Review Article

Current Status of Poultry Coccidiosis in Developing India

Abstract:

It is expected that half of the world's population growth will be concentrated in just nine countries (India, Nigeria, Democratic Republic of the Congo, Pakistan, Ethiopia, Tanzania, USA, Uganda and Indonesia). To meet this ever growing population food, shelter and clothing become imperative. Only food production determines the existence of human for this, so there is much demand in agriculture and agro based industries. To overcome nutritional demand of world as well as India in future, poultry sector is best source of animal food and eggs. The broiler production is only the source which fulfills the future demand of food. Across the India variety of breeds of the chicken are reared for the purpose of meat and eggs as a source of food. Indian environment shows great climatic variation in every corner of country. Native Indian breeds can tolerate and adapted to such variable environment. But propagation of backyard poultry on large scale is quite impossible everywhere due to various conditions like lack of scientific knowledge of poultry management, microbial infections and other biosecurity strategies. Many diseases in chicken hamper the production of chicken in organized and unorganized poultry. Chicken coccidiosis and other zoonotic diseases cause pathological impact on growth of the chicken. In spite of the availability of effective drugs and other medicine, coccidiosis is great threat to poultry industry. All over the world seven species of *Eimeria* produces morbidity and mortality, poor weight, and loss of egg production causinghuge economic loss to the poultry sector.

Indian poultry majorly affected by coccidia in monsoon season followed by winter and summer. The percentage prevalence of coccidiosis is higher in unorganized poultry than organized. Poor management practices and less care may increase the percentage of diseases among chicks in the early stage of life. *Eimeria tenella* and *Eimeria necatrix* are potential killer species in the poultry coccidiosis.

Key words: Population, Poultry, chicken, coccidiosis, Developing India etc.

Introduction:

Recent world population of world is of 7.6 billion it will reach up to 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100 (According New United Nation Report). Approximately, 83 million people being added every year in world population.It is expected that half of the world's population growth will be concentrated in just nine countries (India,

Comment [h1]: Too many introductory sentence before the main points

Comment [h2]: It should be removed

Nigeria, Democratic Republic of the Congo, Pakistan, Ethiopia, Tanzania, USA, Uganda and Indonesia). India is on top among these nine countries [1]. To meet this ever growing population food, shelter and clothing become imperative. Only food production determines the existence of human for this, so there is much demand in agriculture and agro based industries. To overcome nutritional demand of world as well as India in future, poultry sector is best source of animal food and eggs. Many diseases in chicken hamper the production of chicken in broiler industry. Poultry sector of developing countries mostly suffers from various diseases like avian influenza, Newcastle disease, coccidiosis due to lack of biosecurity and proper vaccination [23].Mcdonald SC reported that Eimeria infection can increased pathogen carriage (*E. tenella* increases *Campylobacter jejuni* and *Salmonella enteric Typhimurium* infection load in intestine of chicken) [26,27]coccidia and its co infection causes necrotic enteritis by *Clostridium*and necrotic enteritis increases the indirect expenses to poultry owner[28,29] .Coccidia free chicken is one of the challenge in front of poultry owner because omnipresent nature, higher spreading and reproduction ability of coccidiaoocysts[30].

Comment [h3]: Out of topics no need of using this much sentence to explain the population growth and food demand

Comment [h4]: Citation needed

Comment [h5]: Citation needed

Comment [h6]: Citation needed

Comment [h7]: Objectives of this study should be added

Population and growth of poultry in India:

India is most populous country in the world with on sixth of world's population. According to the UN estimate India overtake the China at the end of April 2023[1].

Current poultry production status of India

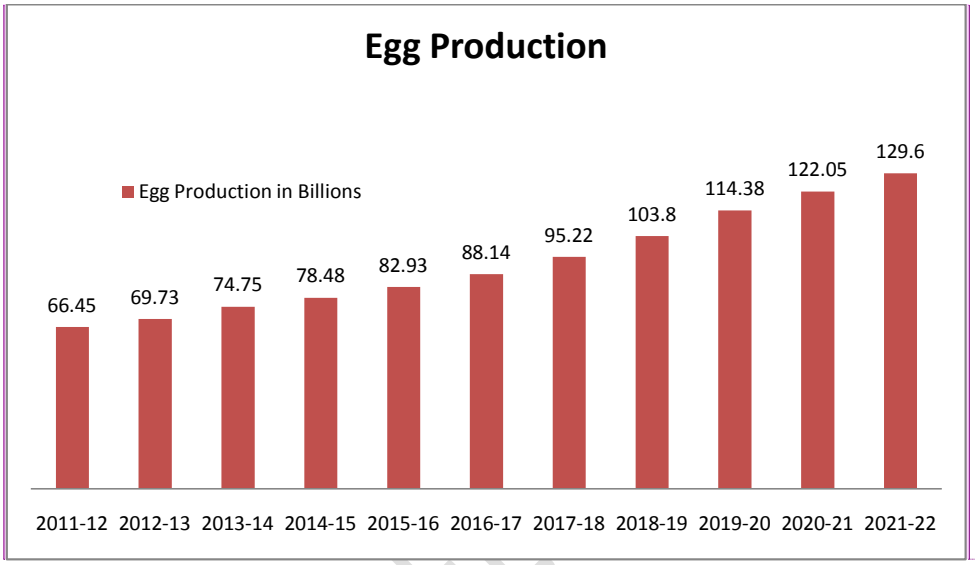
In the era of modern technology, poultry sector in India has taken an abrupt change during last four decades, emerging from conventional to commercial poultry production. As per 20th livestock census poultry population of India is 851.81 million and around 129.60 billion egg production and per capita availability is around 95 per annum during 2021-22. India shows 6.19 % positive growth in eggs production in 2021-22[2].

List 1 : Production of eggs from 2011 to 2022

Sr. No.	Year	Egg Production in Billions
1	2011-12	66.45
2	2012-13	69.73
3	2013-14	74.75
4	2014-15	78.48
5	2015-16	82.93
6	2016-17	88.14
7	2017-18	95.22
8	2018-19	103.80

9	**2019-20**	**114.38**
10	**2020-21**	**122.05**
11	**2021-22**	**129.60**

Fig 1 :Increased production of eggs (2011 to 2022)



Host range and infection:-

Though, percentage prevalence of coccidiosis is predominant in birds. But it also reported from Platyhelminthes, arthropod, Mollusca and all five classes of vertebrates.In the avian group Anseriforms, charadiforms,columbiformes, galliformes and piciformes shows great threat of coccidia. Basically all the species of Eimeria parasitize the epithelial cell of the intestine,colon, rectum colon, rectum,caecum and its associated glands [31] .

Native Chicken Breeds of India

Eighteen native chicken breeds has been recognized and registered in India. Ankaleshwar, Aseel, Busra,Chittagong, Danki, Daothigir, Ghagus, Harringhata Black, Kadaknath, Kalasthi Kashmir Favorolla, Miri, Nicobari, Punjab Brown, Tellichery,Mewari, Kaunayen, Hansli, Uttara [3]. All different native wild breed can survive up to three to seven year longer, some backyard chicken may live a decade or more [4]. The life span of commercial broiler bird is 42-43 days. Life span of commercial layer and broiler breeder is 72 weeks and 68 weeks respectively [5].Some of them under threat of extinction due to various environmental as well

Comment [h8]: Source should be explained

Comment [h9]: Its not as such important for this review paper if important its source has to be explained

Comment [h10]: Citation needed and grammatical error

Comment [h11]: Citation needed

Comment [h12]: Scientific names should be italicized

as anthropological factors. So, it is responsibility of government to protect and conserve native breed as well as backyard poultry sector in future [3].

Central Poultry Development Organizations:

CPDOs (Central Poultry Development Organisation) play a key role in the poultry sector, located at Mumbai, Chandigarh, Bengaluru, and Bhubaneswar in India. This organisation improves the variety of chicken helpful to small scale farmers and gives basic training to them. Kalinga Brown, Kaveri, Chhabro and Chann are the varieties / strain of Low Input Technology birds (Chicken) developed by these CPDOs. Besides, they also maintain indigenous varieties like Kadaknath, Aseel etc. to promote breed conservation.

Comment [h13]: Out of the topic

Etiology (Life cycle)

Outbreak of coccidiosis is species specific and site specific which may either cecal or small intestinal coccidiosis [33]. Multiplication of coccidian oocyst occurs in the intestinal tract causes tissue damage which interrupts the digestion process, blood loss, loss of skin pigmentation and increased susceptibility to other disease [32]. Genus *Eimeria* from sub kingdom Protozoa and phylum Apicomplexa causes coccidiosis in domestic and wild species of chicken and other animals. *Eimeria* recorded from chicken completed their fecal oral life cycle within 5-7 days depending on species. Life cycle starts with ingestion of unsporulated oocyst through oral route. Replication of unsporulated oocyst to sporulated oocyst and formation of sporozoite occurs inside the host's intestine cells. Asexual replication (merogony or schizogony) and sexual reproduction (gametogony) is completed inside the host cell. At the end of cycle number of oocysts are produced which is excreted with faeces and sporulated in environment outside the body of chicken. [6]

Comment [h14]: Citation needed

Comment [h15]: Citation needed

Current Indian scenario:

India ranks 3rd in egg and 5th in chicken meat production. Occurrence of coccidiosis in India is similar to globe one. However the growth of poultry sector is affected by coccidia in great concern. The growth rate of layer and broiler market is 6 % to 7% and 8% to 10% respectively. 75% egg production from the commercial poultry and 25% from house hold or backyard poultry[7]. Saurabh Sharma et al. 2013 from Jammu region found highest prevalence (53.61%) in unorganized (Backyard poultry) as compared to organized (25.55%) in monsoon with *Emirian*species. Percentage may high due to poor management practice. AbiodumJosehphFatoda et al. 2018 in his update focused on genomic study of diversity of *Eimeria* parasitesbecome imperative for effective vaccine design against coccidiosis.Dwivedi et al. 2020 worked on financial analysis of broiler production unit from J&K. They noted that three group of broiler unit group I below 2000 birds, group II 2001-5000 birds and group III

Comment [h16]: Citation needed

Comment [h17]: Citation needed

5001 and above birds. The benefit- cost ratio per farm pet lot observed on highest on group III i.e. 1:52 followed by 1.35 and 1.17 in Group II and group I respectively on sampled farm in Kathua district of Jammu and Kashmir [8]. Coccidia cause great loss due to morbidity and mortality, poor weight, and loss of egg production. In spite of the availability of effective drugs and other medicine coccidiosis is great threat to poultry industry [9].Singh M, Kaur P, Singla LD, Kashyap N, Bal MS (2021) while assessment of risk factor associated with prevalence of gastrointestinal parasites in poultry showed that coccidiosis was the predominant infection among all GIT parasites based on fecal and intestinal tract content analysis. The risk factors associated with the prevalence of GIT parasitic infections were geographical location, deep litter system, broilers, age, crossbred breeds, and monsoon season [10]. Das M (2020, 21) from subtropical hilly region of Meghalaya recorded the overall prevalence of Eimeria sp. in the backyard poultry was 30.12%. Eight species of *Eimeria* viz. *E. tenella* (24.63%), *E. necatrix* (10.84%), *E. maxima* (0.98%), *E. mitis* (1.48%), *E. brunetti* (1.97%), *E. praecox* (1.48%), *E. mivati* (0.98%) and *E. acervulina* (2.96%) were recorded. Mixed infections were recorded in 54.68% chicken from backyard poultry[11] [12]. Biswajit Singh et al. (2023) reported overall prevalence of coccidia is 77.9% among 1304 backyard poultry chicken. The most of the coccidia infected backyard poultry chicken shows *Eimeriatenella, Eimerianecatrix*and*Eimeriabrunetti*. The highest prevalence was recorded in rainy (95.2%), followed by summer (83.76%) and lowest in winter (44%) [13].

Kalita, A., Kakati, P. and Sarmah, P.C. (2021). Reported successful result of PCR analysis performed in gut tissues of experimentally infected broiler chickens indicated gut tissue as a better option to oocysts for molecular identification of *Eimeria* species from field cases [14].

Present finding also revealed higher incidence of coccidiosis in the farms with flock size of more than 1000 birds[15]. The epidemiological investigation of coccidia in Uttarakhand revealed that prevalence of coccidiosis is maximum (56.25%) in August to September in broiler farm while it is equal33.3% June to November and *Eimeria tenella* was most (66.6%) prevalent followed by *E. necatrix, E. maxima, E. acervulina*. The mortality rates were 3.1% and 4.4% for broilers and layers, respectively in and around Tarai Region of Uttarakhand[16]. Praveen et al. 2021 studied socio economic status and constrains faced by broiler farmers in Uttarakhand state, found that most of farmers choose poultry as their subsidiary occupation. Large sized farm and proper knowledge of poultry business found most profitable. Higher expenditure on feed, day old chick and medicine and daily fluctuation of price were the major problem faced by the poultry owner [17].

Comment [h18]: Citation needed

B. ChengatPrakashbabu et al. 2017 worked on *Eimeria* genetic diversity among various geographic regions of Northern and Southern parts of India. They noted uneven occurrence of highly pathogenic species *E. tenella and E. necatrix* polymorphism in genetic variation population structure described previously [18].PoornimaGumasta, et al. (2021) worked on post-mortem study of 421 Kadaknath chicken and recorded various microscopic organism which produce great pathological impact in the intestine of Kadaknath chicken in Chhattisgarh he recorded infection of coccidia, helminths, pneumonia etc.NDHirani et al. (2018) from Agricultural University, Anand, Gujarat, studied comparative efficacy of four commonly used coccidiostst through haematological alteration in experimentally *Eimeria tenella* infected birds [20]. Aarthi S. et al. 2010 molecular prevalence and preponderance of *Eimeria* species among chickens in Tamil Nadu.TA Vijayalingum from Ramnathapuram District of Tamilnadu reported that desi chicken is resistant to coccidiosis, along with breed up gradation, wet deep litter conditions, poor ventilation are main factors in outbreak of coccidia among desichicken[21]. Pooja GM 2021reported 37.66 % occurrence of Eimeria species in and around Thrissur, Kerala state. The rate of infection is higher in backyard poultry than organised farm. He reported that *E.tenella* was found to be significantly higher compared to *E. necatrix E. maxima.*[22]. S.V. Nikam et al 2012 gives comparative prevalence of chicken coccidiosis among eight district of Marathwada. She reported average 25.40% prevalence of coccidiosis in Marathwada.[24, 25]

Conclusion:

All over the world seven species of *Eimeria* produces huge economic loss to the poultry sector. Indian poultry majorly affected by coccidia in monsoon season followed by winter and summer. The percentage prevalence of coccidiosis is higher in unorganized poultry than organized. Poor management practices and less care may increase the percentage of diseases among chicks in the early stage of life.*Eimeria tenella* and *Eimeria necatrix* are potential killer species in the poultry coccidiosis. Genetic diversity also noted by certain researchers which may increases curiosity in genetic biodiversity among coccidia in relation to different geographic conditions. Recently, many farmers selected poultry (organized or unorganized) as a subsidiary business for economic support as insurance against crop failure due to unevenness in climatic conditions. To uplift the conditions of Indian poultry system need to percolate scientific knowledge of poultry to the inexperienced poultry owner to avoid loss in poultry.

References

1. UN Population census estimate *"India overtakes China to become world's most populous country". The Guardian. 24 April 2023*
2. https://dahd.nic.in/sites/default/filess/FINALREPORT2023ENGLISH.pdf
3. https://nbagr.icar.gov.in/en/registered-chicken
4. (https://thehumaneleague.org/article/how-long-do-chickens-live#:~:text=Generally%2C%20most%20wild%20chicken%20breeds, longer%20lifespans%20than%20domestic%20chickens.
5. www.thepoultrysite.com
6. Nahed A. El-Shall,et al. 2022 Phytochemical control of poultry coccidiosis: a review. Poultry Science 101:101542
7. Yashpal Singh 2022https://zootecnicainternational.com/field-reports/poultry-production-in-india
8. Dwivedi, S., Sharma, S., Isher, A.K., Sharma, P.K. and Rai, P.K. (2020). Financial analysis of broiler production units. J. Anim. Res., 10(5): 821-825.
9. K.P. Jithendran Indian Veterinary Research Institute, Regional Station, Palampur (Himachal Pradesh), 176 061 https://krishi.icar.gov.in/jspui/bitstream/123456789/3851/1/109-Jithendran%20papers%20Cocci2.pdf
10. Singh M, Kaur P, Singla LD, Kashyap N, Bal MS (2021) Assessment of risk factors associated with prevalence of gastrointestinal parasites in poultry of central plain zone of Punjab, India, Veterinary World, 14(4): 972-977
11. Das M (2021) Diversity of Eimeria species in backyard poultry of subtropical hilly region of Meghalaya, India Journal of Entomology and Zoology Studies 2021; 9(2): 360-365
12. Das M, Laha R, Doley S. Gastrointestinal parasites in backyard poultry of subtropical hilly region of Meghalaya. Journal of Entomology and Zoology Studies 2020; 8(5):1301-1305
13. Biswajit Singh et al. (2023), Prevalence of poultry coccidiosis in West Medinipur district of West Bengal State The Pharma Innovation Journal 2023; SP-12(7): 34-38
14. Kalita, A., Kakati, P. and Sarmah, P.C. (2021). Isolation and molecular identification of Eimeria species circulating in broiler chicken flocks of Assam (India). Haryana Vet. 60(2): 251-254

15. Kalita, A., P.C. Sarmah, M.K. Borah, L. Hussain and Bhattacharjee, K. 2018. Magnitude of Coccidia Infection in Small Scale Broiler Chicken Farms of Rural Assam (India). Int.J.Curr.Microbiol.App.Sci. 7(10): 3399-3403
16. Sachin Pant, Prakash Bhatt, S. Shekhar and Gopal Krishna 2018. Epidemiological Investigation of Poultry Coccidiosis in and around Tarai Region of Uttarakhand. Int.J.Curr.Microbiol.App.Sci. 7(07): 374-380
17. Praveen et al. 2021 Socio-economic characteristics and constraints faced by broiler farmers in foothills of Kumaon region of Uttarakhand State Indian Journal of Poultry Science (2021) 56(1): 81−87;
18. B. Chengat Prakashbabua,1, V. Thenmozhi b,1, G. Limona, K. Kunduc, S. Kumar c, R. Gargc, E.L. Clark d, A.S.R. SrinivasaRaoe, D.G. Rajf , M. Ramanb, P.S. Banerjeec, F.M. Tomley d, J. Guitiana, D.P. Blake d,∗ Eimeria species occurrence varies between geographic regions and poultry production systems and may influence parasite genetic diversity Veterinary Parasitology 233 (2017) 62–72
19. PoornimaGumasta, RC Ghosh, ShubhangiArgade, SumitSatpaty, DK Jolhe, Padamveer Singh, HemantSahu and Charlee Porte (2021) Occurrence of various disease conditions and their pathology in Kadaknath chickens The Pharma Innovation Journal 2021; SP-10(8): 218-222
20. N.D. Hirani* , J.J. Hasnani, S.S. Pandya and P.V. Patel (2018) "Haematological Changes in Broiler Birds with Induced Caecal Coccidiosis following Prophylaxis with Different Coccidiostats" Int.J.Curr.Microbiol.App.Sci 7(4): 1094-1100
21. TA Vijayalingam, NV Rajesh and S Ilavarasan 'A report on intestinal coccidiosis in a KairaliDesi chicken farm in Ramanathapuram district'. Journal of Entomology and Zoology Studies 2019; 7(2): 965-968
22. Pooja, G. M., Asha, R., Devada, K., Priya, M. N., Sajitha, I. S. and Karthika, R., 2021. Occurrence of poultry coccidiosis in different management systems in Thrissur, Kerala. J. Vet. Anim. Sci. 52(3): 303-307
23. Alexander D.J. Newcastle disease. *Br. Poult. Sci.* 2001;42:5–22.
24. S.V. Nikam et al. 2012 Comparative study of seasonal incidence (Winter) of Chicken coccidia in different eight districts, Marathwada region (M.S.) World Journal of Science and Technology 2012, 2(8):09-12
25. S.V. Nikam et al. 2012 Comparative study of seasonal incidence (Monsoon) of Chicken coccidia in different eight districts, Marathwada region (M.S.) Journal of Experimental Sciences 2012, 3(5): 38-41

26. Macdonald SE, van Diemen PM, Martineau H, Stevens MP, Tomley FM, Stabler RA, Blake DP (2019) Impact of *Eimeriatenella* coinfection on *Campylobacter jejuni* colonization of the Chicken. Infect Immun
27. Arakawa A, Baba E, Fukata T (1981) *Eimeriatenella* infection enhances *Salmonella* typhimurium infection in chickens. PoultSci 60(10):2203–2209
28. Moore RJ (2016) Necrotic enteritis predisposing factors in broiler chickens. Avian Pathol 45(3):275–281
29. Wade B, Keybrun A (2015) The true cost of necrotic enteritis. World Poultry 31:16–17
30. Allen PC, Fetterer R 2002 Recent advances in biology and immunobiology of *Eimeria* species and in diagnosis and control of infection with these coccidian parasites of poultry. ClinMicrobiol Rev 15(1):58-65.
31. https://shodhganga.inflibnet.ac.in/bitstream/10603/211115/10/10_chapter%202.pdf
32. McDougald, L.R. and S.H. Fitz-Coy. 2008. Protozoal infection, pp. 1068–1080. InY.M. Saif, (ed.).Disease of Poultry. 12th ed
33. Dickinson, E.M., 1949. *Coccidiosis control in chickens*. Corvallis, Or.: Oregon Agricultural Experiment Station. Oregon State College

Comment [h19]: Very old