

FOUR NEW SPECIES OF CERATOMYXA THELOHAN 1892 (MYXOSPOREA : CERATOMYXIDAE) FROM GALL BLADDER OF SOME TELEOSTS OF THE BAY OF BENGAL COAST OF WEST BENGAL, INDIA

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Four new species of *Ceratomyxa* Thelohan 1892 (Myxosporea : Ceratomyxidae) have been described from the gallbladder of some teleosts of the Bay of Bengal. These are *Ceratomyxa jellae* sp.n. from *Arius jella*, *Ceratomyxa militarisa* sp.n. from *Osteogeneiosus militaris* (Linnaeus), *Ceratomyxa subequalis* sp.n. from *Arius gagora* (Hamilton-Buchanan) of Ariidae and *Ceratomyxa asymmetrica* sp.n. from *Liza parsia* of Mugilidae.

Key words : *Ceratomyxa* spp., Myxosporea, Ariidae (marine), Mugilidae, Gall bladder. The Bay of Bengal, West Bengal, India.

INTRODUCTION

The species of the genus *Ceratomyxa* Thelohan 1892 (except a few species) are coelozoic myxosporea infecting marine fishes throughout the world. Altogether 179 species are known today (Eiras, 2006; Lom & Dykova, 2006; Reed *et al.*, 2007; Heiniger *et al.*, 2008). Only 15 *Ceratomyxa* spp. have been described from Indian fish (Kalavati & Nandi, 2007). The present investigation made by me on the diversity of myxosporean infection in fish of the Bay of Bengal coast of West Bengal, India during 2003-2007 has been resulted in isolation of some gallbladder-inhabiting species. Four new species of the genus *Ceratomyxa* Thelohan 1892 have been incorporated here.

MATERIALS AND METHODS

Fishes were collected from the Bay of Bengal coast of West Bengal at Digha and preserved in a large box with ice and brought to the laboratory. These fishes have been examined under the microscope from time to time for myxosporean infections. Squash preparations of the infected gallbladder and other organs contents were made and live mature myxosporean spores and plasmodia detected were observed under the microscope (10x & 100x oil magnification). The live spores were measured according to the guidelines provided by Lom & Arthur (1989). The arithmetic mean and standard deviation of spore measurements are provided in micrometers (μm), followed in parentheses by minimum and maximum values. Spores were measured from several infected host specimens samples of gall bladder containing plasmodia and spores. Giemsa (1:20) was used for staining dry smears of infected tissue after prefixed in absolute methanol. The figures were drawn with the aid of camera lucida and Coreldraw 12. The microphotographs were taken with standard equipment. The following abbreviations have been used here :

(Abbreviations. Llsv : length of large shell valve; Lssv : Length of small shell valve; Sd : sutural diameter; Sp : spore; Sv : shell valve; Pc : polar capsule; diam : diameter; L : length; W : width).

RESULTS AND DISCUSSION

Ceratomyxa jellae sp. n. (Figs. 1, 2)

Early plasmodium not seen; mature plasmodia disporic; mature spores broadly elongated; its anterior surface strongly convex and the posterior surface almost straight; shell valves conical, symmetrical, smooth with slightly protruding ends; two polar capsules unequal, almost spherical, placed at the centre of the spores just below the convex margin; suture not discernable; polar filament in each capsule not distinct; small sporoplasm encircles the polar capsules with no distinct nucleus. Dimensions of spores (based on 30 fresh spores) : 16.4 ± 1.43 (15 - 18) μm x 33.04 ± 4.243 (30 - 39) μm and polar capsule large 6.23 ± 0.865 (5.7 - 7.5) μm , small: 4.2 ± 0.954 (3.8 - 5.0) μm .

Taxonomic summary

Host : *Arius jella* Family : Ariidae

Site of infection : Gallbladder

Prevalence : 2/17 (11.8 %)

Pathogenicity : Not apparent

Locality : The Bay of Bengal coast of West Bengal, India

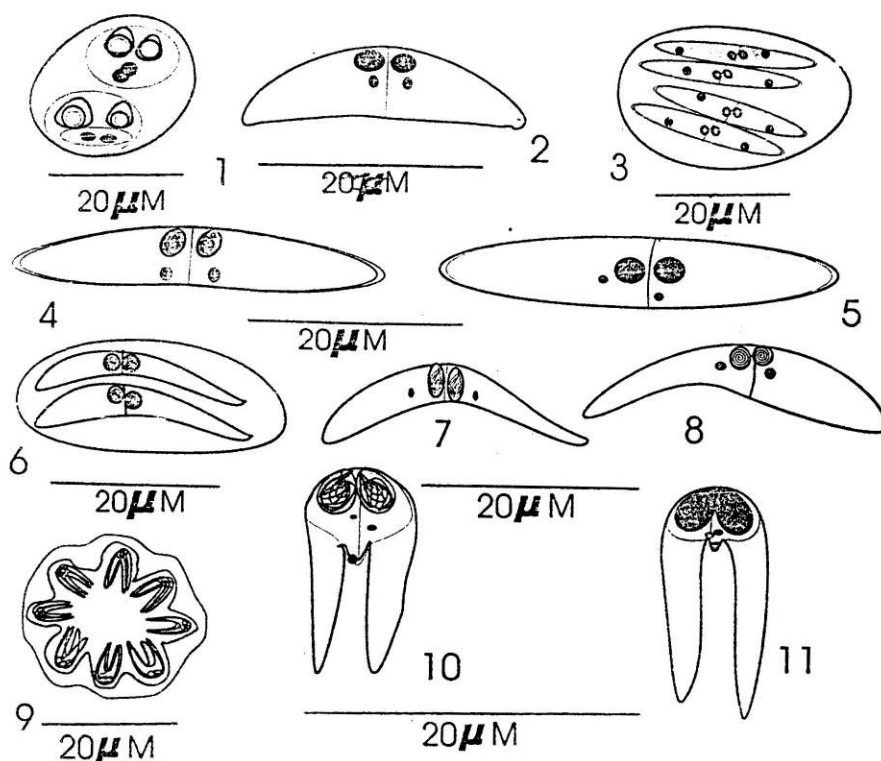
Material : Syntypes on slide no. MxCrb. - 102, deposited to the Protozoa section of ZSI Kolkata, India.

Affinities : This *Ceratomyxa* sp. in the shape of spores, shows some similarities with the following *Ceratomyxa* spp. reported from the gallbladder of marine fishes: *C. mesospora* Davis 1917 reported from *Cestracion zygaena*, USA off Atlantic Ocean (Sp. - convex anterior and straight posterior surfaces, 8 μm x 50 - 60 μm ; pc.- asymmetrical, spherical 4.5 μm diam.); *C. obtusa* Shulman 1966 from *Sphaeroides borealis* of Russia off Sea of Japan (Sp.- anteriorly convex, posteriorly almost straight or slightly concave, 9 - 10 μm x 44 - 49 μm); *C. sebasta* Moser *et al.* 1976 from *Sebastes carnatus* of USA off Pacific Ocean (Sp - anterior convex and posterior straight or minutely concave, 14.5 (13 - 16) μm x 31.5 (25 - 35) μm ; *C. lagocephali* Kpatcha *et al.* 1996 from *Lagocephalus laevigatus* of Senegal off Atlantic Ocean (Sp - anterior convex and posterior straight or slightly concave, 9 - 10.5 μm x 20 - 22.5 μm and *C. sympetala* Aseeva 1992 from *Epidopsetta bilineata* of Russia off Okhotsk Sea (Sp - anterior convex, posterior straight or minutely concave, Sv. unequal, 10 - 16 μm x 38 - 45 μm , Pc. equal, 2.7 μm diam.). However, the mensural data of spores of the current *Ceratomyxa* sp. (Sp. 15 - 18 μm x 30 - 39 μm) is somewhat overlapped by the mensural data of *C. sebasta* and *C. sympetala* but the ratio of sutural diameter to spore width 1: 2.17 and 1:3.19, respectively of the later two species are greater than 2.09 of the present species. Moreover, its polar capsules are unequal and the locality of its host is far away place. So, I consider the current species a new one and is named *Ceratomyxa jellae* sp.n..

Etymology : The epithetic name is given after the species name of the host.

Ceratomyxa militarisa sp. n. (Figs. 3-5)

Plasmodia large, tetrasporic; mature spores laterally elongated with broadly pointed, both anterior and posterior surfaces slightly convex, suture not distinct, shell valves equal, symmetrical and smooth; two polar capsules equal, ellipsoidal, placed towards



Figs. 1-11 : Plasmodium and spore of *Ceratomyxa jellae* sp.n. **1.** A disporic plasmodium-Lugal's iodine; **2.** A spore in side view - Giemsa. *C. militaris* sp.n. **3.** A tetrasporic plasmodium- Giemsa; **4,5.** Spores in side view and top view respectively-Giemsa. *C. asymmetrica* sp.n. **6.** A fresh disporic plasmodium-Lugal's iodine; **7.** A stained spore in side view-Giemsa; **8.** A fresh spore in side view-Lugal's iodine. *C. subequalis* sp.n. **9.** A fresh polysporic, dispansporoblastic plasmodium - Lugal's iodine; **10,11.** Spores in fresh and stained respectively.

anterior surface, turns of polar filament not discernable. extra-capsular spore cavity filled by binucleate sporoplasm encircling the paired polar capsule.

Measurements : (Based on 30 fresh spore) : Spore - Sutural diameter - 6.33 ± 0.726 ($5.5 - 7.0$) μm , Width - 49.33 ± 2.41 ($47 - 52$) μm ; Dimension of polar capsule : 5.05 ± 0.852 ($4.0 - 6.0$) $\mu\text{m} \times 3.53 \pm 0.71$ ($3 - 4$) μm .

Taxonomic summary

Host : *Osteogeneiosus militaris* (Linnaeus) Family : Ariidae

Site of Infection: Gallbladder

Incidence : 2/19 (10.53%)

Pathogenicity : Not apparent

Locality : The Bay of Bengal coast of West Bengal, India

Material : Syntypes on slide no. MxCrm. -102, deposited to the Protozoa section of ZSI, Kolkata, India.

Affinities : The present *Ceratomyxa* sp. having broad, laterally elongated spores with round ends shows resemblances with *C. aggregate* Davis 1917 from *Synodus foetuns* of USA off Pacific Ocean (Sp.- $6.0 - 7.0 \mu\text{m} \times 50.0 \mu\text{m}$, Pc.: $3.5 \mu\text{m}$ diam.). *C. californi*

Jameson 1929 from *Pilistostrema stouti* of USA off Pacific Ocean (Sp.- 7.8 - 9.0 μm x 48.0 - 59.0 μm ; *Ceratomyxa orthospora* Kovaleva *et al.* (2002) reported from the gallbladder of *Chaenodraeo wilsoni* (Sp.- 6.7 - 7.8 μm x 40.0 - 53.0 μm ; Pc. 3.3 μm x 3.9 μm). However, the shape of the spore and dimension of the polar capsules are much different. Moreover, the polar capsule of the present species are broadly pyriform and larger than the other *Ceratomyxa* spp. mentioned above. Besides, the spores of *C. nangae* Sarkar 2004 from *Tachysurus nenga* of West Bengal, India off The Bay of Bengal has broadly pointed ends while it is narrowly round in the spore of the present species with longer spore width and smaller polar polar capsule. So, the present species is considered new and named *Ceratomyxa militarisa* sp.n.

Etymology : The epithetic name is derived from host's name.

***Ceratomyxa asymmetrica* sp. n. (Figs. 6-8)**

Early plasmodia not observed; sporogonic plasmodia ellipsoidal and disporic; mature spores asymmetric with convex anterior and concave posterior surfaces; two shell valves equal but dissimilar in shape- one shell valve conical with round end and other elongate-s-shaped, sharp, narrow but round end; suture straight and vertical; two polar capsules equal, broadly pyriform opening anteriorly side by side, polar filament in each capsule not discernable; binucleated sporoplasm occupying entire extracapsular spore cavity.

Measurements : (based on 30 fresh spores): Sd - 6.08 ± 1.39 (5.25 - 8.0), SpW - 52.5 ± 3.881 (48 - 57); PcL - 5.91 (5.25 - 6.75), PcW - 3.8 (3.2 - 4.5).

Taxonomic summary

Host : *Liza parsi* Family : Mugilidae

Locality : The Bay of Bengal coast of West Bengal, India

Site of infection : Gallbladder

Incidence : 4/36 (11.1%)

Pathogenicity : Not apparent

Period of infection : July to October of 2005, 2006

Material : Syntypes on Sl.no. MxCra. - 213, deposited to parasitology section of ZSI, Kolkata, India.

Affinities : The present *Ceratomyxa* sp., regarding the spore shape, conforms with the following *Ceratomyxa* spp. reported from the gall bladder of marine fishes: *Ceratomyxa aglomerata* Davis 1917 from *Synodus foetans* off Atlantic Ocean (Sp- elongate, Sv - unequal, larger valve attenuated, laterally compressed, 5 μm x 24-28 μm , Pc-3 μm diam.; *C. recurveta* Davis 1917 from *Cestracion zygaena* off Atlantic Ocean (Sp - occasionally asymmetrical, 8 - 9 μm x 16 μm , Pc - 4.5 μm diam.); *C. intexua* Meglitsch 1960 from *Jordanidia solandri* off Pacific Ocean (Sv - quite unequal, Sp - slightly curved, 4.4 (3.4 - 5.4) μm x 15.4 (9.3 - 20.1) μm and *C. australis* Gaevskaya *et al.* 1979 from *Tachysurus tachysurus capensis* off Atlantic Ocean (Sv - one slightly longer and narrower, Sp - 4 - 5.3 μm x 13.3 - 15 μm , Pc - 3 μm x 1.8 - 2.5 μm). *C. miyajinae* Fujita 1923 (cited from Eiras, 2006) from *Rhinoplagus japonica* off Sea of Japan (Sp- asymmetrical, 17 μm x 45 - 60 μm , Pc- 5 μm diam.) and *C. lophii* Heiniger *et al.* 2008 from *Lophius piscatorius* off west and northwest of Scotland and from *L. budegassa* off south coast of Portugal (Sp.- asymmetrical, 5.6 - 8 μm x 30.0 - 39.6 μm , Sv- unequal and smooth, Pc - 3.0 - 5.4 μm

diam). All these *Ceratomyxa* spp. except *C. miajina* and *C. lophii*, are somewhat similar in shape of spores but the mensural data of spore and polar capsule of the current species is much larger than that of the above mentioned *Ceratomyxa* spp.. However, the spore of *C. miajinae* in morphometry almost overlaps the spore of the present species except that the sutural diameter of the current species 6.08(5.25 - 8.25µm) is much smaller. Similarly, the spore of *C. lophii* looks alike but its width is smaller than that of the current *Ceratomyxa* sp. So, the present species has been considered a new species and named *Ceratomyxa asymmetrica* sp.n..

Etymology : The species name has been derived from the asymmetrical nature of its shell valves.

***Ceratomyxa subequalis* sp. n.(Figs. 9-11)**

No early plasmodia observed, sporogonic plasmodia polysporic, dispansporoblastic; mature spores inverted 'U'-shaped, two shell valves descend downwards opposite to hemispherical anterior surface forming an acute angle between two at suture, suture thin and vertical - slightly bent, two shell valves subequal in length and width, the ends gradually taper to roundly pointed; two polar capsules broadly pyriform, converging anteriorly- one at each side of suture, polar filament in each capsule 5 – 6 turns, polar capsule encircled by oval binucleate sporoplasm having a triangular short projection opposite to polar capsules, no vacuole or mucous envelope.

Measurements : (based on 30 fresh spores): Sd.- 7.92 (6.0 - 9.0) µm, SpW - 54.8 (50.0 - 59.0)µm; PcL - 5.04 (3.75 - 5.25)µm, PcW - 3.9 (2.9 - 4.5) µm, Llsv - 28.3 (25.0 - 31.0) µm Lssv - 24.24 (23.0 - 26.0) µm; Ratio of Lssv: Llsv = 1: 1.2

Taxonomic summary

Host : *Arius gogora* (Hamilton-Buchanon) *Family :* Ariidae

Site of Infection : Gallbladder

Incidence : 2/68 (2.94%)

Pathogenicity : Not apparent

Location : The Bay of Bengal coast of West Bengal, India

Period of infection : January - February, 2005 & 2006

Material : Syntypes on Sld.no. MxCrs. 47, deposited to the Protozoa section of ZSI, Kolkata, India

Affinities : The present *Ceratomyxa* sp. in having inverted U-shaped spore and subequal shell valves conforms with *Ceratomyxa globulifera* Thelohan 1894 reported from the gallbladder of *Merluccius vulgaris* from Japan off Mediterranean Sea (Sv. - unequal, longer with tapered end and shorter with rounded end, Sp.- 10µm x 50µm, *C. protopsettae* Fujita 1923 (cited from Eiras 2006) from gallbladder of some flounders from South Korea off Sea of Japan (Sv. unequal - thicker with blunt end and thinner with sharp end, Sp- 10 - 12µm x 50 - 65µm, Pc. 6µm x 4µm), *C. jamesoni* Kudo 1933 from *Triakis semifasciatus* of USA off Pacific Ocean (Sv.- unequal with ends projected, Sp.- strongly bent, 7.5 - 9.5µm x 95 - 117µm, Pc.- unknown), *C. porrecta* Dogiel 1948 (cited from Shulman 1966) from *Gymnacanthus herzensteini* of Russia off Sea of Japan (Sv.- thin, slightly unequal - 23 - 30 µm or 27 - 34 µm, Sp.- 4 - 5µm x 50 - 64 µm, Pc.- 3µm dia.), *C. hokarari* Meglitsch 1960 from *Genypterus blacodes* of New Zeland off Pacific

Ocean (Sv.- subequal, Sp.- sharply bent, 11.9µm x 35.6µm to 48.4µm, Pc.- 3.9µm diam.), *C. uncinata* Meglitsch 1960 from *Pelotretis flavilatus* of New Zealand off Pacific Ocean (Sp - strongly bent, Sv.- unequal, 11.7 (10.9 - 14) µm x 32.2 (27.8 - 36)µm Pc. 4 (3.3 - 4.4)µm x 3.6 (3.3 - 4) µm, *C. fistulariae* Kpatcha *et al.* 1996 from *Fistularia petamba* of Senegal off Atlantic Ocean (Sv.- unequal, Sp.- 10.2µm x 39.6µm, Pc.- 5.2µm) and *C. trichuri* Kpatcha 1996 from *Trichiurus lepturus* of Senegal off Atlantic Ocean (Sp- strongly arched, 10.6 (10 - 12) µm x 99.2 (98 - 100) µm, Pc - 4.8µm diam.) and *C. aspera* Aseeva 2003 from *Limanda aspera* of Russia off Sea of Japan (Sv - unequal, Sp - 8 - 10µm x 38 - 69µm, or 34 - 43µm, Pc - 4 - 4.5µm). All the *Ceratomyxa* spp. mentioned above have been obtained from the gallbladder of respective hosts. The present *Ceratomyxa* sp., by virtue of its inverted "U"- shaped spores resembles closely with *Ceratomyxa hokarari*, *C. jamesoni*, *C. protecta* and *C. aspera* but differ also by thinner long shell valve with narrow pointed and thicker broad end and dark, pointed projection from opposite to arched surface and very large polar capsule. The rest of the *Ceratomyxa* spp. mentioned above have different mensural data of spores than the current species. Therefore, the present species has been considered new and proposed the name *Ceratomyxa subequalis* sp.n.

Etymology: The epithetic name is given to highlight the slightly unequal shell valves.

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REFERENCES

- ASEEVA, N.L. 1992. Myxosporidia from *Lepidopsetta bilineata* of the Avachinskaya Bay. *Parazitologiya*. **26** : 161-165 (In Russian).
- ASEEVA, N.L. 2002. New species of myxosporeans (Myxozoa, Myxosporidia) from sculpins of the north-western Japan Sea. *Acta Parasitol.* **47** : 179-189.
- ASEEVA, N.L. 2003. New species of myxosporean (Myxozoa, Myxosporidia) parasites of *Ceratomyxa* from fishes of Peter the Great Bay (Japan Sea). *J. Parasitol.* **89**: 1172-1180.
- DAVIS, H.S. 1917. The Myxosporidia of the Beaufort region. A Systematic and Biologic study. *Bull US. Bur. Fisheries*. **35** : 199-252.
- EIRAS, J.C. 2006. Synopsis of the species of *Ceratomyxa* Thelohan 1892 (Myxozoa : Myxosporidia: Ceratomyxidae). *Syst. Parasitol.* **65** : 49-71.
- GAEVSKAYA, A.V. & KOVALEVA, A.A. 1979. Two new species of myxosporidia, *Davisia doneceae* sp.n. and *Ceratomyxa australis* sp.n. from the horse mackerel of the southeastern Atlantic. *Biol. Mor. Bladivos*. **3** : 80-83 (In Russian).
- HEINIGER, H., GUNTER, N.L. & ADLARD, R.D. 2008. Relationship between four novel Ceratomyxid parasites from the gallbladder of labrid fishes from Heron Island, Queensland, Australia. *Parasitol. Inter.* **57** : 158-165.
- JAMESON, A.P. 1929. Myxosporidia from California fishes. *J. Parasitol.* **16** : 59-68.
- KALAVATI, C., PADMA DOROTHY, K. & PANDIAN, P. 2002. Gallbladder inhabiting Myxosporidia from fishes of Andaman Sea. *J. Parasit. Dis.* **26** : 89-100.
- KALAVATI, C. & NANDI, N.C. 2007. A Hand Book on Myxosporean parasites of Indian Fishes. Ed. By Director, ZSI, Kolkata : 295pp.
- KOVALEVA, A.A., RODIUK, G.N. & GRUDNEV, M.A. 2002. Myxosporeans (Cnidospora : Myxosporidia) of Atlantic fishes. *Parazitol.* **36** : 502-513.

- KPATCHA, T.K., DIEBAKATE, C. & TOGUEBAYE, B.S. 1996. Quelques nouvelles espèces e Myxosporidies, du genre *Ceratomyxa* Thélohan, 1895 parasites des poissons marins du Sénégal, Afrique de l'Ouest. *Parasite* **3** : 223-228.
- KUDO, R. 1933. A Taxonomic consideration of Myxosporidia. *Trans. Amer. Micros. Soc.* **25** : 195-216.
- LOM, J. & ARTHUR 1989. A guideline for the preparation of species description in Myxosporidia. *J. Fish Dis.* **12** : 51-56.
- LOM, J. & DYKOVA, I. 2006. Myxozoan genera: definition and notes on taxonomy, Life cycle, terminology and pathogenic species. *Folia Parasitol.* **53** : 1-36.
- MEGLITSCH, P. 1960. Some coelozoic myxosporidia from New Zealand fishes. I. General and family Ceratomyxidae. *Trans. Royal Soc. New Zealand.* **88** : 265-365.
- MOSER, M., LOVE, M.S. & JENSEN L. A. 1976. Myxosporidia (Protozoa) in California rockfish *Sebastes* spp. *J. Parasitol.* **62** : 690-692.
- NARASIMHAMURTI, C.C., KALAVATI, C., ANURADHA, I. & PADMA DOROTHI, K..1990. Studies on the protozoan parasites of deepwater fishes from the Bay of Bengal. *Proc. Ist. work. Sci. Res. FORV Sagar Sampada.* 1989 : 325-336.
- REED, C.C, BASSON, L, VAN, L.L. & DYKOVA, I. 2007. Four new myxozoans (Myxosporidia:Bivalvulida) from intertidal fishes along the south coast of Africa. *Folia Parasitol.* **54** : 283-292.
- SARKAR, N.K. 2004. On some new coelozoic myxosporidia from some teleost fishes of West Bengal, India. *J. Environ & Sociobiol.* **1** : 35-47.
- SHULMAN, S.S. 1966. Myxosporidian fauna of USSR. *Nauka, Moscow*, pp. 504.
- THELOHAN, P. 1894. Recherches sur les Myxosporidies. *Bull. Sci. Fr. Belg.* **26** : 100-394.