NITRATE AND NITRITE GROWTH INHIBITION OF *DESULFOVIBRIO* STRAINS

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ABSTRACT

Sulfate-reducing bacteria (SRB) can perform desirable functions such as immobilization of environmental heavy metals, but they also cause oil "souring" because of their sulfide end product. Growth of SRB can be controlled by the inhibitory effects of nitrate and nitrite. However, prior studies have suggested that nitrate does not directly inhibit SRB. Rather, it was thought that nitrate is converted to the more toxic nitrite, which serves as the ultimate inhibitor. Here we tested whether nitrate can inhibit SRB by a mechanism other than through nitrite inhibition, and therefore whether responses of SRB to these different inhibitors might also be different. We measured growth kinetics and the fitness of thousands of mutants of the model SRB *Desulfovibrio vulgaris* Hildenborough and *Desulfovibrio alaskensis* G20 in lactate-sulfate plus nitrate. We found that mutations in homologous gene clusters (DVU0251-DVU0245/Dde_0597-Dde_0605) and in the Rex transcriptional regulator (DVU0916/Dde_2702) of these SRB confer resistance to nitrate. The same mutations did not confer nitrite resistance, and no nitrate consumption was observed. We also found that *D. vulgaris* can use subinhibitory concentrations of nitrite, but not nitrate, as a nitrogen source or terminal electron acceptor for growth. Since nitrate did not support growth of *D. vulgaris* as a nitrogen source, we infer that significant nitrite is not generated from the nitrate. These results show that nitrate inhibition of SRB can be independent of nitrite production. Furthermore, they reveal previously uncharacterized metabolic abilities which may allow niche expansion of *D. vulgaris* in low-sulfate environments containing nitrogen oxides. These insights into the interactions of SRB with nitrate and nitrite may lead to better control of SRB in industrial settings and better prediction of their interactions in the environment.