

Natural Marine Toxins: PSP and Domoic Acid

Paralytic shellfish poisoning (PSP) toxins and domoic acid are naturally occurring marine toxins. Single-celled marine plants (phytoplankton) produce these toxins. Marine animals that filter their food from seawater may accumulate these toxins. The toxins do not appear to directly harm the animals, but people or some predatory animals eating toxic seafoods may become poisoned. PSP toxins and domoic acid are powerful nerve poisons. PSP toxins and domoic acid have no taste or odor. There is no visible difference between toxic and safe seafoods. Cleaning seafoods in many cases will not remove the toxins. Cooking does not destroy the toxins.

Paralytic Shellfish Poisoning Toxins

Certain one-celled organisms called dinoflagellates produce PSP toxins. Bivalve shellfish (2 shells) filter these organisms from the water. PSP toxins accumulate in the dark digestive organs or viscera of most shellfish. In Washington clams, PSP toxins also accumulate in the siphons (necks). Mussels, oysters, clams, and scallops have caused PSP outbreaks in California, but abalone, crab, shrimp and fish have never been implicated as a source of PSP.

PSP symptoms begin within a few minutes to a few hours after eating toxic shellfish. Symptoms begin with tingling and numbness of the lips, tongue and fingertips. Later symptoms are lack of balance, lack of muscle coordination, slurred speech and problems in swallowing. Complete paralysis and death can occur in severe cases.

Domoic Acid

Domoic acid was only recently discovered (1991) in California. Certain one-celled plants called diatoms produce domoic acid. Bivalve shellfish and some finfish filter these diatoms from the water. In most cases, domoic acid accumulates in the viscera of these animals. In razor clams, domoic acid also accumulates in the meat. Unsafe levels of domoic acid have been found in mussels, oysters, razor clams and the viscera (but not in the muscle tissue) of sardines, anchovies, crab and lobster. Many other species have yet to be investigated.

Domoic acid poisoning symptoms begin within 30 minutes to 24 hours after eating toxic seafood. In mild cases, symptoms may include vomiting, diarrhea, stomach cramps, headache, dizziness and confusion. Difficulty breathing, seizures, coma and death can occur in severe cases. Survivors of severe cases have suffered permanent loss of short-term memory, a condition known as amnesic shellfish poisoning (ASP).

California's Mussel Quarantine

The California Department of Public Health (CDPH) places a quarantine on sport harvesting of mussels for food from May 1 through October 31. This is the period when mussels are most likely to accumulate PSP toxins. The annual mussel quarantine also provides protection from domoic acid poisoning. If monitoring activities confirm unsafe levels of toxins, the quarantine may be expanded to include all bivalve shellfish in the affected area.

Local health officers enforce the quarantine. They post signs advising people of the quarantine. These signs also warn people that clams and scallops at times may contain toxins. During the quarantine period, sport harvesters should remove the viscera from clams and scallops and remove the siphons from Washington clams, and eat only the remaining white meat. Missing or destroyed signs do not change the quarantine period.

Natural Marine Toxins: PSP and Domoic Acid

Marine Toxin Monitoring Program

CDPH monitors marine toxins in sport and commercial seafoods year-round. This program allows CDPH to follow changes in toxin levels and to alert the public and local health agencies if necessary. When CDPH finds unsafe toxin levels in seafoods, the CDPH does not allow the affected species to be commercially harvested or sold. CDPH also issues public warnings for sport harvesters of these species.

Unsafe toxin levels sometimes occur outside the annual quarantine period. CDPH declares special local quarantines whenever unsafe levels of toxins appear. Almost all (over 99%) of PSP cases in California have occurred during the annual quarantine months. Domoic acid poisoning has never been reported in humans in California.

Commercially Harvested Shellfish

The annual mussel quarantine does not apply to companies licensed by the State as certified shellfish harvesters. CDPH tests and certifies the shellfish from these companies to be safe.

Oysters are the principal bivalve shellfish harvested commercially in California. Other shellfish are available in California retail food stores and restaurants throughout the year. These products come from both local and out-of-state sources. State and federal agencies regulate all commercially harvested shellfish in the United States. These regulations make certain that only safe and wholesome shellfish are available to the consumer.

Mussels may be harvested and sold for fish bait at any time. Labels on containers of mussels for fish bait state:

**"MUSSELS FOR BAIT ONLY
UNFIT FOR HUMAN FOOD"**

Annual Mussel Quarantine in California: May 1 - October 31

Shellfish Information Line

CDPH provides a recorded current update on marine toxin activity in California. The messages also report any special quarantines or public warnings. The telephone number is:

510/412-4643 (callers in 510 area code, or out of state)

800/553-4133 (Calif. callers outside the 510 area code)

CDPH updates the message as needed. Callers may leave a message at this number to request more detailed information. Annual reports on the shellfish monitoring program are available on the Internet at:

<http://www.cdph.ca.gov/healthinfo/environhealth/water/Pages/Shellfish.aspx>

Natural Marine Toxins: PSP and Domoic Acid

Myths About Red Tides

During late spring, summer, or fall, localized patches or streamers of color appear in the ocean or bays along the California coast. These reddish areas or "red tides" appear suddenly and last from a few days to a few months before disappearing. The color of the water comes from the millions of tiny organisms in the water. Water color varies from brown to red depending on how many and what kinds of organisms are present.

Many people believe that red tides cause shellfish to be toxic. *Most red tides are harmless.* Toxin-producing organisms do not generally cause red tides. Although the presence of a red tide is a warning that shellfish may be toxic, *the absence of a red tide does not mean they are safe to eat.* Shellfish can consume enough toxic organisms to become toxic even when there is no visible red tide.

Safety Tips For Sport Harvesters

During a quarantine:

- Do not gather mussels or other quarantined shellfish for food. Toxic mussels are very dangerous because people eat the entire mussel including the viscera. In toxic razor clams, the toxin is present in the meat. In toxic Washington clams, the toxin is present in the siphons.
- Remove and discard the viscera of all clams and scallops, and the siphons of Washington clams.
- When domoic acid may be present, remove the viscera of anchovies and crabs immediately after capture. In fish and crabs, domoic acid is confined to the internal organs.

During non-quarantine periods:

- Scallop viscera can remain toxic year-round. Do not eat scallop viscera at any time.
- Following an outbreak of PSP, the siphons of Washington clams may retain toxins for a year or more. If this occurs, CDPH sets and publicizes special local quarantines on Washington clams. Razor clams apparently retain domoic acid in their meat; this phenomenon is currently under study.
- Be familiar with the California Department of Fish and Wildlife sport fishing regulations. These regulations are available on the Internet (<http://www.dfg.ca.gov/regulations/>) and in stores selling sporting goods.
- Gather shellfish only in areas free from sewage contamination. If in doubt, contact the local county environmental health agency to find out if the shellfish are safe to eat.

**Bivalve shellfish include:
clams, mussels, oysters and scallops**

Natural Marine Toxins: PSP and Domoic Acid

Visit the US Food and Drug Administration's Bad Bug Book (Second Edition), Foodborne Pathogenic Microorganisms and Natural Toxins Handbook (<http://www.fda.gov/food/foodborneillnesscontaminants/causesofillnessbadbugbook/default.htm>) for additional information on:

- Ciguatoxin
- Shellfish toxins (PSP, DSP, NSP, ASP, AZP)
- Scombrototoxin
- Tetrodototoxin
- Gempylotoxin
- Venomous Fish

Revised by

Gregg W. Langlois, Senior Environmental Scientist, California Department of Public Health, Environmental Management Branch, 850 Marina Bay Parkway, Rm. #G165, Richmond, CA 94804

Pamela D. Tom, Academic Coordinator Emerita, University of California, Department of Food Science and Technology, One Shields Avenue, Davis, CA 95616

The information presented here is revised and expanded from the 1991 California Sea Grant publication:

"Natural Marine Toxins"

by

Robert J. Price, Kenneth H. Hansgen and Gregg W. Langlois.

UCSGEP 14-1W April 8, 2014

This work is sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce, under grant number NA10OAR4170060, project number A/EA-1, through the California Sea Grant College Program, and in part by the California State Resources Agency. The U.S. Government is authorized to reproduce and distribute reprints for governmental purposes.

University of California and the United States Department of Commerce cooperating.