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Metabolic Regulation in Halobacteria Analyzed by Photo-Irradiated Solid-State NMR

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Summary

Halobacteria is one of microorganisms of the Archaea domain that require high salt concentration at least 2.5 M for growth. The bacteria have retinal-binding proteins and pigments, such as lycopene and β-carotene, to pump ions and sense light environment by light absorption. Further, halobacteria was well adapted to hypersaline environments because it stored high concentration of K^+ ions in cell. We have applied solid-state NMR methods to investigate the metabolic reaction of halobacteria relevant to light and high salt concentrations. Using by in-situ photo-irradiated solid-state NMR apparatus, we have successfully detected the photoisomerization of retinal in bacteriorhodopsin, which is a light-driven proton pump in purple membrane of halobacteria, during ^{13}C NMR measurements. Therefore, we might be able to control the photo reaction for growth in halobacteria during NMR measurements. And, in order to examine the distribution of potassium ions in the halobacterial cells, we performed the ^{39}K and ^{23}Na NMR experiments. Major ^{39}K NMR signal of halobacteria was not shifted by addition of shift reagent of Dysprosium (III) acetyl acetonate. This experiment suggests that K^+ ions in the cells are mainly free.