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Lipid Droplets Stabilize Genomic DNA to Survive a Bacterium in Extreme Environments

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The lipid droplet (LD) is a multi-functional organelle that exists in organisms ranging from bacteria to humans. LD research has focused on lipid metabolism while other LD functions remain to be explored. Here, we report two functions of LDs in the bacterium *Rhodococcus jostii* RHA1 (RHA1). 1) The bacterial LDs bound and protected genomic DNA through the major LD protein, microorganism lipid droplet small (MLDS), which increased survival rate of RHA1 during ultraviolet exposure or extremely low nitrogen environments. MLDS expression was regulated by a transcriptional regulator, MLDS regulator (MLDSR) that bound the operator and promoter of the operon of *mlds* and *mldsr*. 2) LDs sequestered MLDSR to control its availability for transcriptional regulation. Together, this study suggests that the LD is a unique endomembrane organelle that can function in a manner analogous to the eukaryotic nucleus to facilitate bacterial survival and adaption to extreme environments.

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