R/MP-79: 3.1.1998–8.31.2001 and R/MP-89: 3.1.2000–2.28.2002

Frontiers in Squid Reproduction: Prospecting for New Antibiotics

David Epel
Stanford University—Hopkins Marine Station

Background

Many strains of disease-causing bacteria have become resistant to antibiotics, leading those in the medical profession to search for new sources of drugs.

Although most antibiotics have been derived from terrestrial life, it is the marine world that may provide the pharmaceutical industry with the next generation of medicines. The biochemistries of seemingly simple marine organisms such as blue-green algae, sponges and squid are inspiring new ideas for drug development.

The Project

Marine biology professor Dr. David Epel of Stanford University was funded to study the anti-microbial properties of coatings on squid egg sheaths. Recent studies have shown that female squid inoculate their eggs with a paste that protects the eggs from fungi, bacteria and parasites during their one-month incubation on the seafloor.

It is hoped that these protective coatings work through biochemical pathways that have not been seen in terrestrial animals. Such compounds offer the best defense against a growing number of antibiotic-resistant diseases.

A female lays her eggs. Photo: © Sea Studios Foundation.

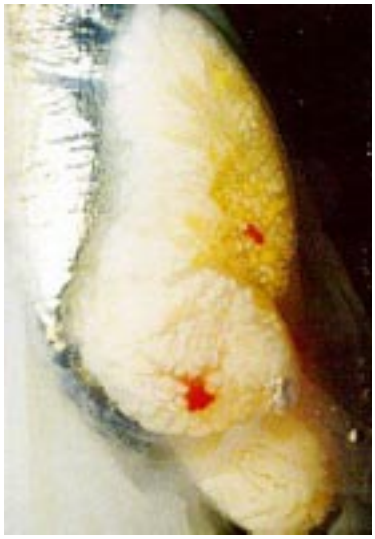
In previous Sea Grant research, Dr. Epel's laboratory isolated two novel types of bacteria—a *Shewanella* sp. and *Roseobacter* sp.—from the eggs and accessory nidamental glands of the California market squid (*Loligo opalescens*). The accessory nidamental glands are reproductive organs located beside the egg-producing nidamental glands. They also harbor a dense bacterial community that is secreted onto the eggs. These bacteria are collected from seawater by female squid.

In this project, Dr. Epel and post-doctoral researcher Dr. Todd Ciche continued their examination of these protective bacteria, using a molecular technique that allows them to identify all the different types of bacteria present on squid eggs.

Using this new technique, Drs. Epel and Ciche have discovered about eight previously unknown kinds of bacteria in the egg sheath of the market squid. The researchers have also succeeded in growing most of these new bacteria in culture. In earlier experiments, they were unable to do this.

The Findings

Only one of the 10 bacterial species was shown to produce anti-bacterial compounds. Based on this, the scientists hypothesize that the group of bacteria work in concert, communicating through chemical signals, to produce antibiotic and anti-fungal compounds. Thus, although most bacteria may not directly produce protective compounds, they may play a key role in signaling other bacteria to produce them.



Accessory nidamental gland showing concentrations of bacterial pigment. Photo: Dr. David Epel, Stanford University.

In subsequent experiments, Drs. Epel and Ciche have characterized the bacteria in the egg coatings of two other species of squid—one native to Hawaii and the other native to the Mediterranean Sea. Although the squid species have geographically distant ranges, their egg sheaths contain several of the same bacteria found in the sheaths of the California market squid. The finding suggests that these common bacteria are involved in a common biological process, and that the bacteria and their protective function

Female squid cut open to show internal anatomy. Photo: Dr. David Epel, Stanford University.

have remained unchanged during the many millions of years it took for the different squid species to evolve.

Drs. Epel and Ciche's future work will focus on isolating and describing the antibiotics present in the egg coatings. They also plan to study the communication mechanism among the different species of bacteria.

Cooperating Organizations

Monterey Bay Aquarium Research Institute
School of Fisheries, University of Kyoto, Japan
University of Hawaii
University of Wisconsin

Trainee and Thesis

Eufemia, Nancy, Ph.D. in Biology, Department of Biological Sciences, Stanford University, December 2000, "The Role of the Multixenobiotic Resistance Mechanism (MXR), P-Glycoprotein, as a Protective Response Against Environmental Stress in Mytilus Mussels."

For more information:
Dr. David Epel
Professor, Biological Sciences
Stanford University
Hopkins Marine Station
Tel.: (831) 655-6226
Email: depel@leland.stanford.edu

PUB. NO. CSG-MP-02-001 **AUGUST 2002**

This work is sponsored in part by a grant from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA06RG0142, Project number A/P-1. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any of its sub-agencies. The U.S. Government is authorized to reproduce and distribute for governmental purposes.

California Sea Grant College Program
Russell A. Moll, Director • Dolores M. Wesson, Deputy Director • Paul Olin, Interim Associate Director for Extension • Marsha Gear, Communications Coordinator
University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0232
Phone:(858) 534-4440 Fax: (858) 453-2948 Web site: http://www-csgc.ucsd.edu