The function of plant xanthophylls in photoprotection

Roberto Bassi, Dott Luca Dall'Osto
Professor of Plant Physiology, Università di Verona, Italy, roberto.bassi@univr.it

The carotenoid composition of plants is one of their most conserved properties, suggesting each xanthophyll species has a specific function. The most abundant carotenoid in dark adapted plant leaves is lutein followed by beta-carotene, violaxanthin and neoxanthin. In addition, zeaxanthin is found in high light treated plants where is synthesized from violaxanthin. In order to determine the function of each xanthophyll species a combined approach has been undertaken by constructing and characterizing ko mutants in xanthophyll biosynthesis enzymes producing arabidopsis plant either lacking one specific xanthophyll species or missing all but one. In addition, individual recombinant proteins have been produced engineered in their xanthophyll content. Plants and recombinant proteins have been characterized for their capacity of quenching singlet chlorophyll excited states, producing carotenoid triplet by quenching Chl triplet excited states and for their ROS productivity upon illumination and/or capacity for scavenging exogeneously supplied ROS species. Results show that each xanthophyll species has a specific role namely: lutein is specialized in 3Chl quenching, violaxanthin in $^1O_2$ scavenging and neoxanthin in superoxyde scavenging. Zeaxanthin has enhanced effect in both Chl triplet quenching and singlet oxygen scavenging. In addition it has a strong constitutive 1Chl* quenching, which makes it unsuitable in limiting light conditions thus accounting for its absence in low light. Zeaxanthin synthesis is controlled by VDE (Violaxanthin de-epoxydase) a soluble enzyme in the chloroplast lumen which, at low lumenal pH, becomes membrane bound and lead to the accumulation of zeaxanthin in both the lipid phase and specific sites of monomeric Lhc*b* proteins CP29, CP26 and CP24 where it up-regulates NPQ (non photochemical quenching) of excess excitation energy. In addition to these direct effect in photoprotection, the xanthophyll composition also affects transcription and protein turnover in vivo thus controlling acclimation of plants to different light/temperature conditions.