The photosystem II associated carbonic anhydrase Cah3 of Chlamydomonas reinhardtii increases the efficiency of photosynthetic water-oxidation at low hydrogencarbonate levels

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Flash-induced O_2 evolution patterns (FIOPs) of isolated photosystem II (PSII) membrane fragments from both the higher plant *Spinacia oleracea* and the green unicellular algae *Chlamydomonas reinhardtii* were determined under well-defined inorganic carbon concentrations. The FIOPs were obtained inside of a glove-box using a Joliot-type electrode-allowing measurements at 35-times reduced concentrations of inorganic carbon (C_i) in both the gas phase and in the sample suspensions.

The obtained O_2 patterns show that: (*i*) the miss probability at ~0.4 μM C_i (Ci depleted) is larger than at ~14 μM C_i (air-equilibrated); (*ii*) the increase of the miss parameter is more pronounced in a mutant of *C. reinhardtii* (cia3) that is lacking the PSII-associated carbonic anhydrase Cah3, than in *C. reinhardtii* wild type and spinach preparations; and (*iii*) addition of HCO_3^- (5 mM) to the C_i-depleted PSII samples largely reverts the enhanced miss probability at pH 6.3. Re-addition of HCO_3^- to C_i-depleted cia3 cells at pH 5.5 fully restores the miss-value to the same level as observed in equilibrium with air. Our results will be discussed in the context of the Cah3/HCO_3^--system as an important component of a proton translocating network on the donor side of PSII.