

Occurrence of two species of *Thelohanellus* (Myxosporea: Myxozoa) of Far-Eastern origin in common carp populations of the Hungarian fish farms

Dr. Kálmán MOLNÁR — Dr. Éva KOVÁCS-GAYER

Veterinary Medical Research Institute, Hungarian Academy of Sciences, Budapest, Hungary —
Central Veterinary Institute, Budapest, Hungary

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ABSTRACT. In carp raised in Hungarian fish farms two *Thelohanellus* species were found which differed morphologically and in their localization on the host. These parasites probably reached Eastern Europe with the introduction of the amur wild carp (*Cyprinus carpio haematopterus*) and were introduced into Hungary through natural waters. We have proved that *T. nikolskii* Achmerov, 1955 developing on the carp fins and *T. hovorkai* Achmerov, 1960 living on the serous membranes of the inner organs are highly host- and organospecific parasite species, and, in contrast to earlier suggestions, they are not identical with *T. dogieli*.

During a routine veterinary examination of common carp raised in Hungarian fish farms two *Thelohanellus* species of significantly different morphology were found on the fins and on the serous membranes of the swimbladders, respectively. The parasites were identified as *Thelohanellus nikolskii* Achmerov, 1955 and *T. hovorkai* Achmerov, 1960 which had been first detected in waters of the Far East.

The occurrence of a *Thelohanellus* species in Hungary was first recorded by JENEY (1979) who identified the parasites found on the fins of the common carp (*Cyprinus carpio*) as *T. dogieli* Achmerov, 1955 and believed that this parasite was introduced to Europe by the Far-Eastern carps.

Prior to this, in Europe *Thelohanellus* species had not been described from the common carp and only *T. pyriformis* (Thélohan, 1892), *T. fuhrmanni* (Auerbach, 1909), *T. oculileucisci* (Trojan, 1909), *T. notatus* (Mavor, 1916) and *T. swellengrebeli* (Schuurmans-Stekhoven, 1918) were known from other carp species (BAUER, 1948; PETRUSHEVSKY and BAUER, 1948; LOM, 1961; SCHÄPERCLAUS, 1954).

In Far-Eastern waters six *Thelohanellus* species were described from the common carp: five by ACHMEROV (1955, 1960) from the amur wild carp (*Cyprinus carpio haematopterus*) and one by HOSHINA and HOSODA (1957) in Japan. Among these species SHULMAN (1962, 1966) regarded only *T. dogieli* to be valid, and considered *T. nikolskii*, *T. amurensis* Achmerov, 1955, *T. cyprini* Hoshina and Hosoda, 1957 and *T. hovorkai* to be synonymous with *T. dogieli*, and *T. acuminatus* Achmerov, 1955 to be synonymous with *T. fuhrmanni*.

The aim of the present paper is to prove - on the basis of spore morphology and the characteristic localization of the cysts - the validity of *T. nikolskii* and *T. hovorkai* spp. recently found in Hungarian fish farms.

MATERIALS AND METHODS

Our investigations were carried out between April 1979 and October 1981. One- to three-summer old common carp from different fish ponds of Hungary were submitted regularly to the laboratory either for routine veterinary examination or for research purposes. Field inspections were also conducted at two week intervals, and included about 20 fish per farm. In the period indicated above 6 155 carp were examined during routine diagnostic work and 1 300 carps were dissected in our laboratories where parasitological, bacteriological and histopathological examinations were made, mainly on young fry.

Parasitological examinations of fish that were killed or that had died recently were made under a dissecting microscope. Impression smears and squash preparations of the gills, kidneys, liver, spleen and swimbladder were also taken. The gills and the aforementioned organs of two fish per sample were fixed in 10% formalin and cut by cryostat for routine purpose. Organs showing alterations were fixed in aqueous Bouin's fixative embedded in paraffin wax and cut into 4 to 8 μ m sections which were stained with haemotoxylin and eosin. Before fixation the lumen of the swim bladders was filled up with egg-white.

Spores obtained from myxosporean cysts were examined either in fresh or after embedding in glycerine-jelly. Measurements of spores were taken on the material in glycerine-jelly.

RESULTS

The *Thelohanellus* infection described by JENEY (1979) was regularly observed in common carp fry populations during the summer breeding period. In 1979 the infection was demonstrated only at the eastern border of the country, in fish farms along the water-system of the River Körös. By 1981, however, *Thelohanellus* infection appeared in some fish farms of Western Hungary and in the eastern part of the country infection became general. In some fry-rearing ponds of Eastern Hungary the prevalence of infection reached 60 to 90%, and the intensity, 20-40 cysts per fish. In 1981 cysts were detected on the fins of even two- and three-summer old carps. Infection was restricted to the fins, and the thick-walled cysts of 1-2 mm in diameter were localized close to the fin rays (Fig. 1).

The developing cysts deformed the structure of the rays, and produced cartilageous outgrowths from them. Cysts were surrounded by a thick capsule consisting of loose connective tissue which was covered by intact epithelium toward the surface of the fin (Fig. 2-3). The first signs of infection could usually be detected by early July, and the infection dropped off at the end of August but at latest in October when the cysts burst. Although in heavy infection the break down of fins was observed, losses exclusively due to thelohanellosis were not recorded.

Thelohanellus stages developing in organs other than fins were found only in 1981 when during the histological examination of two-summer old carp originating from a pond farm established on the water-system of the River Tisza, relatively thin-walled cysts (Fig. 4) containing *Thelohanellus*-like spores were found in the swim bladder serose. More thorough examinations revealed that about 20% of the fish harboured lens-shaped cysts with a diameter of 1-3mm which were located on the swim bladder serosa

Legends to Figures

Fig. 1: Common carp fry infected with *Thelohanellus nikolskii* cysts on the fins. Original size.

Fig. 2: Histological section of a semimatured *T. nikolskii* cyst. H. E. x 100.

Fig. 3: Histological section of a young *T. nikolskii* cyst. H. E. x 100.

Fig. 4: Histological section through the swimbladder wall. *T. hovorkai* cysts containing some spores. H. E. x 100.

Fig. 5: *T. nikolskii* spores. x 1100.

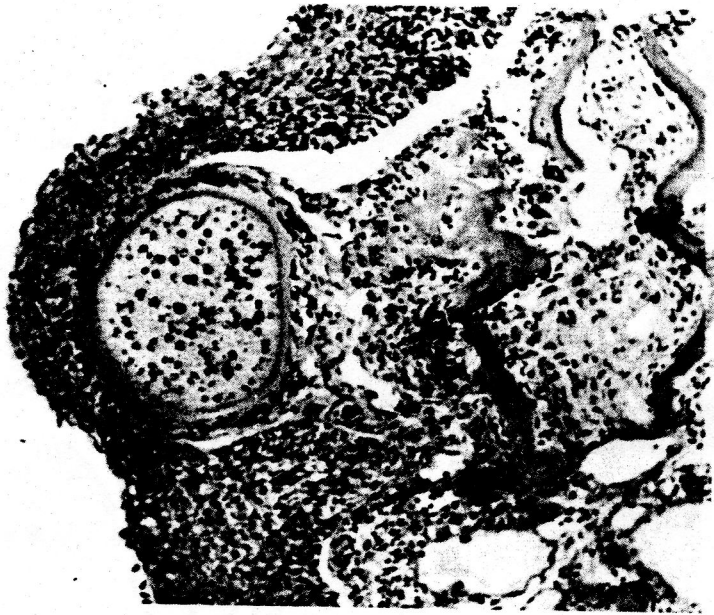
Fig. 6: *T. hovorkai* spores. x 1100.



1



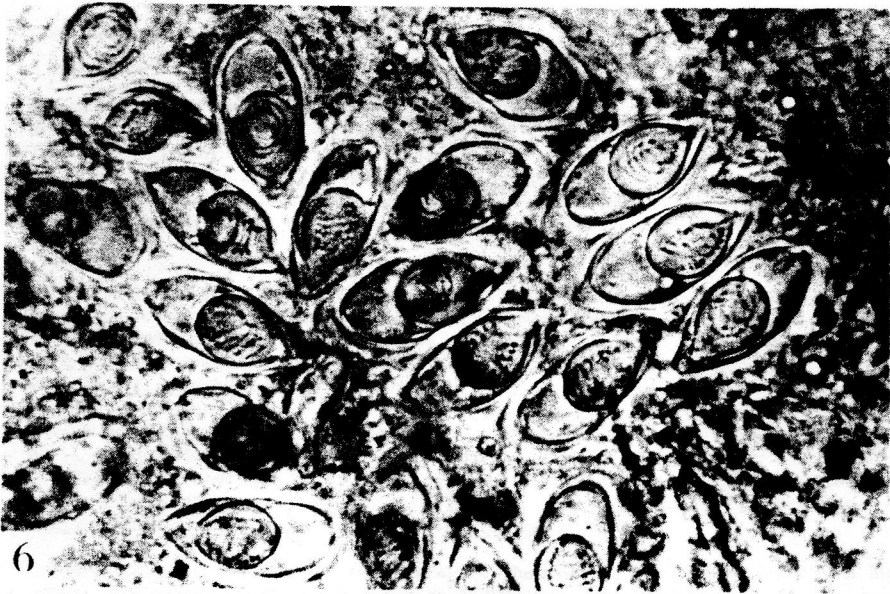
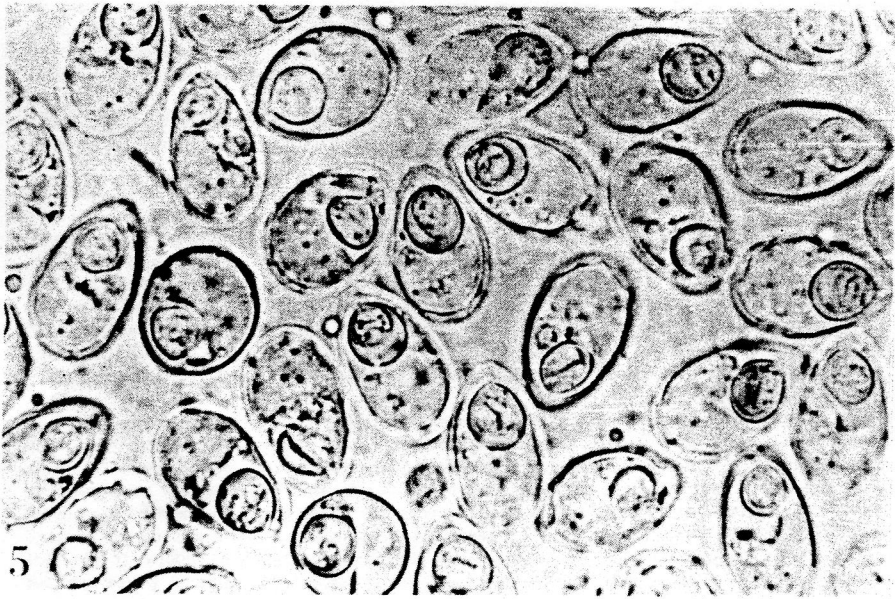
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3



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adjacent to the tunica externa and showed a pearl-like arrangement. These cysts contained mature spores. In August and September some of the cysts were already empty, but in the macrophage centres of the kidneys, free Thelohanellus-spores could be found. Regarding their shape and measurements the spores found in the swim bladder and the kidney were identical but significantly differed from those obtained from cysts developing in the fins.

The Thelohanellus species found in the fins was identified as T. nikolskii Achmerov, 1955, the other found in the swim bladder wall as T. hovorkai Achmerov, 1960.

The description of the two species on the basis of the examination of 30 spores each is the following:

T. nikolskii (carp fin parasite): Cysts round, thickwalled (60-100 μm), with a diameter of 1.0-2.0 mm. Pansporoblasts irregularly rounded, disporous. Spores (Fig. 5) oval, somewhat narrowing anteriorly and slightly flattened frontally. There is only one short ellipsoidal, relatively small polar capsule in the spore. Spore wall thick, with suture well observable, emerging from spore surface at spore end. No mucous envelope. Spore length 17.5 (17-18.5) μm , width (in the plane of the suture) is 10.5 (10-11) μm , and thickness (sutures up and down) 8.5 (8.3-8.7) μm . Polar capsule 6.8 (6.5-7.0) μm long and with a diameter of 5.5 (5.1-6.2) μm . Sutural width at the ends of spores 1.7 (1.6-1.8) μm .

T. hovorkai (swim bladder parasite): Cysts lensshaped with a thin wall of 10-15 μm and a diameter of 2-3 mm. Developmental stages were not observed. Length and width of the spores (Fig. 6) nearly equal. From front-view spores oval shaped, slightly narrowing at the anterior end. From side-view an indentation can be seen bilaterally at the midportion of the spores. There is only one, relatively large oval-shaped polar capsule in the spores. Spore wall relatively thin, suture hardly observable. Spore surrounded by a thin, transparent mucous envelope starting from anterior end. Spore length 19.0 (18.7-19.5), width 8.5 (7.5-10.2) and thickness 8.4 (8.3-8.5) μm . Polar capsule 10.2 (9.5-11.0) μm long and with a diameter of 7.5 (6.8-8.5) μm . Mucous envelope with a length of 24 and a width of 16 μm .

DISCUSSION

During the present investigations two distinct Thelohanellus species were found in common carp. These parasites should be considered to be new members of the parasite fauna of the Carpathian Basin. They were apparently introduced to the Transcarpathian region of the Soviet Union and to Roumania by the introduction of the amur wild carp (Cyprinus carpio haematopterus). The culturing of the amur wild carp and its hybrids in the abovementioned areas was described by IVASIK et al. (1970). The parasites presumably entered Hungary by active invasion through the River Körös or possibly the River Tisza.

JENEY (1979), accepting SHULMAN's opinion (1962), identified the species living on the carp fins as T. dogieli. During our investigations, however, we obtained ample evidence to show that in contrast with SHULMAN's view T. nikolskii Achmerov, 1955 and T. hovorkai Achmerov, 1960 are undoubtedly valid, distinct species. The results of examinations made on several thousand fish have clearly revealed that T. nikolskii really is an organospecific parasite - as stated by ACHMEROV (1955, 1960) - and that it develops exclusively on the fins, unlike T. dogieli which occurs on the skin of fish. The morphological characteristics found by us are also in agreement with those observed by ACHMEROV (1960), and significantly differ from the data given for T. dogieli. The only slight difference between ACHMEROV's and our data is that according to our results the spores of T. nikolskii are somewhat smaller. These data prove the validity of T. nikolskii while we consider the fin parasite species T. cyprini described in Japan to be synonymous with T. nikolskii.

The same conclusion was drawn in the case of the Thelohanellus species found in the swim bladder-serose. This species, as it was described by ACHMEROV (1960), develops in cysts on seroseous membranes, in our case on the swim bladder serose of the carp. On the basis of the characteristic, bilaterally indented spores, the mucous envelope surrounding the spores, the shape of the large polar capsule and the measurements agreeing with those given in the original description, this species was easily identified as T. hovorkai.

ACHMEROV (1960) used both the designations T. hovorkai and T. hovorkae in his original paper. The designation T. hovorkae must be regarded as an erroneously formed name, therefore the name T. hovorkai should be accepted.

At present T. nikolskii is a wide-spread parasite in Hungary, occurring mainly in carp fry populations. Details of its development and pathology are given elsewhere (MOLNÁR /in press/).

Data concerning the incidence of T. hovorkai are not satisfactory as this parasite has only recently been found in a single pond of a fish farm. However, taking into consideration that during our investigations special attention was always paid to the examination of the swim bladder, the incidence of this parasite cannot be frequent. At the time of our investigations T. hovorkai cysts were already in an advanced stage of development and contained only a few spores. Therefore, the appearance of dispersed spores in the macrophage centres of the kidney is not surprising. A similar phenomenon is frequently observed in the case of other myxosporean species developing in the inner organs.

Few data are available on the host specificity of the two Thelohanellus spp., but according to our present knowledge both parasites seem to be strictly host-specific.

The pathological significance of the two parasites is not known properly as yet. The distortion and breaking down of the fins by the growing cysts appeared to be the most serious pathological manifestation of the damage caused by T. nikolskii. Although up to now no losses have been recorded, the cysts causing significant changes in appearance render the fish unmarketable. In order to clarify the pathological significance of the parasite developing in the swim bladder serosa further investigations are needed. T. hovorkai primarily has a differential diagnostical importance since it produces lesions at the same site where the lesions caused by swim bladder disease are localized.

In our opinion, because of irresponsible acclimatization of fish, the parasite fauna of the European common carp has increased by two new species, the pathological role of which is not yet completely known. Among the parasites introduced to Europe with the amur wild carp, after Dactylogyrus achmerowi Gussev, 1955 and Khawia sinensis Hsü, 1935 (MOLNÁR, 1976; MOLNÁR and BUZA, 1975) Thelohanellus nikolskii and T. hovorkai have also become permanent pathogens of Hungarian fish farms.

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MOLNÁR, K. — KOVÁCS-GAYER, É.: Két távol-keleti származású Thelohanellus faj (Myxosporea: Myxozoa) előfordulása a magyarországi tógazdasági pontyokban

Magyarországi tógazdaságokban tenyésztett pontyokon az elmúlt évben két, morfológiailag és lokalizációjuk tekintetében különböző Thelohanellus (Protozoa, Myxozoa) fajt találtunk. Thelohanellus fajok előfordulása korábban sem Magyarországon, sem pedig Európában nem volt ismert pontyokon. Európai vizekben való megjelenésük minden bizonnyal összefügg az amuri tópony (Cyprinus carpio haematopterus) telepítésével. Ezt a ponty-alfajt az 1950-es években a Szovjetunió európai részébe telepítették, és hibridjei a "Kárpáton tuli" területeken is megtalálhatók. A távol-keleti pontyokról ACHMEROV (1955, 1960) öt Thelohanellus fajt írt le. Bár ezeket a fajokat SHULMAN (1962) a T. dogielii szinonimáinak tekintette, vizsgálataink alapján kétségtelenné vált, hogy az ACHMEROV által leírt fajok létező,