

Protein accumulation and gene regulation: conservation of MBD-ACD mechanism across plant species

Abstract:

DNA methylation is a well-studied epigenetic modification that is often, though not always, associated with gene silencing. In the plant model organism *Arabidopsis thaliana*, methyl-CpG-binding domain (MBD) proteins regulate gene expression downstream of DNA methylation by forming complexes with specific α -crystallin domain (ACD) proteins. ACDs are often found in small heat shock proteins (sHSPs), but *A. thaliana* appears to have co-opted sHSP function for dynamic protein accumulation to control gene and transposable element expression. While unique and well-studied in *A. thaliana*, it's unclear how pervasive this mechanism is in other plant species. Using multiple sequence alignment, AlphaFold protein structure prediction, and microscopy experiments, we have discovered conservation of ACD and MBD proteins and interactions. These data suggest diverse plant species, from *A. thaliana* to crops, leverage chaperones and protein accumulation for gene regulation. This mechanism has the potential to be a novel method to target epigenetic tools for gene regulation using endogenous and plant-specific mechanisms, with implications across diverse plant species.