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Two new species of *Myxobolus* (Myxozoa: Myxosporea: Bivalvulida) infecting an Indian major carp in Ropar and Kanjali wetlands (Punjab)

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Abstract In India, more than 104 species of *Myxobolus* are recorded infecting freshwater and marine fishes. During our study on the myxozoan parasites of fishes of Punjab wetlands, India, two new myxosporean species, *Myxobolus ropari* sp. nov. and *Myxobolus kanjali* sp. nov. were recorded from mucous membrane around gill lamellae and scales of *Cirrhina mrigala* (Ham.), respectively. Spores of the first species, *M. ropari* sp. nov. measure 12.58 × 4.5 μm in size, elongately pyriform, slender in shape with a pointed anterior end and a rounded posterior end. Polar capsules are two, equal, elongately pyriform, measuring 4.96 × 1.50 μm in size, placed posteriorly from the tip of the spore running parallel to each other. Spores of the second species, *M. kanjali* sp. nov. measure 9.5 × 7.7 μm in size, spherical in shape with rounded anterior and posterior extremities. Polar capsules are two, equal, broadly pyriform with a blunt anterior and a rounded posterior end measuring 4.8 × 1.8 μm in size. A prominent tubular structure originate from the anterior end of one of the polar capsule and extend backward beyond the margin of the spore body and run upwards to join the posterior end of the other polar capsule.

Keywords Freshwater fishes · Kanjali wetland · *Myxobolus* · Ropar wetland

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Introduction

Classification of the phylum Myxozoa have a long history since the discovery of Myxosporea by Jurine (1825) and subsequent observations by Muller (1841). This actually began when Butschli (1882) classified Myxosporida (along with Sarcosporida) as a subclass of the then class Sporozoa. Smothers et al. (1994) made phylogenetic analysis of the first myxozoan based on SSU rDNA confirming the marginalized suppositions of earlier authors (Stolc 1899; Weill 1938) that myxozoa are multicellular organisms and placed myxozoans within the metazoan.

Myxosporeans are the abundant and diversified group of parasites infecting freshwater and marine fishes. They cause production loss and death, and some fish have to be discarded because they are unsightly and are not considered to be fit for human consumption. Up till now, phylum Myxozoa include four malacosporean and 2,180 myxosporean species to a total of 62 genera (Lom and Dykova 2006). Recently, a new genus *Thelohanelloid bengalensis* gen. nov. sp. nov. from gall bladder of *Arius sagor* (a marine fish in Bay of Bengal) has been described by Sarkar (2009). The genus, *Myxobolus* is predominant having more than 744 species reported (Eiras et al. 2005). Kalavati and Nandi (2007) have reported the existence of 104 myxobolid species from Indian species. Recently, Kaur and Singh (2008; 2009a,b; 2010a,b; 2010/2011; and 2011) reported ten new species infecting Indian major carps in wetlands of Punjab. During the present study on the fishes of Ropar and Kanjali wetlands of Punjab (India), a total number of 85 fishes belonging to *Cirrhina mrigala* were examined. The present communication describes two new species *M. ropari* sp. nov. and *M. kanjali* sp. nov. collected from gill lamellae and scales, respectively. The description has

been prepared in accordance with the guidelines of Lom and Arthur (1989).

Materials and methods

Plasmodia from gills and scales of infected *Cirrhina mrigala* (Ham.) were smeared on clean slides in a drop of 0.98% Nacl solution covered with cover slip and were examined for the presence of spores. Fresh spores were treated with 8% KOH solution for the extrusion of polar filaments. For permanent preparation, air-dried smears fixed in Bouins fixative were stained with Ziehl-Neelsen and Iron-haematoxylin. Drawings were made from stained material with the aid of camera lucida. Measurements (based on 15–20 fresh spores treated with Lugol's iodine solution) of spores were done under oil immersion with the aid of a calibrated ocular micrometer. All measurements are in microns (μm) as range values followed by mean ±SD in parentheses. The abbreviations used in the paper are as follows: LS length of spore; WS width of spore; LPC length of polar capsule; WPC width of polar capsule; ICP intercapsular process; TS thickness of shell valves; NC number of coils of polar filaments; SD standard deviation.

Results and discussion

Myxobolus ropari sp. nov. (Figs. 1, 3, 5b, Table 1).

Plasmodia

Small, microscopic and present in the mucous membrane around gill lamellae. 5–7 spores were present per plasmodium.

Description

LS: 12.58 ± 0.56 (12.18–12.98)
WS: 4.5 ± 0.70 (4.0–5.0)
LPC: 4.96 ± 0.14 (4.86–5.06)
WPC: 1.50 ± 0.56 (1.10–1.90)
Ratio: LS/WS = 2.7
ICP: Medium-sized
NC: 9–10

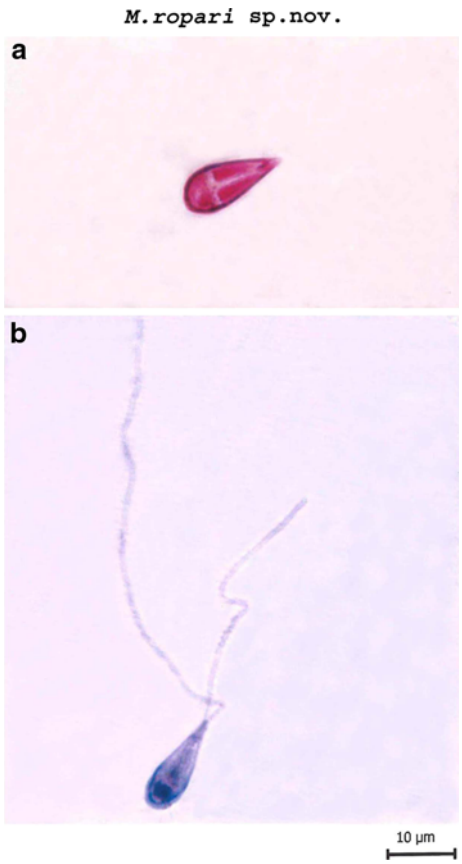

Fig. 1 **a** Spore stained in Zieh1-Neelsen **b** Spore stained in Iron-haematoxylin (extruded polar filaments)

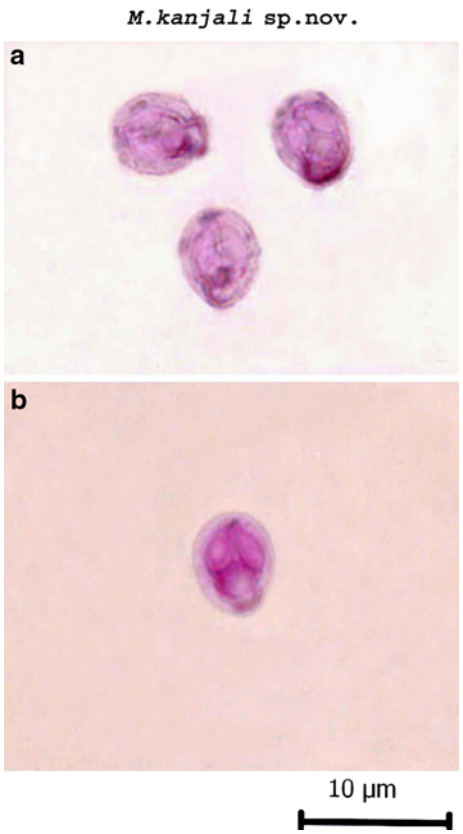

Fig. 2 **a**, **b** Spore stained in Zieh1-Neelsen (showing *tubular structure*)

Parietal folds: absent
TS: 0.58

Spores

Histozoic, elongately pyriform and slender in shape having a pointed anterior end and a rounded posterior end. Shell valves are smooth and symmetrically thin but posterior end of the spore appear thicker (which stains dark blue with Heidenhains Iron-haematoxylin) than the rest on the spore body. Parietal folds are absent. Two equal polar capsules, elongately pyriform in shape, placed posteriorly from tip of the spore and run parallel to each other. Polar capsules are pointed anteriorly and rounded posteriorly. A medium-sized intercapsular process is present at the anterior end of spore. Sporoplasm is agranular and homogenous occupying entire extracapsular space behind the polar capsules. An iodinophilous vacuole is absent. Sporoplasmic nuclei two, each measuring 1.5–1.6 μm in diameter.

Taxonomic summary of *M. ropari* sp. nov.

Type host	*Cirrhina mrigala* (Ham.) vern mrigal
Type locality	Ropar wetland, Punjab (India)
Type specimen	Paratypes are spores stained in Ziehl-Neelsen and Iron-haematoxylin, slide no.CM/H/ZN/ 23.05.2009 and CM/H/IH 23.05.2009 deposited in the museum of Department of Zoology, Punjabi University, Patiala (Punjab), India. Pin code-147002
Site of infection	Gills
Prevalence of infection	30/55(54.5%)
Etymology	The species epithet *ropari* is named after the name of type locality "Ropar wetland"

Discussion

The present species was compared with *M. macrocapsularis* Reuss 1906 from gills of *Blicca bjoerkna*; *M. aureatus* Ward 1919 from fin of *Notropis anogenus*; *M. angustus* Kudo 1934 from gills of *Cliola vigilax*; *M. calbasui* Chakravarty 1939 from gall bladder of *C. mrigala*; *M. mrigalae* Chakravarty 1939 from scales of *C. mrigala*; *M. catlae* Chakravarty 1943 from gills of *C. mrigala*; *M. indicum* Tripathi 1952 from muscles, liver, intestinal wall of *C. mrigala*; *M. rewensis* Srivastava 1979 from scales of *C. mrigala*; *M. carnaticus* Seenappa and Manohar 1980 from gills of *C. mrigala*; *M. vanivilasae* Seenappa and Manohar 1980 from beneath muscles, scales integument of *C. mrigala*; *M. hosadurgensis* Seenappa and Manohar 1981 from gills, muscles of

Table 1 Comparative description of *M. ropari* sp. nov. with morphologically similar species (measurements are in micrometers)

Species	Host	Site of infection	Locality	Spore	Polar capsule
M. ropari sp. nov. (present study)	*Cirrhina mrigala*	Gill filaments	Ropar wetland, Punjab (India)	12.58 × 4.5	4.96 × 1.50
M. macrocapsularis Reuss 1906	*Blicca bjoerkna*	Gills	Russia	9.0–14.5 × 6.0–9.9	5.0–8.6 × 2.4–3.6
M. aureatus Ward 1919	*Notropis anogenus*	Fin	USA	12.4–13.5 × 6.5–7.5	6.0–7.5
M. angustus Kudo 1934	*Cliola vigilax*	Gills	USA	14.0–15.0 × 7.0–8.0	8.0–9.5 × 2.5–3
M. calbasui Chakravarty 1939	*C. mrigala*	Gall bladder	India	12.4–15.0 × 8.2–10.0	6.18 × 4.12 and 4.12 × 3.09
M. mrigalae Chakravarty 1939	*C. mrigala*	Scales	India	7.2–8.2	5.15 × 3.09 and 3.09 × 2.06
M. catlae Chakravarty 1943	*C. mrigala*	Gills	India	14.5–16.5 × 6.18	10.3–12.36 × 2.06–3.01
M. indicum Tripathi 1952	*C. mrigala*	Muscles, liver, intestinal wall	India	9.5–10.8 × 7.5–8.2	2.7–3.6 and 1.8
M. rewensis Srivastava 1979	*C. mrigala*	Scales	India	9.66 × 8.05	4.8 × 3.2
M. carnaticus Seenappa and Manohar 1980	*C. mrigala*	Gills	India	8.6 × 6.8	3.8 × 2.0 and 2.1 × 1.5
M. vanivilasae Seenappa and Manohar 1980	*C. mrigala*	Beneath muscles, scales integument	India	8.0–10.0 × 7.0–9.0	3.57 × 2.57
M. hosadurgensis Seenappa and Manohar 1981	*C. mrigala*	Gills, muscles	India	10.5 × 6.25	5.37 × 2.3 and 3.3 × 1.43

Table 1 continued

Species	Host	Site of infection	Locality	Spore	Polar capsule
M. shetti Seenappa and Manohar 1981	*C. mrigala*	Gills	India	8.8 × 7.4	3.4 × 2.3
M. vedavatiensis Seenappa and Manohar 1981	*C. mrigala*	Gills	India	13.8 × 9.2	6.2 × 3.4 and 3.9 × 2.6
M. venkateshi Seenappa and Manohar 1981	*C. mrigala*	Gills	India	9.75 × 7.15	5.25 × 2.0
M. mathuri Jayasri et al. 1981	*Puntius saranae*	Gills	India	8.7–23.5 × 5.1–10.1	2.7–11.9 × 1.8–4.6 and 2.7–7.8 and 1.8–4.6
M. pseudokoi Li and Desser 1985	*Notropis cornutus*	Gills, skin	Canada	13.5 × 6.5	6.5 × 2.5
M. indirae (Kundu 1985) Gupta and Khera 1988	*C. mrigala*	Scales of tail fin	India	12.6 × 9.6	4.7 × 2.2
M. trichogasteri (Sarkar 1985) Gupta and Khera 1988	*Trichogaster fasciatus*	Gall bladder	India	15.5 × 9.4	10.1 × 3.3
M. haldari Gupta and Khera 1989	*C. mrigala*	Fin, gills	India	9.31 × 7.95	4.31 × 2.97 and 2.95 × 1.98
M. yogindrai (Tripathi 1952) Landsberg and Lom 1991	*C. mrigala*	Inner side of scales	India	9.0–9.5 × 7.2	2.8 × 3.6
M. longisporus Nie and Li 1992	*Cyprinus carpio*	Gills	China	16.0–17.5 × 6.5–7.0	7.5–8.2 × 2.0
M. kribiensis Fomena and Bouix 1994	*Brycinus longispinnis*	Skin, eye-sclera	Cameroon	21.2 × 9.5	16.1 × 15.4
M. orissae Haldar et al. 1997	*C. mrigala*	Gills	India	15.71 × 6.8	8.8 × 1.78 and 7.58 × 2.57
M. maculates Casal et al. 2002	*Metynnis maculates*	Kidney	Brazil	21.0 × 8.9	12.7 × 3.2
M. ophthalmasculata Basu and Haldar 2002	*C. mrigala*	Eye-muscles	India	13.13 × 8.04	5.47 × 3.06 and 3.03 × 1.99
M. rocatlae Basu and Haldar 2002	*Catla catla x L. rohita*	Gills, gut	India	18.5 × 5.9	12.9 × 2.8
M. catmriglae Basu and Haldar 2004	*Catla catla x C. migala*	Gill lamellae	India	18.8 × 5.9	11.9 × 2.5
M. bilobus Cone et al. 2005	*Notemigonus crysoleucas*	Gill filaments	Canada	21.0 × 8.4	10.8 × 2.7 and 10.1 × 2.3
M. shuleensis Eiras et al. 2005	*Pseudorasbora parva*	Gills	China	16.1 × 9.0	7.1 × 3.0
M. naini Kaur and Singh 2008	*C. mrigala*	Gills	India	12.9 × 8.2	4.9 × 3.1 and 3.33 × 1.63
M. eirasi Kaur and Singh 2009a	*C. mrigala*	Gills	India	8.6 × 6.7	3.2 × 1.57
M. leptobarbi Szekely et al. 2009	*Leptobarbus hoevenii*	Muscles	Malaysia	16.0 × 8.9	10.5 × 3.0 and 9.9 × 3.0
M. slendrii Kaur and Singh 2009b	*C. mrigala*	Gills	India	14.87 × 3.4	5.74 × 1.48
M. mehlhorni Kaur and Singh 2011	*C. mrigala*	Gill lamellae (mucous membrane)	India	8.9 × 6.8	3.7 × 2.5 and 2.6 × 1.5

C. mrigala; *M. shetti* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. vedavatiensis* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. venkateshi* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. pseudokoi* Li and Desser 1985 from gills, skin of *Notropis cornutus*; *M. indirae* (Kundu 1985) Gupta and Khera 1988 from scales of tail fin of *C. mrigala*; *M. trichogasteri* (Sarkar 1985) Gupta and Khera 1988 from gall bladder of *Trichogaster fasciatus*; *M. haldari* Gupta and Khera 1989 from fin, gills of *C. mrigala*; *M. yogindrai* (Tripathi 1952) Landsberg and Lom 1991 from inner side of scales of *C. mrigala*; *M. longisporus* Nie and Li 1992 from gills of *Cyprinus carpio*; *M. kribiensis* Fomena and Bouix 1994 from skin, eye-sclera of *Brycinus longispinnis*; *M. orissae* Haldar et al. 1997 from gills of *C. mrigala*; *M. maculates* Casal et al. 2002 from kidney of *Metynnis maculates*; *M. ophthalmasculata* Basu and Haldar 2002 from eye-muscles of *C. mrigala*; *M. rocatlae* Basu and Haldar 2002 from gills, gut of *Catla catla x L. rohita*; *M. catmriglae* Basu and Haldar 2004 from gill lamellae of *Catla catla x C. migala*; *M. bilobus* Cone et al. 2005 from gill filaments *of Notemigonus crysoleucas*; *M. shuleensis* Eiras et al. 2005 from gills of *Pseudorasbora parva*; *M. naini* Kaur and Singh 2008 from gills of *C. mrigala*; *M. eirasi* Kaur and Singh 2009a from gills of *C. mrigala*; *M. leptobarbi* Szekely et al. 2009 from muscles of *Leptobarbus hoevenii*; *M. slendrii* Kaur and Singh 2009b from gills of *C. mrigala*; and *M. mehlhorni* Kaur and Singh 2011 from gill lamellae (mucous membrane) of *C. mrigala* but differ from all of the above species in morphometric characteristics.

The present species show much similarity in having slender (LS/WS = 2.7) shape with *M. longisporus* (LS/WS = 2.4), *M. maculates* (LS/WS = 2.3), *M. bilobus* (LS/WS = 2.5), *M. kribiensis* (LS/WS = 2.2), *M. rocatlae* (LS/WS = 3.1), *M. trichogasteri* (LS/WS = 1.6), *M. catmriglae* (3.18), and *M. catlae* (LS/WS = 2.5) but differ in having a medium-sized intercapsular process at the anterior end and in having elongately pyriform polar capsules placed parallel in the middle of the spore cavity.

Furthermore, the present species resemble *M. macrocapsularis* (LS/WS: 1.4) in having slender shape and an intercapsular process, however, differ in having much wider spores as indicated above by comparing LS/WS ratios (indicated in parenthesis). In addition, the shell valves in the present species appear thicker at the posterior end of spore than the rest on the spore body. However, similar thickened posterior shell valves has also been reported in *M. mathurii* Jayasri et al. 1981 and *M. slendrii* Kaur and Singh (2009b).

Based on above differences cited, we hereby propose species under study as new to the science and named it as *M. ropari* sp. nov. through this communication.

M. kanjali sp. nov. (Figs. 2, 4, 5b; Table 2).

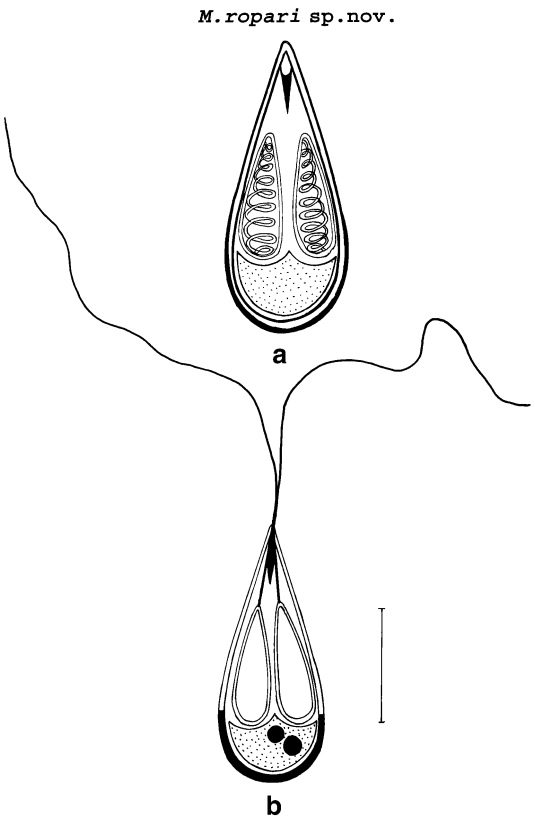

Fig. 3 **a** Spore stained in Zieh1-Neelsen (valvular view) **b** Spore stained in Iron-haematoxylin (extruded polar filaments) *scale bar* 0.005 mm

Plasmodia

Large, white colored, 4–5 in number and present all over the scales. They measure 1–2 mm in size. 10–15 spores were present per plasmodium.

Description

LS: 9.5 ± 0.28 (9.3–9.7)
WS: 7.7 ± 0.42 (7.4–8.0)
LPC: 4.8 ± 0.56 (4.4–5.2)
WPC: 1.8 ± 0.28 (1.6–2.0)
Ratio: LS/WS = 1.2
ICP: absent
NC: 6–7
Parietal folds: absent
TS: 0.4–0.5

Spores

Histozoic, spherical in shape with rounded anterior and posterior extremities. Shell valves are smooth and symmetrically thin. Parietal folds are absent. Polar capsules are two, equal, broadly pyriform with blunt anterior and

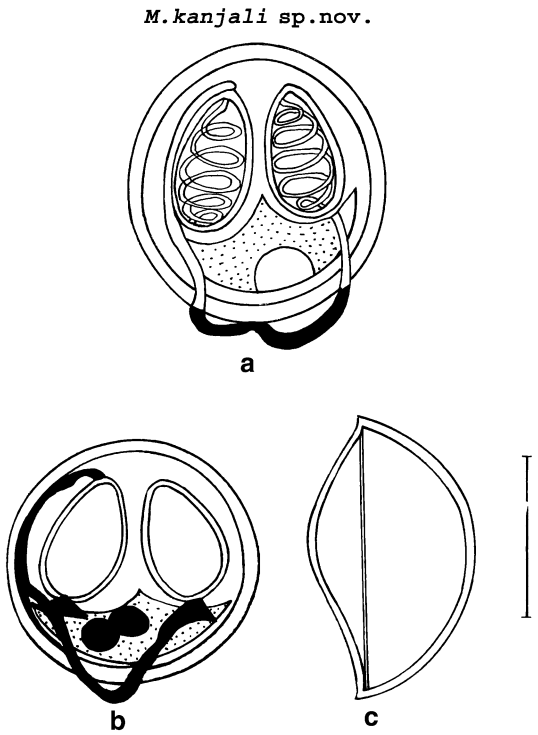

Fig. 4 **a** Spore stained in Zieh1-Neelsen (valvular view) **b** Spore stained in Iron-haematoxylin **c** Spore in side view *scale bar* 0.005 mm

rounded posterior ends. An intercapsular process is absent. Both polar capsule converge towards anterior end and are placed at a distance posteriorly occupying nearly half of the spore body cavity. Sporoplasm is agranular, half-moon shaped and homogenous occupying entire extracapsular space behind the polar capsules. Two capsulogenic nuclei measuring 1.17 μm in diameter are present. Sporoplasm contain two nuclei and an iodinophilous vacuole measuring 1.175–1.181 μm and 2.1–4.1(3.1 ± 1.37) μm in diameter, respectively. A prominent tubular structure originate from anterior end of one of the polar capsule and extend backward beyond the margin of the spore body and run upwards to join the posterior end of the other polar capsule.

Taxonomic summary of *M. kanjali* sp. nov.

Type host	*Cirrhina mrigala* (Ham.) vern mrigal
Type locality	Kanjali wetland, Punjab (India)
Type specimen	Paratypes are spores stained in Ziehl-Neelsen and Iron-haematoxylin, slide no.CM/l/ZN/ 24.05.2009 and CM/l/IH 24.05.2009 deposited in the museum of Department of Zoology, Punjabi University, Patiala (Punjab), India. Pin code-147002
Site of infection	Scales
Prevalence of infection	22/30(73.3%)
Etymology	The species epithet *kanjali* has been given after the name of type locality "Kanjali wetland"

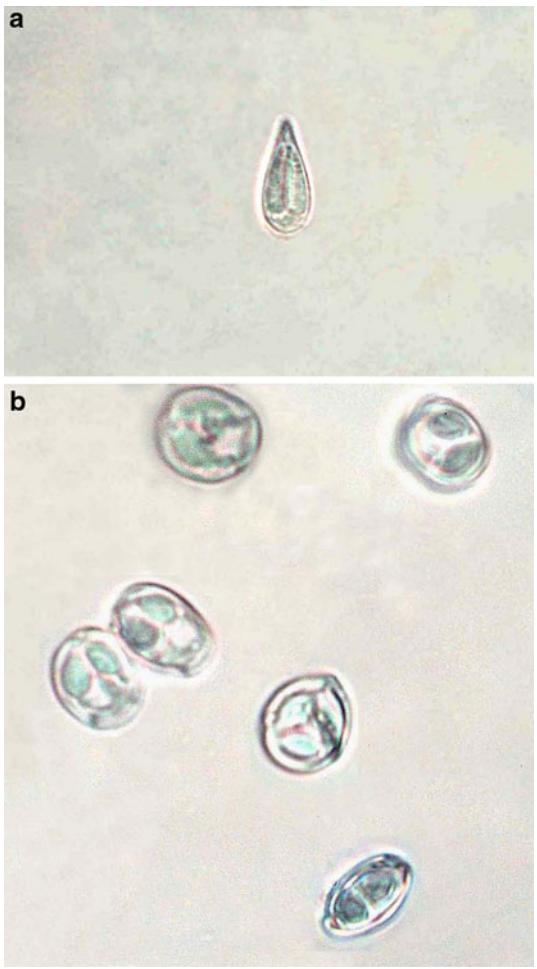

Fig. 5 **a** Fresh spore of *M. ropari* sp. nov. **b** Fres spores of *M. kanjali* sp. nov.

Discussion

The present species was compared with *M. pfeifferi* Thelohan 1895 from muscles, gills, kidney, spleen, body cavity of *Barbus barbus*; *M. calbasui* Chakravarty 1939 from gall bladder of *C. mrigala*; *M. mrigalae* Chakravarty 1939 from scales of *C. mrigala*; *M. catlae* Chakravarty 1943 from gills of *C. mrigala*; *M. nemacheili* Weiser 1949 from head connective tissue of *Nemacheilus barbatulus*; *M. indicum* Tripathi 1952 from muscles, liver, intestinal wall of *C. mrigala*; *M. amurensis* Akhmerov 1960 from fin, gut of *Cyprinus carpio haematopterus*; *M. sprostoni* Shulman 1962 from gut serosa of *Silurus europius*; *M. musajevi* Kandilov 1963 from gills of *Varicorhinus capoeta*; *M. rewensis* Srivastava 1979 from scales of *C. mrigala*; *M. carnaticus* Seenappa and Manohar 1980 from gills of *C. mrigala*; *M. exsulatus* Pugachev 1980 from gills of *Abramis brama*, *Catostomus*

Table 2 Comparative description of *M. kanjali* sp. nov. with morphologically similar species (measurements are in micrometers)

Species	Host	Site of infection	Locality	Spore	Polar capsule
M. kanjali sp. nov. (present study)	*Cirrhina mrigala*	Scales	Kanjali wetland, Punjab (India)	9.5 × 7.7	4.8 × 1.8
M. pfeifferi Thelohan 1895	*Barbus barbus*	Muscles, gills, kidney, spleen, body cavity	Basin of Amur rivers	10.0–13.0 × 9.0–12.2	5.0–5.7
M. calbasui Chakravarty 1939	*C. mrigala*	Gall bladder	India	12.4–15.0 × 8.2–10.0	6.18 × 4.12 and 4.12 × 3.09
M. mrigalae Chakravarty 1939	*C. mrigala*	Scales	India	7.2–8.2	5.15 × 3.09 and 3.09 × 2.06
M. catlae Chakravarty 1943	*C. mrigala*	Gills	India	14.5–16.5 × 6.18	10.3–12.36 × 2.06–3.01
M. nemacheili Weiser 1949	*Nemacheilus barbatulus*	Head connective tissue	Czech Republic	9.0–11.0 × 8.0–9.0	5.0 × 2.0
M. indicum Tripathi 1952	*C. mrigala*	Muscles, liver, intestinal wall	India	9.5–10.8 × 7.5–8.2	2.7–3.6 and 1.8
M. amurensis Akhmerov 1960	*Cyprinus carpio haematopterus*	Fin, gut	Amur basin	9.0–13.5 × 9.0–12.5	4.5–7.0 × 3.8–4.2
M. sprostoni Shulman 1962	*Silurus europius*	Gut serosa	Amur basin	11.0–13.0 × 10.0–11.7	5.5–7.5 × 3.5–4.0
M. musajevi Kandilov 1963	*Varicorhinus capoeta*	Gills	Caucasus	11.5–14.0 × 10.0–11.0	6.0–7.0 × 3.3–5.0
M. rewensis Srivastava 1979	*C. mrigala*	Scales	India	9.66 × 8.05	4.8 × 3.2
M. carnaticus Seenappa and Manohar 1980	*C. mrigala*	Gills	India	8.6 × 6.8	3.8 × 2.0 and 2.1 × 1.5
M. exsulatus Pugachev 1980	*Abramis brama, Catostomus catostomus*	Gills	Siberia	9.7–9.9 × 9.0–9.1	5.4–5.6 × 3.0
M. vanivilasae Seenappa and Manohar 1980	*C. mrigala*	Beneath muscles, scales integument	India	8.0–10.0 × 7.0–9.0	3.57 × 2.57
M. hosadurgensis Seenappa and Manohar 1981	*C. mrigala*	Gills, muscles	India	10.5 × 6.25	5.37 × 2.3 and 3.3 × 1.43
M. shetti Seenappa and Manohar 1981	*C. mrigala*	Gills	India	8.8 × 7.4	3.4 × 2.3
M. vedavatiensis Seenappa and Manohar 1981	*C. mrigala*	Gills	India	13.8 × 9.2	6.2 × 3.4 and 3.9 × 2.6
M. venkateshi Seenappa and Manohar 1981	*C. mrigala*	Gills	India	9.75 × 7.15	5.25 × 2.0
M. kuleminae Donec in Shulman 1984	*Aspius aspius, Leuciscus leucisucs*	Muscles, heart	Ukraine	15.0–19.5 × 12.0–15.0	7.0–9.0 × 4.0–5.0
M. indirae (Kundu 1985) Gupta and Khera 1988	*C. mrigala*	Scales of tail fin	India	12.6 × 9.6	4.7 × 2.2
M. haldari Gupta and Khera 1989	*C. mrigala*	Fin, gills	India	9.31 × 7.95	4.31 × 2.97 and 2.95 × 1.98
M. crucifilus (synonyms *Gyrospora crucifilus* Qadri 1962) Landsberg and Lom 1991	*Labeo fimbriatus*	Gills	India	9.0–10.0 × 8–8.5	4.0–4.5

Table 2 continued

Species	Host	Site of infection	Locality	Spore	Polar capsule
M. salmonis (Hoshina 1949) Landsberg and Lom 1991	*Oncorhynchus keta*	Lower side of scales	Russia	8.2–10.4 × 7.4–9.5	3.6–5.8 × 2.1–3.4
M. yogindrai (Tripathi 1952) Landsberg and Lom 1991	*C. mrigala*	Inner side of scales	India	9.0–9.5 × 7.2	2.8 × 3.6
M. orissae Haldar et al. 1997	*C. mrigala*	Gills	India	15.71 × 6.8	8.8 × 1.78 and 7.58 × 2.57
M. ophthalmasculata Basu and Haldar 2002	*C. mrigala*	Eye muscle	India	13.13 × 8.04	5.47 × 3.06 and 3.03 × 1.99
M. balantiocheili Levsen et al. 2004	*Balantiocheilos melanopterus*	Central nervous system	Thailand	12.3 × 10.0	5.7 × 3.6
M. naini Kaur and Singh 2008	*C. mrigala*	Gills	India	12.9 × 8.2	4.9 × 3.1 and 3.33 × 1.63
M. eirasi Kaur and Singh 2009a	*C. mrigala*	Gills	India	8.6 × 6.7	3.2 × 1.57
M. slendrii Kaur and Singh 2009b	*C. mrigala*	Gills	India	14.87 × 3.4	5.74 × 1.48
M. mehlhorni Kaur and Singh 2011	*C. mrigala*	Gill lamellae (mucous membrane)	India	8.9 × 6.8	3.7 × 2.5 and 2.6 × 1.5

catostomus; *M. vanivilasae* Seenappa and Manohar 1980 from beneath muscles, scales integument of *C. mrigala*; *M. hosadurgensis* Seenappa and Manohar 1981 from gills, muscles of *C. mrigala*; *M. shetti* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. vedavatiensis* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. venkateshi* Seenappa and Manohar 1981 from gills of *C. mrigala*; *M. kuleminae* Donec in Shulman 1984 from muscles, heart *of Aspius aspius*, *Leuciscus leucisucs*; *M. indirae* (Kundu 1985) Gupta and Khera 1988 from scales of tail fin of *C. mrigala*; *M. haldari* Gupta and Khera 1989 from fin, gills of *C. mrigala*; *M. crucifilus* (synonyms *Gyrospora crucifilus* Qadri 1962) Landsberg and Lom 1991 from gills of *Labeo fimbriatus*; *M. salmonis* (Hoshina 1949) Landsberg and Lom 1991 from lower side of scales of *Oncorhynchus keta*; *M. yogindrai* (Tripathi 1952) Landsberg and Lom 1991 from inner side of scales of *C. mrigala*; *M. orissae* Haldar et al. 1997 from gills of *C. mrigala*; *M. ophthalmasculata* Basu and Haldar 2002 from eye muscle of *C. mrigala*; *M. balantiocheili* Levsen et al. 2004 from central nervous system of *Balantiocheilos melanopterus*; *M. naini* Kaur and Singh 2008 from gills of *C. mrigala*; *M. eirasi* Kaur and Singh 2009a from gills of *C. mrigala*; *M. slendrii* Kaur and Singh 2009b from gills of *C. mrigala* and *M. mehlhorni* Kaur and Singh 2011 from gill lamellae (mucous membrane) of *C. mrigala*, however, differ from above species in morphometric characteristics.

In the present species, spores are spherical having rounded anterior and posterior ends without parietal folds. An intercapsular process is absent. A prominent tubular structure originate from the anterior end of one of the polar capsule and extend backwards beyond the margin of the spore body and run upwards to join the posterior end of the other polar capsule. In this respect, the present species is comparable with *M. crucifilus* in which a thread-like structure has also been reported in the sporoplasm which join the posterior ends of each polar capsule directly (without any prominent bodies) and to *M. eirasi* having a band-like structure running in its sporoplasm originating from one rounded body to join the second rounded body present just beneath the other polar capsule (laterally). However, the spores of *M. crucifilus* and *M. eirasi* are pyriform, with more narrower and bluntly curved posterior end in the former and anterior end broader with posterior end bluntly rounded in the later. The thread-like structure/band in both the above mentioned species are confined to sporoplasm only unlike in the present species in which the tubular structure extend backwards beyond the margin of the spore body and runs upwards to join the posterior end of the other polar capsule.

On the basis these difference, we propose the species under study as new to the science and named it as *M. kanjali* sp. nov. through this communication.

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