimodal, with an average annual rainfall of 1172 mm and a mean annual temperature of 20°C. The poultry farmers used integrated agriculture, which produced crops and livestock. The study area includes extensive, semi-intensive, and intensive poultry rearing approaches.

2.2 Study population

The study focuses on chickens raised in intensive, semi-intensive, and extensive husbandry systems. In the study area, both local and exotic chickens are considered. Most of the time, the local breed is reared under extensive management. However, exotics are typically found in semi-intensive or intensive management systems. Both sexes and all ages of the chickens were included in the study.

2.3 Study Design

A cross-sectional study was conducted to evaluate the prevalence, associated risk factors, and treatment choices for *Ascaridia galli* in chickens. The Central Gondar Zone was chosen as the study area due to its substantial chicken population. Subsequently, the districts of Chuahit, Koladiba, Gondar Town, and Maksegnit within this zone were selected by using a random sampling method. Within each selected district, three villages per district were randomly chosen as sampling sites. Following this, individual farmers' farms within these villages were selected through a random sampling technique, and individual chickens were then randomly selected from each of these farms. The study included both local and exotic chicken breeds, encompassing males and females of all age groups. The study also considered chickens reared under extensive, semi-intensive, and intensive husbandry systems. A simple random sampling technique was employed to ensure unbiased representation across the different management systems.

2.4 Sample Size Determination

A simple random sampling method was used to select 380 chickens for fecal sample, 30 chickens for necropsy, and 120 farmers for interview, up to the maximum sample size, following the standard formula described by Thrusfield.

That is as follows:

N (1.962 * Pexp * (1 - Pexp)) / d², $(1.96)^2$ 44.5% (1-44.5%)/ $(0.05)^2$ =380

Where: N = required sample size, Z = (1.96) at 95% confidence interval, Pexp =expected prevalence, and d = desired absolute error (0.05) (12)

In the study, a 95% confidence level, 5% desired absolute precision, and 44.5% prevalence, as reported by Abram *et al.* (2021), were considered.

2.5 Sample collection and laboratory procedure

Using a sterile spatula, fresh feces samples were aseptically removed directly from the chicken cloaca. The spatula tip containing the feces was then put into a clean sampling container in the icebox. The material was then brought to the veterinary parasitology laboratory at the University of Gondar, Ethiopia, and kept in 10% formalin until it was processed for a fecal flotation procedure. Standard protocols for flotation, utilizing saturated sodium chloride (NaCl) as the flotation fluid, were used to evaluate fecal samples for the detection of parasite eggs in the laboratory (13).

A 3-g fecal sample was thoroughly mixed with 10 mL of flotation solution and placed in a test tube. To fill the tube to the top, more flotation solution was poured into the suspension. On top of the surface, a cover slip was placed and left for 10–15 minutes (13).

Postmortem diagnosis: The chicken that tested positive for egg ascariasis had a postmortem examination. The intestines were removed from each carcass after the researchers had handled it and humanely euthanized the chicken. To gather the mature parasites, the small intestines were opened. Using a sampling vial, the adult parasites were collected and brought to the parasitology laboratory for microscopic inspection.

A questionnaire survey was conducted to assess the availability of drugs for chicken parasites and health management practices. A total of 120 farmers were interviewed about parasite diseases and the availability of drug options.

2.6 Data Management and Analysis

The collected data was coded and stored in Microsoft Excel spreadsheets. Data analysis was done using SPSS to summarize the raw data. Multivariate Logistic Regression and Chi-square statistics were used to describe the contribution of risk factors to parasite prevalence. A statistical significance level was set at $p < 0.05$, with a 95% confidence interval. Descriptive statistical analysis was used to summarize and present the collected data.

3 Results

This study's results revealed that 62.63% of the chickens were female, and a higher percentage (63.95%) of the chickens were over 5 months old. In terms of breed composition, 72.89% of the chickens are Bovans Brown. Approximately 73.16% of the chickens were managed under a semi-intensive system, as shown in Table 1.

Table 1. Characteristics of chicken demography

Variables		Frequency	Percentage
Sex	Female	238	62.63
	Male	142	37.37
	Total	380	100.00
Age	Under 5 months	137	36.05
	Above 5 months	243	63.95
	Total	380	100.00
Breed	Local	103	27.11
	Exogenous	277	72.89
	Total	380	100.00
Management Type	Intensive	90	23.68
	Semi intensive	138	36.31
	Extensive	150	39.47
	Total	380	100.00
District	Gondar	190	50.00
	Maksegnit	60	15.79
	Koladiba	70	18.42
	Chewahit	60	15.79
	Total	380	100.00

Coprological examination of 380 chickens revealed that 115 were positive for ascaridiasis, resulting in a prevalence rate of 30.26% (115/380). Sex was identified as a significant factor, with a prevalence of 34.03% in females compared to males (χ^2 = 4.29, p = 0.038). Local breeds showed a higher prevalence (45.63%) compared to exotic breeds (24.55%) (χ^2 = 15.81, *p* < 0.001). Regarding management practices, the prevalence was 35.3% under extensive, 33.45% under semi-intensive, and 19.84% under intensive systems (χ^2 = 4.994, *p* = 0.025). The current investigation indicated that age (χ2=9.915, *p*=0.002), sex (χ2=4.29, *p*=0.038), breed (χ2=15.81, *p*<0.001), and management type (χ2=4.994, *p*=0.025) were significantly associated with the occurrence of *Ascaridia galli* in chicken, as indicated (Table 2).

Table 2. Chi-square Analysis Prevalence of Chicken Ascaridiasis and its Associated Risk factors

Variable		No. chicken	Positive	Prevalence	χ^2 (*p*-Value)
Sex	Female	238	81	34.034 %	4.29 (0.038)
	Male	142	34	23.944 %	
Age	<5 months	137	55	40.15 %	9.915(0.002)
	>5 months	243	60	24.69 %	
Breed	Local	103	47	45.63 %	15.81(0.000)
	Exogenous	277	68	24.55 %	
Management Type	Intensive	90	22	19.84 %	4.994 (0.025)
	Semi Intensive	138	50	33.45 %	
	Extensive	150	53	35.3%	
Chicken Origin	Gondar	190	58	30.53 %	2.912 (0.405)
	Maksegnit	60	20	33.33 %	
	Koladiba	70	24	34.29 %	
	Chewahit	60	13	21.67 %	
Overall		280	115	41.07%	

The coprological analysis revealed different parasitic types detected in the examined chickens, encompassing nematodes (*Ascaridia galli*, *Heterakis gallinarum*, *Capillaria species*), cestodes (Raillietina species, Davainea species), and coccidian species. The prevalence of specific parasitic elements in the 380 chickens was as follows:

cestode eggs (39.47%, N=150), coccidian oocysts (48.68%, N=185), *Heterakis gallinarum* eggs (22.89%, N=87), Capillaria species eggs (6.84%, N=26), and *Ascaridia galli* eggs (55.79%, N=212), as indicated in Table 2.

Multivariate Logistic Regression analysis reveals significant associations between chicken and *Ascaridia galli*, particularly influenced by the breed of chicken (OR = 0.47, 95% CI: 0.28-0.78) and sex (OR = 0.70, 95% CI: 0.43-1.15). The current research results indicate that indigenous breeds and younger chickens, which are less than 5 months old, are more susceptible to *Ascaridia galli* infections, as shown in Table 3.

Table 3. Multivariate Logistic Analysis to Indicate Strength of Association of Host Factors to Chicken Ascaridiasis

Variables		Parasite Status		OR (95% CI)
		Negative	Positive	
Sex	Female	238	81	0.700 (0.43, 1.15)
	Male	142	34	
Age	Less than 5 months	137	55	0.54 (0.34, 0 .86)
	Above 5 months	243	60	
Breed	Local	103	47	0.47 (0.28, 0 .78)
	Exogenous	277	68	

The odds ratio of Ascaridiasis parasitic diseases in chickens was 1.52 (95% CI: 0.85–2.7) times higher under certain poultry management practices. Moreover, the likelihood of these diseases varied by district, with an odds ratio of 1.14 (95% CI: 0.61–2.11), as presented in Table 4.

Table 4. Multivariate Logistic Analysis to Indicate Strength of Association of Management and Environmental Factors to Chicken Ascaridiasis

Variables		Disease Status		OR (95% CI)
		Negative	Positive	
Management	Intensive	102	22	1.521 (0.85, 2.7)
	Semi intensive	278	93	
Origin	Gondar	190	58	1.14 (0.613, 2.114)
	Maksegnit	60	20	
	Koladiba	70	24	
	Chewahit	60	13	

Necropsy result: The postmortem findings revealed a significant load of Ascaridia galli in the small intestine of the chicken. A postmortem examination was conducted on 30 chickens, and various parasitic loads were collected from their small intestines as indicated in Figure 1. In 4 chickens, a range of 11-15 parasites was found, while in 13 chickens, 6-10 parasites were collected. The small intestines of the infected chickens showed varying levels of hemorrhage in areas with high parasite loads, as shown in Table 5.

Table 5. load of parasite in chicken intestine

Chicken			Parasite found in the intestine at range			Lesion score	
Sex	Age		(1-5) parasites	(6-10) parasites	(11-15) parasites	Mild Petechial hemorrhage	Mild ulceration and hemorrhage
Female	>6 months	9	3 (33.3%)	4 (44.4%)	2 (22.2%)	6 (66.6%)	3 (33.3%)
	<6 months	9	5 (55.5%)	3 (33.3%)	1 (1.1%)	4 (44.4%)	5 (55.5%)
Male	>6 months	6	3 (50%)	2 (33.3%)	1 (16.6%)	3 (50%)	3 (50%)
	<6 months	6	4 (66.6%)	2 (33.3%)	0 (0%)	2 (33.3%)	4 (66.6%)

During the chicken necropsy evaluation of the small intestine, varying levels of *Ascaridia galli* infestation were observed, as shown in Figure 1. Numerous adult parasites were present, and in some cases, the intestinal lumen was completely blocked by the worms, as indicated in Figure 2.

Figure 1. Ascidia galli in chicken necropsy (A) indictad the Ascaridia Galli collected, B) Ascaridia Galli in the intestine and C) Ascaridia Galli bocked the intestine)

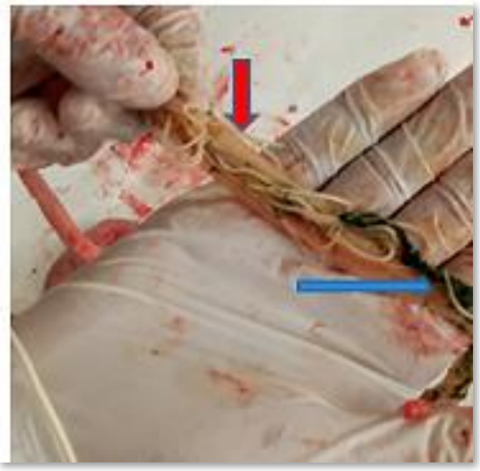

Figure 2. intestine blocked with Ascaridia Galli (The red arrow indicates that numerous Ascaridia parasites block the small intestine of the chicken, while the blue arrow indicates the feed components within the intestine)

Following the removal of *Ascaridia galli* from the small intestine, varying degrees of bleeding and moderate ulceration were seen. As illustrated in Figure 3, petechial hemorrhages were observed on the mucosa of the small intestine in the locations where *Ascaridia galli* had adhered.

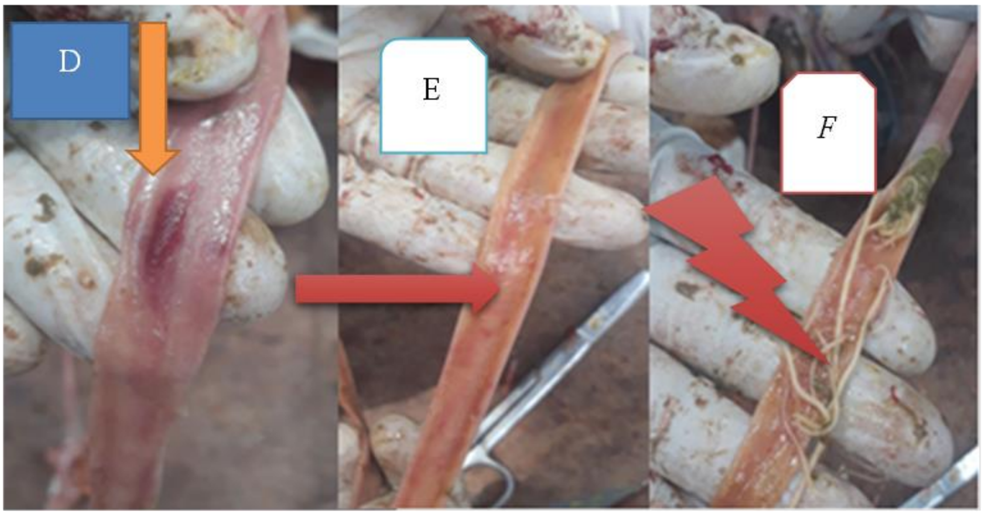

Figure 3. Ascaridia galli inected intestin different level of ulceration and heammorage (D) Mild ulceration of small intestine infected by the parasites. E) Petechial hemorrhage after parasite removed. F) Parasite attached in the intestine)

A questionnaire survey was conducted to evaluate farmers' use of antiparasitic medications for poultry parasites. No pharmacological medications were found to be available for treating endoparasites in chickens. Observations at various veterinary clinics and pharmacies confirmed the lack of antiparasitic drugs specifically for poultry. As a result, 40 backyard chicken farmers (100%) and 36 semi-intensive farmers (90%) reported using herbal remedies. Among intensive farmers, 6 (15%) used pharmaceutical drugs, while 8 (20%) of semi-intensive farmers did the same, as shown in Table 6. These pharmaceutical drugs included amprolium, typically used for coccidiosis, and albendazole, which is formulated for pet animals, not for the chicken.

Table 6. Questioner survey chicken farmer use of drugs

Types of farming	Number of interview	Farmers' drugs use practices	
		Pharmaceutical drug	Herbal drug
Backyard chicken	40	0 (0%)	40 (100%)
Semi-intensive	40	8 (20%)	36 (90%)
Intensive	40	6 (15%)	32 (80%)

Not: intensive and semi-intensive farmers are used pharmaceutical Drugs prepared for cattle, or sheep and humans to treat their chicken

Among various herbal remedies, around six specific herbal drugs are commonly used by poultry farmers. Experienced, skilled, and well-known individuals within the village and community prepare these herbal drugs. Farmers receive these remedies from traditional healers and administer the herbal drugs to their chickens, as shown in Table 7.

Table 7. Type of herbal drugs used by the poultry farmers

No.	Types	Way of treatment	Medication part of plant	Types of parasite
	Feto (Garden Cress)	feed or water	Grain	Endoparasite
	Zigta (calpurani aurea)	water	Leaf and flower	Ecto and indo parasite
	Neem	feed or water	Leaf	Endoparasite
	Grawa (clerodendrum)	water	Leaf	Endoparasite
	Koso (hygenia abeyssinica)	water	Leaf	Endoparasite
	Emoay (solanum margunatu)	Feed or water	Fruit	Ecto and endoparasite

4 Discussion

This cross-sectional study was conducted to determine the prevalence of chicken ascaridiasis and its associated risk factors, as well as the availability of commercial and herbal drugs used by poultry farmers in their practices. The findings of this research will be valuable for farmers, veterinarians, and drug suppliers when planning seasonal deworming programs for chickens.

The overall prevalence of *Ascaridia galli* infection in chickens was 41.07% (115/280). These findings suggest that chicken ascariasis has a substantial negative impact on intestinal health, compromising feed absorption efficiency and, in turn, adversely affecting the productivity and general well-being of the chickens. This research finding is supported by previous studies (14), which reported a 41.4% prevalence in southeastern Ethiopia; (15) reported a 46.9% prevalence in and around Bahir Dar, and Abrham et al. (2021) reported a prevalence of 46.9% in northwest Ethiopia.

However, the findings of this research differ significantly from other *reports. Ascaridia galli*, as reported by (16), reported a prevalence of 23.1% in Addis Ababa; Negash et al. (2015), 20.1% prevalence in and around Hawassa; and a study (17), 20.5% prevalence in Nigeria. These discrepancies may arise from variations in epidemiological factors, farm management practices, and agroecological conditions across the studied sites. Additionally, differences in veterinary interventions and deworming practices among poultry farmers, as well as agro-climatic factors and the presence of intermediate hosts, may directly influence the prevalence of parasites.

In the current study, different age groups were evaluated, revealing a statistically significant association with the risk of Ascaridiasis ($\chi^2 = 9.915$, $p = 0.002$). Younger chickens showed a higher prevalence of the infection compared to adult chickens. This could be attributed to adult chickens developing resistance and sufficient immunological protection against ascaridiasis, a finding supported by Abrham et al. (2021), who reported a relatively higher prevalence of gastrointestinal parasites in younger age groups than in adult age groups. This age-related disparity in incidence might stem from variations in chicken immunity. The potential for lower immunity development and, consequently, higher susceptibility in younger hens exists. The development of intestinal worms in chickens is influenced by multiple factors, including chicken age, infective egg age, the quantity of ingested infective agents, and dietary composition.

This study revealed a significant association between the sex of chickens and the prevalence of ascaridiasis, with female chickens showing a higher infection rate (34.03%) compared to males (23.94%). Several factors may explain this disparity: females typically make up a larger proportion of the flock and tend to have a longer lifespan. Moreover, physiological stresses associated with egg production and brooding may compromise their immune response and reduce their ability to acquire sufficient nutrients, making them more susceptible to infection. Additionally, in many backyard and semi-intensive systems, female chickens tend to be kept longer for egg production, increasing their exposure time and cumulative risk of infection compared to males.

This study demonstrated that management practices for chickens have a significant impact on the prevalence of chicken *Ascaridia galli*. The highest prevalence rates were found in extensive management systems at 35.5%, followed by semi-intensive at 33.5%, and intensive at 19.84%. This finding is consistent with the results of Shiferaw et al. (2016). Notably, this finding indicates that the prevalence of *Ascaridia galli* parasites is lower in production systems characterized by higher quality and modernization. The reduced prevalence in intensive farms can be attributed to their hygienic environments and feeding systems, which are less conducive to the growth and transmission of *Ascaridia galli* parasites. Conversely, free-ranging chickens are more likely to ingest intermediate hosts as they search for feed and water.

The results revealed a higher prevalence of the disease in local chicken breeds compared to exotic breeds. This finding is consistent with a study conducted in northwest Ethiopia by Abraham et al. (2021) and another study by Shiferaw et al. (2016) in the Ambo-West Shoa Zone, which reported a prevalence of 78.11% in local breeds and 48% in exotic breeds. The higher rates in local chickens may be attributed to the fact that most of these local breed chickens were raised in a backyard management system.

In this setting, chickens often obtain their nutrients by foraging, typically searching for food in the upper layers of the soil. These areas are frequently contaminated with the infective stages of parasites and their intermediate hosts. As a result, continuous exposure to free-range conditions may contribute to the spread of parasitic diseases. Necropsy examinations of the chickens revealed *Ascaridia galli* loads ranging from 5 to 15 adult parasites in the intestines. The varying parasite loads were associated with differing degrees of intestinal hemorrhage and ulceration, posing significant challenges to poultry health and productivity. This indicates that the chickens are infested by the *Ascaridia galli* parasite, with the parasite load significantly impacting both their health and productivity. From seasonal and regular deworming, there is a need for the chicken.

Antiparasitic drugs in poultry are essential for maintaining flock health and productivity, particularly in backyard production systems. Antiparasitic drugs control and eliminate parasitic worms that infect poultry (8). However, poultry farmers in Ethiopia rarely use anthelmintic drugs due to limited accessibility. According to the questionnaire survey, 100% of backyard poultry farmers and 80% of intensive poultry farmers reported using herbal remedies to manage poultry parasites, rather than pharmaceutical drugs.

Farmers use ethnoveterinary practices to treat parasitic diseases in chickens, a primary choice supported by (18). Herbal remedies are prepared by community experts and provided to farmers, who administer them through feed or water. Commonly used herbal treatments include feto (garden cress), zgeta (Calpurnia aurea), neem, grawa (Clerodendrum), koso (Hagenia abyssinica), and emboay (Solanum marginatum). However, these herbal remedies require careful dose calculations based on the age and body size of the chicks, pullets, and layers.

5 Conclusion

Ascaridia galli infection showed an overall prevalence of 41.07%, with females exhibiting a higher prevalence (34.03%) than males (23.94%), suggesting that sex may influence susceptibility. The findings suggest that factors such as breed, production system, sex, and age influence the occurrence of intestinal parasites in poultry. Access to anthelmintic treatments is limited, and as a result, farmers across all poultry production systems rely on herbal remedies to manage parasitic infections.

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Not applicable.

Conflict of Interest

The authors declare no competing interests.

Author Contributions

AB collected data, wrote the laboratory report, and ZJ collected the sample, analyzed it, and processed the laboratory work. DT collected the sample, analyzed it, and processed the laboratory work. WA wrote, edited, and provided methodology; SK analyzed and edited; KB analyzed, edited, and provided methodology; BA wrote, edited, and provided methodology; MG wrote, edited, and provided methodology; YT organized laboratory data and performed analysis; and YD wrote, edited, and provided methodology. All authors reviewed the manuscript. All authors checked and approved the final draft of the manuscript.

Data Availability Statement

All authors are ready to provide the available data to readers upon request via email or any other communication platform.

Ethical Considerations

The current study has been approved for its ethical soundness by the Institutional Ethical Review Board (IRB) of the College of Veterinary Medicine and Animal Sciences, University of Gondar, Ethiopia. It is referenced at (Reference No: CVMAS.Sc.16.282024).

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