Effect of α-, β- and γ-Cyclodextrins on Oxygen Evolution by the Thylakoid Membrane. Influence of pH and Temperature

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The present work investigates the effect of α-, β- and γ-cyclodextrins (CD), i.e., α-CD, β-CD and γ-CD, on the oxygen evolution activity, the protein content and the uv-vis spectroscopic characteristics of thylakoid membranes. To study the pH-dependence, the thylakoids were incubated with the cyclodextrins at 273 K for a period of 10 min in the pH range from 5.5 to 9.0. To study the temperature-dependence the membranes were incubated at 273 and 293 K at pH 6.5, that is, the pH which induces a maximal oxygen evolution in the thylakoid preparations. The major observations are: (*i*) a stimulation of oxygen evolution in thylakoids incubated with α- and β-CD either in acidic or alkaline conditions, (*ii*) a low inhibitory effect induced by γ-CD on oxygen evolution, (*iii*) a significant decrease of the stimulatory effect of α- and β-CD on oxygen evolution as the incubation temperature is raised from 273 to 293 K, (*iv*) the apparent inability of the cyclodextrins to change the protein contents of the thylakoids, and (*v*) a significant CD-induced red-shift from 681 to 683 nm observed in the absorption and second derivative spectra of the thylakoid membranes treated with β-CD. First, it was found that the temperature effect described here is in accord with the general trend of the chemical effect of various cyclodextrins, i.e., the increase of the CD efficiency with decreasing temperature. Secondly, the CD effect is related to the size of the inner cavity diameter of the cyclodextrin molecules. An important conclusion in this work is that the molecular targets of the cyclodextrins are not limited to the thylakoid lipids as was described previously [Rawyler A. and Siegenthaler P.A. (1996) Biochim. Biophys. Acta **1278**, 89–97], but are located as well in other molecular species exposed at the stromal side of the thylakoid membrane. In particular, the CD-induced red-shift from 681 to 683 nm in the absorption and second derivative spectra of the thylakoid membranes indicates that the cyclodextrins targets might be either the exposed heme macrocycle in cytochrome b559, or the chlorophylls and pheophytins in the pigment-proteins of the photosystems I and II.