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Marine toxins

DANIEL G. BADEN[1,2], LORA E. FLEMING[1,3] and JUDY A. BEAN[1,3]

[1]NIEHS Marine and Freshwater Biomedical Sciences Center, [2]Department of Biochemistry and Molecular Biology, and [3]Department of Epidemiology and Public Health, University of Miami, Miami, FL, USA

Throughout the world, marine toxins cause a variety of acute, subchronic, and chronic diseases in humans, as well as diseases in other mammals, fish, and birds (Table 1) (Hughes and Merson 1976; Southcott 1979; Baden 1983, ILO 1984; Sakamoto et al. 1987; Halstead 1988). The diseases in humans range from acute neurologic diseases, such as ciguatera and paralytic shellfish poisoning, to chronic dementia, as reported with domoic acid exposure. The marine toxins cause disease predominantly through the ingestion of contaminated fish and shellfish, although certain diseases are via skin contact and even by inhalation. Therefore, the food web and the bioconcentration of these toxins through the marine food web play important roles in the transmission of marine toxin diseases. These marine toxins accumulate in a range of intermediate marine hosts (i.e. the transvectors), both shellfish and fish, prior to contact with humans. Often there are additional secondary transvectors with further bioaccumulation (such as carnivore fish eating contaminated herbivores).

In addition, most of the toxins are small, nonpeptidic highly potent substances; quantities as small as < 1 mg/kg body weight can lead to illness. For example, the marine toxin ciguatoxin is estimated to be toxic for humans at a dose of 1 mg/kg body weight (ILO 1984; Miller 1991); its co-occurring toxin maitotoxin is estimated to be even more potent. The marine toxins are predominantly neurotoxins, although hemolytic substances have been identified. In general, the natural marine toxins are tasteless, odorless, and heat- and acid-stable. Therefore normal screening and food preparation procedures will not prevent intoxication if the fish or shellfish is contaminated (ILO 1984; Sims 1987; Halstead 1988; Perl et al. 1990; Teitelbaum et al. 1990; Miller 1991).

The general source of these toxins, with the exception of tetrodotoxin in puffer fish and the blue-green algae cyanophytes, are the dinoflagellates and diatoms. The dinoflagellates are phylogenetically unique marine organisms. Dinoflagellates are single-celled algae-like biflagellated organisms dating back some 450 million years, with both prokaryotic and eukaryotic attributes. They can be benthic or pelagic organisms found throughout the marine world, especially in coral reefs and their surroundings (Levinton 1982; Winter et al. 1990, Miller 1991). Of the total known 2000 species of dinoflagellate, only about 20 species have been demonstrated to produce specific toxins (Steidinger and Baden 1984). Certain diatoms can also produce toxins under the proper environmental circumstances. Diatoms, like the dinoflagellates, are single-celled algae, but not flagellated and are by definition enveloped by a silica wall or frustule. Like the dinoflagellates, they occur as freely moving organisms or attached to solid surfaces.

Dinoflagellates are most notorious as the cause