Three planktonic cyanophytes producing water blooms in Western Slovakia

Tri planktónové sinice tvoriace vodný kvet na západnom Slovensku

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Abstract

In recent years, three rare cyanophytes, *Microcystis botrys* TEILING, *M. novacekii* (KOMÁREK) COMPÈRE and *Radiocystis geminata* SKUJA, appeared in great abundance in the plankton of eutrophic lakes and fishponds in Western Slovakia. During the summer they produced or contributed to a massive planktonic water bloom. The two *Microcystis* species exhibit some similarities with *M. aeruginosa* but differ by smaller, unperforated colonies with very densely aggregated cells. *M. botrys* is distinguished from *M. novacekii* (and from other species of the genus) by semiglobose or tubular gelatinous protuberances in the colonial mucilage. Colonies of *R. geminata* stand out by the radially oriented cells in the mucilaginous envelope.

Introduction

Microcystis botrys TEILING and *M. novacekii* (KOMÁREK) COMPÈRE are cyanophytes that are cited rarely in the relevant literature but have been reported from several localities from the territory of Slovakia. While *M. novacekii* [published as *M. marginata* (MENEGHINI) KIRCHNER, see GEITLER 1932] was recorded previously from water reservoirs or running waters (cf. LHOTSKÝ et al. 1974; HINDÁK & HINDÁKOVÁ 1998), *M. botrys* was recognized quite recently from gravel pit lakes in Bratislava (HINDÁK 2001: Figs. 120, 121; HINDÁK & HINDÁKOVÁ 2001). Another planktonic cyanophyte, *Radiocystis geminata* SKUJA with cells radially arranged in colonial mucilage, has not been reported from Slovakia.

In recent years all mentioned species have appeared in the phytoplankton of eutrophic lakes and fishponds in Western Slovakia in abundance, occasionally producing a massive planktonic water bloom. In this contribution,

their occurrence in Western Slovakia is presented and their taxonomy is discussed.

Results and discussion

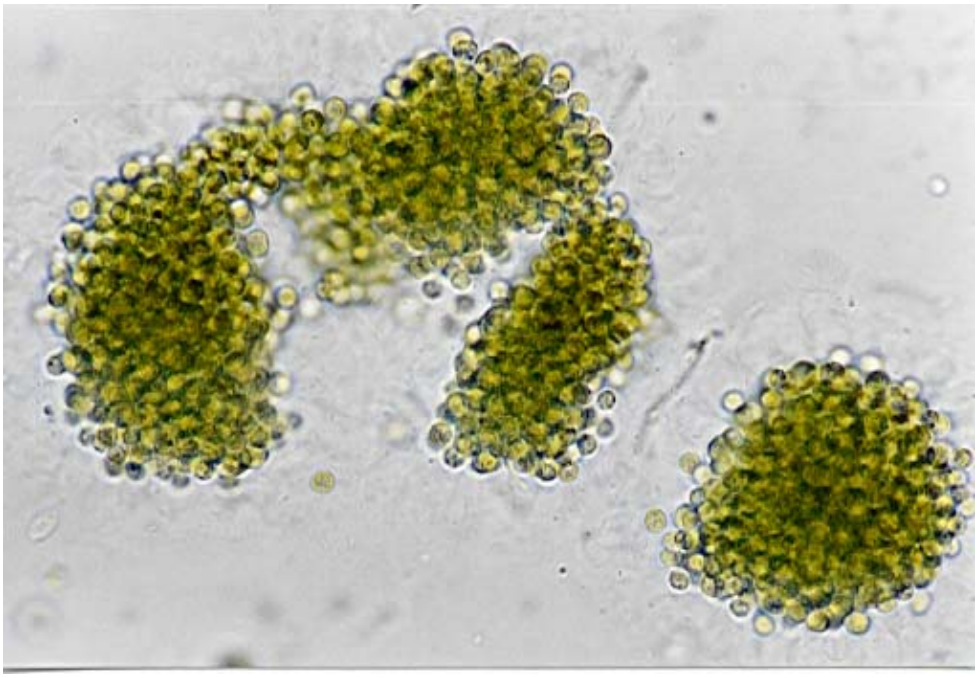
Microcystis botrys **TEILING**, *M. novacekii* (KOMÁREK) COMPÈRE and *M. aeruginosa* (KÜTZING) KÜTZING are similar in some morphological features, especially during the blooming period or in young or old populations. However, they can be recognized by the shape of colonies and by the structure of their mucilaginous envelopes.

Microcystis botrys TEILING 1942 (Figs. 1, 2)

Colonies of *M. botrys* and *M. novacekii* are usually smaller than in *M. aeruginosa* and are not perforated. In our material colonies of *M. botrys* are more or less spherical to irregular, mostly 80 – 110 μm in diameter and after reaching this size they break up into parts or rarely form composed colonies to 200 μm in diameter. The cells in colonies form dense clusters, regularly spherical in shape, solitary or after division in twos, green olive, (5)–6–7 μm in diameter, with distinct aerotopes. *M. botrys* differs from *M. novacekii* and other species of the genus *Microcystis* by thick, solid, 5–10–(20) μm wide and colourless mucilaginous envelopes. The structure of mucilage is as described by TEILING (1942, see also KOMÁREK 1996 and KOMÁREK & ANAGNOSTIDIS 1998). The mucilage envelope is mostly indistinct (staining or using phase contrast is recommended), and is composed of more or less wide, radially oriented semiglobose and/or tubular gelatinous protuberances (Figs. 1, 2; see also HINDÁK 2001, Figs. 120, 121). In the colonial mucilage the endogloeic filamentous cyanophyte *Pseudanabaena mucicola* (NAUMANN et HUBER – PESTALOZZI) BOURRELLY is commonly found (Fig. 2).

M. botrys was originally described by TEILING (1942) from Southern Sweden and there is only a few data about the distribution of *M. botrys* in the world. According to CRONBERG & BAALEN (2004) it is often misidentified as *M. aeruginosa*. KOMÁREK & ANAGNOSTIDIS (1998) stated that it occurs in the plankton of lakes and in slightly brackish waters mainly from the Baltic region but also from other countries (C Europe, E Africa). CRONBERG (in CRONBERG & BAALEN, 2004) noticed massive blooms of *M. botrys* in park ponds in the town of Malmö, S Sweden in the summer of 2003, causing the death of birds and fish. The first published reports of the occurrence of *M. botrys* in Slovakia are from urban gravel pit lakes in Bratislava: Kuchajda (HINDÁK 2001: Figs. 120–121), Rohlík (HINDÁK & HINDÁKOVÁ 2001), and just recently from Štrkovec (HINDÁK & HINDÁKOVÁ 2005).

The main feature that distinguishes *Microcystis botrys* from all other species of the genus is the peculiar structure of colonial mucilage. It shares the more or less spherical to subspherical shape of the colonies with *M. novacekii*.



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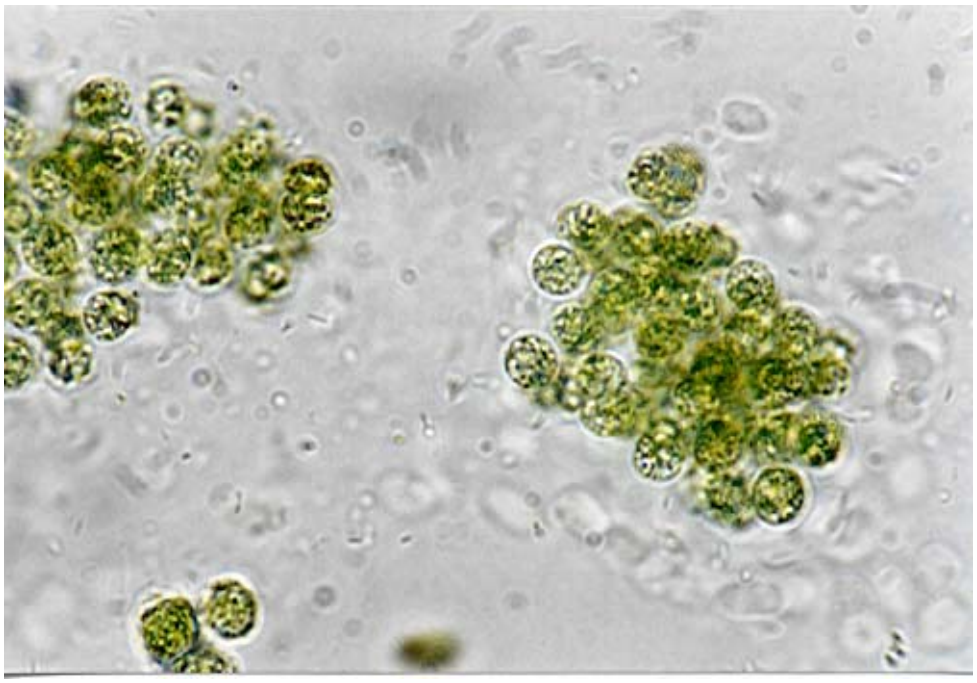

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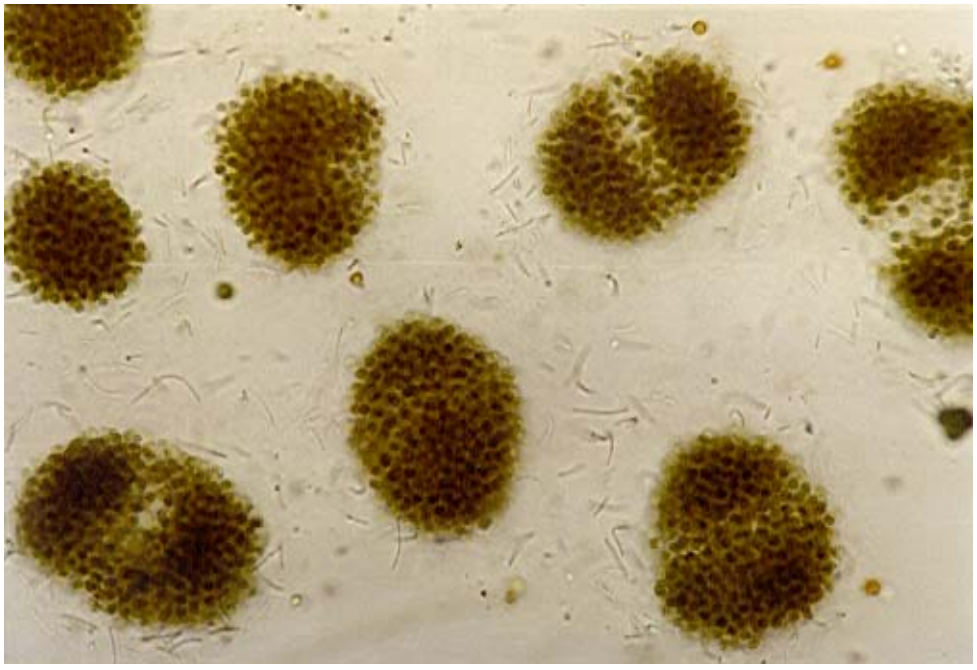
Figs. 1, 2: *Microcystis botrys* TEILING from the gravel pit lake Kuchajda in Bratislava; notice wide, radially oriented semiglobose and tubular protuberances in the gelatinous envelopes; (from HINDÁK 2001).

Microcystis novacekii (KOMÁREK) COMPÈRE 1974 (Figs. 3 – 6)
(basionym *Diplocystis novacekii* KOMÁREK 1958; synonyms see KOMÁREK 1958 and KOMÁREK & ANAGNOSTIDIS 1998)

Young colonies are spherical to slightly oval, mostly to 50 – 70 μm in diameter. When they reach a size of about 60 – 70 μm, they begin to divide into two parts (Fig. 3) or, by repeated divisions, into more parts (Fig. 4). In that way large complex colonies are formed. These complex colonies reach 350 μm in diameter and comprise 3 – 4 or more spherical, subspherical to slightly irregular subcolonies (Figs 5, 6), occasionally also catenate subcolonies without perforations. The common mucilaginous envelope is hyaline, clearly visible due to commonly occurring filaments of *Pseudanabaena mucicola* or bacteria but no visible structural elements or refractive outlines of colonies are observed. Cells are regularly spherical, 3.5 – 5 – (5.5) μm in diameter, blue-green or yellow green in colour, with aerotopes, in colonies densely aggregated.

According to KOMÁREK (1958) and KOMÁREK & ANAGNOSTIDIS (1998) the species occurs in eutrophic waters, sometimes forming or contributing to water blooms; however, it is rarely cited in the phycological literature. In Slovakia it has been reported in water reservoirs or running waters as *M. marginata* (MENEGHINI) KIRCHNER (cf. LHOTSKÝ et al. 1974, HINDÁK & HINDÁKOVÁ 1998). According to our photomicrographic records, *M. novacekii* was documented for the first time in the summer of 1997 from the fishponds in Bratislava – Železná Studienka. At that time the species occurred in low abundance or as a member of a *M. aeruginosa* dominated cyanophyte water bloom. In the beginning of this century, *M. novacekii* became a dominant phytoplanktonic species forming dense blooms in many lakes and fishponds of Western Slovakia. The massive development of this species was recorded in the gravel pit lake Kuchajda, the inundation lake Stará Morava in Bratislava – Devín, and in the fishponds at Šašín – Stráže, Modra and Báhoň. In small quantities it was already found in running waters, e.g. in the river Danube in Bratislava – Petržalka and the Morava river in Bratislava – Devín (HINDÁK & HINDÁKOVÁ 2004, as *M. botrys*) and also at Lanžhot, S Moravia, Czech Republic (HINDÁK et al., in the press).

Microcystis novacekii does not belong to the well – known planktonic cyanophytes although it is well distinguished by its more or less regular spherical and unperforated colonies, and by its wide and homogeneous hyaline mucilaginous envelope. The cells are mostly slightly smaller than those of *M. aeruginosa* and *M. botrys*.



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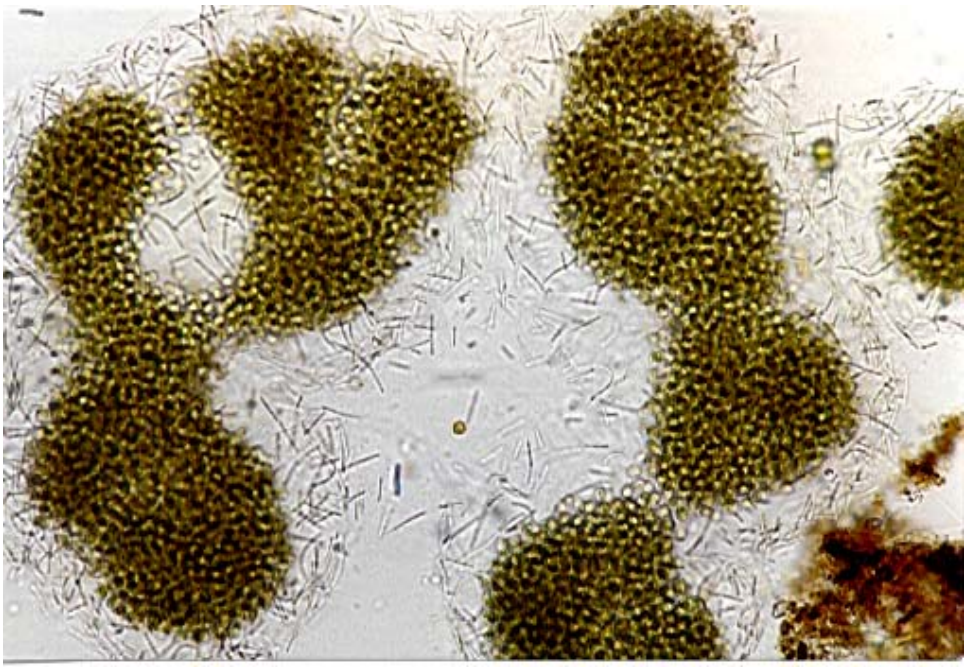

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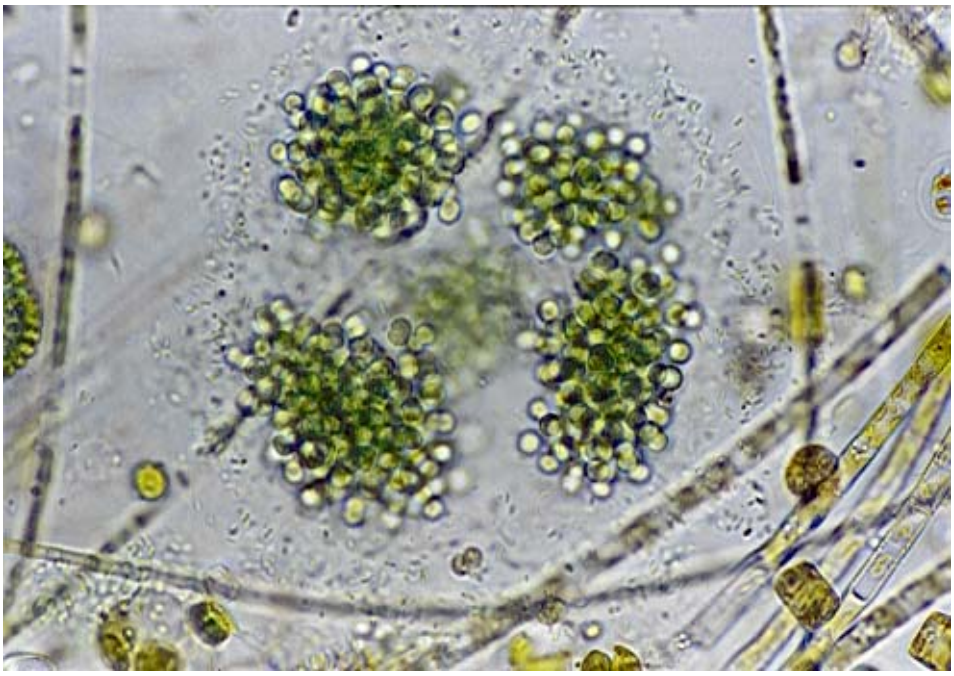
Figs. 3, 4: *Microcystis novacekii* (KOMÁREK) COMPÈRE, shape of colonies from the fishpond at Šaštín – Stráže; notice endogloeic filamentous cyanophyte *Pseudanabaena mucicola.*



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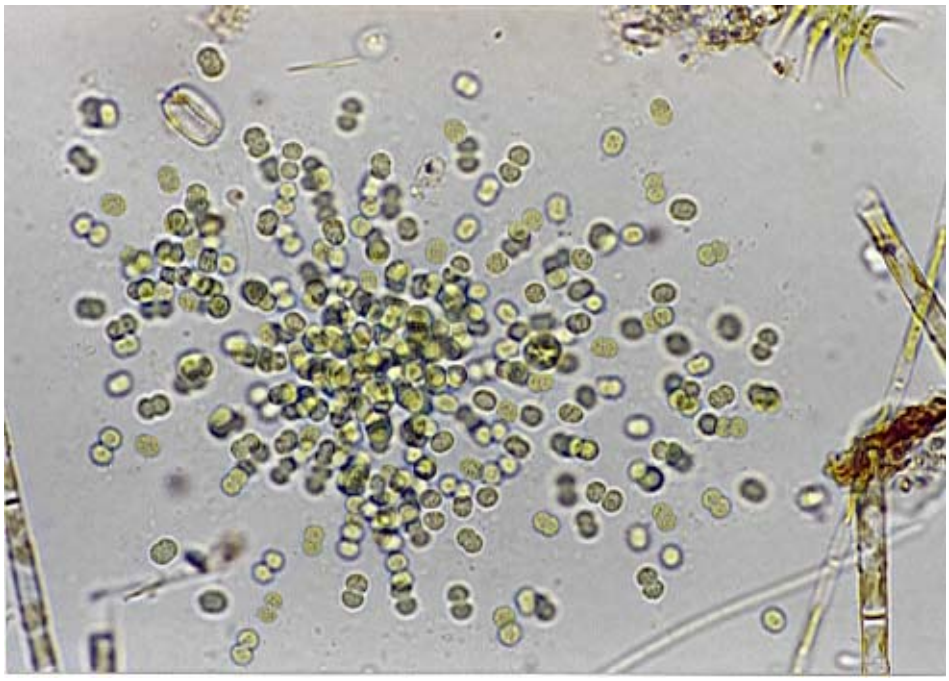
Figs. 5, 6: *Microcystis novacekii* (KOMÁREK) COMPÈRE, shape of colonies from the fishpond in Bratislava – Železná Studienka.

Radiocystis geminata SKUJA 1948 (Figs. 7, 8)

A typical feature of this species is the changing structure of young colonies during their development from small number of cells. The cells in young colonies are arranged more or less radially (Fig. 7), but due to continued division of cells, the radial arrangement of cells disappears and the cells in the colony form dense aggregates (Fig. 8). The size of young colonies reaches 45 – 80 μm in diameter after which the colonies divide into two or three parts resulting in complex colonies of up to 150 μm diameter. The cells are spherical, 4.5 – 5.5 μm in diameter, olive green, with aerotopes, and after repeated successive divisions their length reaches 8 – 10 μm.

In the summer of 2004 and 2005 the species appeared as a dominant species in the fishponds in Bratislava-Železná Studienka, sometimes giving rise to a slight bloom.

In contrast to *Radiocystis aphanothecoidea* HINDÁK 1996 (cf. KOMÁREK & ANAGNOSTIDIS 1998, HINDÁK 2001) which commonly occurs especially in the plankton of gravel pit lakes in W Slovakia, *Radiocystis geminata* has not yet been found in this habitat in this country.



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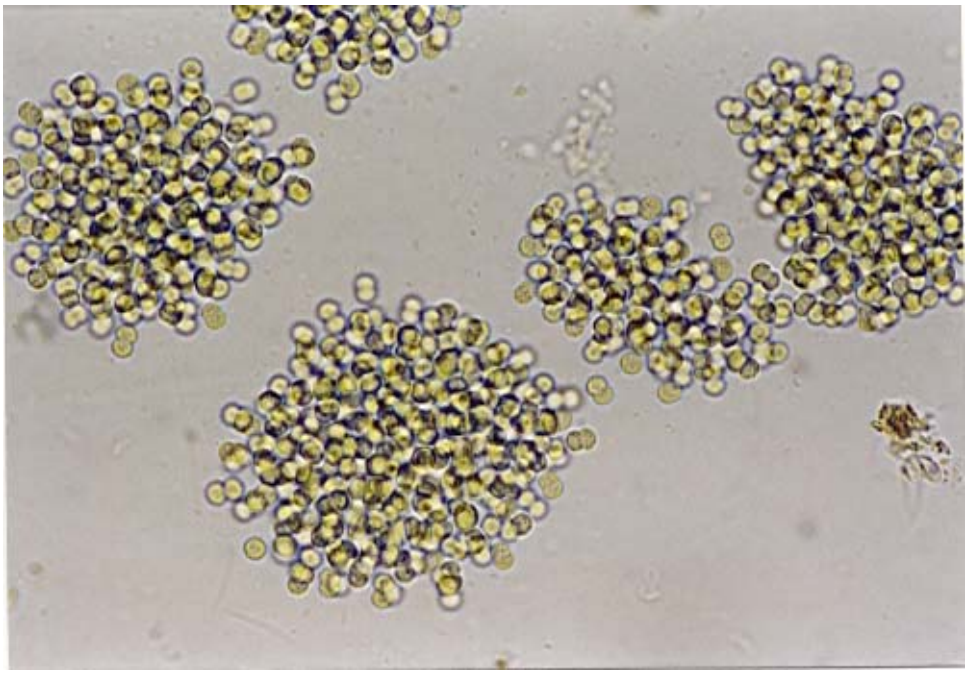

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Figs. 7, 8: *Radiocystis geminata* SKUJA, shape of colonies from the fishpond in Bratislava – Železná Studienka: 7 young colonies, 8 older colonies.

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References

CRONBERG, G. & BAALEN VAN, L. (2004): *Microcystis botrys* and *M. toxica* – the same species? – 16th Symposium of the International Association for Cyanophyte Research, Luxembourg 2004. Book of Abstracts, p. 31.

GEITLER, L. (1932): Cyanophyceae – In: Rabenhorst´s Krypt.-Fl. 14: 1–1196. Akad.Verlagsges., Leipzig.

HINDÁK, F. (2001): Fotografický atlas mikroskopických siníc. – Veda, Bratislava, 128 pp.

HINDÁK, F. & HINDÁKOVÁ, A., 1998: Sinice a riasy. Cyanophytes/Cyanobacteria and Algae. – In: MARHOLD, K. & HINDÁK, F. (eds) Zoznam nižších a vyšších rastlín Slovenska. Checklist of Non-Vascular and Vascular Plants of Slovakia, VEDA, Bratislava, p. 11–100.

HINDÁK, F. & HINDÁKOVÁ, A. (1999): Cyanobaktérie a riasy štrkoviskového jazera Štrkovec v Bratislave. [Cyanobacteria and algae of the gravel–lake Štrkovec in Bratislava]. – Bull. Slov. Bot. Spol. pri SAV, Bratislava, **21**: 19–25.

HINDÁK, F. & HINDÁKOVÁ, A. (2001): Cyanobaktérie a riasy štrkoviskového jazera Rohlík v Bratislave. [Cyanobacteria and algae in the gravel pit lake Rohlík in Bratislava]. – Bull. Slov. Bot. Spoločn., Bratislava, 23: 13–18.

HINDÁK, F. & HINDÁKOVÁ, A., 2004: Diverzita fytoplanktónu rieky Moravy a Dunaja v Bratislave r. 2003. [Diversity of the phytoplankton of the rivers Danube and Morava in Bratislava in 2003) – Bull. Slov. Bot. Spoločn., Bratislava, 26: 9–17.

HINDÁK, F. & HINDÁKOVÁ, A. (2005): Diverzita cyanobaktérií a rias štrkoviskového jazera Štrkovec v Bratislave v r. 1999–2004. [Diversity of the cyanobacteria and algae in the gravel pit lake Štrkovec in Bratislava (Western Slovakia) in 1999–2004]. – Bull. Slov. Bot. Spoločn., Bratislava, 27: 23–29.

HINDÁK, F., HINDÁKOVÁ, A., MARVAN, P., HETEŠA, J. & HAŠLER, P. (2006): Autumnal phytoplankton of the Morava river in 2005. – Czech Phycology x: xx-xx.

KOMÁREK, J. (1958): Die taxonomische Revision der planktonischen Blaualgen der Tschechoslowakei. – In: KOMÁREK, J. & ETTL, H.: Algologische Studien, p. 10–206, Nakl. ČSAV, Praha.

KOMÁREK, J. (1996): Klíč k určování vodních květů sinic v České republice. – In: MARŠÁLEK, B., KERŠNER, V. & MARVAN, P. (eds), Vodní květy sinic, Nadatio Flos–Aquae, Brno, pp. 22–85.

KOMÁREK, J. & ANAGNOSTIDIS, K. (1998): Cyanoprokaryota, 1. Teil Chroococcales. – Süsswasserfl. Mitteleuropa, Gustav Fischer, 19/1: 1–548.

LHOTSKÝ, O., ROSA, K. & HINDÁK, F., 1974: Súpis siníc a rias Slovenska. – Veda VSAV, Bratislava, 204 pp.

SKUJA, H., 1948: Taxonomie desPhytoplanktons einiger Seen in Uppland, Sweden. – Symb. Bot. Upsal. 9(3): 1–399.

TEILING, E. (1942): Schwedischer Planktonalgen 3. Neue oder wenig bekannte Formen. – Bot. Notiser 1942: 64–68.