

The Study of Influence of Aerotechnogenic Pollution on Lichenized Fungi by Means of Electron Microscopy

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FINDINGS

Lichens are successful symbiotic organisms capable of existing under extreme environmental conditions that are not suitable for many plants. On the other hand, they are very sensitive to atmospheric pollution and are considered as natural indicators of environmental conditions. The mycobionts (lichenized fungi) are the main form-building components of lichens. However, the existence of mycobionts significantly depends on functioning phycobionts (algal components). Under the conditions of technogenic action, especially in industrial areas, lichens are more sensitive than vascular plants. In particular, this sensitivity can be attributed to high cation exchange activity in the thalli and morphological peculiarities providing deposition of the toxicants within thallus and their weak excretion (Richardson 1995).

The aim of my investigation was to study the influence of aerotechnogenic pollution (heavy metals and SO₂) on some fruticose lichens. The attention was focused on the changes of morphology and ultrastructure of the thalli of lichens caused by air pollution and on the mineral element composition of the surfaces of the thalli.

The lichens of genus *Cladonia*, i.e. *C. crispata*, *C. cryptochlorophaea*, *C. cyanipes*, *C. deformis*, *C. ecmocyna*, and *C. stellaris* were collected in heavily polluted areas of the Cola peninsula located close to the industrial town of Monchegorsk. The ultrastructure of the lichens was examined by means of scanning electron microscopy. The air-dried samples were coated with gold and studied in the scanning electron microscope CamScan (Cambridge Instruments, Cambridge, England). The presence of heavy metals and other mineral elements on lichen surfaces was determined by microscopic roentgen spectral analysis (X-ray microanaly) applied to the scanning electron microscope JSM 6880 LA (Jeol, Tokyo, Japan). For this analysis, the air-dry samples were coated with carbon.

The observations demonstrated significant effects of pollutants on lichens. The morphological deformations were directly visible. Electron microscopic studies showed that dramatic alterations of lichen morphology were connected with alterations of hyphal growth (Vlasova 2013).

X-ray microanalysis showed that the elements always detected in significant amounts in both polluted and unpolluted areas were aluminum (Al) and silicon (Si). Relatively high concentrations of iron (Fe) and potassium (K) were also present in many cases (Table 1).

In polluted areas, higher concentrations of sulfur (S), nickel (Ni) and manganese (Mn), in comparison with unpolluted ones, were detected (Table 1). The element amounts varied in the different portions of the thalli. The occurrence of heavy metals and sulfur on lichen surfaces is undoubtedly caused by their presence in the atmosphere.

The high content of Al and Si and sometimes of Fe may be explained by the presence of these elements (possibly aluminosilicates) in the podzolic soils of these areas.

Further experiments are needed to study details of element distribution in the lichen thalli.

Table 1 Mass % of elements on the outer thallial surfaces of *Cladonia ecmocyna* in the polluted and unpolluted areas

	Element					
	Al	Si	S	K	Fe	Mn
Polluted	0,4	0,91	0,20	0,39	0,84	0,11
Unpolluted	0,30	0,83	0,08	0,29	0,36	0,02

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