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Infestation of *Oreochromis niloticus* and *Tilapia zilli* fresh-water fishes with myxosporean parasites, Qena Province, Egypt

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ABSTRACT

Freshwater fishes were sampled from the River Nile at different localities in Qena Governorate (Qus, Qift, Dandara, El-Trammsa, El-Maana, Dishna and Nag-Hammady). The investigated fishes are *Oreochromis niloticus* (180) and *Tilapia zilli* (66). Out of 246 fishes examined, 61 (24.8%) were found to be infected with myxosporean parasites. The infection rate was 25% of *O. niloticus* and 24.2% of *T. zilli*. Eight species of *Myxobolus* spp. were described from gills and one species was found in blood. The collected parasites are *M. agolus*, *M. heterosporus* (type 2), *M. clarri*, *M. heterosporus* (type 3) and a myxosporean species had been found infecting gill filaments of *O. niloticus*. Meanwhile, blood of one *O. niloticus* fish was found harboring *Myxobolus* sp.I. *M. tilapiae*, *M. niloticus*, *M. zilli* and *M. fahmii* were found parasitizing gill filaments of *T. zilli*. *M. heterosporus* (type 2) had been studied using scanning electron microscope. Comparisons with closely related species are provided.

Key words: Fresh-water Fishes, Gills, *Myxobolus*, Infection rate, Qena, Egypt.

INTRODUCTION

A few works studied the myxosporean parasites of fresh-water fishes in Egypt. Fomena and Bouix (1997) listed 48 *Myxobolus* species infecting fishes in Africa, six *Myxobolus species* from Nile fish, five of which are new and one is redescribed: *M. naffari*, Abdel-Ghaffar *et al.*, 1998 was recovered from the gills of *L. niloticus* and the mouth of *B. bynni*; *M. caudatus* was observed in the tail fin of *B. bynni*; *M. fahmii* occurred in the gills of *B. bynni*; *M. imami* was found in the kidney of *L. niloticus*. *M. intestinalis* was recorded from the intestine of *B. bynni*, and *M. perforate* was found in the intestinal surface of the operculum of *H. forskalii*.

Ali *et al.* (2002) described *M. perforate* from the surface of the gill operculum of *Hydrocynus forskalii*. Abed (2005) made light and electron microscopic studies on *M. forskalii* (Myxozoa: Myxosporea) infecting the Nile fish *H. forskalii* at Assiut, Upper Egypt.

Abdel-Ghaffar *et al.* (2005) studied the ultra-structural characteristics of sporogenesis of the genus *Myxobolus* which infect four economically important Egyptian fishes: *O. niloticus niloticus*, *Barbus bynni*, *Labeo niloticus* and *H. forskalii*, specimens of which were collected at Giza city. Although the cysts were observed in different organs, the pattern of sporogenesis was the same. Moreover, the sporogenesis found in the present study followed the usual pattern valid for most of the Myxosporean genera studied. Hassan *et al.* (2007) found *Myxospora* sp. in blood of *Synodontis clarias* (prevalence 1.9%).Abdel-Baki (2011) have been studied *M. egyptica* sp. nov. (Myxozoa, Myxosporea), infecting the hornlip mullet *Oedalechilus labiosus* from the Red Sea.

The present study aimed to identify and to describe *Myxobolus* species parasitizing fresh-water fishes *Oreochromis niloticus* and *Tilapia zilli* in Qena province, Egypt.

MATERIAL AND METHODS

Freshwater fishes were collected from the River Nile at different localities in Qena Governorate (Qus, Qift, Dandara, El-Trammsa, El-Maana, Dishna and Nag-Hammady), Egypt. The 246 investigated fishes are 180 *Oreochromis niloticus* (Linnaeus, 1758) and 66 *Tilapia zilli* (Gervais, 1848). The fishes were immediately transported to the laboratory of zoology department, Faculty of Science, South Valley University, Qena to be investigated. Fresh gill smears of hosts and thin blood films were made. The smears and blood films were air dried. Permanent preparations were fixed with absolute methyl alcohol and stained with Giemsa's stain. Examinations of prepared slides were made with a compound microscope. Description were made according to Lom and Arthur (1989) and Lom and Dyková (1992). All measurements are measured with an eyepiece micrometer and presented in micrometers (µm).

For scanning electron microscope (SEM), cysts and spores were fixed in phosphate buffer 3.5 gluteraldehyde at pH 7.4, post fixed in 1% OSO_4 washed in Na-phosphate buffer (pH7.4). Fixed cysts were gently crushed. The spores were transferred to glass cover slips and mounted on copper studs, gold coated, and examined using Jeol JSM-T 10 Kv Scanning electron microscope following Gracia *et al.* (1997).

RESULTS

Eight species of *Myxobolus* were described from gills and one species was found in blood, in addition to one myxosporean species in gill filaments of *O. niloticus*. Out of 246 fishes examined, 61 (24.8%) were found to be infected with *Myxobolus* spp. The examined fishes are 180 *O. niloticus* and 66 *T. zilli*. The infection rate was 25% of *O. niloticus* and 24.2% of *T. zilli*. Regarding to collected parasites, *M. agolus*, *M. heterosporus* (type 2), *M. clarri*, *M. heterosporus* (type 3) and the myxosporean species had been found infecting gill filaments of *O. niloticus*. Meanwhile, blood of one *O. niloticus* fish was found harboring *Myxobolus* sp.I. Regarding to *T. zilli*, the collected parasites; *M. tilapiae*, *M. niloticus*, *M. zilli* and *M. fahmii* were found parasitizing gill filaments. The spores' measurements (µm) are presented in table (1).

Table 1: Measurements (µm) of *Myxobolus* spp. in the present study.

Species	Host	Spore		Polar capsule			Polar filaments length
		length	width	size	length	width	
M. agolus	*O. niloticus*	10.5-11.2	8.5-9.2	Equal in size	4.8-5.5	3.5-3.8	30-34.5
M. tilapiae	*T. zilli*	14-16.4	7.8-10.6	equal	3.5-4.7	2.4-3.5	------
M. niloticus	*T. zilli*	11.2-13.5	5.6-7.5	Unequal	5.8-7.2‹ 4.9-5.7	1.3-3.0‹ 1.8-2.6	-------
M. zilli	*T. zilli*	8.7-11.5	5.4-7.3	Equal	5.0-5.6	2.2-3.0	------
M. heterosporus type 2	*O. niloticus*	11.2-14.5	6.2-7.5	Equal	6.9-8.5	2.1-3.0	------
M. clarii	*O. niloticus*	9.1-12.4	6.8-9.7	equal	3.7-4.8	2.1-3.7	-----
M. fahmii	*T. zilli*	8.8-12.5	5.5-7.8	equal	6.0-7.8	2.1-3.8	-----
M. heterosporus type 3	*O. niloticus*	8.0-10	6.0-7.5	Two equal polar capsules	4.0-6.0	2.5-4.0	-----
Myxosporean species	*O. niloticus*	11.2-12.4	6.0-7.2	Three equal capsules	4.0-8.0	2.4-3.0	------
Myxobolus sp.I	*O. niloticus*	9.2-11.5	7.5-9.0	Two equal polar capsules	6.5-7.8	3.0-3.8	-----

***M. agolus* Landsberg, 1985 (Figs. 1-4):**

Spores ellipsoidal, anterior end rounded, length of polar capsules > 1/3 of spore length, polar capsules are greater than half of spore length, length of spores is 10.5-11.2µm, and width is 8.5-9.2µm, polar capsules are oval in shape equal in size, occupy about half the spore length, they are 4.8-5.5µm in length and 3.5-3.8µm in width. Length of polar filaments is 30-34.5µm. A large triangular inter-capsular process was noted between the anterior ends of the polar capsules, and sporoplasm occupies half the spore cavity. There are many pigments stained with Giemsa's stain in the upper part of the sporoplasm, and two rounded iodinophilous vacuoles.

***M. tilapiae* Abolarin, 1974 (Figs. 5 and 6):**

Spores are large in size, elongate (length 1.4 / width 2), with 2 small polar capsules generally located at anterior end, in plane parallel to sutural plane, shell valves are smooth, spores ellipsoidal, length of polar capsules 1\3 of spore length, polar capsules ovoid, their length < 1/4 of spore length, they are equal in size. The spores are 14.0-16.2µm in length and 7.8-10.6µm in width. Polar capsules are 3.5-4.7µm in length and 2.4-3.5µm in width. The triangular inter-capsular process is absent. Sporoplasm contains one rounded iodinophilous vacuole in the upper part of it, between and below the two polar capsules in the middle of the spore.

***M. niloticus* Fahmy *et al.*, 1971 (Fig. 7):**

Spores are elongate, ovoid, anterior end is more attenuated; polar capsules are unequal, pyriform. Sporoplasm has two rounded iodinophilic vacuoles; the triangular inter capsular process is absent. Spores measured 11.2-13.5µm in length and 5.6-7.5µm in width. Larger polar capsules are 5.8-7.2µm in length and 1.3-3.0µm in width. The small polar capsules are 4.9-5.7µm in length and 1.8-2.6µm in width.

***M. zilli* Sakiti *et al.*, 1991 (Fig. 8)**

Spores are sub-spherical, with a pointed anterior end and a rounded posterior end, including two polar capsules equal in size and pyriform with pointed anterior and posterior ends and wide in the middle, polar capsules occupied more than half of the spore length, each polar capsule has a small nucleus below it, stained blue in color with Giemsa's stain, sporoplasm contains two rounded iodinophilous vacuoles in the middle. Spores measured 8.7-11.5µm in length and 5.4-7.3µm in width. Polar capsule length is 5-5.6 µm and 2.2-3 µm in width.

***M. heterosporus* type 2 Baker, 1963 (Figs. 9 &10)**

Spores are elongated, ellipsoidal, anterior end rounded, length of polar capsules is greater than half of the spore length, polar capsules pyriform and very elongate (Ratio length / width = 4), reaching 2/3 of spore length; below each polar capsule a very small nucleus is found, very small inter capsular process is present between the anterior ends of polar capsules, the posterior end of the spores is pointed. The spores are 12.2-14.5µm in length and 6.2-7.5µm in width, length of polar capsules is 6.9-8.5 µm and width is 2.1-3.0µm.

Scanning electron microscopy for plasmodia showed irregular spores at various angles. Some features of spores are more clearly resolved by SEM where the dorso-ventral aspects had an oval shape. SEM revealed the smooth nature of the spore valve surface, and showed the lacking of mucus strands on the surface. Also showed the shell valves (SV), the anterior polar capsules (PC), and the structural ridge line (Sr. L) represented by anterior and posterior grooves. The ventral view of the spore showed that the cytoplasm (C) extends to the wall of the spore.

***M. fahmii* Ali *et al.*, 2002 (Fig. 11)**

Plasmodia are oval to sub-circular in shape and situated mostly at the central part of gill filaments, the infected fish harbored 2-7 cysts; they are 0.3-0.8 mm. Spores

were Pear-shaped with a characteristic ripple-like anterior tip, they are 8.8-12.5 x 5.5-7.8 µm. Shell valves of spores are moderately smooth and symmetrical without any articulations or thickenings; a large triangular inter-capsular process between the openings of the two equal polar capsules is found. Sporoplasm is disporic with a large iodinophilous vacuole between the two ends of polar capsules. Polar capsules were pyriform in shape, equal in size and occupied more than half the spore length. They are 6.0-7.8 µm in length, and 2.1-3.8 µm in width.

***M. clarii* Mandour *et al.*, 1993 (Fig. 12)**

The cysts of this *Myxobolus* species are detected from gill filaments of *O. niloticus* fish. It is small in size, white in color, the plasmodia are oval and the diameter is 0.4-0.9 mm. The spores are mostly round and sometimes slightly elliptical; they are 9.1-12.4 µm in length and 6.8-9.7 µm in width. Spore was provided with two oval and equal polar capsules, the triangular inter capsular polar process is absent. The polar capsules are 3.7-4.8 µm in length and 2.1-3.0 µm in width.

***Myxobolus* sp. I (Present parasite), (Fig. 13)**

Haemoparasite of the genus *Myxobolus* was observed only in the blood of *O. niloticus,* where only one specimen out of 180 is infected with this parasite with prevalence of 0.55%. Spores are sub-spherical, 8.0-10 µm in length and 6.0-7.5 µm in width, with two large oval and equal polar capsules each of them is measured 4.0-6.0 µm in length and 2.5-4.0 µm in width, and there is a small inter-capsular process between the anterior ends of polar capsules.

***M. heterosporus* type 3 Baker, 1963 (Fig. 14)**

Cysts of this parasite were found in gills of *O. niloticus*, spores ovoid 1.2 < length/width, 9.2-11.5 µm in length and 7.5-9.0 µm in width, polar capsules are large in size, elongated, they are 6.5-7.8 µm in length and 3.0-3.8 µm in width occupied more than half the spore length, equal in size, ratio of polar capsule length/width ≥2. Polar capsules are sometimes curved, shell valves moderately smooth and symmetrical without any articulations or thickenings. The anterior ends of polar capsules are crossing over each other. There is a round iodinophilous vacuole in sporoplasm which is a small region of the spore. A small triangular inter-capsular polar process is present between the anterior ends of polar capsules.

The myxosporean species (Fig. 15)

Spores elongate 11.2-12.4 µm in length with pointed anterior end and rounded posterior end; in dorsal view there are three capsules, two are polar in position, but the third lies between the posterior ends of them in the middle of the body, and the three capsules are pyriform and equal in size, their length is 4.0-8.0 µm and their width is 2.4-3.0 µm. There is no inter-capsular process, the body of the spores in the region of the two polar capsules is wider than the part posterior to them 6.0-7.2 µm. Sporoplasm is a small and clear region without any nucleus or iodinophilous vacuoles.

DISCUSSION

The closely related *Myxobolus* species previously described in some freshwater fishes in Africa and spores of Cichlid fishes from Africa according to Fall *et al.* (2000) are summarized in tables (2 and 3) for comparison and to avoid multiple repetitions.

***M. agolus* Landsberg, 1985**

These spores are preliminarily identified as *M. agolus* Landsberg, 1985 and previously recorded in the same host *O. niloticus* by Fall *et al.* (2000) in Cameroon, Senegal and Chad, and also recorded in *O. niloticus* and *T. zilli* in Nigeria by

Obiekezie and Okaeme, (1990) and in *O. niloticus* and *Hemichromis fasciatusfrom* Cameroon by Fomena and Bouix (1997).

Table 2: Measurements (µm) of *Myxobolus* spp. previously described in some freshwater fishes in Africa.

Parasite species	Host	Spore			Polar capsule		N. of Polar filament coils
		shape	length	width	length	width	
M. niloticus Fahmy *et al*., 1971	*L. niloticus*	elongate, polar capsules unequal	10-12	6.5-8.0	Large: 5-7 small: 2.5-4.5	Large: 2.5-3.5 small: 1.5-2.0	-----
M. fahmii Ali *et al*., 2002	*B. bynii*	pear shaped with a characteristic nipple-like anterior tip	10.8-12.0	6.4-8.0	6.4-7.2	2.8-3.8	6-7
M. clarii Mandour *et al*., 1993	*C. gariepinus*	mostly rounded or slightly elliptical	10.3-12.3	7.8-10.3	4.4-5.8	2.6-3.3	5
M. nelei after Faisal and Shalaby, 1987	*O. niloticus*	elongate with rounded anterior end	11.5-12.5	7.5-8.5	7-8	3.0-3.5	5-6
M. tilapiae Abolarin, 1974	*O. niloticus, T. zilli*	ellipsoidal with rounded anterior end	12-20	7.5-11	2.0-3.5	2.0-2.5	------
M. dossoui Sakiti *et al.*, 1991	*O. niloticus, T. zilli*, *T. mosambica*	Polar capsules are unequal in size	8.5-11	8.0-10.5	Large: 4.5-6.5 Small: 3.5-5.0	2.0.5-5 2.0-3.5	7-9 5-6
M. zilli Sakiti *et al.*, 1991	*C. gariepinus*	oval, polar capsules are pyriform	8.3-10.3	5.9-6.9	5.1-6.4	2.5-2.9	9
M. tilapiae Abolarin, 1974	*T. randalli randalli*	oval with bluntly rounded anterior and posterior end	14-15.5	12-12.6	3.8-5.0	3.0-4.0	4-6
M. paludinosus Reed *et al.*, 2002	*B. paludinosu*	pyriform to ovoid with tapering anterior and rounded posterior end	11.2-13.7	7.5-10	5.0-6.8	2.0-2.5	6-8

Table 3: Measurements (µm) of *Myxobolus* spp. spores of Cichlid fishes from Africa according to Fall *et al.* (2000).

Species	Shape	Spore		Polar capsule			N. of polar filament coils
		length	width	size	length	width	
M. zilli Sakiti *et al.*, 1991	Ovoid, polar capsules pyriform	10-11	5-6	Equal in size	4-7	1-2	6-8
M. israelensis Landsberg, 1985	Ovoid, polar capsules pyriform	14-16	8-10	Equal in size	8-10	3-4	6-8
M. kainjiae Obiekezie and Okaeme, 1990	Ovoid or slightly sub-spherical, polar capsules ovoid	9-11	6-9	Equal in size	3-4	2-3	4-5
M. sarigi Landsberg, 1985	Spores and polar capsules are ovoid	11-13	8-9	Equal in size	4-5	3-4	4-6
M. tilapiae Abolarin, 1974	Ovoid, polar capsules pyriform	14-16	10-12	Unequal in size	4-6	3-4	5-8
M. equatorialis Landsberg, 1985	Polar capsules pyriform	12-14	6-8	Equal in size	Large: 3-5 Small: 2-4	Large: 3-5 Small: 2-4	4-5
M. fotoi, Fomena *et al.*, 1993	Polar capsules oval in shape	13-16	10-14	Equal in size	4-5	3-4	5-6
M. heterosprus Baker, 1963	Polar capsules pyriform, equal in size	9-11	7-9	Equal in size	8-10.5	2-3.5	6-10
M. homosporus Baker, 1963	Spores and polar capsules are ovoid	14-16	9-10	Equal in size	4.5-6.5	3-5	5-6
M. agolus Landsberg, 1985	Sub-spherical, polar capsules pyriform	9-11	9-10	Equal in size	6-7	3-4	-------
M. brachysporus Baker, 1963	Ellipsoidal polar capsules pyriform	11-14	7-9	Equal in size	3.5-5	3-4	5-6
M. camerounensis Fomena *et al.*, 1993	Polar capsules pyriform, spores ovoid	14-22	10-16	Equal in size	6-8	2-5	6-7
M. clarii Mandour et al., 1993	Ovoid or slightly sub-spherical, polar capsules ovoid	10-12	10-11	Equal in size	3-5	2-3	-----

By comparing the shape and measurements of this species with different previously described species of *Myxobolus* we found that it is similar with *M. nelei*, after Faisal and Shalaby (1987) in over all spore shape and some dimensions but the length of the present species spore is smaller than previous one, the spore width and the length of polar capsule is larger. When comparing the present species with *M. tilapiae* described by Abolarin (1974) the two are slightly similar in shape of the spores, but it was found that the spores in the present study are smaller than the previous species. By comparing the present species with *M. agolus* described by Landsberg (1985) it was found that the two are similar in both the spores shape and dimensions and also in the host and in the site of infection, also they differ only in the length of polar capsules, where the length of polar capsules in the present species is slightly smaller than in *M. agolus*. From the previous reports the present species is *M. agolus*.

***M. tilapiae* Abolarin, 1994**

The present species is preliminarily identified as *M. tilapiae* according to Abolarin (1974), and was previously recorded in *O. niloticus*, *T. zilli* and *T. mosambica* in Africa by Fomena and Bouix (1997), and in *T. rendalli rendalli* by Reed *et al.* (2002) in the Okavango River and Delta of Botswana, South Africa, and the same parasite also previously recorded from *O. niloticus* and in *T. margaritacea* in Cameroon by Fall *et al.* (2000).

By comparing the shape and measurements of the present species with different previously described species of *Myxobolus* it was found that it is similar to *M. tilapiae* that is similar to *M. heterosporus* Baker, 1963 in overall spore shape. The polar capsules of *M. heterosporus* are, however, more pyriform, compared with the more spherical polar capsules of *M. tilapiae* that is similar to *M. polycentropsi* Fomena *et al.*, 1985 and *M. synodonti* Fomena *et al.*, 1985, parasites of *Polycentropsis abbreviate* and *S. batesii*, respectively. The former myxosporean species *M. polycentropsi* is similar to *M. tilapiae* in having a bluntly rounded anterior and posterior ends. The polar capsules of M. *polycentropsi* are, however more pyriform (Fomena *et al.*, 1985), compared with the almost spherical ones in *M. tilapiae*. Finally, *M. synodonti* Reed *et al.*, 2002 is distinct from *M. tilapiae* in having anterior end slightly more tapered than the more rounded posterior end. The polar capsules of *M. synodonti* are much larger and elongated compared with the more spherical polar capsules of *M. tilapiae*.

***M. niloticus* Fahmy *et al.*, 1971**

Regarding the similar myxosporean species to the present parasite, only two species were worthy to compare, *M. niloticus* Fahmy *et al.*, 1971 where cysts were located from gills of *L. niloticus* at Assiut, and *M. equatorialis* Landsberg 1985, where cysts were located on the gill filaments of *O. niloticus* and *T. zilli*. In the present study cysts were isolated from the gill filaments of *T. zilli*. By comparing the present parasite with the two previous species, it was found that the three resemble each other in the shape of the spores, but the length and width of the large and small polar capsules in present species is dissimilar with *M. equatorialis* where in the first, the longest capsule is larger in length and smaller in width than in *M. equatorialis*. Also the length of a small polar capsule in present species is more than in *M. equatorialis*. By comparing the present parasite with *M. niloticus* Fahmy *et al.*, 1971, it was found that they are similar in the shape of the spores and also in their dimensions, and both are only different in the host, So that the present species is identified as *M. niloticus* Fahmy *et al.*, 1971.

***M. zilli* Sakiti *et al.*, 1991**

Regarding the similar myxosporean species to the present parasite only two species are worthy to compare: *Myxosoma* sp. Fahmy *et al.*, 1975 and *M. zilli* Sakiti *et al.*, 1991. Comparing the three parasites, the only difference is that the inter capsular process described by Sakiti *et al.* (1991) and in the present study, it was not observed by Fahmy *et al.* (1975), Ali, (1992) and Abdel-Ghaffar *et al.* (1998). In conclusion, due to the very close similarities of these safely assign the present parasite as *M. zilli,* Sakiti *et al.*, 1991. Meanwhile, *Myxosoma sp.* is considered as a senior synonym for this species. Fahmy *et al.* (1975) described *Myxosoma* sp. in *T. nilotica*. Cysts of the present parasite are found as a tiny white spot on the gill filaments of *T. zilli*. The three previous reports of *M. zilli* was only reported from family Cichlidae in the study of (Fahmy *et al.*, 1975); Sakiti *et al.* (1991) and Ali (1992), while in Abdel-Ghaffar *et al.* (1998) it was recorded from *Clarias gariepinus*. In the present study it was recorded from the gill filaments of *T. zilli*.

***M. heterosporus* (type 2) Baker, 1963**

Regarding the similar myxosporean species to the present parasite only two species were worthy to compare *M. Heterosporus* Baker, 1963 and *M. equatorialis* Landsberg, 1985 and those two species are previously described by Fall *et al.* (2000). The two species were found in the same host like that found in the present species, this host is *O. niloticus*.

Comparing the three parasites, *M. equatorialis* Landsberg (1985) resembles the present species in the spore length and width, but differs from it in having two unequal polar capsules in each spore rather than the two equal polar capsules in the present species. By comparing the present study with *M. heterosporus* it was found that the two are similar in shape and dimensions, so the present species is identified as *M. heterosporus* Baker, 1963.

***M. fahmii* Ali *et al.*, 2002**

Regarding the similar Myxosporean species to the present parasite, the following *Myxobolus* species resemble the spores of this species in general shape: *M. macrocapsularis* Reuss, 1906 (Lom and Dykova, 1992); *M. carassi* Klokacheva, 1914 (Lom and Dykova, 1992); *M. barbi* Fomena *et al.*, 1985; and *M. iranicus* Molnar *et al.*, 1996. *M. macrocapsularis* has wider spores. *M. carassii* possesses significantly larger and wider spores. *M. barbi* showed slightly narrower polar capsules. *M. iranicus* is larger in most spore dimensions. Ali *et al.* (2002) reported *M. fahmii* as a new species of *Myxobolus* and by comparing the present parasite with *M. fahmii* Ali *et al.*, 2002, it was found that the two species are similar in both the spore shape and dimensions and they differ only in the host where in the present species cysts were located on the gill filaments of *T. zilli*, but in previous one cysts were collected from gill filaments of *B. bynni*, so that the present species is identified as *M. fahmii* Ali *et al.*, 2002.

***M. clarii* Mandour *et al.*, 1993**

These spores are previously identified as *M. clarii* which was described by Mandour *et al.* (1993) and were also recorded from the ovaries of *C. gariepinus* (Abdel-Ghaffar *et al.*, 1998). In Africa, Siau (1971) recorded *M. dahomeynsis* in *Cynodontis ansorgii* with very brief description. Then, Sakiti *et al.* (1991) recorded the same species from the ovaries of *Sarotherodon melanotheron*, *T. zilli* and *T. hybrid*. Spores in *M. dahomeyensis* are smaller in most dimensions than the present spores and also differs in having narrow anterior part than the posterior part. Fall *et al.* (2000) also recorded the same species of *Myxobolus* in gills of *O. niloticus*, and in the present study the cysts are collected from the gill filaments of *O. niloticus*. By comparing the present species with *M. clarii* described by Mandour *et al.* (1993) it was found that the present species agree with the previous species where all of them have ovoid spores, mostly rounded or slightly sub-spherical in shape with two oval anterior polar capsules and also they are similar in spore dimensions. In conclusion, due to the very close similarities of these can safely assign the present spores as *M. clarii* Mandour *et al.*, 1993.

***Myxobolus* sp.I (present parasite)**

Hassan *et al.* (2007) reported the presence of *Myxospora* sp. in blood of *S. clarias* with a prevalence of 1.09 %, but they did not give any description for that parasite, while the present parasite is found in blood of *O. niloticus* with prevalence 0.55 %, and from the features and measurements of the present parasite it was found that the spores have two polar capsules located at anterior end and according to Fomena and Bouix (1997), this parasite is from genus *Myxobolus* Buetschli, 1882.

***M. heterosporus* (type 3) Baker, 1963**

As described by Baker (1963), the spores of *M. heterosporus* fall into three main types. The present spores are similar with the type 3 where their polar capsules sometimes curved, more than half spore length; spore length 10-14.5 µm, spore width 6.5-8.0 µm. In the present study the spore length is 9.2-11.5 µm, spore width 7.5-9.0 µm. Polar capsules in *M. heterosporus* type 3 Baker (1963) was 5.5 x 2.3 µm, but in the present species it is 6.5-7.8 x 3.0-3.8 µm. In addition the present species is found in the same host. For this reason, it is diagnosed as *M. heterosporus* Baker, 1963.

The myxosporean species

According to Fomena and Bouix (1997) key to identify the different genera of Myxosporea, spores with single polar capsule is *Thelohanellus*; spores with two polar capsules may be related to genus *Myxobolus, Myxobilatus*, *Sphaerospora*, *Myxidium*, *Unicauda* or *Henneguya*; quadrangular or sub quadrangular in apical view spores with four polar capsules with four shell valves are of genus Kudoa; spores which are spherical or nearly so with four polar capsules located at anterior end with two valves are of genus *Chloromyxum*. The present spores are different from all previously described species of Myxosporea in having three equal polar capsules, Therefore the present parasite is identified as a myxosporean species.

CONCLUSION

Fresh-water fishes are still suffering from infections with *Myxobolus* species, which are documented in the present paper. Affections of these parasites on the economically important fishes lead to a huge economic loss. So the parasitic diseases of freshwater fishes deserve further investigations.

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LAST OF FIGEUR

Figs. (1-4): Light photograph of *Myxobolus agolus* from gills of *Oreochromis niloticus* (Scale bar = 10 μm) showing the presence of large triangular inter capsular polar process (Fig. 1), the length of polar filament when it is extruded (Fig. 2), sporoplasmic granules in the sporoplasm of spore, and a large triangular inter-capsular polar process (Ipp) (Fig. 3), and mature spores revealed the presence of two rounded iodinophilic vacuoles (IV) within the sporoplasm (Fig. 4).

Figs. (5-6): Light photograph of *Myxobolus tilapiae* spores from gills of *Tilapia zilli* (Scale bar = 10 μm) showing accumulated spores (Fig. 5) and isolated spores, size and shape of polar capsules and the sporoplasm (Fig. 6).

Fig. (7): Light photograph of isolated spore of *Myxobolus. niloticus* from gills of *Tilapia zilli* showing the two unequal polar capsules and the two rounded iodinophilic vacuoles (IV) in the sporoplasm (Scale bar = 10 μm).

Fig. (8): Light photograph of isolated spore of *Myxobolus zilli* from gills of *Tilapia zilli* showing the two equal polar capsules and the two rounded iodinophilic vacuoles (IV) through the sporoplasm (Scale bar = 10 μm).

Figs. (9-10): Light photograph of isolated spore of *Myxobolus heterosporus* type 2 from gills of *Oreochromis niloticus* showing the two equal and elongate polar capsules (Scale bar = 10 μm) (Fig. 9) and SEM micrograph of the spore of *Myxobolus heterosporus* type 2 revealing the oval shape, the smooth nature of the spore valve surface, and showing the lacking of mucus strands on the surface, also showing the shell valve (SV), the site of polar capsules (PC), and the sutural ridge line (Sr. L) represented by anterior and posterior groove (Scale bar = 1 μm) (Fig. 10).

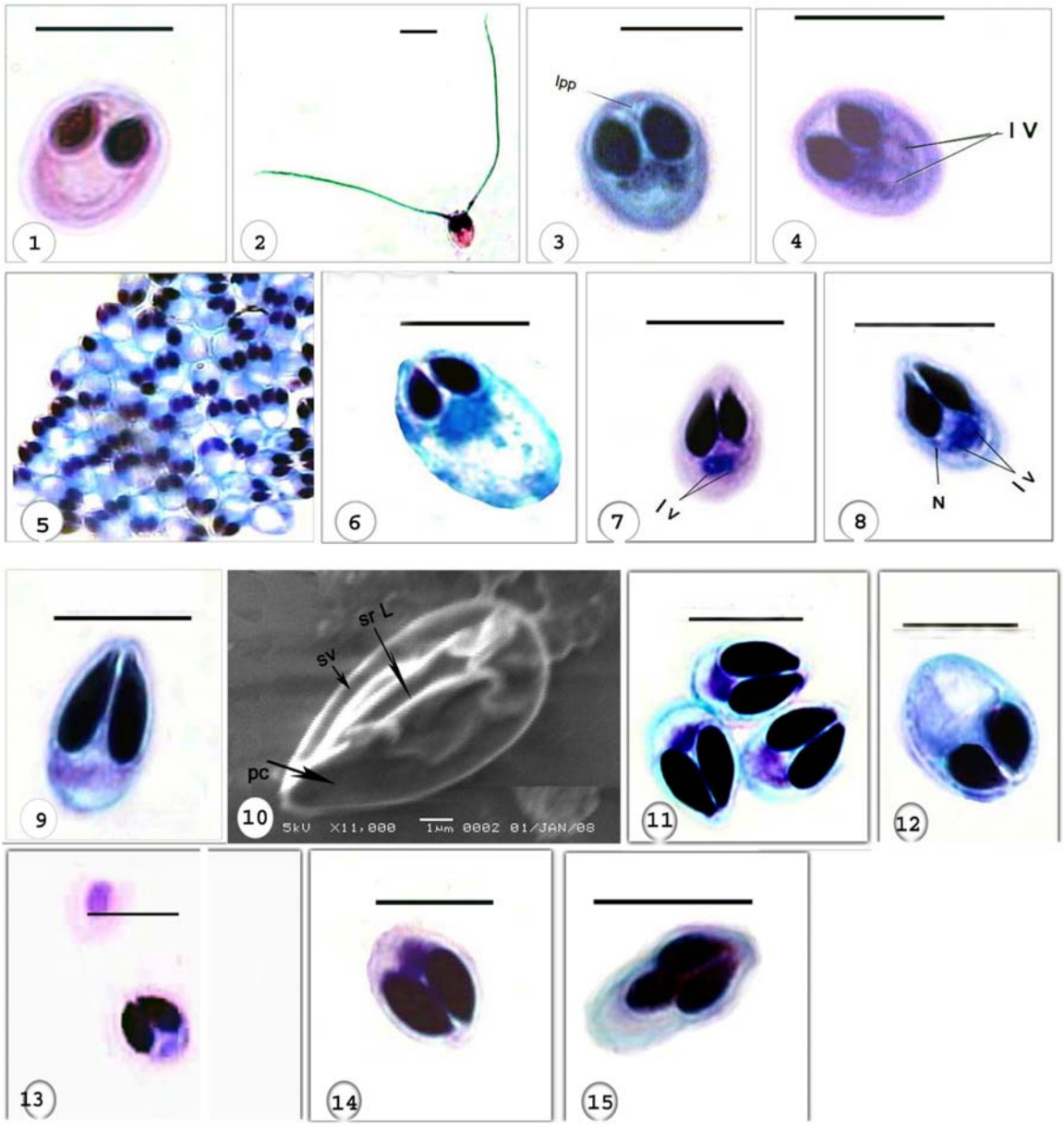
Fig. (11): Light photograph of mature spores of *Myxobolus fahmii* from gills of *Tilapia zilli* (Scale bar = 10 μm).

Fig. (12): Light photograph of mature spore of *Myxobolus clarii* from gills of *Oreochromis. niloticus* (Scale bar = 10 μm).

Fig. (13): Light photograph of a spore of *Myxobolus* sp.I in blood of *Oreochromis niloticus* (Scale bar = 10 μm).

Fig. (14): Light photograph of *Myxobolus heterosporus* type 3 spores (Scale bar = 10 μm).

Fig. (15): Light photograph of a spore of the myxosporean species in gills of *Oreochromis niloticu* (Scale bar = 10 μm).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ARABIC SUMMARY

إصابة أسماك المياه العذبة ، البلطى النيلى والبلطى الأخضر ، بالطفيليات الميكسوسبورية فى محافظة قنا ، مصر

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تم جمع أسماك المياه العذبة من مواقع مختلفة من نهر النيل فى محافظة قنا (قوص- قفط- دندرة- الترامسة- المعنى- دشنا- نجع حمادى). تم فحص 180 من أسماك البلطى النيلى (*Oreochromis niloticus*) و 66 من أسماك البلطى الاخضر (*Tilapia zilli*). من بين 246 سمكة تم فحصها وجد 61 (24.8%) سمكة مصابة بالطفيليات الميكسوسبورية. معدل الإصابة كان 25% بين أسماك البلطى النيلى و 24.2% بين أسماك البلطى الأخضر. بالنسبة لطفيليات ميكسوبلس التى تم وصفها ، ثمانية أنواع منها وجدت متطفلة على الخياشيم ونوع آخر وجد متطفلاً فى الدم. وجد *M. agolus*, *M. heterosporus* (type 2), *M. clarri*, *M. heterosporus* (type 3) متطفلاً على خياشيم البلطى النيلى بالإضافة إلى *Myxobolus* sp.I في الدم. بينما وجد *M. tilapiae*, *M. niloticus*, *M. zilli* and *M. fahmii* متطفلاً على خياشيم البلطى الأخضر. تم أيضا وصف نوع من الميكسوسبورا من خياشيم البلطى النيلى. تمت دراسة *M. heterosporus* (type 2) بالميكروسكوب الإلكتروني الماسح وتمت مقارنة بين الميكسوسبورا فى هذا البحث والأنواع التى سبق وصفها.