Pawel Brzezowski, Ph.D.
Assistant Professor
Department of Plant Physiology and Biochemistry
Faculty of Biochemistry, Biophysics and Biotechnology
Jagiellonian University
Kraków, Poland

Deciphering singlet oxygen-induced chloroplast retrograde signalling using model organism *Chlamydomonas reinhardtii*

Abstract

Endosymbiotic processes were the defining events in the evolution of the eukaryotic organisms. As current chloroplasts and mitochondria evolved in this course, the development of an efficient communication system between the organelle and nucleus was required. Such signalling system is one of the most crucial factors for any "symbiotic consortium" to function properly. Information exchange between chloroplasts, mitochondria, and nucleus takes place by means of anterograde ("forward", nucleus-to-organelle) and retrograde ("backward", organelle-to-nucleus) signalling pathways. This bi-directional communication is necessary for coordination of organelles' development, function, and adjustments to changing environmental conditions. There is evidence that chloroplasts as well as mitochondria can exert an effect on nuclear gene expression. One of the retrograde signalling pathways was proposed to involve reactive oxygen species (ROS), particularly hydrogen peroxide (H_2O_2) and singlet oxygen ($^1O_2$). Although some progress has been made in deciphering the involvement of H_2O_2, the ROS-induced signalling seems to be very complex and despite 30 years of study in different groups, the components involved and mechanisms governing this signalling pathway remain largely unknown. Using a novel mutant screen, transcriptomic analysis and metabolite profiling, we demonstrated that the chloroplast retrograde signalling involving $^1O_2$ depends on mitochondrial and cytosolic processes and that the metabolic status of the cell determines the response to $^1O_2$. Although our study showed that the metabolic configuration of the cell is essential for $^1O_2$-signalling, this does not exclude the involvement of proteinaceous and other cellular components in this signalling network. Selected aspects of the retrograde signalling pathways will be discussed during the meeting.

Recommended literature

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