New study shows OPR protein function is important for efficient photosynthesis

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Credit: Vitaly Krivosheev / Fotolia

Green algae and higher plants both harbor specialized cell organelles – the chloroplasts – in which photosynthesis takes place. This process allows these organisms to utilize energy from sunlight to power their biochemical reactions, including the production of carbohydrates. Chloroplasts are descended from formerly free-living single-celled organisms that were engulfed by other cells millions of years ago, and have survived since then because their hosts benefit from their activities. Chloroplasts have retained their own genomic DNA – albeit much reduced in size – it now carries only around 100 genes. The expression of the genes in the chloroplast is largely under the control of so-called Helical Repeat Proteins, termed PPRs and TPRs, which are encoded in the cell nucleus.

"A new class of helical repeat proteins has recently been discovered, called Octotricopeptide Repeat Proteins (OPRs)," says Alexandra-Viola Bohne, who is a member of Professor Jörg Nickelsen's research group at LMU's Biocenter. Interestingly, while green algae possess genetic blueprints for many different representatives of this new protein family, most land plants make only one. "That is why we were so interested in finding out what this protein actually does in land plants," Bohne says, "and we selected the OPR protein RAP found in the model plant Arabidopsis thaliana for study."

Important promoter of protein synthesis

Bohne and her colleagues first investigated genetically modified plants that were unable to synthesize RAP. Their findings revealed that the RAP protein has an important role in the translation of the genetic information in the chloroplast DNA into specific proteins. RAP turns out to be involved in the maturation of the so-called 16S rRNA, which is a major component of the "protein factories" in the chloroplast. "Loss of RAP leads to a reduction in the level of protein synthesis in the chloroplasts, which in turn results in a decrease in the efficiency of photosynthesis," says Nickelsen. "In addition, we were able to demonstrate, for the first time, that processing of the rRNA takes place in the nucleoid, a DNA-RNA-protein complex found in the chloroplasts. That had been previously proposed, but had remained unproven until now."

Intriguingly, evidence from other studies suggests a link between the RAP protein and resistance to plant pathogens. In that context, it appears that lower levels of RAP are associated with an increase in resistance. "So our results may also help us to gain new insights into the role of the chloroplasts in defending plants against attack by pathogens," Bohne adds.

More information: "RAP, the Sole Octotricopeptide Repeat Protein in Arabidopsis, Is Required for Chloroplast 16S rRNA Maturation." Laura Kleinknechta, et al. *The Plant Cell* February 2014 tpc.114.122853. doi: dx.doi.org/10.1105/tpc.114.

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