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The Biomedical Potential of California Marine Organisms

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Background

Despite tremendous advances in medicine, there are no cures for some of the most deadly and crippling diseases. HIV/AIDS, arthritis, several types of cancer, and many viral and fungal diseases are some examples of horrible afflictions that cannot yet be cured. There are also previously curable illnesses (e.g., strains of tuberculosis) that have become resistant to standard antibiotic therapies. Now, as much as ever, new treatments are needed to save and improve human lives.

Currently, about half of all prescribed medicines are extracted or derived from terrestrial plants and microorganisms. Many synthetic drugs, it should be noted, were originally inspired by novel compounds discovered in terrestrial organisms.

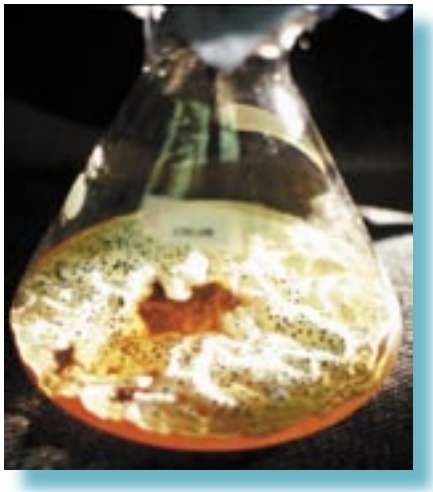
Although few marine natural products are currently on the market or in clinical trials, marine organisms represent the greatest unexploited source of potential pharmaceuticals. Because of the unusual diversity of chemical structures isolated from marine organisms, there is intense interest in screening marine natural products for their biomedical potential.

Project

Most studies of metabolites from California marine organisms were performed during the 1970s, when techniques for evaluating pharmacological activity were comparatively primitive. In recent decades, as biomedical techniques have improved, those prospecting for new drugs have often focused their search on tropical environments such as coral reefs. However, relatively little is known about the biomedical potential of what is living off the coast of California.

The goal of this project was to screen metabolites extracted from sponges, ascidians and other invertebrates living along California's coast for their antimicrobial, antifungal and anticancer activity, using state-of-the art bioassay technologies. In addition to the goal of discovering new pharmaceutical agents, the scientists were funded to collect data that will allow others to further study the biomedical potential of California's marine invertebrates and algae.

The California marine sponge (*Haliclona* spp.) is being studied for its anticancer compounds. Photo: Michael McCoy



A flask of specimens for screening in the lab. Photo: William Fenical

Summary

In 2001–2002, marine biologists screened 114 specimens (most of which were collected from the Channel Islands) for their biomedical activity. Of these, three "priority 1" compounds were discovered. "Priority 1" means a compound is potent and selective for one or two types of cancer cell lines. Six "priority 2" compounds were also discovered, indicating the compounds had potency but less selectivity. Three extracts showed activity in the HIV-1 integrase assay, one of three targets that stops viral replication of HIV inside a cell. Three extracts also showed antifungal activity.

In 2002–2003, scientists collected 41 sponges, 1 ascidian and 1 hydrozoan from subtidal and intertidal zones off the Point Loma and La Jolla areas of San Diego. From these samples, researchers found three sponges containing anticancer compounds.

In addition, three new compounds were discovered from yet another local sponge. Although these novel compounds were not active in any bioassay, their discovery is considered important because it adds to the knowledge base of compounds unique to the marine environment. Future assays might also show that

*D. John Faulkner died November 2002; the project was completed by William Fenical.

these compounds do indeed have medical applications.

Implications

The ocean is a potential source of new drugs for fighting antibiotic-resistant infections and other deadly diseases. The California coast has a rich diversity of marine life that, besides being ecologically important, may also hold promise for biomedical discoveries. To continue to understand and fully appreciate native biota, marine biologists say they need to continue studies of the region's unique marine environments. This means, among other things, more fully exploring deeper waters off the coastline.

As part of this Sea Grant project, scientists completed a "specimen voucher" for every species collected. These vouchers are maintained at the Benthic Invertebrate Collection at Scripps Institution of Oceanography and are made permanently available to any scientist for chemistry, taxonomic, comparative or ecological studies.

Collaborations

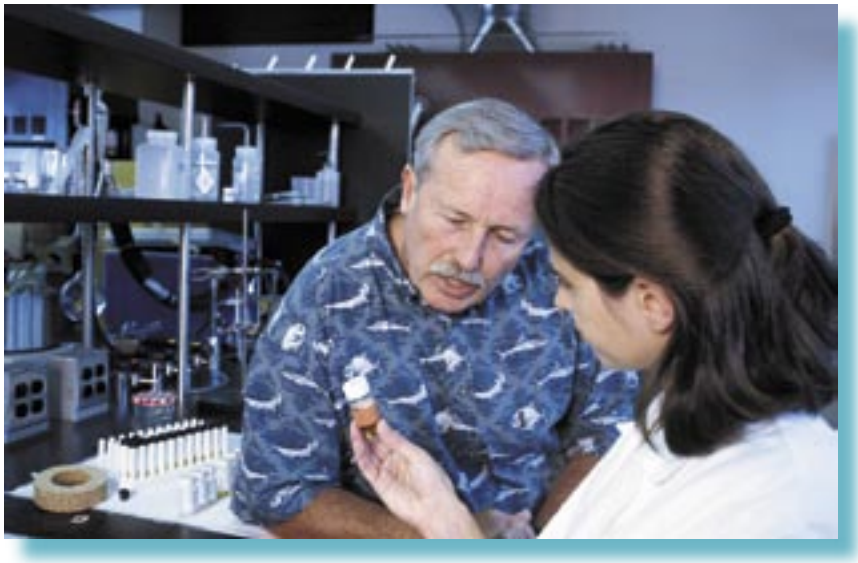
Cancer assays were done in collaboration with one of the country's largest pharmaceutical companies. The HIV/AIDS component of the research was conducted in collaboration with the Salk Institute for Biological Studies, La Jolla.

Awards

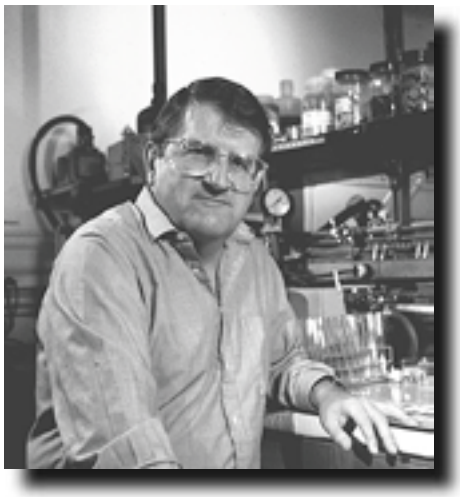
Paul J. Scheuer Award in Marine Natural Products to D. John Faulkner in 2000.

Trainees

Michael McCoy
Joel Sandler



Dr. William Fenical and student in his lab at the Center for Marine Biotechnology and Biomedicine. Photo: Scripps Institution of Oceanography



Dr. D. John Faulkner 1942–2002, a pioneer in the field of marine natural products chemistry. Photo: Scripps Institution of Oceanography

Publications

McCoy, M.C., and D.J. Faulkner. 2001. Uoamines A and B, piperidine alkaloids from the ascidian *Aplidium uouo*. *J. Nat. Prod.* 64:1087–1089.

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