

TRACE ELEMENTS IN PLANTS MEASURED BY X-RAY  
EMISSION SPECTROSCOPY

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Study of transport of trace element through the biomembranes is of the great importance in physiology of the plants as well as biological systems in general. Through such investigations one can obtain information about the structure and function of biomembranes through which the selective exchange of the matter and energy with the environment is occurring. Single cell algae *Chlorella* are very suitable for such studies. The biology of *Chlorella* is well known and these algae have the ability of fast reproduction and good adaptability. The mass of samples to be investigated is of the order of magnitude of few mg, therefore the expected amounts of trace elements will be in range of  $10^{-8}$  and  $10^{-9}$  g. The development of X-ray emission spectroscopy as an analytical method for determination of trace element made this study possible. X-ray emission spectroscopy system at "Ruđer Bošković" Institute is based on fluorescence excitation by the X-ray tube (Mo anode, 2 kW), and could detect all medium heavy and heavy elements in quantities in the range of  $10^{-6}$  -  $10^{-9}$  g. Minimum detection limit of a similar system but based on the proton excitation (Van de Graff accelerator in "Jožef Stefan" Institute) is more than an order of magnitude lower, in the range of the  $10^{-11}$  g.

We intend to use both systems to study the transport of several trace elements like Mn, Fe, Ni, Cu and Zn in *Chlorella* in order to obtain experimentally the values of phenomenological coefficients under different conditions. The obtained coefficients we intend to use in the theory of nonequilibrium thermodynamics of the irreversible processes which could be applied to the mechanism of the transport through the biomembranes.