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CALOTHRIX CONFERVICOLA AGARDH EX BORNET ET FLAHAULT (CYANOPROKARYOTA) – A NEW POSSIBLE CAUSATIVE AGENT OF *SEEWEED DERMATITIS*?

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The paper is dedicated to Prof. D. Temniskova on the occasion of her 80th jubilee

Abstract: The present paper is intended to serve as *alarm* in order to sharpen the attention of scientists to the benthic heterocytous cyanoprokaryote *Calothrix confervicola*, which seems to be the most probable potential causative agent for a human skin irritation (*seewed dermatitis*, or *swimmer’s itch*), detected recently in one site on the southern Black Sea coast of Bulgaria.

Key words: benthic toxic algae, Black Sea, cyanotoxins, coastal harmful cyanoprokaryotes, swimmer’s itch

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Scientific and public awareness of toxic cyanoprokaryotic (cyanobacterial) blooms in freshwaters, and of health hazards which they can cause, is constantly increasing. Many data on distribution of toxic producers, history of animals and fish deaths, as well as outbreaks of human illness and poisonings are available since years all over the world (*e.g.* Carmichael 1994, 2001; Vasconcelos 1994; Codd 1995; Chorus & Bartram 1999; Codd et al. 1999, 2005; Maršálek et al. 2000**;** Carmichael et al. 2001**;** Pavlova & Bratanova 2005**;** Agrawal et al. 2012 among the many others and citations there-in). Nowadays much more attention is paid to these events also in the countries of south-eastern Europe, in spite of the fact that, as a rule, they are not controlled by national legislations (*e.g*. Pavlova et al. 2006, 2007, 2013, 2014; Juković et al. 2008, Teneva et al. 2010; Pantelić et al. 2013, Svirčev et al. 2013 and citations therein). The most frequently found and almost everywhere mentioned toxin producers belong to the genera *Microcystis* Kützing ex Lemmermann, *Dolichospermum* (Ralfs ex Bornet et Flahault) Wacklin, Hoffmann et Komárek (Syn. *Anabaena* p.p.), *Nodularia* Mertens ex Bornet et Flahault, *Planktothrix* Anagnostidis et Komárek, *Aphanizomenon* Morren ex Bornet et Flahault, *Cylindrospermopsis* Seenaya et Subba Raju in Desikachary, *etc*. A detailed description of the toxicological properties of cyanotoxins known so far is out of the scope of this study and can be found in extensive publications on the topic (*e.g*. Chorus & Bartram 1999; Meriluoto & Codd 2005; Funari & Testai 2008).

However, much less attention has been paid to the freshwater benthic or soil mat-forming genera and their effects on human health or animals, and to the brackish and marine cyanoprokaryotes as well (*e.g*. Codd 1994; Matern et al. 2001; Hrouzek et al. 2005; Teneva et al. 2005, 2013; Becher & Juttner 2006; Carvalho et al. 2013; Quiblier et al. 2013 and citations there in). As summarised by Codd 1994 and later by Sellner 1997, there are at least three toxic producing genera: *Lyngbya* C. Agardh ex Gomont, *Schizothrix* Kützing ex Gomont and *Oscillatoria* Vaucher ex Gomont. The most *popular* species among them is the benthic coastal filamentous *Moorea producens* Engene et al. 2012 (Syn. *Lyngbya majuscula* Harvey et Gomont 1892). According to Wendy Guiry (2014) this recent taxonomic transformation was supported by Wynne (2013). The species is well known for the production of a variety of biologically active components. Among them are the cyanotoxins from lyngbyatoxin group (A, B, C), aplysiatoxin and their brominated derivatives, used as a defensive secretion to protect the species itself from predation by fish, being potent irritants and vesicants, as well as carcinogens (Fujiki et al. 1981; Aimi et al. 1990; Kozikowski et al. 1991; Osborne et al. 2001; Ito et al. 2002; Edwards & Gerwick 2004; Jiang et al. 2014, *etc*.). *Moorea* became negatively popular mostly as a causative agent of human skin irritation (*seaweed dermatitis, or swimmer's itch*) – Cardellina et al. (1979), Burja et al. (2001). In spite of the increasing knowledge on the coastal hazardous cyanoprokaryotes and their toxins, the relevant risk assessment of other widespread coastal benthic

cyanoprokaryote species (from the genera *Calothrix* Agardh ex Bornet et Flahault, *Rivularia* Agardh ex Bornet et Flahault, *etc*.) still is unsufficient and can be outlined as "needed research". Nevertheless of the relatively scattered character of the investigations, it has to be mentioned that in some strains of these genera strong biologically active compounds (calophycin, calothrixins A and B, *etc*.) with antialgal, antifungal, antibacterial and/or other allelopathic activities, have already been detected (e.g. Flores & Wolk, 1986; Moon et al. 1992; Abarzua et al. 1999; Rickards et al. 1999; Schlegal et al. 1999; Doan et al. 2000, 2001; Berry et al. 2008; Tuet 2010).

The aim of the present paper is to serve as *alarm* in order to sharpen the attention of scientists to the benthic heterocytous cyanoprokaryote *Calothrix confervicola*, which seems to be the most probable potential causative agent for a human skin irritation, detected recently in one site on the southern Black Sea coast of Bulgaria.

A 36-year old woman was referred to a dermatologist on the occasion of itching skin rash, which appeared after a contact with the sea-rocks, overgrown by algal mats in the place "Mekite Skali" (which means in Bulgarian language "soft rocks") near the Varvara village on the Black Sea coast (Fig. 1). The dermatological examination revealed an erythematous papular rash, localized on the skin of the abdomen, glutei, outer surface of the elbows and thighs (Fig. 2). The histhopathological investigation of the irritated skin showed moderate and irregular acanthosis, edema in the papilar derma and significant inflammation infiltrate in the middle derma. The diagnosis made was *allergic dermatitis* and treatment with oral antihistamine and topical corticosteroid cream was applied. A complete disappearance of the skin rash in three weeks was observed.

The pointed rocky places (Fig. 1) were visited and living material was collected from them (by scratching of the algal mats, which covered the rock surface in the pseudolittoral zone) almost immediately after the event, in spite of the fact that the patient visited the dermatologist 10 days after the first symptoms appear.

The investigation of the collected algal material revealed a dominating heterocytous cyanoprokaryote with heteropolar trichomes in yellow-brown sheaths (10–12 μm wide trichomes, 14–16 μm wide filaments) and one basal heterocyte per trichome (Fig. 3), and typical numerous hormogonia. Young trichomes were ensheathed in colourless mucilage. The morphological features of the specimens, observed by light microscopy (under immersion 100 objective on Motic 400 microscope, equipped with digital microphotocamera Moticam 2000 and supplied with photoprocessing program Motic Images Plus 2,0) coincided with the description of the marine coastal species *Calothrix confervicola* Agardh ex Bornet et Flahault 1886, given by Komárek (2014). The species is considered to be cosmopolitan, marine, widespread in coastal regions, known as quite common in Mediterranean region and Black Sea (Komárek 2014).

Fig. 1. Map of Bulgaria with the location of the sampling point.

Figs. 2–3. Skin rash and *Calothrix confervicola.* Fig. 2: Skin rash (*seeweed dermatitis*) on the patient body (detailed description is in the text). Fig. 3: *Calothrix confervicola* – heteropolar trichome with a terminal heterocyst, ensheathed in a well-developed yellow-brownish mucilage sheath.

Discussing the possible causative agent of the observed skin rash, we have not to ignore the fact that many cyanoprokaryotic crusts and mats are formed mainly by filamentous species (including those of *Calothrix*), able to excrete extracellular polymeric substances. This polysaccharide-rich matrix not only confers desiccation and freeze tolerance to the given mat, but serves as a trap for many sediment particles and forms a new habitat with a new physical medium for a great variety of other organisms, including viruses, heterotrophic bacteria, protists and microinvertebrates, and has different chemical properties in comparison to the overlying water or air (e.g. VINCENT 2009). In addition, it has to be taken into account that the pigment composition generally shows differences in the mat profile: the surface layer is rich in photoprotective pigments, especially carotenoids (orange and red) but also sometimes scytonemin (black or brown), overlying a deeper blue-green layer rich in light-harvesting phycobiliproteins and chlorophyll *a* (VINCENT 2009). Therefore we would like boldly to underline that, in spite of the fact, that the output of biologically active compounds (incl. hepatotoxin) of different strains of *Calothrix* was proved and in some regions its freshwater and soil species were mentioned among the toxic producers (*e.g*. MOHAMED ET AL. 2006; AL-ARAJY & SULTAN 2008; MOHAMED 2008), in the present paper we could only suggest the *probability* for *Calothrix confervicola* mats to induce human skin rash. Rendering an account to its abundant development in the studied site, as well as its wide distribution in the coastal regions, we would like to propose further detailed investigations of this species and its compounds.

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