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Mathematical Modeling of Growth and Selenium Metabolism of *S. maltophilia* O2

S. maltophilia O2 was isolated from a mercury contaminated site in Oak Ridge, TN. This bacterium is able to survive and grow in the presence of several toxic metals including copper, mercury, lead, and selenium among others. Our study deals with selenite, an oxidized form of the element selenium. Normally, selenium is required in the diets of most organisms in trace amounts. However, an excess of selenium is toxic. *S. maltophilia* O2 is able to survive in the presence of toxic levels of selenite by reducing and precipitating it into non-toxic elemental selenium.

This study followed the growth of *S. maltophilia* O2 in the presence and absence of selenite by measuring turbidity and viable cell counts. Protein expression was studied via two-dimensional gel electrophoresis to identify any proteins which may confer selenite resistance. The selenium in the supernant and inside the cells was also measured. The growth of the control strain followed a classical growth curve with lag, log, and stationary phases. In the experimental group, the bacteria shifted from an exponential phase into a stationary phase after the addition of selenite.

Our mathematical model accounts for the bacterial growth and the selenite metabolism. It is based on a system of differential equations involving a modified logistic growth equation coupled with Michaels-Menten enzyme kinetics. The model predicts the bacterial biomass and the concentration of selenium in the supernant and inside the cells at any point in time. Analysis and comparison to experimental data was carried out using XPP and R. Parameters for the logistic growth model were determined by using the control group data and R's nonlinear least-squares regression software. The results of the mathematical model compared favorably with experimental data throughout the growth cycle and give a mechanistic model for the reduction of selenite by bacteria.

Undergraduate Poster Session