

Analysis of chlorophyll fluorescence and electric events at the thylakoid and plasma membrane of Anthoceros for evaluation of bioenergetics characteristics

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The evaluation of bioenergetics characteristics of biological systems includes monitoring the physiological conditions of the cells organelles and the membrane complexes. In the case green plants, analysis of chlorophyll fluorescence provides considerable information about primary reactions of photosynthesis, including the efficiency of charge separations in photosystem II (PSII), the rate of linear electron transport, and “energy-dependent quenching” related to the pH gradient (ΔpH). In addition to ΔpH , the transmembrane electric potential of thylakoids is crucial for energy conversion. The choice of a hornwort *Anthoceros* is substantiated by such advantages as the feasibility of simultaneous measurements of the chloroplast membrane potential, the electric potential changes at the cell membrane, and changes in chlorophyll fluorescence parameters occurring upon the absorption of photosynthetically active radiation (PAR). Its thin thallus facilitates the access of substances from the outer medium to the cell surface, which is important for testing the action of physiologically active agents on photopotentials of the chloroplast and cell membranes. The use of small-size thalli necessitates the application of sensitive fluorometric devices collecting light emission from the area of 0.01 to 10 mm². Specialized fluorometers - a Microscopy-PAM (Walz, Germany) based on the saturation pulse method and a plant efficiency analyzer (PEA, Hansatech, United Kingdom) designed for measurements of the fluorescence induction curves with a time resolution of 10⁻⁶ s - fully meet these requirements. The Microscopy-PAM device allows measurements on microscopic parts of a thallus such parameters as the quantum yield of the charge separations in PSII (F/F_m'), coefficient of photochemical quenching related to the redox state of PSII primary acceptor, and the coefficient of nonphotochemical quenching indicative of energy-dependent fluorescence quenching related to ΔpH formation in the thylakoids. A remarkable property of *Anthoceros* cells is an electrical excitation of the plasma membrane in response to light pulses with a length of few seconds. The actions potentials are enhanced upon deenergization of cells with phosphorylation uncouple and are suppressed upon the excessive energization in the presence of some electron acceptors. The feasibility of a complex assessment of the cell physiological condition based on measurements of photoelectric responses of chloroplasts, light-triggered action potential at the plasma membrane, and parameters of photosynthetic activity implies that the micromethods are promising for cell biomonitoring.