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Using extremely halophilic bacteria to understand the role of surface charge and surface hydration in protein evolution, folding, and function WOUTER HOFF, Oklahoma State University, RATNAKAR DEOLE, Northeastern State University, OSU COLLABORATION — Halophilic Archaea accumulate molar concentrations of KCl in their cytoplasm as an osmoprotectant, and have evolved highly acidic proteomes that only function at high salinity. We examine osmoprotection in the photosynthetic Proteobacteria Halorhodospira halophila. We find that H. halophila has an acidic proteome and accumulates molar concentrations of KCl when grown in high salt media. Upon growth of H. halophila in low salt media, its cytoplasmic K+ content matches that of Escherichia coli, revealing an acidic proteome that can function in the absence of high cytoplasmic salt concentrations. These findings necessitate a reassessment of two central aspects of theories for understanding extreme halophiles. We conclude that proteome acidity is not driven by stabilizing interactions between K+ ions and acidic side chains, but by the need for maintaining sufficient solvation and hydration of the protein surface at high salinity through strongly hydrated carboxylates. We propose that obligate protein halophilicity is a non-adaptive property resulting from genetic drift in which constructive neutral evolution progressively incorporates weakly stabilizing K+ binding sites on an increasingly acidic protein surface.

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