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Some marine toxins

Aquaculture Department, Southeast Asian Fisheries Development Center

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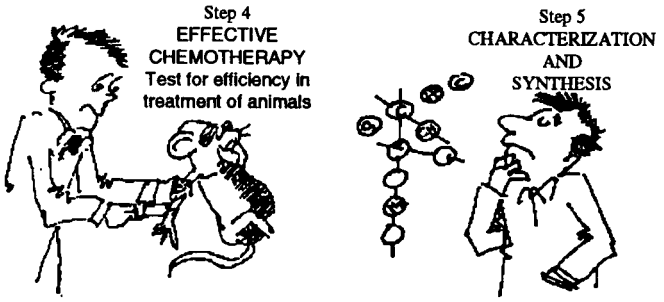
Some marine toxins



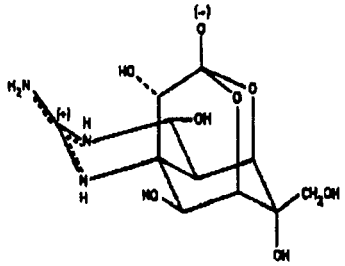
Tetrodotoxin: puffer-fish toxin

Ancient writings especially in China and Japan have referred to toxic puffer-fishes (Tetraodontidae). The Chinese book **Sankaikyo**, written about 2,000 years ago, describes the death of a man who ate puffer-fish intestines. The initial symptom includes paralysis of the tongue and lips that occurs in about 20 minutes to 3 hours and is progressive. Death occurs in 6-8 hours. The toxin is present in most tetraodontid species (about 29 in Japan), approximately half of which are edible. *Fugu* for example is an expensive delicacy. As the toxin is concentrated in the intestines and skin, the art of preparing *fugu* lies in removing these without contaminating the rest of the fish. Stringent regulations for handling *fugu* were introduced during the Edo period (1603-1868), and in Japan today all cooks must pass an examination on its preparation before they can serve *fugu.*

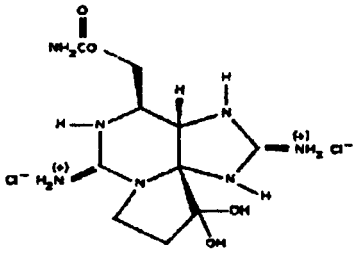
blockage of sodium ions. It is widely used in neurophysiological research on the mechanisms regulating nerve impulses. Tetrodotoxin has also been used in clinical medicine; in Japan it is used as a muscle relaxant and as an analgesic in the treatment of certain tumors.

Saxitoxins: paralytic shellfish poison

Another cause of food poisoning in humans is found in mussels and shellfish. The toxin comes from red microalgae (dinoflagellates) that mussels and shellfish ingest. The toxin concentrates on their bodies, and in turn they become toxic and inedible. Paralytic shellfish poison poses a very serious problem in the United States and Canada, as the puffer-fish does in Japan. There are similarities between the poisons -- they have both caused many deaths, they produce very similar symptoms and the causative agents are highly toxic and act in much the same way. The



Tetrodotoxin (left) isolated from the pufferfish, and **saxitoxin** (right) isolated from the microscopic red algae which cause "red tides", are extremely toxic and block the transmission of nerve impulses. They have been widely used in neurophysiological research.



The toxin in puffer-fish is tetrodotoxin, one of the most poisonous non-protein toxins known to man (LD_{50} about 10 μg/kg in rats). Attempts to isolate the toxin date back to 1909, and it was not until 1964/65 that its structure was established by three research teams working independently of each other. The long wait was not in vain; tetrodotoxin has a previously unknown structural characteristics. It is a neurotoxin that inhibits the transmission of nerve impulses by selective

first toxin to be isolated was saxitoxin obtained from an edible bivalve, the *Saxidomus giganteus.* Its structure was established in 1975 by Shantz and his collaborators, after more than 20 years of research.

Palitoxin: the most toxic marine product

Palitoxin is isolated from a zoonthurian *Palythoa toxica.* An ancient Hawaiian legend

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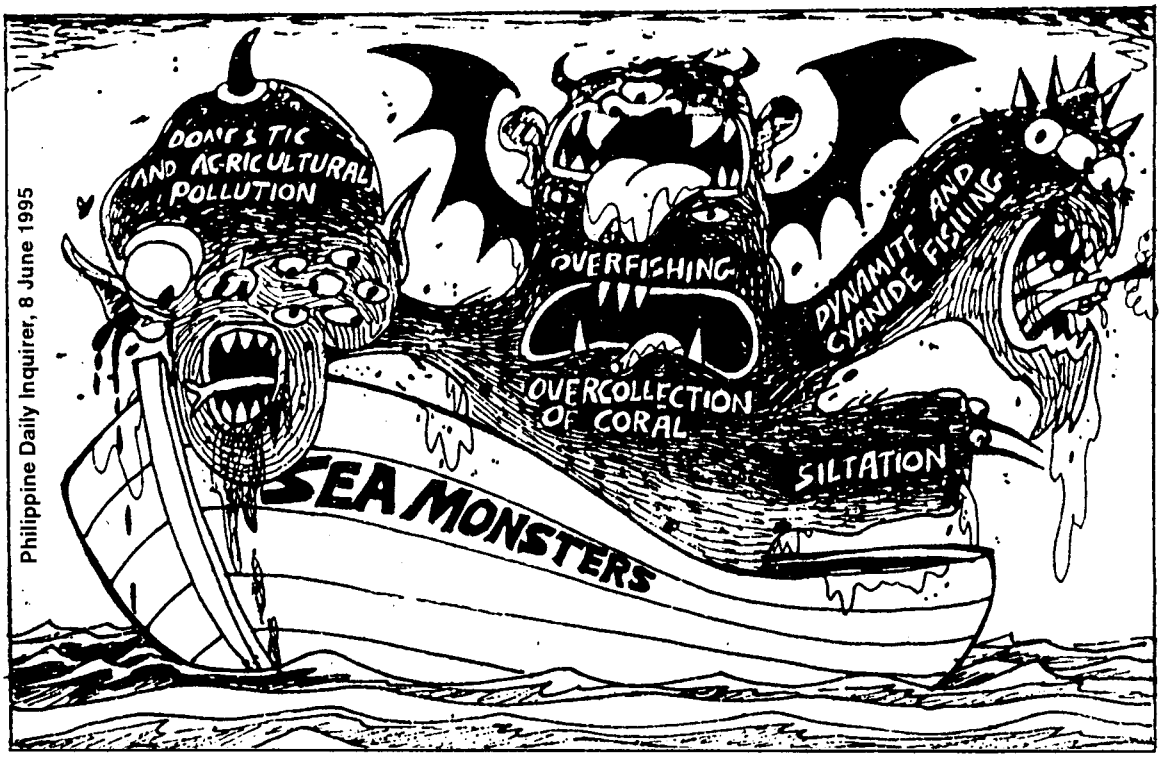

Philippine Daily Inquirer, 8 June 1995

SOME MARINE TOXINS ... FROM PAGE 14

describes a potent poison found in seaweed known as **limu-make-O-Hana** (the deadly seaweed of Hana). The islanders of old smeared the tips of their lances. It was not until 1861 that the habitat described in the legend was discovered and scientists were able to collect the seaweed. Moore and Scheuer isolated the toxin in 1971, and its structure was definitively established ten years later. Palitoxin has an unusual structure. Despite its great molecular weight (around 3,300 daltons), it is not formed by the repetition of simple structural units like polysaccharides. Palitoxin is extremely poisonous (LD_{50} about 0.5 µg/kg in rats) and possesses antitumoral properties. A dose of around one-tenth of the minimum lethal dose completely cures Ehrlich's tumor in rats. It has recently been used as a local anaesthetic in maxillofacial surgery, allowing surgeons to operate for several hours at a time. It is a powerful vasoconstrictor and is potentially useful in the study of angina in animals.

Excerpted from: Luigi Minale. 1985. *Medicine from the sea.* In: SG Richardson (ed). **Managing the Ocean; Resources, Research, Law.** Lomond Publications Inc. Maryland 1985.

FUTURE DRUGS FROM THE SEA ... FROM PAGE 17

from marine organisms: **We should expect marine chemicals to inspire new drugs rather than to provide them.**

Chemicals from marine organisms have proved to be different from plant sources, and have provided valuable tools for biomedical research, as well as inspiration to the pharmaceutical industry. Biochemical studies have positively influenced marine biology, in as much as they have focused attention on marine invertebrates and led to pioneering research on invertebrate aquaculture and invertebrate-cell tissue culture. If we consider the 1980s to be a period of basic research on chemicals from marine organisms, then the 1990s will surely see new drugs and other chemical products that are inspired by this research. We will then have accomplished our goal of demonstrating the biomedical potential of chemicals from marine organisms without causing any lasting damage to the marine environment.

Sources: (1) **Oceanus**, 1992. **Oceanus** reports on research at the Woods Hole Oceanographic Institution. (2) **Science** Vol. 266. November 25, 1994.