Spectral Comparisons Reveal General Stress Response Strategies in *Desulfovibrio vulgaris*

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ABSTRACT

Here we report a high-resolution Fourier transform infrared (FTIR) spectromicroscopy study of stress responses in *Desulfovibrio vulgaris* triggered by oxygen (O_2), nitrate (NO_3), and sodium chloride (NaCl). The advantage of the FTIR spectroscopy approach is that it allows us to immediately detect *in situ* intracellular molecules or molecular structures, to nondestructively monitor and quantify metabolites produced in response to different stresses, and to rapidly characterize growth-dependence phenomena and stress-response mechanisms. Because the chemical and structural information of molecules associated with cellular processes inside microbes are contained in each infrared spectrum, one can extract chemical and structural information from each spectrum regarding the physiological conditions of a cell or a group of cells. Comparative analysis of time-dependent infrared spectra of *D. vulgaris* exposed to different stressors reveals the following interesting findings. When exposed to moderate concentrations of O_2 or NO_3, *D. vulgaris* increases the production of exopolysaccharides but with little change in protein structures. However, when exposed to moderate concentration of NaCl, *D. vulgaris* again increases the production of exopolysaccharides while exhibiting a significant change in protein structures. These results, together with microscopy images, confirm the importance of exopolysaccharide production in enhancing the stress resistance and survival of *D. vulgaris*.

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