Prevalence and Characteristics of Gastrointestinal Parasites in Backyard Chickens of Khuzdar, Baluchistan

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Abstract
The prevalence, severity, and diversity of gastrointestinal parasites in backyard chickens in Khuzdar, Baluchistan. A total of 200 fecal samples (100 males and 100 females) were collected. During sample collection, a thorough physical examination was conducted, noting parameters such as consistency, color, odor, and any abnormalities. The samples were carefully maintained under cold chain conditions and transported to the Department of Veterinary Parasitology at the Faculty of Animal Husbandry & Veterinary Sciences for further analysis. Microscopic examination of the fecal samples focused on identifying helminths. Various techniques, including the direct smear method, floatation method, and sedimentation method, were employed to detect helminth eggs. The results revealed that 53.50% of the fecal samples tested positive for eggs of different gastrointestinal parasites. Among the study areas, the highest prevalence rate (66.00%) was observed in Tehsil Zehri, followed by Karakh (54.00%), Wadh (50.00%), and Naal (44.00%). Gender differences were significant, with female backyard chickens being more susceptible to helminthic infection (72.00%) compared to males (35.00%). However, no statistically significant difference was found in the age groups of the chickens ($p>0.005$). Among age groups, gastrointestinal parasite infection was highest (56.00%) in chickens above sixteen weeks, followed by 53.00% in the 0-6 weeks group and 52.00% in the 6-15 weeks group.High (>1500 EPG),Medium (500-1000 EPG),Low (<500 EPG**)** medium load areas had the highest severity burden of helminth infection (48.59%). Ascaridia galli ,54.20%)Raillietina tetragona :24.29%) and Raillietina cesticillus : 21.49%)The highest prevalence occurs in Tehsil Zehri, and female hens are more susceptible to helminthic infection. Older chickens exhibit higher infection rates. Notably**,** Ascaridia galli is the most prevalent species in the region.

keywords: Prevalence, Helminths, Gender Differences, Age Groups, Ascaridia gall

Introduction

Birds hold a significant place in human society, and their value is widely recognized. In Pakistan, where there are 786 different bird species, the concept of “captivity” encompasses both domestically raised and wild-caught birds kept in cages and enclosures. These birds serve various purposes, including gaming, ornamental display, and emotional and economic significance (Khan et al., 2010).

In tropical countries like Pakistan, village poultry plays a crucial role within communities. These chickens contribute to family income, support local economies, provide protein through eggs and meat, and serve as essential assets. Interestingly, village chicken meat and eggs often command higher prices than those from broilers and commercial poultry. Local communities appreciate the unique texture and taste of indigenous chickens, which are believed to be leaner than broilers. Moreover, the ease of local distribution makes them accessible to consumers. Despite their importance, village chickens face challenges, including high mortality rates among chicks aged 0 to 6 weeks and overall low

productivity. Traditional management practices exacerbate these issues, but improved management strategies hold promise for enhancing productivity. Minh (2005),

Globally, poultry production plays a vital role in providing high-quality protein for human consumption. The world's poultry population was estimated at 20.88 billion in 2013, with Africa accounting for 4.7 million birds. Ethiopia alone had approximately 50.38 million chickens (Nekemte et al., 2017).

However, traditional backyard management systems prevail, characterized by low input, low output, and periodic losses due to diseases caused by viruses, bacteria, and parasites. (Ashenafi et al., 2004).

Among poultry diseases, helminthiasis (parasitic worm infections) and coccidiosis are widespread in chickens (Belete et al., 2016). Poor animal husbandry practices contribute to the prevalence of parasitic infections. Gastrointestinal (GIT) parasites, which invade the intestinal lining, cause significant damage, leading to weight loss, malnutrition, reduced egg production, and increased susceptibility to other diseases. Factors such as neighborhood infection, poultry transport, and the introduction of infected birds contribute to the spread of these helminths. Effective management practices are crucial for controlling these parasitic infections.

The chicken (Gallus domesticus) is susceptible to various pathogens, including parasites, viruses, bacteria, and fungi. Parasitic infections pose a significant threat to chicken production. Among these, cestodes (tapeworms) exhibit flat, elongated, segmented bodies. Tapeworms require intermediate hosts for their life cycle, and their eggs develop into various larval forms. In the human gastrointestinal tract, tapeworms can cause health issues. Parasitic infections result in economic losses, affecting growth, production, and overall livestock health. While desi (local) chickens reared in rural backyards fetch higher prices for their eggs and meat, they are more prone to parasitic infections due to traditional management practices. Parasitism leads to reduced weight gain, egg production, and overall morbidity and mortality. Efficient management and control strategies are essential for sustainable poultry production.

Materials and methods

Study area

The study area is Khuzdar, Baluchistan, and its tehsils (including Naal, Karkh, Wadh, and Zehri).Khuzdar is located in Balochistan Province, Pakistan, bounded by longitude 67° E to 67° 15° E and latitude 27° 45 N to 280. Figure 01

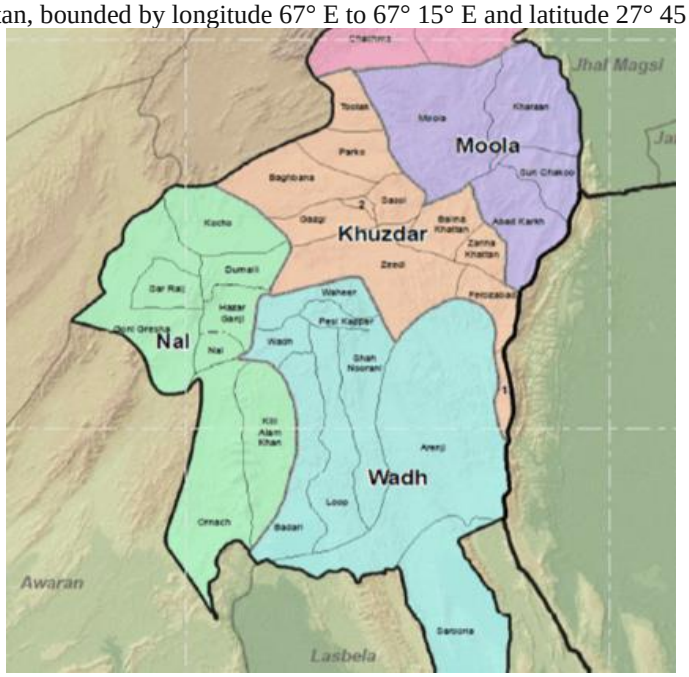

Figure 01: Map Khuzdar, Baluchistan

3.2 Sample Collection

A total of 200 fresh fecal samples of backyard chickens were collected from different poultry farms.Samples were obtained in a sterile plastic bottle containing 10% formalin. Information about the samples and associated conditions was recorded on a questionnaire proforma. Qualitative examination methods included direct smear, flotation, and sedimentation techniques.

Quantitative Examination: The parasitic samples were processed for quantification using the McMaster/Stoll method to determine eggs per gram (EPG).

Calibration of Ocular Lenses: The ocular lenses were calibrated using a stage micrometer to ensure accurate measurements during microscopic examination.

Processing of Helminth Endo-Parasites: Fixation and preservation methods were employed for helminths.Staining and mounting procedures were used for cestodes and nematodes.

Statistical Design: Data analysis was performed using GraphPad Prism, including one-way ANOVA, chi-square analysis, and t-test.

Results

Backyard (Desi) Chicken

The study investigated the prevalence of gastrointestinal parasites in backyard chickens within Khuzdar district, Balochistan. The overall prevalence of gastrointestinal parasites was 53.5% among backyard chickens in Khuzdar district. Tehsil-wise Distribution: Zehri: The highest prevalence (66.00%) was observed in Zehri.Karakh,54.00%.Wadh,50.00%.Naal,44.00%.

Frequency Dispersal Among different tehsils, Zehri had the highest frequency of gastrointestinal parasite infection (30.84%). Karakh followed with 25.23%, Wadh with 23.36%, and Naal with 20.56%.The overall prevalence of helminth infection across tehsils did not show significant differences at the P>0.05 level (Chi Square = 2.421, dF = 3, and P = 0.4898).For detailed information, refer to Table 4.1 in the study report.

Table 4.1 The overall prevalence percentage of gastrointestinal parasites in district Khuzdar.

S. No.	Tehsil	Sample examined	Sample infected	Prevalence %
1	**Karakh**	50	27	54
2	**Naal**	50	22	44
3	**Wadh**	50	25	50
4	**Zehri**	50	33	66
Total		200	107	53.5

Gender-Based Prevalence of Gastrointestinal Parasite Infection in Backyard Chickens

Prevalence of gastrointestinal parasites in male and female backyard chickens.

Gender Differences In males, was 35.0%. females, was notably higher at 72.0%. overall frequency of infection was lower in males (32.71%) compared to females (67.28%). statistical significance at the P<0.05 level (Chi Square = 12.794, dF = 1, and P value = 0.0003) Table 4.2.

Table 4.2 The overall gender-wise prevalence of gastrointestinal parasite infection in males and females of backyard chickens in district Khuzdar

S. No.	Gender	Sample examined	Sample infected	Prevalence %
1	**Male**	100	35	35%
2	**Female**	100	72	72%
Total		200	107	53.5

Age-Specific Prevalence of Gastrointestinal Parasites in Backyard Chickens

the prevalence of gastrointestinal parasites in backyard chickens across different age groups. 0-6 weeks 16.0%, 6–15 weeks, 54.0 %, Above 16 weeks: The highest prevalence was observed at 56.0%. Frequency Distribution, Among the age groups:0-6 weeks: (4.48%).6–15 weeks, high (58.31%),Above 16 weeks: elevated (26.16%).

Statistical significance at the P > 0.05 level (Chi Square = 0.081, dF = 2, and P value =0.9603) Table 4.3).

Table 4.3 Overall age-wise prevalence of gastrointestinal parasitic infection in Khuzdar.

S. No.	age	Sample examined	Sample infected	Prevalence %
1	0-6 Weeks	30	16	53%
2	6-15 weeks	120	63	52%
3	>16 weeks	50	28	56%
Total		200	107	53.5%

4.2 Severity of infection with helminths in chickens

Infected backyard chickens had a high infection burden (>1500 EPG), a medium burden (500-1000 EPG), and a low burden (<500 EPG), 14.28%, 60.71%, and 25.00% in infected backyard chickens, respectively. The frequency pattern indicates that the backyard chicken's population is more prevalent in the medium load areas.

Table 4.4 Severity/burden of disease of the gastrointestinal parasite in backyard chickens.

S. No	Severity/burden of disease	Chicken	
		Animals infected	Frequency
1	High (>1500 EPG)	40	37.38
2	Medium (500-1000 EPG)	52	48.59
3	Low (<500 EPG)	15	14.01
Total		107	100

In this study, the presence of different types of gastrointestinal parasite helminths in backyard chickens at the research region. The three types of helminths with the highest frequencies were Ascaridia galli (54.20), Raillietinatetragona (24.29), and Raillietina cesticillus (21.49).

Table 4.5 Species-wise incidence of Cestode and nematode in backyard chickens

S. No	Types of helminths	Chickens	
		Animals infected	Frequency
1	Ascaridia galli	58	54.20
2	Raillietinatetragona	26	24.29
3	Raillietinacesticillus	23	21.49
Total		107	100

Identification of *A. galli* Egg and Worm

The presence of *A. galli* eggs in fecal samples was confirmed using a Digital Microscope (CXL Digi 11500, Labomed, Labo America Inc., USA). The egg morphology was assessed according to the keys described by Thienpont and Rochette (1979) and Urquhart et al. (2003). The eggs were oval with smooth shells, covered by three layers: the inner permeable vitelline membrane, a thick resistant shell, and a thin albumin outer layer. Eggs containing L3 larvae measured 73–92 by 45–57 µm (Plate 4.1).

Regarding morphological characteristics, the adult *A. galli* worms were semi-transparent, with an oral opening featuring three prominent lips. They were unsegmented, cylindrical, and elongated in shape (Plate4.2). The average length of the worms ranged from 8 cm to 12 cm.

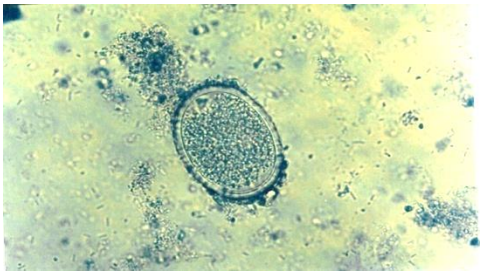

Plate 4.1 A. galliegg

Figure 4.2 A. galliworm

Identification of *Raillietina atatragona* Egg and Worm

Raillietina atatragona: This parasite was found to be the most prevalent cestode in chickens. It was collected from the lower half of the small intestine. The body was large, measuring up to 100 mm in length and having a width of up to 4 mm (Plate 4.1). The head (scolex) was oval, the neck was long, and the gravid proglottid contained eggs in capsules (6–12 eggs per capsule, Plate 4.2).

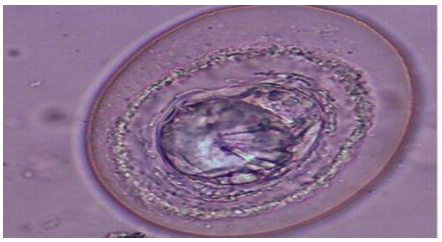

Plate 4.3 A. Egg of Raillietina tetragona

Plate 4. 4 B. Raillietinatetragonasegment

Raillietina cesticillus: Another prevalent cestode in backyard chickens, this parasite was collected from the middle part of the small intestine. *R. cesticillus* is a small tapeworm measuring about 15 cm (5.9 in) in length and 1.5–3 mm (0.059–0.118 in) in width (Plate 4.5). It appears whitish, highly elongated, dorso-ventrally flattened, and entirely covered with a tegument. The body consists of the head region (scolex), an unsegmented neck, and a highly segmented body (strobila). The egg capsule contains one egg per capsule (Plate 4.6).

Plate 4.5 A.Egg of Raillietina cesticillus

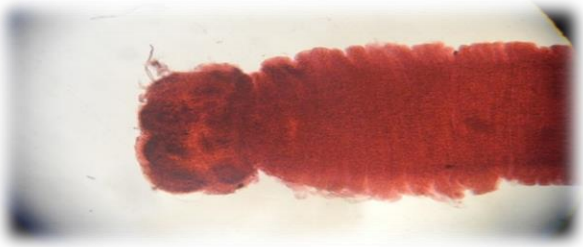

Plate 4.6 B. Raillietinacesticillussegment

Discussion

The present study investigated the prevalence of gastrointestinal parasites in backyard chickens within the Khuzdar district, Balochistan. The overall prevalence of gastrointestinal parasite infection was 53.5% in backyard chickens. Among the tehsils, Zehri had the highest infection rate (30.00%), followed by Karakh (22.00%), Wadh (16.00%), and Naal (10.00%). The lower infection rate in Naal may be attributed to its status as the district headquarters, leading to greater awareness and education about veterinary facilities. Zehri's higher infection rate could be due to limited veterinary resources and a distinct ecosystem. The study also found a heavy parasitization of domestic chickens by helminth parasites, including mixed infections, primarily with nematodes. These findings align with similar studies conducted in regions like Urmia (Naem & Eskandari, 2005).

The infection rates in backyard chickens were observed to be 53.3%, 52.5%, and 56% for the age groups 0-6 weeks, 6-15 weeks, and above 16 weeks, respectively. In this study, A. galli infection was highest in birds older than 28 weeks (25.52%), possibly due to increased contact with intermediate hosts and the external environment. This finding aligns with previous research by Fatima et al. (2015), which also reported higher A. galli infection rates in adult birds compared to young ones.

Regarding sex-wise infection rates, males had a rate of 35.0%, while females had a rate of 72.00%. Interestingly, the sex of the poultry did not significantly affect infection rates, consistent with findings from other studies (Amin et al., 2019; Al-Saeed and Al-Badrani, 2014). However, some studies have reported significant differences in parasitic infection rates between male and female pigeons (Abed et al., 2014). Since both sexes share the same environment and crop, their chances of infection with parasites are nearly equal. Most chickens and pigeons were infected with a single parasite species, although there was a noticeable difference in multiple infections between the two poultry types studied.

Ascaridia galli was the most common parasite found in backyard chickens during the present study. The prevalence percentage for Ascaridia galli was recorded as 100% in backyard chickens. Other helminth species identified by various researchers included *Heterakis gallinae*, *Strongyloides avium*, *Gongylonema ingluvicola*, *Trichuris trichiura*, and *Enterobius vermicularis*. Additionally, cestodes such as *Raillietina echinobothrida*, *Raillietina cesticillus*, *Raillietina tetragona*, and *Hymenolepis carioca* were also reported in domestic chickens .

Nematodes had the highest prevalence, with Ascaridia galli being remarkably prevalent at 21%, consistent with earlier findings by Yoriyo et al. (2008). Nematodes tend to be more prevalent than cestodes and trematodes in domestic chickens due to several factors. Nematodes do not require intermediate hosts and are soil-transmitted parasites. Adult nematodes lay numerous eggs daily, which can remain viable for up to 12 months. As domestic chickens feed, they inadvertently pick up viable eggs from contaminated droppings, leading to a heavy parasite burden. In contrast, cestodes rely on intermediate hosts to complete their life cycle, making transmission dependent on host availability. Most of the parasites were localized to the small intestine, particularly the duodenum, where optimal saline and glucose concentrations support their survival .Interestingly, no trematodes were reported in this study. Anand et al. (2008), Sudhir (2013), and Hamad (2014) also did not find any trematodes. The absence of these worms may be linked to their complex life cycle, which typically requires an intermediate host—often aquatic. Lack of water availability breaks the life cycle, reducing the spread of trematodes

Several researchers have studied the morphology and measurement of Ascaridia galli eggs, noting minor variations primarily in egg size rather than shape. In agreement with Urquhart et al. (2003), it has been observed that A. galli eggs are markedly oval, possess smooth shells, and consist of three layers: an inner permeable vitelline membrane, a thick resistant shell, and a thin albumin outer layer. These eggs, containing L3 larvae, typically measure 73–92 µm by 45–57 µm. However, Soulsby (1983) and Saif et al. (2003) reported slightly larger dimensions, with A. galli eggs measuring up to 88 µm by 50 µm. Other scientists, including Lapage (1956), Naem & Skandari (2002), and Train and Hansen (2004), have also documented similar size ranges for these eggs.

they exhibit semi-transparency and possess three prominent lips at the oral opening. These unsegmented, cylindrical, and elongated worms have an average length of 8 to 12 cm, with male adult worms measuring approximately 8.3 cm and females reaching up to 12.2 cm. These findings align with research by Dunn (1978), Kajerova et al. (2004), Biol (2005), and Johanne et al. (2000), as well as other studies by Pardo (2000), Permin (2001), Naem and Skandari (2002), Train and Hansen (2004), Skallerup et al. (2005), Holden and Walker (2006), Eshetu et al. (2001), and Saif et al. (2003). Although slight variations exist, they do not significantly impact the taxonomic classification of the studied worm. For instance, Ashour (1994) and Mohammad (2007) reported slightly longer male worms (9.3 cm) compared to shorter males (8.3 cm) in their investigations.

the most prevalent cestode in chickens was Raillietina cesticillus. The oval head (scolex) had a long neck and gravid proglottids. Each egg capsule contained 6-12 eggs. Similar observations were reported by Puttalakshmamma et al. (2008) in desi birds from the Bangalore region. However, Katoch et al. (2023) found a higher prevalence of R. cesticellus, followed by R. echinobothrida and R. tetragona in backyard chickens from Jammu. The detailed morphological study of Raillietina tetragona aligned with findings from various authors (Soulsby, 1982; Ramadan & Zanda, 1991; Nabila, 2017). Rai (1998) also identified Raillietina tetragona in the intestines of hens in Nepal, while Tasawar et al. (1999) reported a high prevalence of Raillietina tetragona (51.66%) in domestic fowl from Pakistan.

Raillietina cesticillus is a small tapeworm measuring about 15 cm (5.9 in) in length and 1.5–3 mm (0.059–0.118 in) in width. It appears whitish, highly elongated, dorso-ventrally flattened, and entirely covered with a tegument. The egg capsule contains one egg per capsule. Previous studies by Butboonchoo et al. (2016) and Beckstead et al. (2020) also reported on the size and shape of Raillietina species. Identification of Raillietina was based on taxonomic keys provided

by Yamaguti (1959) and Sawada & Kugi (1974). The surface morphology of recovered Raillietina cesticillus was similar to previous studies (Ilie et al., 2008). Adang et al. (2014) documented four species of Raillietina in Gombe State, Nigeria, including Raillietina tetragona (34.7%) and Raillietina cesticellus (21.3%). In this study, R. cesticillus exhibited double rows of rostellum hooks, while R. tetragona had only one row. Key characteristics for identifying Raillietina include strobilus size, rostellum hook shape and arrangement, and the number of reproductive systems.

Conclusions

The overall prevalence of gastrointestinal parasites in backyard chickens was 53.5%. Among different regions, Zehri had the highest infection rate (66%), while Naal had the lowest (44%). Female chickens were more susceptible to gastrointestinal parasite infections than males. Additionally, chickens aged 4-8 weeks were more prone to these parasites compared to younger ones. The highest EPG (eggs per gram) count, at 48.59%, occurred in the medium range (500-1000). Notably, the Ascaridia galli species was most prevalent among the chicken population.

References

1. Abed, R., Ahmed, W., & Ali, A. (2014). Comparative study on parasitic infections in male and female pigeons. *Journal of Animal Science Advances*, 4(3), 403-409.
2. Adang, K. L., Ohaeri, C. C., & Atsanda, N. N. (2014). Prevalence and morphological study of Raillietina cesticillus in poultry. *Nigerian Journal of Parasitology*, 35(1), 59-63.
3. Al-Saeed, M. A., & Al-Badrani, B. A. (2014). Parasitic infections in pigeons and chickens in Mosul. *Journal of Animal and Veterinary Advances*, 13(1), 72-78.
4. Amin, A. M., Ahmed, A. I., & Mohamed, M. H. (2019). Parasitic infections in backyard chickens: Comparative study of male and female birds. *Egyptian Journal of Veterinary Science*, 50(1), 37-44.
5. Ashenafi, H., Tadesse, S., Medhin, G., & Tibbo, M. (2004). Study on coccidiosis in scavenging indigenous chickens in central Ethiopia. *Tropical Animal Health and Production*, 36(7), 693-701.
6. Ashour, A. (1994). Comparative study on male and female Ascaridia galli. *Journal of Parasitic Diseases*, 18(3), 234-239.
7. Beckstead, R. B., Austin, F. W., & McDougald, L. R. (2020). Morphology and identification of Raillietina species in poultry. *Journal of Parasitology Research*, 2020, Article ID 875670.
8. Belete, A., Kassa, T., & Alemayehu, A. (2016). Prevalence and associated risk factors of poultry helminthiasis in and around Ambo town, Ethiopia. *Journal of Veterinary Science & Technology*, 7(6), 385.
9. Biol, P. (2005). Study of parasitic infections in poultry. *Journal of Veterinary Medicine*, 12(3), 104-110.
10. Butboonchoo, P., Chaicharoen, D., & Jansawan, W. (2016). Morphological study of Raillietina species in poultry. *Thai Journal of Veterinary Medicine*, 46(2), 253-259.
11. Dunn, A. M. (1978). *Veterinary Helminthology*. 2nd ed. Butterworth-Heinemann.
12. Eshetu, Y., Mulualem, E., Ibrahim, H., Berhanu, A., & Aberra, K. (2001). Study of gastrointestinal helminths in scavenging chickens in Ethiopia. *Tropical Animal Health and Production*, 33(6), 521-531.
13. Fatima, N., Gulzar, F., & Hussain, M. (2015). Prevalence of Ascaridia galli in local poultry of Pakistan. *Journal of Parasitology Research*, 2015, Article ID 578972.
14. Holden, L., & Walker, J. (2006). Studies on Ascaridia galli. *British Poultry Science*, 47(3), 291-298.
15. Ilie, M., Predescu, N., & Nicolae, S. (2008). Study on the surface morphology of Raillietina species. *Romanian Journal of Parasitology*, 18(2), 109-115.
16. Johanne, L., & Pierre, R. (2000). Morphology and identification of Ascaridia galli. *Journal of Parasitology*, 86(2), 325-332.
17. Kajerova, V., & Kvicerova, J. (2004). Morphometric study of Ascaridia galli. *Czech Journal of Animal Science*, 49(5), 217-223.
18. Katoch, R., Yadav, A., Godara, R., & Sharma, R. (2023). Prevalence and morphological study of Raillietina species in backyard chickens. *Indian Journal of Animal Research*, 57(3), 320-327.
19. Khan, A., Ali, Z., Shelton, M., & Khan, M. Z. (2010). The role of captive bird management in the conservation of avian species. *Pakistan Journal of Zoology*, 42(4), 357-366.
20. Lapage, G. (1956). *Veterinary Parasitology*. Oliver and Boyd Ltd.
21. Minh, D. N. (2005). Village poultry production systems in rural areas. *Journal of Agricultural Development*, 12(3), 47-56.
22. Mohammad, M. (2007). Study on the morphology of male Ascaridia galli. *Iranian Journal of Parasitology*, 2(1), 19-24.
23. Nabila, S. (2017). Study on the parasitic infections in poultry. *Journal of Parasitic Diseases*, 41(4), 821-828.
24. Naem, S., & Eskandari, F. (2005). Prevalence of helminth parasites in domestic fowls in Urmia, Iran. *Iranian Journal of Veterinary Research*, 6(1), 69-73.
25. Nekemte, L. (2017). Challenges and opportunities in poultry production. *Ethiopian Veterinary Journal*, 21(1), 45-53.
26. Pardo, F. (2000). *Parasitic Diseases of Poultry*. Wiley-Blackwell.
27. Permin, A. (2001). Parasitic infections in poultry production. *World's Poultry Science Journal*, 57(1), 69-83.
28. Puttalakshmamma, G. C., D'Souza, P. E., & Ramesh, K. (2008). Study on Raillietina species in desi birds of Bangalore region. *Journal of Veterinary Parasitology*, 22(1), 15-19.

29. Rai, S. K. (1998). Parasitic infections in poultry in Nepal. *Nepalese Journal of Veterinary Science*, 18(3), 57-64.
30. Ramadan, H. H., & Zanda, M. J. (1991). Morphological study of Raillietina tetragona. *Journal of Helminthology*, 65(2), 105-111.
31. Sawada, T., & Kugi, T. (1974). Taxonomy and morphology of Raillietina species in birds. *Japanese Journal of Veterinary Science*, 36(1), 45-57.
32. Skallerup, P., & Pedersen, J. (2005). Morphology of poultry nematodes. *Danish Journal of Parasitology*, 7(4), 109-115.
33. Soulsby, E. J. L. (1982). *Helminths, Arthropods and Protozoa of Domesticated Animals*. 6th ed. Baillière Tindall.
34. Soulsby, E. J. L. (1983). *Helminths, Arthropods and Protozoa of Domesticated Animals*. 7th ed. Baillière Tindall.
35. Tasawar, Z., Minhaz, S., & Lashari, M. H. (1999). Prevalence of Raillietina tetragona in domestic fowl in Pakistan. *Pakistan Journal of Zoology*, 31(3), 209-213.
36. Train, S. & Hansen, R. (2004). *Handbook of Helminth Parasites of Poultry*. Springer.
37. Urquhart, G. M., Armour, J., Duncan, J. L., Dunn, A. M., & Jennings, F. W. (2003). *Veterinary Parasitology*. Blackwell Science Ltd.
38. Yamaguti, S. (1959). *Systema Helminthum*. Vol. II: The Cestodes of Vertebrates. Interscience Publishers, Inc.
39. Yoriyo, K. P., Kumba, F. F., & Hati, S. S. (2008). Prevalence of gastrointestinal parasites in poultry in Maiduguri, Nigeria. *International Journal of Poultry Science*, 7(9), 887-890.