Shellfish Poisoning in Association with the Occurrence of Potentially Toxic Dinoflagellates in the Gulf of Thailand

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Introduction

Paralytic shellfish poisoning in tropical regions was reported in the Indo-Pacific region by Maclean (1975a, b, 1977, 1979) and Worth et al. (1975). The last recorded deaths resulting from the consumption of shellfish in Papua New Guinea occurred in 1972 and 1973. Similar occurrences in Brunei's coastal waters and in neighbouring Sabah took place in 1976 (Beales 1976, 1982). In the Philippines, several persons died after consuming mussels in June 1983 (Hermes and Villoso 1983). The causative organism was *Pyrodinium bahamense* var. *compressa* (Böhm) (Steidinger et al. 1980), which was confirmed by Harada et al. (1982) to contain paralytic shellfish poisons at a high level of 1.5×10^{-4} MU/cell. Chemical studies were undertaken by Yasumoto et al. (1984) to identify the toxins in this dinoflagellate and infected bivalves at Koror, Palau Islands; they reported the presence of gonyautoxin V and VI, neosaxitoxin, saxitoxin, and decarbamoyl-saxitoxin.

Red tides in Thai coastal waters have been documented back to 1957 (Charernphol 1957; Suvapepun 1982; Suvapepun et al. 1984). Until recently, there have been no previous medical records of shellfish poisoning in the Gulf of Thailand. The first case of patients suffering from neurological symptoms involved 63 people, one of whom died, in the area of the mouth of the Pranburi River on the western coast of the Gulf of Thailand. The toxification of bivalves in the area was also observed by the Division of Food Analysis, Department of Medical Science, Ministry of Public Health. It was reported that some samples of *Perna viridis* possessed up to 714 MU/g paralytic shellfish toxins.

In response to this recognized PSP in Thai waters, this study has been carried out since May 1983 to detect the causative organisms and to osberve the occurrence of the toxic bloom and red tides in the toxic shellfish bed.

Materials and Methods

Phytoplankton was collected from the area in the Pranburi River where poison shellfish were observed. Five stations were sampled in adjacent areas from the mouth of the river upstream to approximately 2 km (at the incident area). Five-litre water samples were collected at three depths: subsurface, mid-depth, and near bottom. Cell counts were estimated by concentrating seawater to 5 mL by filtering through a 20-μm silk cloth; then 1 mL of the concentrate was counted under a microscope using both fresh and preserved samples. The stomach contents of the mussel *Perna viridis* were collected from the affected area and were also examined. Weekly samples were obtained from 16 May 1983; after June 1983, samples were collected on a monthly basis until August 1984.

Results and Discussions

The species composition of the plankton sampled during the incident of PSP is presented in Table 1. The plankton community was dominated by Cyanobacteria and diatoms, of which *Skeletonema costatum*, *Thalassiosira* spp., *Chaetoceros* spp., and *Cyclotella* were the major species. Dinoflagellates formed a significant constituent of the population. Their appearance, however, was uncommon to the plankton

Table 1. Species composition of phytoplankton collected on 16 May 1983 from the mouth of the Pranburi River (listed in order of dominance by number).

Bacillariophyceae
Skeletonema costatum
Chaetoceros pseudocurvisetus
Cyclotella sp.
Thalassiosira spp.
Chaetoceros spp.
Bacteriastrum spp.
Nitzschia closterium
Rhizosolenia spp.
Pleurosigma spp.
Hemiaulus sinensis
Dinophyceae
Protoperidinium quinquecorne
Prorocentrum micans
Peridinium spp.
Dinophysis caudata
Dinophysis sp.
Cyanophyceae
Cyanobacteria

Table 2. Rainfall data for May 1983, Pranburi River.

Date	Quantity (mm)	Date	Quantity (mm)
1	0.0	16	0.0
2	0.0	17	0.0
3	0.0	18	0.0
4	0.0	19	0.0
5	0.0	20	0.0
6	0.0	21	0.0
7	0.0	22	15.0
8	15.7	23	Trace
9	10.1	24	Trace
10	2.0	25	5.6
11	Trace	26	14.3
12	0.0	27	3.5
13	3.6	28	Trace
14	0.0	29	0.5
15	0.0	30	0.6

Source: Environmental Health Department, unpublished data.

Table 3. Concentration of pollutants (kg/month) in Pranburi River in 1983.

Month	Total nitrogen	Phosphate	Lead
March	3732	—	544
April	3655	233	1166
May	12312	518	1814
June	6091	907	1685
July	5668	778	778
August	1089	3110	1011
September	2566	1555	—

Source: Environmental Health Department, unpublished data.

Table 4. Salinity (ppt) of water at incident area.

	Surface	Bottom
16 May 1983	6	—
March 1984	5.98	6
April 1984	12.62	13.23
May 1984	8.35	9.03
June 1984	13.93	15.99
August 1984	19.95	20.49

communities in the estuarine waters of the Gulf of Thailand. The most abundant species was *Protoperidinium quinquecorne,* at a density of 40000 cells/L. Other species that were found in large numbers included *Prorocentrum micans, Peridinium* spp., and *Dinophysis* spp. These species, however, are not toxic. Small numbers of *Protogonyaulax* sp. appeared in the samples during the PSP occurrence, but were quite rare after May 1983, until August when cell numbers increased again but did not bloom. The appearance of *Protogonyaulax* in August 1984 did not affect the shellfish as the level of toxins in shellfish collected from Pranburi River were not above acceptable levels. The analysis of stomach contents of *Perna viridis* collected from the infected area did not contain any suspected causative organisms; only a few cells of diatoms remained.

According to rainfall data collected about 5 km from the incident area in May 1983 (Table 2), heavy rainfall was recorded on 8 May, i.e., 2 days before the red tide appeared in the mouth of the Pranburi River. The occurrence of the red tide after the heavy rain may be related to substances in land runoff. This was supported by total nitrogen data (Table 3), which showed that the concentration in May was very high.

The salinity at the incident area during the peak of the PSP occurrence was 6 ppt surface salinity. Between March and August 1984, the surface salinity ranged from 5.98-19.95 ppt and bottom salinity from 9.03-20.49 ppt (Table 4). Depth of the water in the area was 4 m.

Because *Protogonyaulax* sp. was found at the mouth of the Pranburi River during the PSP incident, this organism may have been involved in the toxification of shellfish there even though present in extremely small numbers . Onoue et al. (1980) reported that, in concentrations of as few as

10 cells/L, *P. catenella* affected oysters in Senzaki Bay significantly.

It is difficult to draw a conclusion regarding the identification of the causative organisms; this must await further studies.

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