CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

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Project Number
S1701

Project Title
Cell Wall Formation from Marine Diatom Protoplasts: Implications for Novel Transformation and Nanotechnology Techniques

Abstract

Objectives/Goals
Biosilification, or the biological processes responsible for silica deposition, is of growing interest in many fields of study from marine biology to nanotechnology. Since diatoms can so readily make three-dimensional intricate structures that exceed current synthetic methods, investigation of diatom cell wall development offers applications in microengineering, photonics, and nanotechnology. Diatoms also have shown potential as a source of lipids for biodiesel. However, diatom research is impeded because access to the cellular DNA is obstructed by the silica cell wall. The purpose of this research is to (1) study the biological processes of frustule development from the protoplasts of the marine diatom Nitzschia alba and (2) establish procedure for protoplast growth and regeneration. This information regarding structure formation may be used to aid development of more efficient biomimetric designs in future research.

Methods/Materials
In this study, the marine apochloratic diatom Nitzschia alba was induced to grow without a cell wall using a silica-starved media, L+2%, consisting of 0.5% bacto-yeast extract, 1% bactotryptone, and 2% sodium chloride. Rapid agitation was necessary to induce frustule divergence. The resulting protoplasts were then harvested and transferred to an artificial seawater media with PDMPO, a silica fluorescence stain. The cell wall regeneration was observed for pattern and growth comparison after 24 and 48 hour time periods using an epifluorescence microscope.

Results
A successful procedure was developed to induce protoplast growth in the diatom species Nitzschia alba and these protoplasts were shown to be viable cells. The cell wall was regenerated into wild-type morphology form and shown to reproduce through multiple successive generations (viewed via silica staining) from the protoplast form.

Conclusions/Discussion
It was determined that viability was maintained through the protoplast procedure as evidenced by the complete regeneration of the cell wall with wild-type morphology through multiple generations. Further investigation is required to establish genes responsible for independent steps of cell wall formation but the implications suggest the potential for an alternative gene transformation technique and pave the way for further studies of diatom cell wall development.

Summary Statement
This study developed a procedure for growing the diatom species Nitzschia alba without its cell wall and proved that the resulting protoplasts are viable and regenerate their cell walls in the wild-type morphology.

Help Received
Used lab equipment at Scripps Institution of Oceanography under supervision of Dr. Mark Hildebrand (but research conducted independently)