Description of a new species of *Myxobolus* Bütschli, 1882 from the *Cirrhinus mrigala* Hamilton, 1822 an edible fish of India

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Abstract *Myxobolus* Bütschli 1882 is an important group of parasitic protozoa infecting a large number of freshwater fish species worldwide. The severity of *Myxobolus* infection leads to heavy loss in production of fishes. During the survey of the fish parasites, a new species of the genus *Myxobolus* have been isolated from the gills of a freshwater edible fish *Cirrhinus mrigala* Hamilton, 1822 from Canning, South 24 Parganas, West Bengal, India which has been described here.

Keywords Freshwater carp · Myxozoan parasite · West Bengal

Abbreviations

LS	Length of the spore
BS	Breadth of the spore
LLPC	Length of the larger polar capsule
BLPC	Breadth of the larger polar capsule
LSPC	Length of the smaller polar capsule
BLPC	Breadth of the smaller polar capsule
PC	Polar filament
FC	Filament coil

Introduction

Myxosporeans are considered to be one of the most abundant and diverse group of fish parasites found in different geographical areas (Landsberg and Lom 1991; Lom and Dykova 1992). Myxozoa Bütschli 1882, comprises more

than one thousand two hundred available species commonly found in fish (Lom and Dykova 1992). Among them, the genus *Myxobolus* Bütschli 1882 is the largest group of the family Myxobolidae containing 744 described species (Eiras et al. 2005) and has been established as an important pathogen in fresh water fishes. About one hundred four species of this genus from Indian fishes have been reported in addition to 175 species belonging to the genera of Myxosporean (Kalavati and Nandi 2007). The genus *Myxobolus* was first recorded in 1882 by Bütschli having spores with or without an iodophilous vacuole and with one or two polar capsules. The Myxozoan spores having two polar capsules, with or without iodophilus vacuoles and generally two sporogenic nuclei have been placed under the Genus *Myxobolus* Bütschli 1882 (Kudo 1933).

During the present study one species under the genus *Myxobolus* Bütschli 1882 has been identified. The species has been described here according to the guidelines of Lom and Arthur (1989) and Lom and Dykova (1992).

Materials and methods

Host fishes were collected from the bheries of Canning, South 24 Parganas, West Bengal, India and brought alive to the laboratory and cultured in the vats near the laboratory. Host fishes were examined time to time. The fishes were dissected and the gill smears were taken in the grease free slides (1 mm) and air dried. The slides were then fixed in methanol for 2–8 min. Then these slides were taken out and Giemsa stain was put on it. This Indian ink method of Lom and Vavrá (1963) was employed to identify the myxozoan spore and for permanent preparation. It was noticed that each slides were fully dipped into this stain. Staining was done for about 25–30 min and then washed in tap

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water. The slides were then covered with coverslips and mountant with DPX. The slides were then observed under microscope. Sporogonic plasmodia, when found, were carefully removed with sterile needles, smeared on clean grease free slides with drops of distilled water, covered with cover slips and sealed with DPX for examination of fresh spores under the oil immersion lens of Olympus KH phase contrast microscope. Some of the fresh smears were treated with various concentrations of KOH (2–10 %) for the extrusion of polar filament.

Some fresh smears containing the spore were treated with Lugol's Iodine solution for the detection of iodophilus vacuoles. Measurements based on twenty fresh spores (stained with both Lugol's Iodine and Geimsa) were done with a calibrated ocular micrometer. All measurements are presented in micrometer (μm) as mean $\pm$ SD followed by parentheses by the range. Stained spores were examined under the oil immersion lens of Olympus KH phase contrast microscope. Photomicrographs of the stained spores were also taken with the help of an Olympus KH phase contrast microscope fitted with Olympus camera in 100X magnification.

Results and discussion

Myxobolus zoohuri sp. n. (Fig. 1a–d); Fig. 2a–c; Table 1)

Plasmodia

Plasmodia very small, microscopic, attached with the mucous membrane around gill lamellae. Colour creamy white, shape rounded (2–3 mm in diameter) and contains both late developmental stages and mature spores.

Spore description (measurements based on spores in frontal view)

Spore

Immature spores tear shaped. Two polar capsules pear shaped. Sporoplasm contains two nuclei. Mature spores

tear shaped with dimension 14.89 ± 1.19 (13.26–17.34) $\times$ 6.32 ± 0.53 (4.99–7.03). Anterior end of the spores triangular and posterior ends blunt semicircular. The two polar capsules are unequal in shape. Larger polar capsules measures 11.17 ± 0.52 (10.41–12.04) $\times$ 2.83 ± 0.28 (2.24–3.16) and smaller polar capsules have the dimension of 10.63 ± 0.42 (10.1–11.22) $\times$ 2.71 ± 0.36 (2.04–3.06). The capsules elongated with anterior tip and blunt posterior end. The polar filaments not extruded out. The polar capsules containing 17–18 coils in case of larger and 15–16 coils in case of smaller one. The granular sporoplasm fills the extra capsular region. It contains two sporoplasmic nuclei without any glycogen filled iodophilus vacuole.

Spore index

LS: BS = 1: 0.424

LLPC: BLPC = 1: 0.253

LSPC: BSPC = 1: 0.256

LLPC: LSPC = 1: 0.951

BLPC: BSPC = 1: 0.960

Taxonomic summery

Type host *Cirrhinus mrigala* Hamilton.

Type locality Canning, South 24 Parganas, West Bengal, India.

Type specimens Slide No. MB/PA/KU/07-08 containing Holotype and four slides MB/PAKU/09-12 containing Paratype have been deposited in the collection of Prasi-tology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, W.B.

Symbiotype The host specimen bearing no. CM/PARA/01-07 deposited in the museum of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, W.B.

Site of infection Gill lamellae.

Prevalence of infection 8 out of 21 hosts examined (38.095 %).

Table 1 Morphometric characters of *M. zoohuri* sp. n

Parameters	Range	Mean	Standard deviation (SD)	Standard error (SE)	Coefficient of variance (CV%)
Length of the spore (LS)	13.26–17.34	14.89	1.19	1.14	7.99
Breadth of the spore (BS)	4.99–7.03	6.32	0.53	0.73	8.39
Length of larger polar capsule (LLPC)	10.41–12.04	11.17	0.52	0.96	4.66
Breadth of larger polar capsule (BLPC)	2.24–3.16	2.83	0.28	0.46	9.85
Length of smaller polar capsule (LSPC)	10.1–11.22	10.63	0.42	0.94	3.94
Breadth of smaller polar capsule (BSPC)	2.04–3.06	2.71	0.36	0.42	13.27

Fig. 1 a–d Photomicrographs of *Myxobolus zoohuri* sp. n. (Scale bar 5 μ m)

Fig. 2 a–c Camera lucida drawings of *Myxobolus zoohuri* sp. n. (Scale bar 5 μ m)

Specific epithet The name of the species has been given after the name of Professor Moohanmmmed Zohur Chisti, Emeritus Professor, University of Kashmir, Srinagar, India for his outstanding contribution in the field of Parasitology.

Discussion

Taxonomic affinities

The Myxozoan parasite under discussion having two polar capsules, with or without iodophilus vacuoles and generally two sporogenic nuclei justifies its inclusion under the family Myxobolidae and genus *Myxobolus* Bütschli 1882 as described by Kudo (1933).

The present species resembles a number of *Myxobolus* species in morphology or morphometry of the spores and polar capsules. These species includes *M. karnatakæ* Hagargi and Amoji 1981; *M. mahendrae* Sarkar 1986; *M. variformis* Haldar et al. 1996; *M. orissae* Haldar et al. 1996; *M. rocatlae* Basu and Haldar 2002; *M. catmrigalae* Basu and Haldar 2004. A comparative statement has been incorporated in Table 2.

Table 2 Comparative morphology of *M. zochuri* sp. n. with other related species

Name of the species	Host	Site of infection	Length of spore	Breadth of spore	Length of larger polar capsule	Breadth of larger polar capsule	Length of smaller polar capsule	Breadth of smaller polar capsule	Polar filament	Filamentous coils (FC)
<i>M. camrigalae</i> Basu and Haldar (2004)	<i>Catla catla</i> Ham. × <i>Cirrhinus mrigala</i> Ham. (Hybrid)	Gill lamellae	20.4	16.3	11.9	2.3	11	2.3	Absent	Larger: 20–25 Smaller: 20–23
<i>M. karnatakae</i> (Hagargi and Amoji 1981) Landsberg and Lom (1991) [Syn. <i>Myxosoma</i> Kare Hagargi and Amoji (1981)]	<i>Barbus chola</i> Ham. and Buch.	Caudal muscles	16.30–19.40 (17.58)	10.88–13.60 (11.1)	10.88	5.44	7.3	3.58	Absent	6–7
<i>M. mahendrar</i> Sarkar (1986)	<i>Catla catla</i> Ham.	Gill arch epithelium, bucco-pharyngeal cavity	11.52–13.96 (12.7)	9.77–10.47 (9.2)	6.28–7.33 (6.98)	3.49–4.19 (3.73)	4.19–6.98 (5.44)	3.14–3.49 (3.42)	Absent	Larger: 6–7 Small: 4–5
<i>M. orissae</i> Haldar et al. (1996)	<i>Cirrhinus mrigala</i> Ham.	Gills	13.0–19.5 (15.71)	4.9–8.1 (6.8)	7.3–11.8 (8.8)	2.4–3.2 (1.78)	6.5–11.4 (7.58)	1.6–3.4 (2.57)	Absent	–
<i>M. rocatlae</i> Basu and Haldar (2002)	<i>Catla catla</i> Ham. × <i>Labeo rohita</i> Ham. (Hybrid)	Gills, guts	17.5–19.3 (18.5)	5.6–6.2 (5.9)	11.8–13.7 (12.9)	2.5–3.0 (2.85)	10.0–12.2 (11.3)	2.0–2.4 (2.2)	Absent	Larger: 17–19 Smaller: 15–18
<i>M. variformis</i> (Haldar et al. 1996) Kalavati and Nandi (2007) [Syn. <i>Myxobolus variabilis</i> Haldar et al. (1996)]	<i>Mystus gulio</i> Ham.	Body muscles, gills	13.0–17.9 (15.2)	4.9–8.1 (5.65)	8.1–11.7 (9.67)	1.6–4.0 (2.84)	6.5–11.4 (8.6)	1.6–3.2 (2.4)	–	–
<i>Myxobolus</i> n. sp. present study	<i>Cirrhinus mrigala</i> Ham.	Gill lamellae	13.26–17.34 (14.89)	4.99–7.03 (6.32)	10.41–12.04 (11.17)	2.24–3.16 (2.83)	10.1–11.22 (10.63)	2.04–3.06 (2.71)	Absent	Larger: 17–18 Smaller: 15–16

The present species is larger in comparison to *M. mahendrae* while it is smaller than *M. catmrigalae*, *M. rocatlae*, *M. karnatacae* and *M. orissae* respectively in relation to its length. Whereas, *M. catmrigalae*, *M. karnatacae* and *M. orissae* are larger in relation to both its length and width of the spore than the present species but in *M. rocatlae* and *M. variformis* the length of the spore is much longer than the present form while the breadth is slightly smaller in size. The length of large polar capsule is bigger in case of only *M. rocatlae* while it is smaller in all the compared species along with the present form. Where as the width is larger in *M. karnatacae* and *M. mahendrae* but resembles closely with *M. catmrigalae*, *M. rocatlae* and *M. variformis* respectively. Furthermore, while comparing the length and breadth of smaller polar capsule it is found that the length is larger only in *M. rocatlae* and *M. catmrigalae* while it is smaller in case of other compared species and breadth is larger in *M. karnatacae*, *M. mahendrae* and smaller in rest of the species. *M. catmrigalae* and *M. rocatlae* possesses larger polar capsule in comparison to *M. karnatacae*, *M. orissae*, which possesses smaller polar capsule in comparison to present form. The shape of the spore also varies. It is oval and somewhat elongated in shape in all the compared species where as it is tear shaped in the present form. Polar filament is absent in all the forms but the species differs from each other in respect to the number of filamentous coil. The highest number of filamentous coil has been observed in *M. catmrigalae* in comparison to other forms while *M. rocatlae* resembles the present species under study having comparatively same number of coils.

The size of the spore of the present form resembles closely to *M. variformis*, in respect to its length and morphometry but the polar capsules are smaller than that of present one. Although in some cases *M. variformis* shows equal sized polar capsules along polar filaments. Furthermore, in *M. rocatlae* the surface of the spore along with the length and breadth of larger and smaller polar capsule is much bigger in comparison to present form.

Considering all these points, the present *Myxobolus* species under description is new to science and hence it is designated as *Myxobolus zoohuri* sp. n.

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