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Sphaerospora danubialis sp. n. (Myxosporea: Sphaerosporidae) from the kidney of freshwater percid fishes

K. MOLNÁR[1]

Abstract: *Sphaerospora danubialis* sp. n. is a common parasite of striped ruffe (*Gymnocephalus schraetzer*), ruffe (*G. cernua*) and pikeperch (*Stizostedion lucioperca*) of the River Danube. Its spores inhabiting the renal tubules morphologically differ from those of *S. markewitschi* and *S. pectinacea*, the already known sphaerospores of freshwater percids. Besides sporogonic stages in the renal tubules, presporogonic stages in the blood were found in striped ruffe.

Key words: Myxosporea, Sphaerosporidae, *Sphaerospora danubialis*, taxonomy, percid fishes, new species, spores, blood stages, Danube.

INTRODUCTION

Myxosporeans belonging to the genus *Sphaerospora* have recently commanded increasing interest because of their rather high pathogenicity on the one hand and their unique developmental cycle on the other. Lom et al. (1989) reported on 42 known species. Of them, *Sphaerospora tincae* (the agent of head kidney swelling in tench), *S. renicola* (the causative agent of swimbladder inflammation in common carp) and the gill parasite *S. molnari* are expressly pathogenic parasites. The PKX parasite described from salmonids, which Kent and Hedrick (1986) regard as a developmental stage of a renal sphaerospore, also has great economic importance. According to Csaba et al. (1984), in the development of *S. renicola* the sporogonic stage is preceded by a blood and a tissue stage. During the blood stage, the blood of fish contains an extracellular *Sphaerospora* stage (Csaba 1976; Lom et al. 1983) in which eight daughter cells develop by internal cleavage. In the swimbladder of the common carp the blood stages become primary cells enclosing about 40 daughter cells (Kovács-Gayer et al. 1982). In these primary cells triple formations (one secondary cell containing two tertiary cells) develop which get through the renal glomeruli into the convoluted tubules and change into pseudoplasmodia containing sporoblasts and spores (Molnár and Kovács-Gayer 1986). Blood stages containing

1 Veterinary Medical Research Institute, Hungarian Academy of Sciences, Budapest, Hungary

eight daughter cells have been reported by Lom et al. (1985) and Hedrick et al. (1988) also from other fishes. Furthermore, Baska and Molnár (1989) observed forms resembling the swimbladder stages in the blood of cyprinids.

Up to the present, two *Sphaerospora* species of freshwater percid fishes have become known: *Sphaerospora markewitschi* Donets, 1962 parasitizing the Don ruffe (*Gymnocephalus acerina*) and ruffe (*G. cernua*), and *Sphaerospora pectinacea* Bocharova et Donets, 1974, a parasite of the perch (*Perca fluviatilis*). The spores of both species were detected in the urinary tract. No presporogenic stages have been reported from these fishes so far.

Of the two species, *S. pectinacea* has pathogenic importance: Pronin and Pronina (1985) reported that it caused swelling of the kidneys in perch.

In the present paper a new species is described from striped ruffe (*Gymnocephalus schraetzer*) by the name of *Sphaerospora danubialis* sp. n. Besides its typical host, this parasite occurs also in ruffe (*G. cernua*) and pikeperch (*Stizostedion lucioperca*).

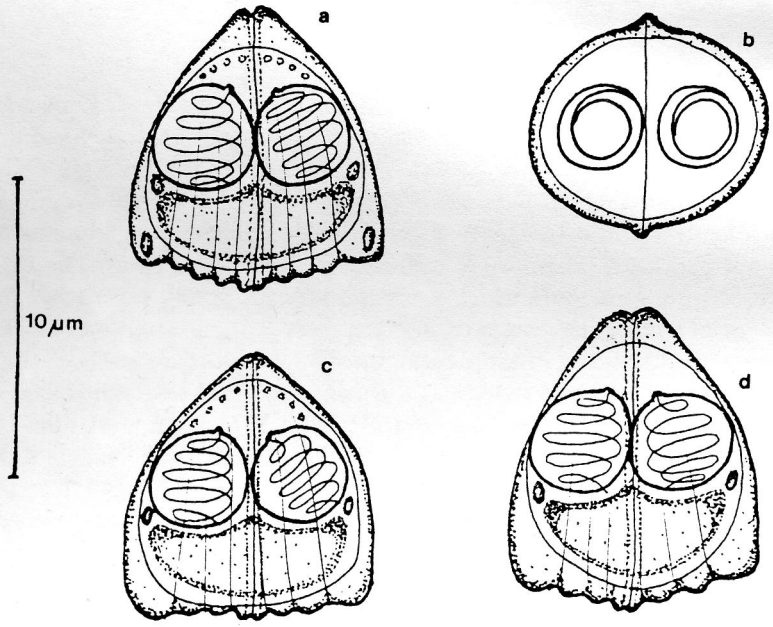
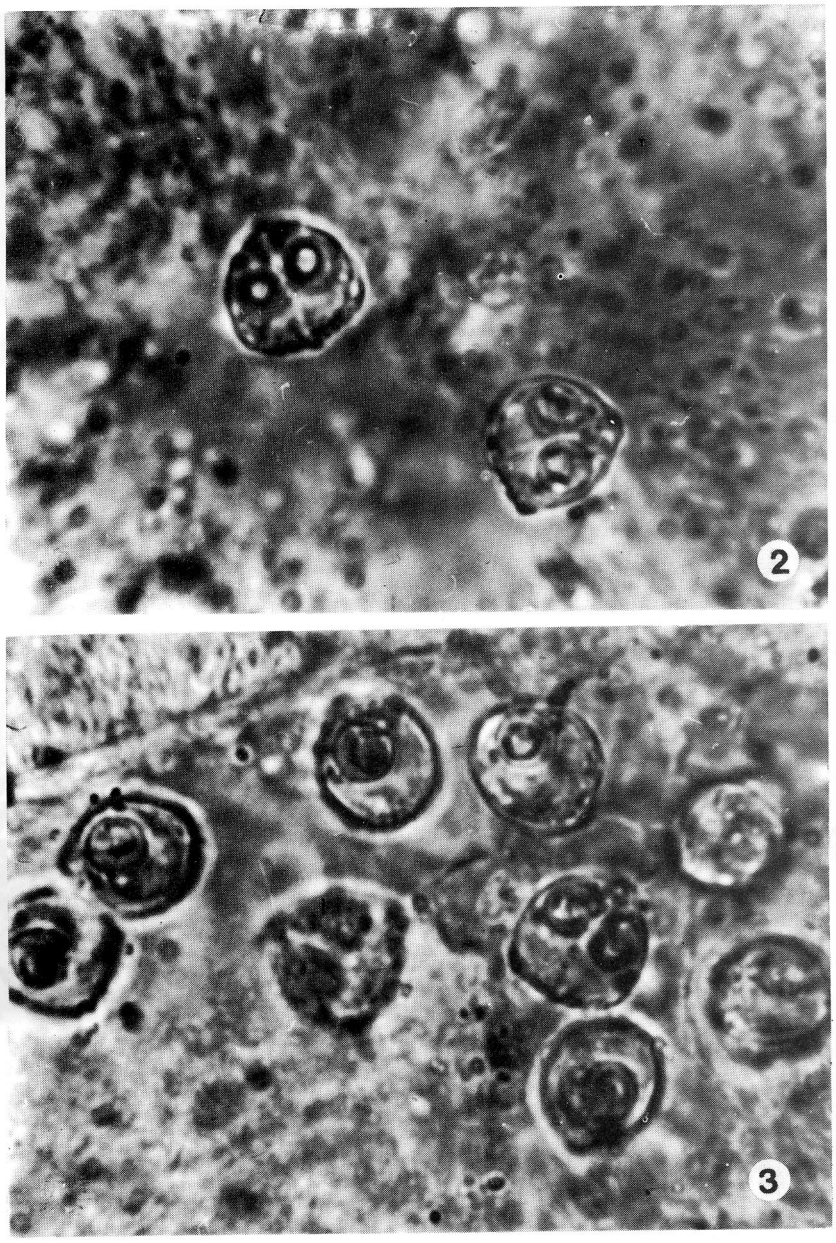


Fig. 1. Schematic illustration of *Sphaerospora danubialis* spores from host fishes. (a) Spore in sutural view from striped ruffe; (b) Spore in upper view from striped ruffe; (c) Spore in sutural view from ruffe; (d) Spore in sutural view from pikeperch



Figs 2-3. Spores of *Sphaerospora danubialis* sp. n.
from the kidney of striped ruffe. ×1800

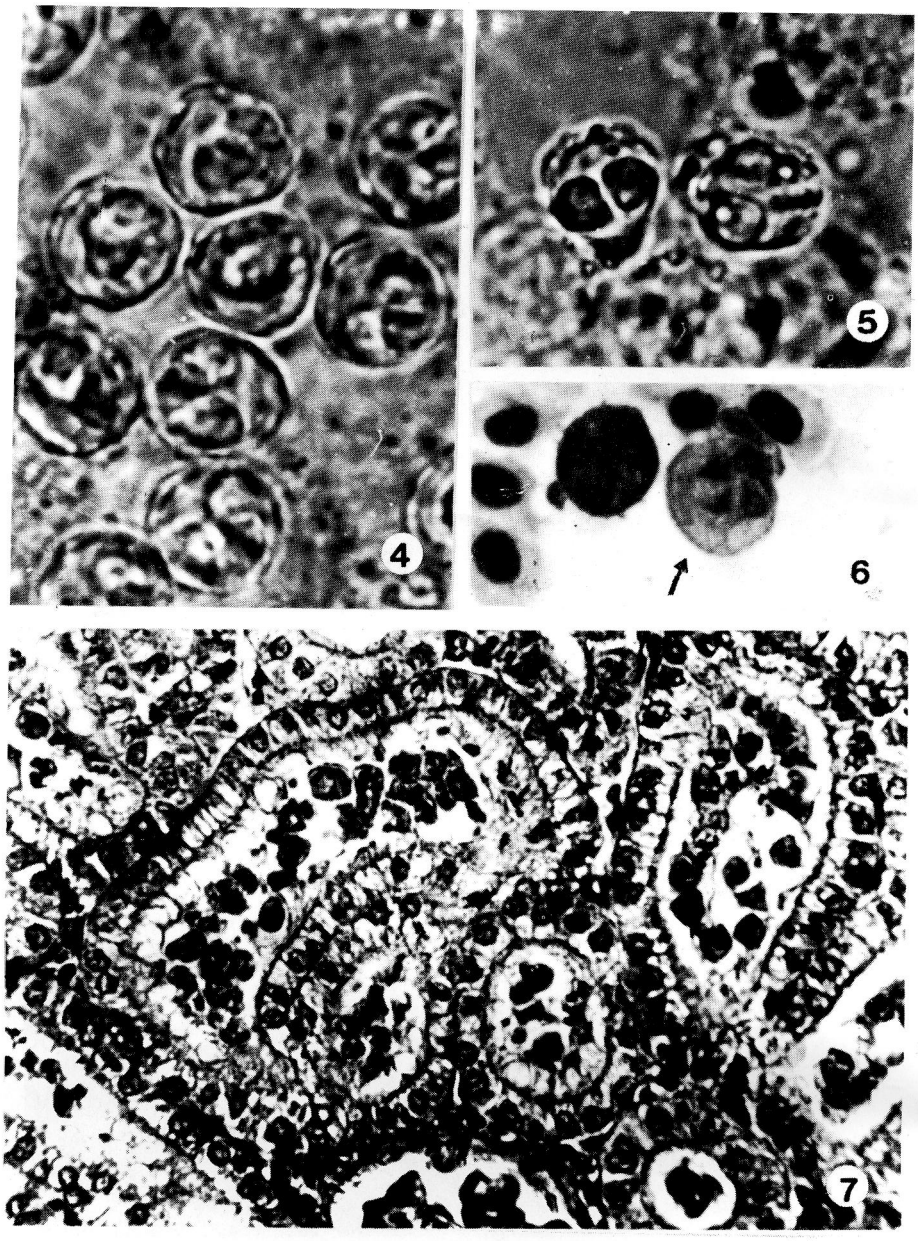


Fig. 4. Round-shaped spores of *Sphaerospora danubialis* sp. n. from the kidney of a pikeperch. × 1800
Fig. 5. "Triangular" spores of *Sphaerospora danubialis* sp. n. from the kidney of a pikeperch. × 1800
Fig. 6. *Sphaerospora* blood stage (↑) in striped ruffe. × 1500
Fig. 7. *Sphaerospora danubialis* sp. n. Spores and pseudo-plasmodia in the renal tubules of a striped ruffe. Histological section. H.-E., × 500

MATERIALS AND METHODS

From 1987 to 1990, 32 striped ruffe (*Gymnocephalus schraetzer*), 16 ruffe (*G. cernua*), 4 pikeperch (*Stizostedion lucioperca*) and 36 perch (*Perca fluviatilis*) specimens were collected from reaches of the River Danube south of Budapest. The striped ruffe and ruffe specimens were 4-12 cm long and more than one summer old, and the pikeperch specimens were 14-18 cm long and 2 summers old. The perch specimens measured 2-6 cm in length and included both fry and several summers old fish. With the exception of 4 striped ruffe and ruffe each and 20 perch specimens, the fish were examined and dissected in April and May.

When the fish were killed, a blood smear was prepared from each. The kidneys were examined partly under a coverslip as fresh preparations, partly as 4 μm thick histological sections previously fixed in Bouin's solution, embedded in paraffin, sectioned, and stained with haematoxylin and eosin.

RESULTS

Twenty-four out of the 32 striped ruffe specimens examined were found to have *Sphaerospora* spores and sporogonic stages (pseudoplasmodia) in the kidney. In two fish blood stages were also detected. Seven out of the 12 ruffe and 1 out of the 4 pikeperch specimens had renal sphaerosporosis. All perches proved negative. All positive cases occurred in April and May.

The spores and pseudoplasmodia found in striped ruffe, ruffe and pikeperch did not differ from each other (Figs 1a, b, c, d, 2, 3, 4 and 5) but were clearly distinguishable from species described from percids until then. On the basis of preparations made and spores collected from striped ruffe, the new species is described as follows.

Sphaerospora danubialis sp. n.

The spores and pseudoplasmodia occurred in the lumen of the convoluted tubules and, less often, inside the Bowman's capsule. The youngest pseudoplasmodia contained a primary cell and two secondary cells (sporoblast). All pseudoplasmodia proved to be disporoblastic. The sporoblasts had 6 nuclei, each of which formed one spore. While smaller pseudoplasmodia measured 9 to 14 μm in diameter and were round in shape, the more mature, spore-containing pseudoplasmodia were short ellipsoidal and reached 9-14×12-19 μm in size.

Description of the spores on the basis of 50 spores collected from *Gymnocephalus schraetzer* is as follows. In sutural view, the spores have a rounded triangular shape due to their flattened caudal surface (Fig. 1a). The suture perpendicular to the plane of the two polar capsules protrudes over the spore surface, making the spores lemon-shaped in upper view (Fig. 1b). Spores are 10.1 (9.5-11) μm long, 9.1 (8.5-9.5) μm wide and 8.7 (8.5-10) μm thick. In sutural view, there are protruding tubercles on both sides of the caudal margin of the spore. In these tubercles the nu-

cleus of the valvogenic cell is sometimes still discernible. Between the tubercles and the suture pectiniform structures can be seen on the spore surface, indicating the presence of fine ribs. The polar capsules are spherical and 4.4 (4.0-4.8) μm in size. The polar filament takes 5, less often 6, turns in the polar capsules. Anterio-laterally 4 bright granules can be observed between the capsules and the wall of the spores. No membraneous envelope can be seen on the spore surface.

Two blood smears made from striped ruffe contained one blood stage each. The blood stages were spherical or short ellipsoidal primary cells measuring 13-14 μm and containing mostly 4 and 3 secondary cells, respectively (Fig. 6).

Enlargement of the kidney was rarely found in the infected fish. Histological findings included widening of the infected tubules and deformation of the otherwise low columnar epithelial cells which had become cuboidal (Fig. 7). Of parasite stages situated in the tubules, the granular pseudoplasmodia were mostly attached to the wall of the tubules and loosely connected with the microvilli. Most of the mature spores were floating freely in the lumen of the tubules.

DISCUSSION

So far only one *Sphaerospora* species, *S. markewitschi*, has been reported from ruffe and Don ruffe. The spores of *S. danubialis* described here differ from those of the above species in their less rounded shape, the pectiniform projections seen on their caudal surface, and the spherical shape of the polar capsule. These differences are striking even if we consider that, according to Dyková and Lom (1982), lateral tubercles (ear-like projections) are typical of young spores only and can be regarded as remnants of valvogenic nuclei.

The possible identity of *S. danubialis* with *S. pectinacea* is a much more controversial question. Namely, both species are characterized by the presence of ribs on the spore surface and characteristic pectiniform projections on the caudal part of the spore. However, as is evidenced by the original drawings of Bocharova and Donets (1974) and the photographs taken by Lom et al. (1989), the triangular spores of *S. pectinacea* strikingly differ in shape from the rounded spores of *S. danubialis*. In this respect, the studies of Pronin and Pronina (1985) are remarkable. Although they identified the spores found in *Perca fluviatilis* with the species *S. pectinacea*, morphologically their spores were more similar to those of *S. cristata*, a parasite of *Gasterosteus aculeatus*. In spore morphology *S. danubialis* indeed resembles this *Sphaerospora* parasitizing a taxonomically distant host.

The host specificity of *Sphaerospora* species is insufficiently known. Therefore, the validity of a given species is primarily based on spore morphology. The only thing which has been confirmed experimentally is that *Sphaerospora* blood stages can be transmitted from goldfish to common carp (Körting et al. 1989). It is very likely that a given *Sphaerospora* species can infect several taxonomically related hosts. Based upon this assumption, the species described here as *S. danubialis* from *G. schraetzer* as typical host is, in all likelihood, identical with those found in *G. cernua* and *S. lucioperca*. Further studies are needed to elucidate why the perch (*Perca*

fluviatilis), derived from the same habitat, was found to be free from infection even when large numbers of specimens were examined.

In the development of *S. danubialis* the renal stage is preceded by a blood stage similarly as was reported for cyprinids (Csaba 1976; Lom et al. 1983; Baska and Molnár 1989). This is yet another finding to support the theory that the extracellular blood stages designated C blood protozoa or UBO are a developmental stage of sphaerospores. Up to now Hedrick et al. (1988) and Lom et al. (1989) have been the only investigators to demonstrate blood stages from non-cyprinid fishes infected by renal sphaerospores: from *Gasterosteus aculeatus* and *Lepomis gibbosus*, respectively.

Despite the intensive infection of the fish examined, in this study no striking pathological lesions apparent by visual inspection could be seen. This is in contrast to the data of Pronin and Pronina (1985) who observed substantial swelling of the kidney in perch infected by *S. pectinacea*.

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Molnár K.: *Sphaerospora danubialis* sp. n. (Myxosporea: Sphaerosporidae) édesvízi sügérfélék veséjéből

A *Sphaerospora danubialis* sp. n. gyakran előforduló élősködő dunai selymes durbincsban (*Gymnocephalus schraetzer*), vágódurbincsban (*G. cernua*) és fogassüllőben (*Stizostedion lucioperca*). A vesetubulusokban talált spórák morfológiailag különböznek a *S. markewitschi* és *S. pectinacea* spóráitól, melyeket ugyancsak édesvízi sügérfélékből mutattak ki. A tubulusokban élő sporogóniás stádiumok mellett selymes durbincs véréből a presporogoniás stádiumok is kimutatásra kerültek.

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Author's address: Dr. Kálmán MOLNÁR
Veterinary Medical Research Institute,
Hungarian Academy of Sciences,
H-1581 Budapest, P.O.Box 18
HUNGARY