TOTAL AND SULFUR BACTERIA DURING HOLOMICTIC PERIOD AND PERIOD OF STRATIFICATION IN THE SALINE ROGOZNICA LAKE (CENTRAL ADRIATIC)

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Abstract

Establishment of the anoxic water column with increasing H_2S concentrations in the Lake was followed by the development of a dense population of photosynthetic sulfur bacteria. The data presented in this paper discuss the relationship between photosynthetic sulfur bacteria and total bacteria during the holomixis and during the period of stratification in the Lake.

Key words: total bacteria, sulfur bacteria, holomixis, stratification

Introduction

The Rogoznica Lake is a small, intensely eutrophied saline lake, situated on the eastern coast of the Adriatic Sea. It has an area of about 5300 m^2 and a maximum depth of 15 m. The Lake has no visible connection with the surrounding sea, but lake tides are detectable on the cliffs indicating that underground water connection exists. Despite permanent water exchange between the Rogoznica Lake and the surrounding sea through the porous karst, anoxic conditions prevail in deeper layers of the Lake, probably due to remineralization of organic matter produced in the period of intensive primary production. Anoxic deep water is rich in sulfur (up to 900μM), especially in the form of sulfide or elemental sulfur (1).

The Rogoznica Lake is particularly interesting from biological point of view because of its specific flora and fauna. Specifically, in the Lake there are living some phytoplankton species that are relatively rare in surrounding sea (*Hermesinum adraticum*, Eunotia sp., *Prorocentrum arcuatum*) and only one copepode species (*Acartia italica* Steuer) (2, 3). Although, very poor qualitatively, phytoplankton and zooplankton communities are quantitatively very rich. Furthermore, in some periods a monospecific bloom appears in the Lake and probably contributes to the mass mortality that occasionally occurs in the Lake. The last mass mortality of the organisms in the Lake occurred in September 1997. The presence and distribution of total and sulfur photoautotrophic bacteria in the condition of mass mortality of the organisms in the Lake (holomictic period) and throughout the time scale of the anoxic water renewal (period of stratification) were studied.

Materials and methods

Measurements and samplings were done biweekly from the beginning of October until the end of December 1997 at 2 m intervals from the surface to the bottom (12 m).

The thermohaline features were measured by CTD multi probe IDRONAUT OS316.

Enumeration of total number of bacteria was made by epifluorescence microscopy using the standard AODC technique (4). Abundance of phototrophic sulfur bacteria were estimated from fresh samples using autofluorescence microscopy (5).

Results and discussion

The holomixis observed right after mass mortality in the Lake was followed by development of anoxic conditions with proportionally high concentration of reduced sulfur compounds (6,2). Maximum number of total bacteria has been occurred during the holomixis right after the mass mortality of the organisms in the Lake due to the intensive processes of remineralization of dead organisms. An average of total bacteria was 2.2×10^7 cells ml^{-1} with maximum values in the surface layer and minimal values at the bottom. The presence of sulfur bacteria has been observed in relatively high concentration throughout the water column as well (average 3.7×10^9- cells ml^{-1}), but their vertical abundance gradually increased from the surface to the bottom. Presence of anaerobic photosynthetic sulfur bacteria could explain proportionally high abundance of elemental sulfur in anoxic water column of the Lake since the bacteria partially transform sulfide to elemental sulfur (1).

Two weeks after the mass mortality of organisms occurred (sampling of 14th October), the values of total bacteria drastically felt to an average of 5.11×10^6 cells ml^{-1} and contemporaneously the number of sulfur bacteria decreased up to an average values of 0.49×10^6 cells ml^{-1}. Vertical distribution of both total and sulfur bacteria was similar, i.e. they were uniformly distributed through the whole water column. It is significant that the presence of sulfur bacteria was evident throughout the water column in high concentrations until 27th October, that was during the holomixis (period of the low oxygen concentration). According to the salinity, temperature and oxygen vertical profiles in the Lake after 27th October, stratification of the water column progressed and vertically stratificated water column was kept until the sampling of 29th December. In that period the concentration of oxygen was increasing in the Lake, specially in the surface layers what is a direct result of phytoplankton community activity (6). With an increase of oxygen content of the Lake the number of sulfur bacteria drastically decreased and their vertical distribution was changed. In the upper oxygenated layers where the oxygen saturation is particularly high, there were no sulfur bacteria at all, whereas in the layer under the thermocline they were far less presented than in the period of holomixis (average value of 0.02×10^6 cellsml^{-1}). To resume, with the increasing of oxygen content the abundance of sulfur bacteria decreased and their vertical distribution changed depending of the vertical distribution of O_2 and H_2S. Similar results have been established by Cohen *et al.* (7), studying the distribution of sulfur photosynthetic bacteria in Solar Lake, and Mazumder and Dickman (8) in Crawford Lake suggesting that the development of the photosynthetic sulfur bacteria communities was closely related to the simultaneous establishment of an anoxic zone with increasing H_2S concentrations toward the bottom.

According to the results shown above, it could be stressed the role of autotrophic sulfur bacteria in the process of photosynthesis during holomyxis (anoxic period). In such conditions an autotrophic sulfur bacteria have very important ecological advantage regarding their capability to utilize high concentrations of H_2S for the process of photosynthesis.

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