RESEARCH ARTICLE

Assessment and Identification of Risk Factors Associated with Avian Coccidiosis in Haryana, India

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Abstract

Coccidiosis caused by protozoan parasite of *Eimeria* species is one of the most important poultry diseases prevalent in different parts of globe including India. The parasite invades the intestinal cells and the disease is characterised by enteritis and diarrhoea leading to weight loss, altered feed conversion ratio, poor growth and eventually death of affected birds. A survey on commercial poultry farms was conducted in 10 districts of Haryana state, India, using a questionnaire to assess the status of coccidiosis, associated risk factors and management practices followed. On analysis of data, it was found that overall, 15 (28.8%) farms had history of coccidiosis. One-fourth (25%) of the farmers reported the use of anticoccidial drugs for chemoprophylaxis or therapeutic purposes at their farms. Further, on statistical analysis using Chi-square, several factors were found to be statistically significant ($p<0.05$) with occurrence of coccidiosis at these farms including type of birds, capacity of birds, visitor's entry, litter removal frequency, number of antibiotics used for treatment and foggers use in summer at farms under study. These factors were identified as predisposing and/ or risk factors associated with occurrence of coccidiosis at the farms. The odds of occurrence of coccidiosis were significantly higher ($p<0.001$) at the farms with presence of risk factors identified in the study as compared to the farms where risk factors were absent. The study revealed history of coccidiosis at several poultry farms leading to undue economic burden to farmers. For effective management of coccidiosis at the farms, the use of foggers may be discouraged. Moreover, litter may be turned or removed frequently along with judicious use of coccidiostats or other alternatives may be encouraged.

Key words: Coccidiosis, Haryana, Odds ratio, Poultry, Risk factors.

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Introduction

The total poultry population in India is 851.81 million, with a large number of small and medium farmers engaged in the rearing of birds (DADF, 2019). India currently ranks 3rd in egg production and 5th in chicken meat production in the world, which implies that poultry is one of the fastest growing segments of agriculture sector in India with around 8% growth rate per annum (DADF, 2019). Despite several perks, the intensive poultry production also presents certain challenges in the form of infectious diseases *viz*., coccidiosis, Newcastle disease, avian colibacillosis, salmonellosis and chronic respiratory disease etc. (Grakh *et al*., 2022).

The incidence of coccidiosis in commercial poultry can range from 5 to 70 % (Du and Hu, 2004). Chickens suffering from coccidiosis quickly become less productive and poor performers (Nematollahi *et al*., 2009). The economic losses due to avian coccidiosis has been estimated to be approx. INR 1.14 billion for the year 2003-04 to the Indian poultry industry (Bera *et al*., 2010). These losses were mainly attributed to reduced body weight gain, increased FCR, chemoprophylaxis, chemotherapy, mortality and egg production losses (Bera *et al*., 2010).

Avian coccidiosis is one of the most commonly encountered diseases which adversely affects the poultry production worldwide (McDougald and Reid, 1997). The intensification of poultry production has provided more probability of direct contact of birds with their faeces and to a wet surrounding ensuring the survival of the oocysts and subsequent transmission to healthy flock (Wondimu *et al*., 2019). The disease is caused by single-celled protozoan parasites of the genus *Eimeria*, commonly known as coccidian parasite (McDougald and Reid, 1997).

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The occurrence of clinical coccidiosis is related to several factors like host, agents, and environment interaction. The factors contributing to outbreaks of clinical coccidiosis include high litter moisture, low immunity, suboptimal inclusion of anticoccidial in feed, environmental and management stress such as overstocking, poor feeding systems, and inadequate ventilation (Singla *et al*., 2007; Singla *et al*., 2012). To the authors' knowledge, the occurrence and associated risk factors of avian coccidiosis in the state of Haryana has not been well addressed. Therefore, the current study was undertaken with objectives to determine the current status, associated risk factors and practices followed by poultry farms in relation to avian coccidiosis.

Materials and Methods

Study Area and Design

The study was conducted in Haryana, a northern state of India spanning between 27°39' to 30°35' N latitude and 74°28' to 77°36' E longitude. Based on the Thornthwaite classification Haryana state is broadly divided into three climatic zones *viz*., arid, semi-arid and dry sub-humid zones, which can be inclusively described in two agro-climatic zone *viz*., western and eastern agro-climatic zone (Niwas *et al*., 2006). A total of 10 districts, harbouring more than 70% of the state's poultry population were selected. A retrospective study was undertaken on randomly selected commercial poultry farms of broiler and layer chickens. The farms were selected by simple random sampling methods for inclusion in this study.

Questionnaire Design

A questionnaire was designed using EpiInfo™ software (CDC, Georgia, USA) (Dean *et al*., 2011) to conduct farm level epidemiological survey to identify predisposing risk factors associated with coccidiosis occurrence on the commercial poultry farms. The study was conducted on commercial intensively reared chickens with consideration of history of coccidiosis occurrence, experience of poultry farming, type of bird, feed, water and management system and other practices as risk factors. A total of 45 questions (including close ended and personal information related questions) were included in the survey. The survey included questions on the number of birds kept on the farm, location of the farm, experience of poultry farming, management practices and general flock health. The information regarding the source of drinking water, and cleaning and disinfection practices, history of coccidiosis at the farm was gathered directly from the owners and recorded using EpiInfo™.

Sample Size

The sample size was determined by assuming the required 10% precision and 85% expected response when normal approximation is used for inference with a 95% confidence interval as described by Thrusfield (2005) and these values had given the minimum required sample size equal to 47. The total farm surveyed in current study was 52 with equal farms from both the agro-climatic zones of Haryana (n = 26 each from Eastern and Western zone). The verbal consent was obtained from farm owners before participation in the interview.

Data Analysis

The raw data entered in EpiInfo™ was exported to MS Excel spread sheets. Computation of descriptive statistics was conducted using statistical package for social science (SPSS) version 20.0. The strength and association between the occurrence history of the disease and each risk factor was assessed using Chi-square test. The association between explanatory variables (factors evaluated) and the response variable (coccidiosis occurrence) was considered statistically significant if the computed p-value was less than 0.05. The Yates's correction was applied wherever necessary. The odds ratio (OR) was calculated to assess the strength of the associations with 95% confidence interval.

Results and Discussion

All the 52 commercial farms surveyed under the study had male owners/respondents and with maximum (40; 76.9%) age more than 40 years. A total of 71.1% respondents had at least attained matric level education and rest of the respondents lack basic formal education. More than half (53.8%) of the respondents had greater than five years of experience in poultry farming. The current study included 41 (78.8%) commercial broiler and 11 (21.2%) layer poultry farms. A total of 15 (28.8%) farmers reported previous occurrence of coccidiosis at their farm at any period of time since the start of the poultry farming venture. However, the exact country-wide prevalence data for avian coccidiosis is lacking in India, a study by Sharma *et al*. (2015), from Jammu and Kashmir reported a prevalence of 39.58% among backyard and commercial farms. The higher occurrence in the current study as well as reported studies can be attributed to inadequate management practices and use of antibiotics in place of coccidiostats (Sharma *et al*., 2015; Garbi *et al*., 2015).

Most of the responses provided by the farmers have been summarised in the Table 1. None of the factors listed in the Table 1 was found to be associated with occurrence of coccidiosis at these farms. However, various other factors *viz*., use of foggers, litter removal frequency, type of birds, increase in number of antibiotics during summer, unrestricted visitor's entry and higher capacity of birds were found to be significantly associated ($p<0.05$) with occurrence of coccidiosis at these farms (Table 2).

Table 1: The factors not found significantly associated with occurrence of avian coccidiosis

Sr. No.	Group Variable	Unique Value	Total	Occurrence events	% Occurrence	p Value (Chi-square)
	Overall		52	15	28.85	
1.	District	Eastern zone	26	9	34.62	0.541
		Western zone	26	6	23.08	
2.	Experience	1-5 years	24	6	25.00	0.856
		5-15 years	17	5	29.41	
		More than 15 years	11	4	36.36	
3.	Source of water	Borewell	43	14	32.56	0.257
		Canal water	9	1	11.11	
4.	Water stored	Concrete tanks	24	9	37.50	0.234
		Plastic tanks	28	6	21.43	
5.	Feeder cleaning frequency	At end of cycle	33	10	30.30	0.908
		Every week	13	3	23.08	
		Monthly	6	2	33.33	
6.	Water pipe/channel cleaning frequency	Daily	39	8	20.51	0.065
		Weekly	5	3	60.00	
7.	Vehicle for transport	On fare	45	11	24.44	0.173
		Farm vehicle	7	4	57.14	
8.	Vehicle that enter	Washed and disinfected at entry	21	5	23.81	0.551
		Neither washed/disinfected	31	10	32.26	
9.	Dead Bird disposal by	Buried	40	13	32.50	0.47
		Open dumping/fed to dogs	12	2	16.67	
10.	Litter/faeces disposal	Sold	28	11	39.29	0.124
		Used as manure	24	4	16.67	
11.	Type of confinement	All in all out	35	8	22.86	0.203
		Multiple flocks and all in out for each	17	7	41.18	
12.	Whether antibiotic used in feed/water	Yes	47	12	25.53	0.137
		No	5	3	60.00	
13.	Health service by AHD	Yes	33	10	30.30	0.569
		No	19	5	26.32	
14.	Conc. of Antibiotics increased in summer	Yes	15	6	40.00	0.318
		No	37	9	24.32	
15.	Minerals increased in summer	Yes	43	11	25.58	0.419
		No	9	4	44.44	
16.	Grass on shed in summer	Yes	33	11	33.33	0.526
		No	19	4	21.05	
17.	Mud on shed	Yes	16	3	18.75	0.34
		No	36	12	33.33	
18.	Water sprinkler on shed	Yes	18	7	38.89	0.337
		No	34	8	23.53	
19.	Coccidiostats used at farm	Yes	13	3	23.1	0.377
		No	39	12	30.8	

Table 2: The factors significantly associated with occurrence of coccidiosis

Sr. No.	Group Variable	Unique Value	Total	Occurred Events	% Occurrence	p Value (chi-square)	Odds Ratio (OR)
	Overall		52	15	28.85		
1.	Use of foggers	Yes	23	12	52.17	0.002	9.45
		No	29	3	10.34		
2.	Litter removing frequency	When become wet	30	2	6.67	0.02	8.18
		At the end of cycle	11	6	54.55		
3.	Type of bird	Layer	11	7	63.64	0.008	7.21
		Broiler	41	8	19.51		
4.	Visitors	Not allowed	38	7	18.42	0.013	5.90
		Allowed	14	8	57.40		
5.	Number of Antibiotics increased in summer	Yes	6	4	66.67	0.049	6.34
		No	46	11	23.91		
6.	Capacity of birds	5000-1000	33	5	15.15	0.001	_
		10000-20000	8	2	25.00		
		More than 20000	11	8	72.73		

The odds of occurrence of coccidiosis on the farms with foggers, layer birds, unrestricted visitors' entry, litter removal only at end of production cycle and increased number of antibiotics was 9.45 times, 7.21 times, 5.90 times, 8.18 times and 6.34 times higher as compared to the farms with no foggers, broiler birds, restricted entry litter removal immediately as it wets, and no increase in number of antibiotics respectively (Table 2). These factors might have acted as risk factor for the disease occurrence. The use of foggers while rearing the chicken in deep litter system, provides optimal temperature and humidity for the sporulation of oocysts. Additionally, lack of removal or turning of litter when it becomes wet aggravate the humidity and provides microenvironment for survival and sporulation of coccidian parasites (Chalchisa and Deressa, 2016; Sharma *et al*., 2015). Moreover, the odds of occurrence of coccidiosis were much higher at farms with foggers and practice of litter removal only at end of cycle as compared to the farms without foggers and employing practice of frequent litter removal.

The higher occurrence of coccidiosis (57.40%; OR = 5.9) at farms with no restrictiction on visitors as compared to the farms with strict restriction signifies the importance of biosecurity measures to prevent the introduction of diseases at the farm (Peek and Landman, 2011; CPDO, 2015). Good biosecurity and management protocols are crucial in controlling and reducing environment contamination of pathogens and preventing diseases (CPDO, 2015; Guabiraba and Schouler, 2015). The farms with higher bird capacity (more than 25000 birds) had higher occurrence of coccidiosis (72.73%) as factors like overcrowding or higher stocking density leads to stress among birds and increased fecal waste and moisture to the shed (Lunden *et al*., 2000).

The higher occurrence of avian coccidiosis among layer birds (63.64%) as compared to broilers was a little bit surprising as cage rearing system provides for feces to fall on manure belt or pit. But as the most of the layer farms in India, had higher stocking density then recommended and it could also be the case with hens reared in cages as some feces can accumulate in some areas of the cage, such as the nests, or cage wires and don't fall on the manure belt below the cage. As *Eimeria* oocysts are ubiquitous, the pecking of feces by hen and other contact with feces exposes the hen to a possible coccidiosis challenge (Appleby, 2010; Dardi, 2018). The lower occurrence among broilers in the current study can be either due to the fact that broiler farmers use increased number of antimicrobials especially the combination of sulphamethoxazole and trimethoprim to prevent the diseases or due to shortened production cycle of commercial broiler (35-40 days).

The occurrence of coccidiosis was higher among districts in the eastern zone as compared to western agro-climatic zone might be attributed to the ample availability of water in the form of ground water and rainfall providing optimal conditions for survival and sporulation of coccidian parasites and oocysts respectively (Lunden *et al*., 2000; Sharma *et al*., 2015). A total of 13 (25.0%) farmers reported the use of anticoccidial drugs at their farm for prophylaxis and therapeutic purposes. Sulphamethoxazole and trimethoprim combination was used by maximum respondents (11/13) as anti-coccidial drug and at two farms amprolium hydrochloride was used. Of the 39 farms not using anticoccidial drugs 12 had history of avian coccidiosis at their farm. Sulphamethoxazole and trimethoprim combination was used by maximum respondents as anti-coccidial drug, despite more effective options are available. This might be attributed to cheaper price of the drug as compared to other

anticoccidial drugs (Kemnic and Coleman, 2021). The farms not using anticoccidial drugs as prophylaxis even after history of coccidiosis, signifies the lack of knowledge about the best practice regarding coccidiosis.

Conclusions

The current study suggests five risk factors *viz*., use of foggers, unrestricted visitors' entry, less frequent litter removal, high stocking density and increased number of antibiotics to be associated with occurrence of coccidiosis in the conditions of state of Haryana. The current study thus suggests that farmers should strictly follow biosecurity measures, the time period of using the foggers should be reduced, litter should be removed or turned frequently and coccidiostats can be used at farms with recurrent infection of coccidiosis.

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