Effect of Membrane Fluidity on Photosynthetic Oxygen Production Reactions

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The effect of changes of membrane fluidity on the oxygen evolving capability of isolated thylakoids was investigated. Alteration of the lipid phase fluidity was achieved by incorporation of the plant sterol stigmasterol. Incorporation of stigmasterol in the lipid bilayer of thylakoid membranes results in rigidization of the hydrophobic phase of thylakoid membranes and decreases the degree of packing of the lipid head groups. These changes of lipid order are accompanied by a reduction of oxygen evolution, measured with 1,4-benzoquinone as an electron acceptor, and by a more pronounced inhibition of PSI-mediated electron transport. By analysis of the parameters of oxygen flash yields and oxygen burst under continuous illumination it was shown that after treatment with stigmasterol: 1.) the number of active oxygen-evolving centres decreased; 2.) the remaining active oxygen-evolving centres were not affected in respect to the oscillation pattern; 3.) the contribution of the slow oxygen-evolving centres in oxygen burst yield was increased. The effect of stigmasterol was compared with the well-studied effect of cholesterol. Results were discussed in terms of determining the role of lipid order for the organization and functioning of the photosynthetic machinery.

Key words: Thylakoid Membrane Fluidity, Oxygen Evolution, Stigmasterol