Material and methods
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During the course of present investigation, spread over three years (from June 2005 to May 2008) an extensive survey was carried out to record the incidence of coccidia in broiler chicken particularly in Aurangabad region. For this study intestine of broiler chicken from different localities around Aurangabad were procured through suppliers and were examined for coccidial infections. Altogether 2524 broiler chicken were examined. The birds (broiler chicken) were sacrificed and various parts of the alimentary canal and caeca were examined. The faecal contents were diluted with water and sieved to remove the large faecal debris, after repeated washing the oocysts were concentrated by centrifugation at 3000 rpm for ten minutes. The oocysts were then spread out in shallow petridishes and covered with 2.5% potassium dichromate solution for sporulation. Care was taken to aerate them properly and also to prevent desiccation. The sporulation was carried out in all cases at room temperature (about 28 to 32 °C).

The oocysts were examined regularly to check up, if they are sporulated. The checking was done twice daily in case of species with shorter
sporulation time the checking was done every two hours. The sporulated oocysts were preserved in the 2.5% potassium dichromate solution and examine later. Studies were made on the structure of both unsporulated as well as sporulated oocysts. Measurements were done with an ocular micrometer and photograph were taken with 5 mega pixel canon power shot A450 camera using 100 x oil immersion objective and 16x eye piece.

The dimensions of the oocysts were based on a study 15 to 30 oocysts picked at random.
Coccidia –
A historical perspective
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Practically all the protozoa are so small that they require a microscope to see them. As a result, it was not until the advent of the microscope that they were discovered. In 1674 Leeuwenhoek saw the first parasitic protozoan, the oocysts of *Eimeria stiedai* in the bile of rabbit, but it was more than 150 years later that it was described. Hake (1839), who did so, thought that the oocysts were pus globules associated with carcinoma of the liver.

A name that was ones used for coccidia was Psorospermium. This name has an interesting history. Johannes Miller (1841) gave the name “Psorospermien” to the cyst of a Myxosporidan of pike and other fish. The name comes from the same root as Psoriasis- the parasite were associated with a dermatitis of the fish. Remak (1845) remarked on the resemblance between the oocysts of *Eimeria stiedai* of the rabbit and Miller Psorosperms, and Liberkuhn (1854) called the former Psorospermien. Revolta (1874) named the rabbit species Psorospermium cuniculi. Later workers talked of “egg shaped Psorosperms” (coccidia) and “fish-psorosperm” or “Millers Psorosperms” (Myxosporidan spores). Later, however when it was realized that the two were very different, the name Psorospermium was dropped for the coccidia.
Another name formerly used was coccidium. This was introduced as a
generic name by Lukart (1879) for the rabbit parasite which he called
*Coccidiam oviforme*. How ever Lindemann (1865) had previously name it
*Mono cystis stiedae*, thinking that it was a Gregarine. Later, when it was
realized that Eimeria and Coccidium were the same genus, the correct name
for this species become *Eimeria stiedae* (Lindemann, 1865) Kisskalt and
Hartmann, 1907; *Psorospermium cuniculi* and *Coccidium oviforme* were the
synonyms.

The life cycle of coccidia, with its alternation of sexual and asexual
generations, was worked out piecemeal. Sporulation inside the oocyst was
first described by Kauffmann (1847) and then in more details by Stieda
(1865) in rabbit Coccidia. Balbiani (1884) described it more accurately.
Kloss (1855) worked out the life cycle of the snail coccidium later named
*Kossia helicina* by Aime Schneider. This was the first finding of coccidia in
invertebrates. Eimer (1870) described the endogenous cycle of “*Gregarina
falsiformis*” in the mouse. This species was later named *Eimeria falciformis*
by Schneider (1875) and designated the type of the new genus. Eimer
thought that the oocysts spread the infection from one mouse to another, and
that the coccidia multiplied in the mouse by schizogony. This is true, but it
was denied by Schneider (1892), Labbe (1896) and others, who thought that
two different genera were involved. Labbe retained this view as late as 1899, when he accepted both *Eimeria falciformis* and *coccidium falciforme* as names for the same species. He said that *Eimeria falciformis* might be only a stage in the development of *Coccidium falciforme*, which reversed the correct names.

The first review of the different coccidia described till then was made by Minchin (1903). He recognized the importance of the number of sporocysts per oocyst as a diagnostic character. This was elaborated by Hoary (1933), who recognized the importance of the number of the sporozoites per sporocyst, besides the number of sporocysts per oocyst. Based on these characters he prepared a table for the identification of the coccidian genra. After extensive studies he revised the table in 1957 and this still remains as one of the most convenient basis for identification of the different genra of the coccidia.


Contributions on coccidia in India are comparatively scattered and pertain mostly to areas in northern and eastern parts of the country. Though the earliest contribution in this area was made during the beginning of the century, the bulk of the publications have been made during the last forty years, and these include work on coccidia of several vertebrate groups besides a few invertebrates.

Records of coccidia of fishes in India have been made by Halawani (1930a,b), Setna (1933), Setna and Bana (1935 a, b), Chakravarty and Kar (1944 a) and Chakravarty and Mandal (1961).

Coccidia have been described from amphibians in India by Ray (1935), Ray and Das Gupta (1935), Ray and Misra (1943) and Chakravarty and Kar (1944a).

Reptilian coccidia have been recorded by Setna and Bana (1935 a,b), Knowles and Das Gupta (1935), Ray and Das Gupta (1936 a,b), Bhatia (1936), Mitra and Das Gupta (1937), Das Gupta (1938), Chakravarty and Kar (1943, 48, 57), Ray and Raghavachari (1942), Ray, Raghavachari and Sapre (1942) and Mandal (1966).

Compared to the other vertebrate groups, relatively more work has been done on the coccidia of bird in India. Most of the work is however restricted to northern and eastern part of the country, particularly Uttar Pradesh and Bengal. As far as can be ascertained from the literature the first record of Eimerians from Indian Birds was made by Mitra and Das Gupta (1937) who described *E. Columbae* from the intestine of the pigeon. Kar (1944) described and Eimerian from the blue throated barbeta. Chakravarty and Kar
(1944 a,b :1947) made the first major contribution on the coccidia of birds from Bengal covering observation on the life history of *I. lacazea* and the morphology of several species.

Misra (1944) recorded *Wenyonella bahli* from the quails in Lucknow, Uttar Pradesh. The same author in 1947 described three coccidian species from the intestine of the Wagtail, Motacilla alba while Ray (1945) described a species of *Wenyonella* from the gut of the domestic fowl, *Gallus gallus domestica*. Ray, Shivnani, oomen and Bhaskaran (1952) described coccidia of birds from Mukteshwar Uttar Pradesh. Ray and Hireguda (1959) studied the coccidia of some birds at the Calcutta Zoo, while Malhotra and Ray (1961) described yet another species of *Eimeria* from Pigeon in Calcutta. Bink and Ray (1961, 64), Studies the Eimerian species from the Indian peacock in Calcutta. The first observations on the coccidia of the Indian duck was made by Dubey and Pande (1963).

Mandal (1975) made a review of the progress in the taxonomy of coccidia from India. Mandal (1970) reviewed the occurrence and distribution of avian coccidia in India, giving a classified list of 74 species of birds examined and the parasites found and a complete statement indicating the diagnostic characters of the 42 species of coccidia comprising of 19 species of *Isospora*, 1 species of *tyzzeria*, 3 species of *Dorisiella*, 16 species *Eimeria*
and 3 species of Wenyonella. Mandal (1976) made a comprehensive review of the various species of coccidia described from Indian vertebrate and provided keys for the identification of the species. He stated that about 60 species of coccidia belonging to six genera have been recorded from Indian bird so far. Of these one species belongs to the genus Sivatoshella Ray and Sarkar (1968), two species to the Genus Tyzzeria Allen (1936), five Species to the genus Wenyonella Hoare (1933), six species to the genus Dorisiella Ray (1930), 21 species to the genus Isospora Schneider (1881), and 24 species to the genus Eimeria Schneider (1875).

All the studies so far on the avian coccidia in India are thus restricted to the areas in Bengal and Uttar Pradesh. There is hardly any record of work in this field in other part of country. Recently Krishnamurthy and Bhosale (1976) gave preliminary report on incidence of avian coccidia in Maharashtra.
Historical review of chicken coccidiosis

Although he did not know it at that time, Leeuwenhoek (1674) discovered the coccidia when in a letter he described bodies in the bile ducts of rabbits which were without doubt the oocysts of *Eimeria stiedae* (Dobell, 1922). Carswell (1838) published a coloured figure of a rabbit liver showing lesions obviously caused by *E. stiedae*, but were erroneously interpreted as tuberculous. Later Remak (1845), found Coccidia in the small intestine of the rabbit. Sporogony of the coccidia in the rabbit was studied by Stieda (1865), and trophozoites by Eimer in 1870. Coccidiosis research in fowl originated in the united state and United Kingdom during the first half of the 20th century. The first detail investigation of the life cycle of coccidian parasite in birds was carried out by Harold Benjamin Fantham (1876 -1937), a distinguished Zoologist and Parasitologist, studied many different microbial organisms. Fantham was aware of pioneering studies of protozoan parasites carried out in Italy, France, and Germany during the last decades of the 19th century.

In Italy Rivolta and Silvestrini were to first to recognize coccidia in the fowl and provided an account of sporulation of oocysts. Rivolta describe Gregarine *Avium intestinalis*, a parasite that Tyzzer was subsequently able to
identify as a cause of acute caecal coccidiosis in chicken. The French workers Railliet and Lucet measured oocysts from caeca of chicken and described a new species *Coccidium tenellum*, a name later changed by Railliet to *Eimeria tenella*. In Germany, details of life cycle were gradually elucidated. Pfeiffer had proposed a cycle involving alteration of parasite generation a multiplicative phase in cell of gut epithelium and reproductive phase leading to formation of oocysts. Fantham described, the entire life cycle of an Eimerian parasite from avium host. The Bureau of Animal industries (1884) in U.K. investigate the condition of domestic animals, causes of disease among them and means for prevention and care and to collect the information, under a veterinarian D.E. Salmon. He mentioned two species *C. tenellum* a parasite of caeca and *Eimeria dubia* a parasite of intestine but could spread to liver and lungs.

Johnson (1928, 30) recognize six species of Eimeria in chicken and provided a brief description of two new species *E.praecox* and *E.necatrix*. P. Philip Levine (1907-79) in New York described two new species *E.hagani* and *E.brunetti*. He also found six species *E.acervulina, E.mitis, E.praecox, E.maxima, E. tenella, and E.necatrix* in poultry flock near Ithaca, New York.

In the 1920's and 1930's many workers were recording coccidial infections in many different hosts and systematic analyses required an understanding of
host specificity, parasite morphology, and life cycles. In the 1930's research on Eimeria was dominated by E. E. Tyzzer from Harvard University Medical School. The most valuable works were those of Johnson (1928; 1930). Johnson described coccidiosis in chicken caused by *E. necatrix* and *E. praecox* and Tyzzer (1929) described the disease caused by *E. acervulina*. Tyzzer (1929) and Tyzzer, Theiler and Jones (1932) revealed the most complete details of the life cycle tissue stages as well as pathology, pathogenicity, reproductive potential and host specificity of three species occurring in the chicken. The papers by Tyzzer have set a high standard for coccidiologists to achieve. In these papers the life cycles of *E. tenella*, *E. necatrix*, and *E. acervulina* were described in detail. In the Tyzzer’s (1929) paper *E. acervulina*, *E. maxima*, and *E. mitis* were described as new species as well as work on *E. tenella*. Tyzzer, Theiler and Jones (1932) pointed out the limitations of characteristics of the oocysts for species identification. Other features including sporulation time, time period of development, distribution of developing stages in the intestinal tract, host-cell parasite relations, pathogenicity and perhaps most important of all cross immunity tests. From both observations in the field and from laboratory infections, both Johnson and Tyzzer concluded that *E. tenella* and *E. necatrix* were the most pathogenic and a major cause of mortality in chicken.
Henry (1931) reported three chicken species, *E. tenella*, *E.acervulina* and *E.mitis* from the California quails, *Lophortyx C. californica* and Mountain quail, *Oreortyx picta*; she claimed to have transmitted all three species to chicken. Fish (1931) first provided evidence for a progressive change in oocyst size as infection developed. He noted that oocysts of *E. tenella* increased in the length and breadth with time, the shape index remain constant. Jones (1932) studied a number of factors likely to influence oocyst size during the patency of infection with *E.acervulina*, *E.maxima* and *E.tenella*. She concludes that oocyst size was independent of the duration and severity of infection and of the breed and age of the host.

Venard (1933) stated that the chicken species, *E. tenella and E. acervulina* occurred in bob white, and claimed to have transmitted *E.tenella* from the quail to two chicks. Haase (1939) reported *E. tenella* from both *Phasianus colchicus colchicus* and *P.C. torquatus*, he did not carry out cross infection experiments with chicken.

Becker et.al. (1955) studied *E. brunetti* in chicken and concluded that small oocysts were produced early in the infection and that large ones succeeded them. In case of *E. necatrix* significant increase in size after 1st three days of patency. B.S.Gill and S. N. Ray (1957) studied life cycle and cytology of a pure line strain of *E. tenella* infecting in white leghorn chick with
symptomatology and pathology of the infection and histopathology of caecal coccidia in chick in Calcutta. Walter H. Pattillo (1958) studied the process of invasion shown by the sporozoites of *E. tenella*. According to his finding the sporozoites first of all invade the surface epithelium at the tip of the villi and then proceed across the basement membrane into tunica propria. N.N. Sharma (1964) studied live sporozoites or sporulated viable oocysts of *E. tenella* cause infection after intravenous, intraperitoneal, intramuscular, subcutaneous or oral inoculations in susceptible chicken, in Georgia Athens. S.A.Edger and C.T. Seibold (1964) reports a new species of chicken Coccidium from which the name *E. mivati* n.sp. is proposed. The specific name is from ancient Sanskrit meaning ‘to move or change’ and was chosen because of the changes in location during endogenous development in the host.

L. Renault (1969, 70) in France made a survey of occurrence as judged by post mortem examination during the year 1969 and 1970, submission were received from 3444 flocks covering about 44.5 million bird, from this population a total of 30972 bird were received for autopsy. B.B. Bhatia (1972) report on poultry coccidiosis due to *E. tenella*, *E. maxima*, and *E. acervulina* with *E. necatrix* and shows histopathological finding in it. In full accord with the account given by Pellerdy (1965). Fernando and remmler (1973a and b) six new coccidial species from the Cylon gugal fowl. Solely on their oocyst characteristics. L.P.Joyner, P.L.Long (1974) from England reviews the principles of the classification of the coccidia parasites in the light of new development and with special reference to the *Eimeria* of domestic fowl.

M.S.Kwatra and B.Chaudhary (1975) from Assam India, present a case paper A presumptive diagnosis of avian necrotic enteritis in the fowl (*Gallus gallus domesticus*) on the basis of gross and microscopic examination the disease was differentiate from coccidiosis and ulcerative enteritis. M.D.Ruff, et al. (1981) recorded effect of aging on survival and pathogenicity of *E. acervulina* and *E. tenella*. Oocysts of both species survived well during storage. After one year 85 and 91% of sporulated oocysts of *E.acervulina* and *E.tenella* respectively appeared morphologically normal and in vitro
