SHORT COMMUNICATION

Prevalence and Species Diversity of *Eimeria* in the Poultry of Chhattisgarh Plains

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Abstract

The present study was undertaken to determine the prevalence of coccidia parasites in poultry across both organized and unorganized farms in four districts, namely Bilaspur, Durg, Korba and Rajnandgaon, located in the plain region of Chhattisgarh. The overall prevalence of poultry coccidiosis was found to be 17.5% (42/240), with organized farms showing an infection rate of 17.2% (31/180), while unorganized farms exhibited a slightly higher rate of 18.3% (11/60). The highest prevalence (40%) was recorded in unorganized farms of the Korba district. Morphometric analysis of the oocysts revealed the presence of mixed *Eimeria* infections in all sampled farms, with 3 to 6 species identified per location. The most prevalent species across the region were *E. acervulina* (93.75%), *E. maxima* (87.5%), *E. mitis* (87.5%) and *E. tenella* (81.25%), followed by *E. necatrix* (25.0%), *E. praecox* (12.5%) and *E. brunetti* (12.5%). These findings highlight the widespread nature of mixed *Eimeria* infections in both organized and unorganized poultry systems. Regular monitoring and region-specific control strategies are essential to minimize production losses due to coccidiosis in Chhattisgarh.

Key words: *Eimeria*, Poultry, Morphometry, Prevalence, Chhattisgarh

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Introduction

Poultry farming plays a crucial role in the national economy, generating over US $30 billion annually (Jones, 2024). India produces approximately 5 million tonnes of broiler meat annually, contributing over rupees 1.8 trillion to the gross value added in the livestock sector in Fiscal Year 2023 (Department of Animal Husbandry and Dairying, 2024). In addition to its economic importance, the sector is a vital source of affordable animal protein, with India ranking as the second-largest egg producer globally, recording over 142.77 billion eggs, as per the annual report of DAHD (2024). Despite this growth, the poultry industry continues to face significant challenges from infectious diseases that impact bird health and farm productivity. Among these, coccidiosis remains a major disease affecting poultry worldwide, posing serious challenges and leading to considerable economic losses within the industry (Jadhav *et al*., 2011). The disease has been reported almost from every part of India *viz*., Jammu (Sharma *et al*., 2015), Aurangabad (Jadhav and Susheel, 2014), Thrissur (Mankani *et al*., 2021), Rewa (Salam and Wani, 2021), Punjab (Singh *et al*., 2021) and Bhubaneswar (Panda *et al.,* 1999) etc. Poultry coccidiosis is caused by intracellular protozoan parasites belonging to the genus *Eimeria*. Among the nine recognized species of *Eimeria*, seven species, *E. acervulina*, *E. maxima*, *E. brunetti*, *E. mitis*, *E. tenella*, *E. praecox* and *E. necatrix*, are commonly reported in India (Mankani *et al*., 2021). Chhattisgarh state is well known for its substantial poultry population, with a total of 187.12 lakh birds as per the Livestock Census (2019). However, there is limited information available regarding the prevalence of poultry coccidiosis in the state. Therefore, the present study was undertaken to investigate the prevalence and etiology of coccidiosis in poultry reared on both organized and free-range farms in the plain region of Chhattisgarh.

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Materials and Methods

Collection and Examination of Faecal Samples

A total of 240 pooled faecal samples were collected from poultry birds across four districts in the plains of Chhattisgarh *viz*., Bilaspur, Durg, Korba, and Rajnandgaon. In each district, samples were obtained from three organized poultry farms (15 pooled samples per farm, totaling 45 samples per district) and unorganized poultry farms (15 pooled samples per district), resulting in 180 samples from organized farms and 60 from unorganized farms. Each pooled sample consisted of faecal droppings collected from 5 to 7 birds housed together in the same pen or enclosure. Faecal samples were collected randomly, irrespective of the bird's clinical condition, age

group or housing unit, to ensure a representative sampling of the overall population. The pooling strategy was adopted to maintain sampling representativeness while ensuring logistical feasibility in terms of time and labour constraints. Samples were collected from freshly voided droppings to minimize environmental contamination. The samples were collected in sterile polythene zipper bags and transported to the laboratory in ice jars for further investigation.

Faecal samples were screened for the presence of *Eimeria* oocysts using both the direct method and the Willis flotation technique with saturated sugar solution (Pal and Sanyal, 2014). The oocysts were identified under a binocular compound microscope using 10X and 40X objectives. Prevalence of coccidiosis was calculated using the following formula:

$$\text{Prevalence (\%)} = \frac{\text{No. of positive birds/ faecal samples}}{\text{No. of screened birds/ faecal samples}} \times 100$$

Sporulation of Oocysts

The oocysts obtained through flotation were pooled farmwise and washed three times with water using centrifugation at 224 × g for three minutes each, to remove residual sugar. The cleaned oocysts were then transferred to a sterile Petri dish for sporulation. To facilitate sporulation and inhibit microbial contamination, a 2.5% potassium dichromate ($K_2Cr_2O_7$) solution was added and the samples were maintained at room temperature for five days with regular aeration. Sporulation was monitored microscopically and the samples were stored in 2.5% potassium dichromate solution.

Morphometric Identification of *Eimeria* spp.

Based on morphometric characteristics, sporulated oocysts were randomly examined for the identification of *Eimeria* species, following the guidelines of Levine (1985). In each district, 45 well-sporulated oocysts were randomly selected and examined from composite faecal samples of organized farms that tested positive for *Eimeria*. Additionally, 15 oocysts were separately selected and examined from unorganized farms, resulting in a total of 60 oocysts analyzed per district. This sample size was considered sufficient for identifying mixed infection of *Eimeria* species and was consistent with the methodology used by Olufemi *et al*. (2020). The oocysts were measured under a microscope at 400X magnification using a calibrated ocular micrometer to determine oocyst size and shape index. The data was analysed using descriptive statistics.

Results and Discussion

The overall prevalence of coccidiosis in poultry from the plain region of Chhattisgarh was found to be 17.5% (42/240), with infection rates of 17.2% (31/180) in organized farms and 18.3% (11/60) in unorganized farms. In Bilaspur, a total of 10 (16.67%)

Table 1: Percentage prevalence of poultry coccidiosis across four districts of Chhattisgarh

District	Type of farms	No. of Samples examined	No. of positive samples	Prevalence (%)	*Eimeria* spp. identified	
					No.	Species
Bilaspur	Organized (OF)	45	8	17.8	5	*E.tn, E.nc, E.ac, E.mx & E.mi*
	Unorganized (UF)	15	2	13.3	2	*E.ac, E.mx & E.mi*
	Total	60	10	16.7	5	*E.tn, E.nc, E.ac, E.mx & E.mi*
Durg	Organized (OF)	45	7	15.5	5	*E.tn, E.nc, E.ac, E.mx & E.mi*
	Unorganized (UF)	15	2	13.3	3	*E.ac, E.mx & E.mi,*
	Total	60	9	15.0	5	*E.tn, E.nc, E.ac, E.mx & E.mi*
Korba	Organized (OF)	45	9	20.0	7	*E.tn, E.nc, E.ac, E.mx, E.mi, E.pr & E.br*
	Unorganized (UF)	15	6	40.0	4	*E.tn, E.ac, E.mx & E.mi*
	Total	60	15	25.0	7	*E.tn, E.nc, E.ac, E.mx, E.mi, E.pr & E.br*
Rajnandgaon	Organized (OF)	45	7	15.6	6	*E.tn, E.nc, E.ac, E.mx, E.mi & E.pr*
	Unorganized (UF)	15	1	6.7	3	*E.tn, E.ac & E.mx*
	Total	60	8	13.3	6	*E.tn, E.nc, E.ac, E.mx, E.mi & E.pr*
Grand Total	Organized (OF)	180	31	17.2		
	Unorganized (UF)	60	11	18.3	7	*E.tn, E.nc, E.ac, E.mx, E.mi, E.pr & E.br*
	Total	**240**	**42**	**17.5**		

(*E.tn = Eimeria tenella, E.nc = Eimeria necatrix, E.ac = Eimeria acervulina, E.mx =Eimeria maxima, E.mi = Eimeria mitis, E.pr = Eimeria praecox, E.br = Eimeria brunetti*)

samples were found positive for coccidial infection, out of which 8 (17.8%) were from organized farms and 2 (13.3%) from unorganized farms (Table 1). Of the samples collected in Durg, 9 (15.0%) tested positive, including 7 (15.5%) from organized farms. The total prevalence rate in Korba was 25.0%, with infection rates of 40% in unorganized farms and 20% in organized farms. The infection rate in Rajnandgaon district was 13.3%, with organized farms showing 15.6% and unorganized farms 6.7%. The highest prevalence of poultry coccidiosis (40%) observed in unorganized farms in Korba may be attributed to the introduction of infected birds with the existing flocks, along with poor management practices.

The results were found to be consistent with those of Salam and Wani (2021), who reported an overall coccidiosis prevalence of 29.75% in the Kashmir Valley during 2018-19, with infection rates of 35.5% in unorganized farms and 24.0% in organized farms. Similarly, Jadhav (2019) documented a 34.09% prevalence of coccidiosis in backyard poultry in Aurangabad District of Maharashtra. These observations of higher prevalence of coccidiosis in the free-range systems could be due to the fact that these birds are more exposed to the environmental pathogens and are often accompanied by poor management practices. In contrast to this finding, Pant *et al*. (2018) reported a higher prevalence, documenting a 56.25% infection rate in organized farms of the Tarai region in Uttarakhand.

Morphometric Identification of *Eimeria* Species

Mixed infections are common in poultry coccidiosis, with more than one *Eimeria* species usually present in an infected host. Therefore, the prevalence of different *Eimeria* species was studied through morphometric analysis. The shape, mean morphometric values and shape index of the oocysts are presented in Table 2 and Figure 1.

The study revealed the presence of *E. tenella*, *E. acervulina*, *E. maxima*, *E. necatrix*, and *E. mitis* in poultry farms located in the Bilaspur and Durg districts (Table 1). In contrast, the Korba and Rajnandgaon districts showed presence of six *Eimeria* species, with *E. praecox* as an additional species prevalent in these birds. Notably, *E. brunetti* was detected exclusively in samples from the Korba district. The results show that *E. acervulina* (93.75%), *E. maxima* (87.5%), *E. mitis* (87.5%) and *E. tenella* (81.25%) are the most prevalent species in poultry farms located in the plain region of Chhattisgarh. In contrast, *E. necatrix* (25.0%), *E. praecox* (12.5%) and *E. brunette* (12.5%) were less commonly detected, indicating their lower distribution.

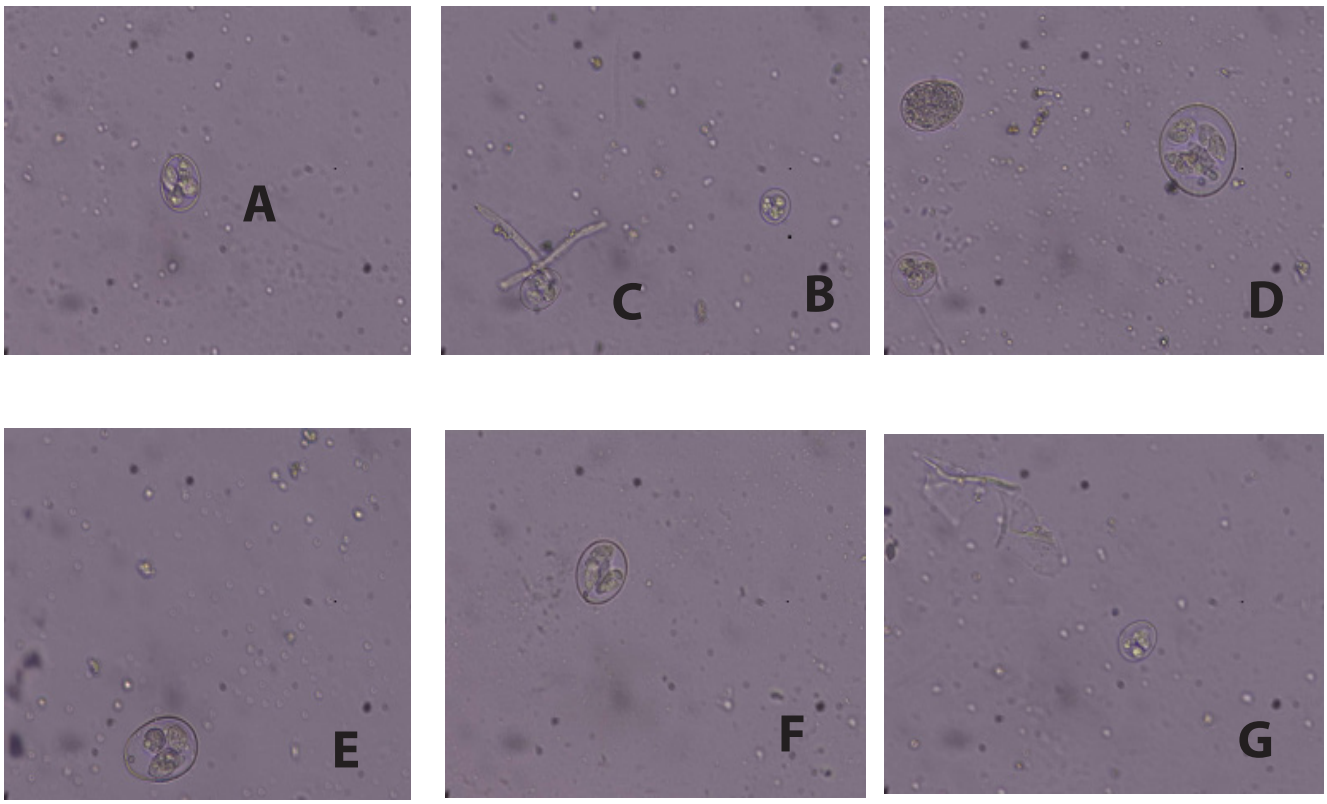

Fig. 1: Different *Eimeria* spp. of poultry identified by morphometry: A- *E. praecox*, B- *E. mitis,* C- *E. necatrix*, D- *E. maxima*, E- *E. brunetti*; F- *E. acervulina*, G- *E. tenella* (400X magnification).

Table 2: Morphometrical mean of *Eimeria* oocysts

***Eimeria* species**	**Shape**	**Mean morphometry (L X B) (µm)**	**Shape index**
E. tenella	Ovoid	20.86 x 17.84	1.17
E. necatrix	Ovoid	20.38 x 16. 90	1.20
E. acervulina	Ovoid	22.38 x 17.74	1.26
E. maxima	Broadly ovoid	26.85 x 17.82	1.50
E. mitis	Sub-spherical	9.99 x 8.91	1.12
E. praecox	Ovoid	23.69 x 19.20	1.23
E. brunetti	Broadly ovoid	24.39 x 18.97	1.28

These results aligned, to some extent, with the findings of Raman *et al*. (2012), who reported a high prevalence of *E. tenella* (48%), *E. maxima* (48%) and *E. acervulina* (42%) in Southern states of India. In their study, *E. necatrix* and *E. brunetti* were observed at lower rates of 9.09% and 21.21%, respectively. However, Jadhav *et al*. (2012) documented a broader diversity of ten *Eimeria* species in the Aurangabad region of Maharashtra, including *E. nikamae*, *E. tarabaie*, and *E. shivpuri*. In contrast, Kalita *et al*. (2021) reported only five species including *E. tenella*, *E. acervulina*, *E. mitis*, *E. maxima* and *E. brunetti* in broiler chicken flocks in Assam, with *E. tenella* being the most prevalent species, affecting 62.5% of the farms. These variations highlight the influence of factors such as climate, farm management and infection sources on the prevalence and diversity of *Eimeria* species across different regions. Thus, the current findings on the occurrence and diversity of *Eimeria* species of poultry in the plain region of Chhattisgarh hold significant value, given the scarcity or absence of documented data on these factors.

The present study allowed for the identification of mixed infection of *Eimeria* species across farm types, however further studies incorporating larger sample sizes covering the entire state and molecular identification of the species by PCR are required to achieve a more comprehensive understanding of the species diversity and their distribution in the Chhattisgarh region.

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