CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
J0412

Project Title
Enzyme Stabilization in Calcified Marine Algae

Abstract

Objectives/Goals
The objective is to determine whether calcareous algae protect their enzymes from heat denaturation more than non-calcified algae.

Methods/Materials
Four red algae were tested for vanadium bromoperoxidase activity, Chondracanthus exasperatus, Mazzella affinis, Corallina vancouveriensis, and Gelidium, by conducting an assay in which, if V-BrPO was present, the enzyme would catalyze the bromination of Phenol Red to Bromo-phenol Blue, as indicated by the color change. To test if the catalyst was a protein, the seaweeds were boiled for 5 minutes and tested for activity. The catalytic activity was destroyed in all the algae except the calcareous Corallina alga. This alga's V-BrPO was then extracted and boiled. The time-course of the reaction was followed spectrophotometrically at 590nm. Enzyme extracts were encapsulated in calcium alginate beads to investigate the effect of this matrix on the thermal stability of the V-BrPO enzyme.

Results
All algae were active for vanadium bromoperoxidase. When heated, all denatured except for the Corallina vancouveriensis. When this alga#s extract was boiled, it denatured. Because the V-BrPO activity could be destroyed by heating (or by extracting and heating) in all the seaweeds, it indicated that all the seaweeds# catalysts were enzymes. The assay in which the time-course of the reaction of Phenol Red to Bromo-phenol Blue was followed showed that the calcareous alga (Corallina vancouveriensis) had the most activity. Then, when the Corallina vancouveriensis# extract (which was denatured when boiled previously) was put in a calcium alginate gel bead and boiled, it retained the V-BrPO activity.

Conclusions/Discussion
The hypothesis was supported, in that calcareous algae do protect the V-BrPO enzyme better than non-calcareous algae against heat denaturation. This was shown because the enzyme in Corallina vancouveriensis (a calcareous alga) did not denature when boiled, whereas the V-BrPO in the other red algae did. Again the hypothesis supported when a calcareous shell (calcium alginate) was made to surround an enzyme extract that would normally denature when boiled for five minutes, and the catalyst in the calcium alginate beads remained active when it was boiled for five minutes.

Summary Statement
The calcium carbonate shell in calcareous marine algae is shown to protect vanadium bromoperoxidase against heat denaturation.

Help Received
Used lab equipment at UCSB under the supervision of Moriah Sandy, a graduate student at UCSB