CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
S0407

Project Title
A Study of Dopa Mediated Mussel Adhesion in Mytilus edulis

Abstract

Objectives/Goals
The goal of this study is to further our understanding of mussel adhesion by identifying the specific roles of dopa rich proteins mfp3 and mfp5 found on the underside of adhesive plaques. Last year's tripeptide model study demonstrated that dopa's reactivity and relative preference to bind to metals or oxidize to quinones was regulated by flanking amino acids. Since in mfp3 dopa is flanked by amino acids that make it reactive but non preferential while in mfp5 some motifs promote iron binding, it is hypothesized that mfp3 is the general workhorse of adhesion while mfp5 plays an important role when the mussel binds to surfaces with a high metallic content. The hypothesis was first tested out on M. californianus as a principal investigator in a joint study. The current study focuses on further corroborating the hypothesis using M. edulis.

Methods/Materials
M. californianus were obtained from Santa Monica pier while M. edulis came from seafood stores. Mussels were cultivated in shallow aerated tanks filled with ocean water replenished daily. In the M. californianus study, 100 plaques were harvested per sample from mussels attached to plastic, $CaCO_3$, steel and glass. Due to meager plaque production by M. edulis, samples with 30, 60 and 100 plaques were collected on plastic and $CaCO_3$ and extracted by grinding in vinegar followed by centrifugation. Pellets were extracted in 8M urea. Supernatants were subjected to SDS PAGE and stained with SimplyBlue. Protein content was measured by A280 assay. M. californianus grown on plastic and $CaCO_3$ served as positive control.

Results
mfp3 and mfp5 were not visible in M. edulis gels. Resulting troubleshooting analysis included ensuring presence of protein in supernatants(A280 assay), confirming validity of protocol using M. californianus as control and pellet analysis to rule out protein loss. The process of elimination leads to the conclusion that the proteins are not visible due to poor staining.

Conclusions/Discussion
While M. californianus plaques from the joint study had a distinct protein profile for each surface and a higher amount of mfp5 in plaques from steel, thus verifying the hypothesis, current M. edulis data cannot provide further support. In future, a dopa specific staining procedure using MBTH will be developed. The completed study will further our understanding of mussel adhesion and help design target molecules for biomimetic and biofouling applications.

Summary Statement
The goal of this study is to identify the precise role of dopa rich proteins mfp3 and mfp5 in mussel adhesion based on their observed relative distribution in plaques of M. edulis grown on metallic and nonmetallic surfaces.

Help Received
Prof. Waite of UCSB advised on mussel growing conditions and project rationale; Jette Wypych (Amgen) for supplying SDS PAGE equipment, Mike Mahoney and Cathy Hutchinson of CSUCI for use of centrifuge, spectrophotometer and gel analysis equipment; parents for logistic support, report editing.