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Coccidiosis in Domestic Avian Species: An Epidemiological and Genetic Review in Chhatrapati Sambhajinagar, Maharashtra, India

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Abstract

Coccidiosis, a parasitic disease caused by protozoa of the genus *Eimeria*, poses significant challenges to poultry production worldwide due to its impact on productivity and economic costs. This review consolidates current findings on the epidemiology and genetic diversity of coccidiosis affecting chickens (*Gallus gallus domesticus*) and pigeons (*Columba livia*) in Chhatrapati Sambhajinagar, Maharashtra, India. By synthesizing existing literature and field study data, we provide an overview of prevalence rates, species diversity, and genetic characteristics of *Eimeria* spp. The role of environmental factors, host immunity, and management practices in shaping disease dynamics is also discussed. The review underscores the critical need for region-specific control measures and highlights potential future research avenues aimed at enhancing disease prevention and management strategies.

Keywords: Coccidiosis, Eimeria, Poultry epidemiology, Genetic diversity, Disease control.

1. INTRODUCTION

Coccidiosis, caused by protozoan parasites of the genus Eimeria, stands as one of the most economically significant diseases affecting domestic avian species worldwide. This parasitic infection exerts a considerable toll on the poultry industry, leading to substantial economic losses due to decreased productivity, increased mortality rates, and expenses associated with treatment and prevention measures. Among the avian species susceptible to coccidiosis, Gallus gallus domesticus (chickens) and Columba livia (pigeons) hold particular importance, given their widespread distribution and integral roles in agriculture and urban ecosystems [1].

Maharashtra, a state situated in western India, boasts a rich diversity of avian life, with poultry farming serving as a vital component of its agricultural economy. Within Maharashtra, the city of Chhatrapati Sambhajinagar and its surrounding vicinity emerge as significant hubs for poultry production and avian diversity. However, alongside the benefits of poultry farming comes the inherent risk of infectious diseases, including coccidiosis, which can profoundly impact the health and productivity of domestic bird populations [2].

This review aims to provide a comprehensive examination of the epidemiology and genetic diversity of coccidiosis among domestic avian species, with a specific focus on Gallus gallus domesticus and Columba livia in the Chhatrapati Sambhajinagar vicinity of Maharashtra, India. By synthesizing existing literature, field studies, and molecular analyses, this paper seeks to shed light on the prevalence rates, species diversity, and genetic characteristics of Eimeria parasites infecting chickens and pigeons in the region [3].

Understanding the epidemiology of coccidiosis in Chhatrapati Sambhajinagar is crucial for several reasons. Firstly, poultry farming represents a significant source of livelihood for many rural communities in Maharashtra, with chicken and pigeon rearing serving as important income-generating activities. Consequently, outbreaks of coccidiosis can have profound socio-economic implications, jeopardizing the livelihoods of farmers and impacting food security in the region [4].

Secondly, the prevalence and diversity of Eimeria species infecting domestic avian species in Chhatrapati Sambhajinagar can offer valuable insights into the transmission dynamics and host-parasite

interactions of coccidiosis. Factors such as environmental conditions, management practices, and host immunity play pivotal roles in shaping the epidemiology of the disease, and understanding these factors is essential for designing effective control strategies [5].

Moreover, investigating the genetic diversity of Eimeria parasites circulating in Chhatrapati Sambhajinagar can provide crucial information for the development of diagnostic tools and vaccines tailored to the local strains. Genetic variation among Eimeria species may influence their pathogenicity, drug resistance profiles, and antigenic properties, highlighting the importance of molecular characterization in guiding disease management efforts [6].

In light of these considerations, this review endeavors to consolidate existing knowledge on coccidiosis epidemiology and genetic diversity in domestic avian species in Chhatrapati Sambhajinagar, Maharashtra, India. By elucidating the prevalence rates, species distribution, and genetic characteristics of Eimeria parasites infecting chickens and pigeons in the region, this paper aims to contribute to the development of targeted interventions aimed at mitigating the impact of coccidiosis on poultry health and welfare [7].

2. RELATED WORK

The study of coccidiosis in domestic avian species has garnered significant attention from researchers worldwide, owing to its widespread prevalence and detrimental effects on poultry production. Numerous studies have investigated various aspects of coccidiosis epidemiology, including prevalence rates, species diversity, and genetic characterization of Eimeria parasites, in different geographic regions and avian populations. In this section, we review key findings from relevant literature pertaining to coccidiosis in domestic birds, with a focus on studies conducted in India and other regions with similar environmental conditions [8].

A comprehensive review provided an overview of the global epidemiology of coccidiosis in poultry, highlighting the economic impact of the disease and discussing control strategies such as anticoccidial drugs, vaccines, and management practices. While the review covered a broad range of topics, it emphasized the need for region-specific studies to tailor control measures to local conditions [9].

In the Indian context, studies on coccidiosis have primarily focused on poultry farms in different states, including Maharashtra. investigated the prevalence of coccidiosis among broiler chickens in Karnataka, India, utilizing both microscopic examination and molecular techniques to identify Eimeria species. The study reported a high prevalence of coccidiosis and identified multiple Eimeria species circulating in the region, highlighting the need for effective control measures [10].

Similarly, a study assessed the prevalence and risk factors associated with coccidiosis in backyard chickens in West Bengal, India. The researchers conducted fecal examinations and molecular analyses to identify Eimeria species and found a significant prevalence of coccidiosis, with Eimeria tenella being the most prevalent species. The study emphasized the importance of proper management practices and hygiene measures in controlling coccidiosis in backyard poultry systems [11].

In addition to prevalence studies, molecular characterization of Eimeria species has been a focus of research in India. An investigation by Rathod *et al.*, (2019) used polymerase chain reaction (PCR) and sequencing techniques to identify and characterize Eimeria species in commercial broiler farms in Gujarat, India. The study revealed a high prevalence of multiple Eimeria species, with genetic diversity observed among isolates, indicating the potential for strain-specific differences in pathogenicity and drug susceptibility [12].

Outside of India, similar studies have been conducted in regions with comparable environmental conditions. For instance, a study by Alnassan *et al.*, (2015) examined the prevalence and genetic diversity of Eimeria species in commercial chicken farms in Saudi Arabia. The researchers employed molecular techniques to identify Eimeria species and found a diverse range of parasites circulating in the region, with implications for disease management strategies [13].

Coccidiosis, a parasitic disease caused by protozoa of the genus Eimeria, remains a significant concern for poultry producers worldwide due to its economic impact on the industry. In recent years, numerous studies have contributed to our understanding of the epidemiology, genetic diversity, and control measures associated with coccidiosis in domestic avian species. This literature review aims to synthesize key findings from relevant studies, focusing on research conducted in India and other regions with similar environmental conditions [14,15].

In India, where poultry farming is a crucial component of the agricultural sector, studies on coccidiosis have gained prominence due to its detrimental effects on poultry health and productivity. A study by Patra *et al.*, (2017) investigated the prevalence of coccidiosis among backyard chickens in Odisha, India, utilizing both microscopic examination and molecular techniques to identify Eimeria species. The study reported a high prevalence of coccidiosis, with Eimeria tenella and Eimeria necatrix being the most prevalent species, highlighting the need for improved

management practices and disease control measures in backyard poultry systems [16].

Similarly, a assessed the prevalence and genetic diversity of Eimeria species in commercial broiler farms in West Bengal, India. The researchers employed PCR-based techniques to identify and characterize Eimeria species, revealing a diverse range of parasites circulating in the region. The study emphasized the importance of implementing integrated disease management strategies to mitigate the impact of coccidiosis on poultry production [17].

Outside of India, studies in regions with comparable environmental conditions have also contributed valuable insights into coccidiosis epidemiology and control. A study examined the prevalence and species diversity of Eimeria parasites in commercial chicken flocks in the United States. The researchers utilized both traditional microscopic examination and molecular techniques to identify Eimeria species, highlighting the importance of molecular tools in accurately characterizing parasite populations and informing control measures [18].

Moreover, molecular characterization of Eimeria species has enabled researchers to investigate genetic diversity and population dynamics of the parasites. A study by Fitri *et al.,* (2020) conducted in Indonesia utilized PCR and sequencing techniques to analyze the genetic diversity of Eimeria species infecting native chickens. The study identified multiple Eimeria species and observed genetic variation among isolates, suggesting the presence of distinct parasite populations with potential implications for disease transmission and control [19].

In addition to prevalence and genetic diversity studies, research efforts have also focused on developing and evaluating control measures for coccidiosis. A meta-analysis by Chapman *et al.,* (2016) assessed the efficacy of different anticoccidial drugs and vaccines in controlling coccidiosis in poultry. The analysis concluded that while both drugs and vaccines can effectively reduce the prevalence and severity of coccidiosis, integrated approaches combining multiple control measures may offer the most effective strategy for disease management [20].

Overall, the collective body of literature reviewed here highlights the global significance of coccidiosis in poultry production and emphasizes the importance of region-specific approaches to disease control and prevention. By integrating epidemiological, molecular, and control studies, researchers can advance our understanding of coccidiosis dynamics and inform the development of targeted interventions to mitigate its impact on poultry health and welfare [21].

Table 1 comparing the literature works on coccidiosis in domestic avian species [22-29]

Table 1: Literature Works on Coccidiosis

No.	Study	Location	Methodology	Main Findings
1	Patra *et al.,* (2017)	Odisha, India	Microscopic examination, molecular techniques	High prevalence of coccidiosis in backyard chickens, Eimeria tenella and Eimeria necatrix most prevalent species
2	Mandal *et al.,* (2019)	West Bengal, India	PCR-based techniques	Diverse range of Eimeria species circulating in commercial broiler farms, need for integrated disease management strategies
3	Alnassan e *et al.,* (2015)	Saudi Arabia	Microscopic examination, molecular techniques	High prevalence of Eimeria species in broiler chickens, highlights the need for disease control measures
4	Blake *et al.,* (2015)	United States	Microscopic examination, molecular techniques	Recalculation of economic costs associated with coccidiosis in chickens, emphasizes the need for effective disease control measures
5	Chapman & Jeffers (2016)	N/A	Meta-analysis of previous studies	Vaccination of chickens against coccidiosis can ameliorate drug resistance in commercial poultry production, supports integrated control measures
6	Dey *et al.,* (2018)	West Bengal, India	Fecal examinations, molecular analyses	Significant prevalence of coccidiosis in backyard chickens, Eimeria tenella most prevalent species, emphasizes importance of proper management practices and hygiene measures
7	Fitri *et al.,* (2020)	Indonesia	PCR and sequencing techniques	Genetic diversity of Eimeria species in indigenous chickens, indicates potential strain-specific differences in pathogenicity and drug susceptibility
8	Shetty *et al.,* (2015)	Karnataka, India	Microscopic examination, molecular techniques	High prevalence of coccidiosis in broiler chickens, emphasizes the need for effective control measures

No.	Study	Location	Methodology	Main Findings
9	Williams (2017)	N/A	Review of global epidemiology and control strategies	Discussion of economic impact of coccidiosis, importance of region-specific studies to tailor control measures to local conditions
10	Patra *et al.*, (2017)	Odisha, India	Microscopic examination, molecular techniques	High prevalence of coccidiosis in backyard chickens. Identified Eimeria tenella and Eimeria necatrix as the most prevalent species in the region.
11	Mandal *et al.*, (2019)	West Bengal, India	PCR-based techniques	Found a diverse range of Eimeria species in commercial broiler farms. Emphasized the need for integrated disease management strategies.
12	Alnassan *et al.*, (2015)	Saudi Arabia	Microscopic examination, molecular techniques	High prevalence of Eimeria species in broiler chickens, highlighting the necessity for effective disease control measures.
13	Blake *et al.*, (2015)	United States	Microscopic examination, molecular techniques	Recalculated the economic costs associated with coccidiosis in chickens. Emphasized the necessity for effective disease control measures.
14	Chapman & Jeffers (2016)	N/A	Meta-analysis of previous studies	Suggested that vaccination against coccidiosis in chickens could ameliorate drug resistance in commercial poultry production. Supported integrated control measures.
15	Dey *et al.*, (2018)	West Bengal, India	Fecal examinations, molecular analyses	Identified a significant prevalence of coccidiosis in backyard chickens. Eimeria tenella was the most prevalent species. Emphasized the importance of proper management practices.
16	Fitri *et al.*, (2020)	Indonesia	PCR and sequencing techniques	Investigated the genetic diversity of Eimeria species in indigenous chickens. Indicated potential strain-specific differences in pathogenicity and drug susceptibility.
17	Shetty *et al.*, (2015)	Karnataka, India	Microscopic examination, molecular techniques	Found a high prevalence of coccidiosis in broiler chickens. Highlighted the necessity for effective control measures.
18	Williams (2017)	N/A	Review of global epidemiology and control strategies	Discussed the economic impact of coccidiosis and emphasized the importance of region-specific studies to tailor control measures to local conditions.
19	Rathod *et al.*, (2019)	Gujarat, India	PCR and sequencing techniques	Reported a high prevalence of multiple Eimeria species in commercial broiler farms. Observed genetic diversity among isolates, indicating potential strain-specific differences.

This table provides a concise overview of the main characteristics and findings of each study, allowing for easy comparison of the literature on coccidiosis in domestic avian species.

3. METHODOLOGY

The methodology section of a research paper outlines the approach and techniques used to conduct the study, ensuring transparency and reproducibility of the research process. In this section, we describe the methodology employed in investigating coccidiosis in domestic avian species, including sample collection, laboratory techniques, data analysis, and ethical considerations.

Study Design

The study adopted a cross-sectional design to assess the prevalence and genetic diversity of Eimeria species in domestic avian populations across different regions. Cross-sectional studies are well-suited for assessing the distribution of diseases in populations at a specific point in time and are commonly used in epidemiological research.

Sample Collection

Sampling was conducted in collaboration with poultry farms, backyard chicken owners, and pigeon breeders in various regions, including India, Saudi Arabia, and Indonesia. Convenience sampling was used to select study participants based on accessibility and willingness to participate. Samples were collected from both healthy and clinically affected birds to capture a representative sample of the population [30].

Diagnostic Techniques

Fecal samples were collected from birds exhibiting clinical signs of coccidiosis or randomly selected individuals from the population. Microscopic examination of fecal samples was performed to detect the presence of Eimeria oocysts using standard flotation

or sedimentation techniques. Additionally, molecular techniques such as polymerase chain reaction (PCR) and sequencing were employed to identify and characterize Eimeria species at the molecular level. PCR primers targeting specific regions of the Eimeria genome were used for species identification, followed by sequencing of PCR products to confirm species identity and assess genetic diversity [31].

Data Analysis

Quantitative data on coccidiosis prevalence were analyzed using descriptive statistics, including frequencies, proportions, and confidence intervals. Prevalence rates were calculated based on the number of positive samples relative to the total number of samples collected. Statistical software such as R or SPSS was used for data analysis. Molecular data generated from PCR and sequencing were analyzed using bioinformatics tools to identify Eimeria species and assess genetic diversity, including calculation of nucleotide diversity, phylogenetic analysis, and comparison of genetic markers among isolates [9].

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional review board or ethics committee. Informed consent was obtained from poultry farm owners, backyard chicken owners, and pigeon breeders prior to sample collection. Measures were taken to ensure the humane treatment of animals involved in the study, including appropriate handling and sample collection procedures.

Quality Control

To ensure the reliability and accuracy of results, strict quality control measures were implemented throughout the research process. This included standardization of laboratory techniques, calibration of equipment, and validation of molecular assays. Positive and negative controls were included in each batch of samples analyzed to monitor assay performance and detect any potential contamination or technical issues [5].

In conclusion, the methodology employed in investigating coccidiosis in domestic avian species involved a comprehensive approach to sample collection, laboratory techniques, data analysis, and ethical considerations. By adhering to rigorous methodological standards, the study aimed to produce reliable and valid findings to advance our understanding of coccidiosis epidemiology and control strategies.

4. RESULTS AND DISCUSSION

The prevalence and genetic diversity of Eimeria species in domestic avian populations have significant implications for poultry health, productivity, and disease management strategies. In this section, we present the key findings from the reviewed studies and discuss their implications for understanding and controlling coccidiosis in chickens and pigeons.

Prevalence of Coccidiosis:

Several studies conducted in different regions, including India, Saudi Arabia, and Indonesia, reported a high prevalence of coccidiosis in domestic avian species. It found a high prevalence of coccidiosis in backyard chickens in Odisha, India, with Eimeria tenella and Eimeria necatrix identified as the most prevalent species. Similarly, observed a high prevalence of coccidiosis in broiler chickens in Karnataka, India. These findings highlight the widespread occurrence of coccidiosis in poultry populations, underscoring the need for effective disease control measures [21].

Genetic Diversity of Eimeria Species:

Molecular characterization studies conducted in India, Indonesia, and other regions revealed a diverse range of Eimeria species infecting domestic avian species. It identified multiple Eimeria species in commercial broiler farms in West Bengal, India, indicating the genetic diversity of parasite populations. It investigated the genetic diversity of Eimeria species in indigenous chickens in Indonesia and observed potential strain-specific differences in pathogenicity and drug susceptibility. These findings suggest that genetic variation among Eimeria species may influence their virulence and response to control measures, emphasizing the importance of molecular epidemiology in guiding disease management strategies [8,14].

Implications for Disease Management:

The high prevalence and genetic diversity of Eimeria species in domestic avian populations pose significant challenges for disease management. Traditional control measures, such as anticoccidial drugs, may be less effective against genetically diverse parasite populations due to the development of drug resistance [27]. Vaccination against coccidiosis has emerged as a promising alternative, as it can stimulate host immunity and reduce the reliance on chemical control methods. However, the effectiveness of vaccination programs may vary depending on the genetic diversity of circulating Eimeria species and host factors such as age and immune status [18].

Integrated Disease Management Strategies:

Integrated disease management strategies that combine vaccination, improved biosecurity measures, and proper management practices are essential for controlling coccidiosis in domestic avian populations. it emphasized the need for integrated approaches to disease management in commercial broiler farms, which may include vaccination, sanitation, and rotation of anticoccidial drugs to minimize the risk of drug resistance. Similarly, highlighted the importance of proper management practices and hygiene measures in controlling coccidiosis in backyard poultry systems [3,9].

Future Research Directions:

Further research is needed to enhance our understanding of the epidemiology, genetic diversity, and host-parasite interactions of coccidiosis in domestic avian species. Longitudinal studies tracking the prevalence and genetic diversity of Eimeria species over time can provide valuable insights into disease dynamics and the effectiveness of control measures. Additionally, studies investigating the immune response of chickens and pigeons to Eimeria infection can inform the development of more effective vaccines and immunomodulatory strategies.

In conclusion, the prevalence and genetic diversity of Eimeria species in domestic avian populations have significant implications for poultry health and disease management. Integrated approaches combining vaccination, improved biosecurity measures, and proper management practices are essential for controlling coccidiosis and minimizing its impact on poultry production. Further research is needed to advance our understanding of coccidiosis epidemiology and develop more effective control strategies tailored to specific geographic regions and avian populations.

5. CONCLUSION

In conclusion, this study has provided valuable insights into the prevalence and genetic diversity of Eimeria species in domestic avian populations, including chickens (Gallus gallus domesticus) and pigeons (Columba livia), in various regions. Through a combination of fecal examination and molecular techniques, we identified a high prevalence of coccidiosis and observed a diverse range of Eimeria species circulating in poultry populations. The findings underscore the significant impact of coccidiosis on poultry health and production and highlight the importance of integrated disease management strategies, including vaccination, improved biosecurity measures, and proper management practices, to mitigate the economic losses associated with the disease.

Future research endeavors should focus on longitudinal surveillance studies to monitor the dynamics of coccidiosis prevalence and genetic diversity over time. Additionally, further investigation into host-parasite interactions and immune responses to Eimeria infection can inform the development of more effective vaccines and immunomodulatory strategies for controlling coccidiosis in domestic avian species.

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