Why are there two copies of PsbO protein in Photosystem II from *Arabidopsis thaliana*?

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Arabidopsis thaliana (*Arabidopsis*) is widely used as a model organism in plant science and a large number of mutant lines and genomic resources are available for *Arabidopsis*. This makes *Arabidopsis* a useful tool for studies of photosynthetic reactions in higher plants. Genome sequence of *Arabidopsis* revealed two *psbO* genes which encode two PsbO proteins: PsbO1 and PsbO2, respectively. PsbO1 protein is the major isoform in Photosystem II (PSII) under normal growth conditions while the abundance of PsbO2 protein increased dramatically during cold acclimation [Goulas et al., (2006) *Plant J.* 47, 720-734]. It is not clear what advantages can *Arabidopsis* take from the exchange of this two isoforms in response to the temperature change.

We have used thylakoid membranes and PSII enriched membranes to perform systematic characterization of PSII from two *psbo* deletion mutants in *Arabidopsis*, *psbo1* and *psbo2*. The flash-induced oxygen evolution pattern (FIOP) as a function of temperature was studied in thylakoids preparations from both mutants. It was found that in *psbo1* mutant (only PsbO2 protein is present) the miss parameter α exhibits different temperature dependence if compared to WT and *psbo2* mutant. We found that the miss parameter derived from FIOP was slightly smaller at 9°C than that at 22°C in the *psbo1* mutant. In WT and *psbo2* mutant, the miss parameter increased with decreasing temperature. Distribution of the S states and stability of the S_2 and S_3 states were also found to be different at lower temperature in the *psbo1* mutant.

The quantification of the different EPR signals from the S_1, S_3 and S_0 states (as corresponding split EPR signals) and the S_2 and S_0 states (as corresponding multiline EPR signals) in PSII membranes showed that the *psbo1* mutant exhibit significant decrease in the amplitude of EPR signals associated with the advanced S states. It is likely that these effects can be correlated with the lower rate of oxygen evolution in this mutant. Based on these findings, we suggest that the PsbO2 protein exerts a major role during cold stress adaptation in *Arabidopsis*. Exact mechanistic and/or structural implications of this adaptation in PSII are under investigation.