PARALYTIC SHELLFISH POISONING (PSP)

Paralytic shellfish poisoning (PSP), a marine biotoxin disease, is probably the best known of all the shellfish poisonings, with one of the first cases occurring in 1793 in British Columbia, Canada and over 100 reported deaths and several thousand illnesses being attributed to PSP around the world. Paralytic shellfish poisoning results from eating shellfish which have fed upon toxic one-celled microscopic organisms, called dinoflagellates, which occurs naturally as a part of the ocean plankton. The first PSP case in Sabah was recorded in 1976 where 202 victims were reported to be suffering from PSP and 7 deaths.

Algal Blooms and Red Tide

There are about 5000 identified species of extant marine phytoplankton and only 300 species can cause sea surface discoloration which is also well-known as “Red Tides”. However about 40 species have been found and reported to have the capacity to produce potent toxins to humans either through shellfish or small fish. Paralytic Shellfish Poisoning (PSP) is the clinical symptoms terminology of various fish and shellfish poisoning caused by causative phytoplankton namely, *Alexandrium catenella*, *Alexandrium minutum*, *Alexandrium tamarense*, *Gymnodinium catenatum* and *Pyrodinium bahamense*. In tropical region particularly Southeast Asian countries such as Indonesia, Philippines, Brunei, Thailand and Malaysia, *Pyrodinium bahamense* (var. *compressum*) has been found to be the only dinoflagellate species that has caused major public health and economic problems.

These unicellular dinoflagellates develop algal blooms throughout the world for unknown reasons, although a variety of factors have been studied, including change in weather, upwellings, temperature, turbulence, salinity, and transparency. These naturally occurring algal blooms on which the shellfish feed can extend over considerable areas and can move with tidal currents.

Although people often believe that a red tide is associated with PSP, dangerous levels of neurotoxin can exist in mollusks without a red tide being present. For this reason, there is no way an individual can determine whether shellfish from a beach are toxic or not. You cannot use a red tide, or lack of one, to determine a safe time for clamming. You cannot rely on the color of the water to indicate the presence of PSP organisms, since different types of shellfish store the PSP toxin at various rates.

The major transvector for PSP are the bivalve molluscs (mussels, clams, oysters, etc.). The transvectors accumulate the toxins via feeding in their digestive organs and soft tissues, apparently without harm to the transvectors. All shellfish
(filter-feeding molluscs) are potentially toxic. However, PSP is generally associated with mussels, clams, cockles, and scallops. The usual route for humans is the consumption of these raw or cooked contaminated shellfish.

There can be wide differences in toxin levels in clams on the same beach, even in the same species of clam. Toxin levels can be very high; death has occurred after ingestion of a single mussel. Levels of PSP can increase to lethal levels in a very short time. One cannot predict where or when levels will become more dangerous. This is one of the reasons PSP is such a health risk.

**PSP Toxins**

The toxins responsible for PSP are derivatives of saxitoxin. Saxitoxin, actually a group of 18 toxins, is a potent neuromuscular blocking agent and is relatively heat stable. Normal cooking or canning processes cannot be relied upon to render a contaminated product as safe.

Consumption of contaminated shellfish may cause a variety of symptoms, which will largely depend on the concentration and types of toxins present. All of the human population are susceptible to shellfish poisoning.

The mouse bioassay is the most commonly used method for routine analysis of PSP in shellfish throughout the world. The assay is standardized using purified saxitoxin. Results are given as Mouse Unit (MU), where 400 MU is equivalents to 80 micrograms of saxitoxin equivalents per 100 grams of shellfish meats (µg/100g) and 1 MU is toxic enough to kill 20 grams of mouse within 15 minutes. Radioimmunoassay and indirect enzyme-linked immunoabsorbent assay (ELISA) have been developed for saxitoxin but not all PSP toxins. HPLC analysis method for all the PSP toxins has been developed with good correlation with mouse bioassay in terms of quantification.

**Characteristics of the Illness**

People eating bivalve molluscs (such as clams, oysters, scallops and mussels) should be aware of the symptoms of PSP. The first indication of poisoning is numbness or tingling of the lips and tongue, which spreads to the fingers and toes. Other symptoms sometimes observed include a sensation of lightness (‘floating in the air’), salivation, intense thirst and temporary blindness. These symptoms are followed by a loss of muscular coordination, terminating in paralysis as well as inability to breathe. In extreme cases (a high intake of
toxins), paralysis of respiratory muscles may progress to respiratory arrest and death within 2-12 hours after consumption.

There is no known antidote for PSP but persons suffering from it should be given artificial respiration. Getting the patient to a medical facility as soon as possible since severe symptoms may occur rapidly. Mouth to mouth resuscitation should be given if breathing problems occur until medical personnel take over treatment.

The diagnosis of PSP is based on patient exposure history and clinical manifestations and on epidemiologic information. The prognosis is favorable for patients who survive beyond 12-18 hours. Because PSP has no specific treatment or antidote, treatment is supportive. Prompt evacuation of stomach contents may help by removing the remaining toxin-containing shellfish.

How to best avoid PSP?

1. Do not harvest shellfish when a red tide alert has been announced. Often those suffering from PSP are those who deliberately ignore warning and advice from the authorities.

2. Observe all television, radio, and other media announcements concerning paralytic shellfish poisoning alerts.

3. Avoid all do-it-yourself methods of trying to determine whether the shellfish is poisonous. Since poisonous shellfish do not look, taste or smell any different, these are not reliable methods. Taste testing shellfish on another person or animal is not a conclusive method because each individual reacts differently to PSP. A single shellfish may contain enough poison to kill an adult.

4. Touching shellfish meat to the lips and waiting for a numbing sensation is also an unreliable detection method.

5. Measuring shellfish toxicity by using a field or home testing kit is unpredictable since no reliable kit has yet been developed.

6. Consuming alcoholic beverages may speed absorption of the toxin.

7. The majority of PSP cases have involved cooked clams and mussels. Usual cooking methods (steaming, baking, boiling, pan-frying) do not reduce toxicity, nor will the toxin be eliminated by freezing.
For further information or reference please do not hesitate to contact or visit our respective branch at:

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   3).  Ainah.Puyong@sabah.gov.my

List of further references can be obtained from this centre;

   a. Air Merah Beracun (Red Tide)
   b. What We Should Know About Red Tide & PSP in Sabah
   2. A Review on Red Tide Occurrences in Malaysia, 1994
   4. Study on Morphological Features of the Pyrodinium bahamanse var. compressum Motile Cell of Sabah Origin and Its Related Biotoxins
Three motile cells of *Pyrodinium bahamense* var. *compressum* in chain form.

Ventral view of *Pyrodinium bahamense* var. *compressum* motile cell
Typical reddish / brownish discoloration of the water during red tides blooming
Types of Clams and Shellfish Which May Become Toxic Due to Harmful Algal Blooms

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Perna viridis (Linnaeus, 1758)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Name</td>
<td>Siput sudu / Kupang</td>
</tr>
<tr>
<td>Common Name</td>
<td>Green mussel/ Asian brown mussel</td>
</tr>
</tbody>
</table>

![Image of a mussel](image_url)
Scientific Name : *Crassostrea* sp.
Local Name : Tiram
Common Name : Flat oyster
Scientific Name : *Meretrix meretrix* (Linnaeus, 1758)
Local Name : Kunau/ Dalus
Common Name : Asiatic hard clam
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Phaxas attenuatus (Dunker, 1862)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Name</td>
<td>Siput gajah/ Siput pahat</td>
</tr>
<tr>
<td>Common Name</td>
<td>Razor shell</td>
</tr>
</tbody>
</table>
Scientific Name: *Haliotis asinina* (Linnaeus, 1758)
Local Name: Siput mentiah
Common Name: Donkey’s ear abalone
Scientific Name : *Strombus canarium* (Linnaeus, 1758)
Local Name : Siput tarik
Common Name : Dog conch
Scientific Name: *Orbicularia orbiculata*
Local Name: Siput lala
Common Name: Short-necked clam
Scientific Name : *Decatopecten radula* (Linnaeus, 1758)
Local Name : Kerang
Common Name : Flatribed scallop
Scientific Name : Amusium pleuronectes (Linnaeus, 1758)
Local Name : Selisip
Common Name : Asian moon scallop
Scientific Name : *Atrina spp.*
Local Name : Beliung
Common Name : Pen shell
Scientific Name: Pteria penguin (Röding, 1798)
Local Name: Siput cabang
Common Name: Penguin wing oyster
Scientific Name : *Perna* spp.
Local Name : Kenjapan
Common Name : Mussel
Scientific Name : Donax spp.
Local Name : Remis
Common Name : Fleshy donax
Scientific Name : *Spondylus* spp.
Local Name : Tiram batu
Common Name : Leaf oyster
Scientific Name : *Anadara granosa* (Linnaeus, 1758)
Local Name : Kerang
Common Name : Granular ark / Blood cockle
Scientific Name : *Oliva oliva* (Linnaeus, 1758)
Local Name : Kalassiu
Common Name : Sea snail / Common olive