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The plastidial protein acetyltransferase GNAT1 forms a complex with GNAT2, yet their interaction is dispensable for state transitions

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Plants are exposed to a constantly changing environment, which requires fast acclimation strategies. Post-translational modifications (PTMs) of proteins allow cells to respond rapidly to varying environmental conditions and have the potential to alter localization, interactions, or enzymatic activities of proteins. Protein acetylation is one of the most abundant co- and post-translational modifications in eukaryotes and its occurrence extends to chloroplasts in vascular plants. In Arabidopsis, a novel plastidial enzyme family consisting of eight acetyltransferases with dual lysine and N-terminal acetylation activities has recently been unveiled. Among them, GNAT1, GNAT2, and GNAT3 reveal notable phylogenetic proximity, forming a subgroup termed NAA90.

Here, I will focus on GNAT1, the closest relative of GNAT2, which is known for its regulatory function in the state transition of photosynthetic antenna proteins. In contrast to GNAT2, GNAT1 was not found to be essential for state transitions. However, our results demonstrate a shared set of N-terminal substrate sites between GNAT1 and GNAT2 in vivo. Furthermore, co-immunoprecipitation coupled to mass spectrometry revealed a robust interaction between GNAT1 and GNAT2, as well as a significant association of GNAT2 with GNAT3, the third acetyltransferase within the NAA90 subfamily. Dimer models of GNAT1-GNAT2 and GNAT2-GNAT3 generated by AlphaFold 2 Multimer indicate that the same surface-exposed amino acid residues of GNAT2 are involved in both interactions. This leads to the conclusion that the formation of multimers containing more than two GNATs is rather unlikely to occur - a conclusion, which is also supported by the AF 2 Multimer confidence score index, according to that all multimeric structures of three or more GNATs decrease significantly in their confidence ranking. Our results point to complex formation as a novel layer of regulation that may fine-tune the activities of plastidial acetyltransferases. Elucidating the specific, functional impact of individual dimer formations will be a promising task for future research.

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