

Ingenious fine-tuning of plant photosynthesis

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Credit: Bernard Wessels

Malgorzata Pietrzykowska has investigated the specific roles of the two most abundant membrane proteins on Earth, Lhcb1 and 2. Both of them are responsible for light harvesting which is the basis of photosynthesis, the process which sustains life on Earth by providing the oxygen we breathe and the food we eat. She defends her thesis at Umeå University on Friday 6 February.

Light is collected by pigments called chlorophylls, which absorb mainly

blue and [red light](#), whilst [green light](#) is reflected, giving plants their characteristic colour. The majority of chlorophylls are associated with the Lhc (light harvesting chlorophyll) protein superfamily, which in [flowering plants](#) consists of 13 members.

"You have surely noticed that the amount of light during the day is continuously changing. Unlike animals, plants cannot move towards or away from sunlight, therefore they have evolved mechanisms which allow them to cope with the rapid changes in light quality and intensity", says Malgorzata Pietrzykowska.

One such process, called state transition, allows plants to redistribute the [excess energy](#) from photosystem II (PSII) to photosystem I (PSI), or vice versa. State transitions are regulated by phosphorylation/dephosphorylation of Lhcb1 and Lhcb2.

In the model plant species *Arabidopsis thaliana* Lhcb1 is encoded by as many as five genes, while Lhcb2 is encoded by three, and the proteins are 98% similar at amino acid sequence level.

"When I started my PhD, I was amazed by the seemingly huge redundancy of these two proteins. Why do [plants](#) need so many copies of almost identical proteins?" asks Malgorzata Pietrzykowska.

Malgorzata Pietrzykowska shows that Lhcb1 is important for regulating the amount of [light harvesting](#) and for providing quenching sites when too much light is absorbed. More importantly, the abundance of Lhcb1 modulates the size and provides flexibility to the photosynthetic membranes.

The role of Lhcb2 on the other hand is mainly in, and limited to, state transitions. When photosystem II is receiving too much energy, Lhcb2 phosphorylation allows detachment of LHCII trimers (consisting of both

Lhcb1 and Lhcb2) from PSII, therefore less energy is transferred to PSII. At the same time these trimers attach to photosystem I forming LHCII-PSI complexes, whose formation balances allows energy flow to PSI.

In summary, Malgorzata Pietrzykowska shows that despite their similarity, the functions of Lhcb1 and Lhcb2 are different but complimentary in fine-tuning photosynthetic light absorption.

More information: The thisis is available online [here](#).

Provided by Umea University

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