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OCCURRENCE OF A COCCIDIAN PARASITE *EIMERIA ARLOINGI* (APICOMPLEXA: EUCOCCIDIORIDA) IN FAECES OF DOMESTIC GOATS IN NASHIK, MAHARASHTRA

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Abstract: *Eimeria arloingi* was identified in the faecal pellets of goats collected from different domestic goats of Nashik, Maharashtra, India for the period of one year from June 2013 to May 2014. The oocysts of *E. arloingi* were re-described by measuring shape and size of the oocyst, sporocyst, sporozoites, sporoblast, micropyle and micropyle cap, colour of the oocyst and thickness of oocyst wall. More than half (53.6%) of the samples were found positive having oocysts of the parasite. The maximum percentage (80%) was recorded in the month of July and gradually decreases to May (20%) and rises again in the month of June (58.3%).

Keywords: Apicomplexa, *Eimeria*, Eimeriidae, Oocyst, Prevalence, Protozoa.

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INTRODUCTION

Coccidiosis is a parasitic disease affecting a variety of animals, especially mammals and birds. The causative organism is coccidian (Chartier and Paraud, 2012), which is a spore-forming protozoan. The protozoans are single celled microscopic eukaryotes with worldwide distribution, having protoplasmic grade of organization (Verma and Prakash, 2020; Ashok, 2021). In goats and sheep, coccidiosis is caused by genus *Eimeria*. At least 17 species of *Eimeria* (Apicomplexa: Conoidasida: Eucoccidiorida: Eimeriidae) are known to infect goats and sheep.

Eimeria having about 1700 species (Ogedengbe *et al*., 2015) are host specific, but only few species are pathogenic to their hosts (More *et al*., 2015). The domestic goat (*Capra hircus* L., 1758) is phylogenetically more adapted to unfavourable conditions having ability to efficiently convert low-quality vegetable matter into energy-dense fat, muscle, and milk (Oltjen and Beckett, 1996). Oocysts are the infective form eliminated in the faeces and transmission happens directly by ingestion so infection is higher in specific conditions regarding environment, management and animal immunity (Cavalcante *et al*., 2011). *Eimeria* species are tetrasporocystic, dizoic, and have sporocyst walls containing of two valves joined by a longitudinal suture. During the present investigation, *Eimeria arloingi* was detected in the faecal samples of a domestic goat and described. Earlier to this study, several workers have documented the incidence of *E.*

arloingi in different states of the country (Shah and Joshi, 1963; More *et al*., 2011; Sontakke *et al*., 2015, 2021; Singh *et al*., 2020).

MATERIALS AND METHODS

During the study, a total 125 samples of goat pellet were collected from the different parts of Nashik, (M.S.), India. These samples were collected in the plastic bags and brought to the laboratory and allowed to air dry. The dried pellets were crushed in the mortar by pestle and strained through the sieve and then through a muslin cloth to remove the extra debris. Strained sample was dissolved in saturated salt and was centrifuged for about 10 min at 2,300 rpm. Thereafter, the supernatant was discarded and saturated sodium chloride was again added in the same centrifuge tube and mixed. The solution was again centrifuged for 10 min at 2,300 rpm. After centrifugation the upper most layer of supernatant containing oocyst was collected by dropper into a separate vial and potassium dichromate (2.5 %) were added to it to preserve the sample. These vials are then stored at 4ºC.

A drop of sample was first observed under the light microscope at low power (10x) for the presence of *Eimeria* and samples containing oocysts were then kept for sporulation in a cavity block at room temperature. After sporulation the sporulated oocysts were observed at high power (100x) for identification. The species were identified on the basis of the morphology of oocysts, sporocysts, sporozoites and stieda bodies (Eckert *et al*., 1995).

RESULTS AND DISCUSSION

Prevalence

This study was carried out for the period of one year from June 2013 to May 2014. Total 125 fecal samples were examined for coccidial infections of which 67 were found positive for *Eimeria* and the total prevalence was recorded 53.6%. Month wise prevalence was recorded in the percentage, which is presented in table 1. The maximum percentage (80%) was recorded in the month of July and the minimum (20%) was recorded in the month of May. The prevalence of coccidial infection gradually decreased from July (80%) to May (20%) and rose again in the month of June (58.3%).

Table 1: Showing the prevalence of *E. arloingi* in goats during the period from June 2013 to May 2014.

Month	Number of samples examined	Number of samples positive	Prevalence (%)
Jun. 2013	12	7	58.3
Jul. 2013	10	8	80
Aug. 2013	7	6	75
Sep. 2013	8	5	62.5
Oct. 2013	10	6	60
Nov. 2013	14	8	57.1
Dec. 2013	11	6	54.5
Jan. 2014	12	6	50
Feb. 2014	10	5	50
Mar. 2014	9	4	44.4
Apr. 2014	12	4	33.3
May 2014	10	2	20
Total	**125**	**67**	**53.6**

Description of the genus *Eimeria*

The oocyst of genus *Eimeria* produces four spores and each spore consist of two sporozoites. Oocyst wall is usually double layered and very smooth. The oocysts are spherical, ovoidal, elliptical, ellipsoidal or elongated in shape. Some species of

genus *Eimeria* possess micropyle and micropylar cap. Unsporulated oocyst consists of oocystic residuum. In sporulated oocyst spores and sporoblast are present. Earlier, 14 species of *Eimeria* were reported from goat, but from India, only 5 species are recorded from north India, *viz*. *E. arlongi*, *E. caprina*, *E. christenseni*, *E. hirci* and *E. ninakohlyakimovae* (Singh *et al*., 2020).

DESCRIPTION OF THE SPECIES

***Eimeria arloingi* (Marotel, 1905), Martin, 1909**

The species (Fig. 1) was observed in goats. The oocysts are ellipsoidal, ovoid with micropyle and micropylar cap. Oocyst measured about 26.4-28.8 μm (27.39 μm) in length and 16.8-19.2 μm (17.91 μm) in width. The oocyst wall is about 1.5 μm thick, double layered, outer smooth, yellow in colour, about 1.1 μm thick and inner layer brownish yellow about 0.3 μm thick. The wall lined by a thin membrane internally. The 4.0 μm wide micropyle bears a micropylar cap, which is 1.0 to 3.0 μm high and 4.2 to 6.3 μm wide. The cap which is flattened or dome shaped and placed asymmetrically over the micropyle is easily dislodged. The polar granules may or may not be present. Oocystic residuum was not seen.

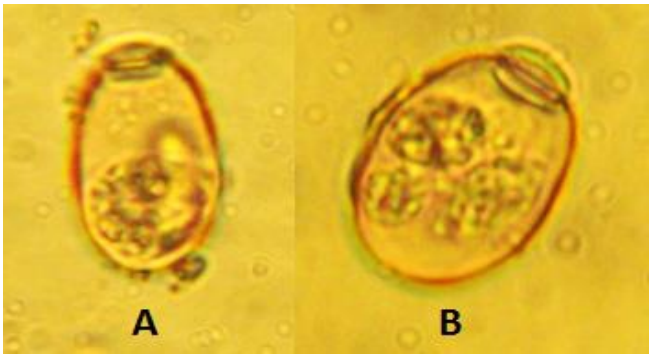

Fig 1: *Eimeria arloingi* (A)**.** Unsporulated oocyst, (B)**.** Sporulated oocyst.

The unsporulated oocyst contains a spherical sporoblast, measuring 14.2 to 18.4 μm in diameter. The sporulated oocyst has four oval or elongate sporocysts, measured 11.2-12.3 μm (11.65 μm) in length and 5.5-6.4 μm (6.3 μm) in width. The sporocyst is also elongated ovoid and possesses a sporocystic residuum, which is in the form of several granules placed at its centre, between the two sporozoites. The sporozoites lie head to tail in position and carry a large refractile body at the broader end and a smaller one at the narrower end. Stieda body is present. The sporulation time of the oocyst was seen 42 hours. There exists a great variation in size (length and width) of oocysts and sporocysts, and height and width of micropylar cap of *E. arloingi* (Shah and Joshi, 1963; More *et al*., 2011; Sontakke *et al*., 2015, 2021; Singh *et al*., 2020).

Comments

Present species *Eimeria arloingi* has been morphologically compared with the same species described previously by various authors (Table 2 and 3). In present study, ellipsoidal, ovoid shape of the oocyst and elongated ovoid sporocysts of *E. arloingi*, resembles with the same species reported by all previous authors namely Levine and Ivens (1970), Shah and Joshi (1963), Majaro and Dipeolu (1981), Silva and Lima (1998), Bandyopadhyay (2004), More et al. (2011), Singh (1964) and Sontakke *et al*. (2021). In present species polar granules are absent which was also absent in the species reported by More (2011) and Sontakke *et al*. (2021). However, one polar granule was observed by Levine and Ivens (1970) and Shah and Joshi (1963).

The oocystic residuum was not seen in present species and it resembles with *E. arloingi* described by previous authors in which also oocystic residuum was absent. Granular sporocystic residumm was observed in present species and all previously reported species. Elongated shape of sporozoite matches with *E. arloingi* reported by Bandyopadhyay (2004). Stieda body is present in present species, which has also been reported by several authors except Shah and Joshi (1963). A slight variation observed in size with the species reported by other authors is presented in table 3.

After comparison of the present species with the other species of genus *Eimeria* and the species *E. arloingi* previously described by various authors, it is found that present species shows the close resemblance with *E. arloingi* in shape and size of the oocyst, sporocyst and sporozoite, absence of polar granules and oocystic residuum, and presence of stieda body. Author observed no distinct morphological differences, hence it is concluded that present species is not new to the subject and re-described here as *E. arloingi*.

Table 2: Showing the morphological features of the oocyst and sporocyst of *Eimeria arloingi* reported by various authors.

Sl. No.	Author	Shape of the oocyst	Sporocyst Shape	Polar granules	Oocystic residuum	Sporocystic residuum	Shape of sporozoite	Steida body
1.	Levine and Ivens (1970)	Ellipsoid, slightly ovoid	Elongated ovoid	1	---	Present	—	—
2.	Shah and Joshi (1963)	Ellipsoid, ovoid	Elongated ovoid	1	---	Present	---	Absent
3.	Singh (1964)	---	---	---	---	Present	---	Absent
4.	Majaro and Dipeolu (1981)	---	---	---	---	----	—	—
5.	Silva and Lima (1998)	---	---	---	---	—	—	—
6.	Bandyopadhyay (2004)	---	---	---	—	—	—	Elongated
7.	More *et al.* (2011)	Elongated, ovoid	Elongated, ovoid	Absent	Absent	Few scattered granules	—	Present
8.	Sontakke *et al.* (2021)	Ellipsoidal, Elongated	Elongated, ovoid	Absent	Absent	Granules found	—	Present
9.	Present species	Ellipsoidal, ovoid	Elongated, ovoid	Absent	Absent	Granular	Elongated	Present

Table 3: Showing the dimensions of oocyst, sporoblast, micropyle, micropylar cap and sporocyst of *Eimeria arloingi* in microns (μm) reported by the various authors.

Sl. No.	Author	Shape of the oocyst		Sporoblast	Micropyle (Width)	Micropylar cap		Sporocyst		Wall Thickness
		Length	Width			Height	Width	Length	Width	
1.	Levine and Ivens (1970)	22.0–35.0 (28.0)	16.0–26.0 (19.21)	—	—	0.4-3.0 (2.0)	4.0-9.0 (6.7)	11.0-17.0 (13.15)	6.0-10.0 (7.8)	—
2.	Shah and Joshi (1963)	22.0–35.0 (28.0)	18.0–26.0 (21.0)	—	—	1.0-3.0 (2.0)	5.0-9.0 (6.0)	11.0-17.0 (13.0)	6.0-10.0 (8.0)	—
3.	Singh (1964)	24.65–37.4 (20.3)	—	—	—	1.7-3.4	3.4-7.6	10	5	—
4.	Majaro and Dipeolu (1981)	22.1-33.1 (26.53)	17.1-25.3 (20.35)	—	—	—	—	—	—	—
5.	Silva and Lima (1998)	22.0-35.0 (28.2)	15.9-23.2 (19.8)	—	—	—	—	9.0-17.0 (12.26)	6.0-10.0 (7.66)	—
6.	Bandyopadhyay (2004)	22.0-35.4 (28.2)	15.9-23.2 (19.8)	—	—	—	—	9.8-17.1 (14.0)	6.1-9.8 (7.3)	—
7.	More *et al.* (2011)	28.0-55.4 (40.32)	19.0–42.1 (32.14)	18.0-22.0	4.0-6.0	2.0-6.0	5.0-10.0	12.0-20.2 (16.0)	8.0-14.2 (11.37)	1.7
8.	Sontakke *et al.* (2021)	29.0-45.0 (34.35)	18.0-34.0 (26.45)	12.0-20.0	4.0-6.0	1.0-5.0	4.0-9.0	11.0-15.0 (4.71)	7.0-11.0 (9.95)	1.7
9.	Present species	26.4-28.8 (27.39)	16.8-19.2 (17.91)	—	4.0-5.0	1.0-3.0	4.2-6.3	11.2-12.3 (11.65)	5.5-6.4 (6.3)	1.5

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