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Has paralytic shellfish poisoning occurred in Sri Lanka? : a case study on deaths after consumption of brown mussel, *Perna perna* (L .)

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Abstract

Poisoning due to the consumption of bivalve shellfish contaminated by algal toxins is the most common and widely reported sea food poisoning in the world. Although the shellfish culture is not established as an industry in Sri Lanka, some of the naturally grown shellfish species are harvested and consumed by people particularly in coastal areas. Shellfish poisonings or blooming of toxigenic marine algae that is normally followed by poisoning outbreaks, were not reported from Sri Lanka. However, recently a breast feeding mother of 30 years and a fishermen of 73 years at two different locations near to Balapitiya town of southern Sri Lanka became ill after consumption of brown mussel, *Perna perna*, harvested from near by sea and died within few hours. Clinical symptoms showed by patients and in postmortem were very similar to common clinical symptoms of the most severe type of shellfish poisoning named Paralytic Shellfish Poisoning (PSP) that kills the victim through respiratory paralysis. But the fact that many other people including members of same families who consumed shellfish from the same lot had not complained about poisoning or any other health disorders after the consumption of shellfish, was a strong negative fact hindering a conclusion. However, further investigations revealed that both victims were frequent asthma patients implying that the sub lethal dose of toxin administered through the consumption of contaminated shellfish has become a lethal dose for both victims in the face of sub optimal activity of their respiratory systems. The presence of toxigenic micro algal species in seawaters of southern Sri Lanka as a component of feeds of shellfish was also an evidence for that mussles may have contaminated by algal toxins.

Key words: shellfish poisoning, Sri Lanka, *Perna perna*, toxic algae

Introduction

The microscopic algae are the major primary producer in world's oceans and critical foods for many animals including filter feeding bivalve shellfish as well as larvae of commercially important crustaceans and finfish (Ransel, 1995; Shumway *et al.*

1995). Hence marine micro algae are essential and important component for the well being of marine ecosystems. But one of the negative effects of the marine micro algae is that some species have the capacity to produce potent toxins (Shumway *et. al*. 1995). Among 5000 species of marine micro algae, about 40 species are reported to produce toxins, which can be accumulated particularly in shellfish and even in some fishes posing a poisoning threat to humans and other animals at higher level of the food chain (Sournia *et. al*., 1991; Hallegraeff, 1995). On a global scale, close to 2000 cases of human poisoning (15% morality) due to the consumption of fish or shellfish contaminated by algal toxins, are reported each year (Hallegraeff, 1995) implying that the poisoning due to the consumption of fish and shellfish contaminated by algal toxins has now become a major way of seafood poisoning in the world.

Based on clinical symptoms, four different types of shellfish poisoning in humans have been identified and descriptively named as Paralytic shellfish poisoning (PSP), Diarrhoeal shellfish poisoning (DSP), Amnesic shellfish poisoning (ASP), and Neurotoxic shellfish poisoning (NSP). The clinical symptoms of these poisonings and main toxin responsible are given with respective toxin producing organisms in Table 1. Out of all these poisonings, PSP is the most severe as its mortality rate is about 12%. Mortalities due to DSP is rare and NSP is not reported so far whilst ASP is the second in severity as its mortality rate is about 3%.

In Sri Lanka, there is a paucity of literature on seafood poisonings. Even the few reports on sporadic outbreaks of sea food poisoning were not shellfish poisoning, but poisonings by other sea foods. (Chandrasisri *et. al*., 1988). Compared to fish, bivalve shellfish are not a popular seafood among local people in Sri Lanka. However some people in coastal areas harvest naturally grown mussels, including brown mussel, *Perna perna*, during low tides and consume after boiling. In 1999, two deaths after such a consumption of brown mussel, were reported from Balapitiya, a small city on the southern coastal belt of Sri Lanka. Investigation conducted by relevant authorities, has not assigned the deaths to common shellfish poisoning, probably because many other people who consumed shellfish from the same lot, had not complained about any neurological or gastrointestinal disorders. But findings of our study on the same cases give some warnings with paramount importance. This paper reports the findings of the case study discussing their importance.

Table 1. Clinical symptoms, causative organisms and responsible toxins of different types of shellfish poisoning (Hallegraeff, 1995).

	Paralytic shellfish poisoning (PSP),	Diarrhoeal shellfish poisoning (DSP)	Amnesic shellfish poisoning (ASP)	Neurotoxic shellfish poisoning (NSP)
Symptoms	neurological (tingling, burning, numbness, drowsiness, incoherent speech, and respiratory paralysis) and gastrointestinal symptoms (nausea, vomiting, abdominal pain) are not common	gastrointestinal (nausea, vomiting, diarrhea, and abdominal pain accompanied by headache, fever and chills.	gastrointestinal (vomiting, diarrhea, abdominal pain) and neurological (confusion, memory loss, disorientation, seizure, coma)	gastrointestinal ,· (diarrhea, vomiting, abdominal pain) and neurological (tingling and numbness of lips, tongue, and throat, muscular aches, dizziness, reversal of the sensations of hot and cold)
Major toxin responsible	Saxitoxin	Okadaic acid Dinophysis toxins Pectenotoxins , Yessotoxin	Domoic acid	Brevetoxin
Causative organism	*Alexandrium* spp. ***Gymnodinium catenatum,*** ***Pyrodinium bahamense***	***Dinophysis*** sp.	*Pseudo-nitzschia* sp.	***Gymnodinium breve***

Materials and Methods

The investigation to find out possible reasons for the deaths was carried out in two phases. As a first and immediate step, information on the cases was collected from relevant sectors in order to find possible reasons for deaths. The examination of seawater samples withdrawn from relevant places for potentially toxic micro algal species was performed in the second stage.

The families of two victims and the medical officer who examined the two victims before their death were visited and inquired to get information on cases. People who consumed shellfish from the same lot on the same day, but not complained about any health problems, were also inquired to know whether they got at least minor health

problems after consumption of mussels. Reports of the postmortem of the two deaths were also studied.

At a later stage, a qualitative survey of marine phytoplankton was conducted to know whether toxigenic species occur in sea waters of Sri Lanka. Samples of sea water from few sites in the continental shelf of southern Sri Lanka, including Balapitiya as one site, were withdrawn once a 4-6 months during a two year period, to examine for the phytoplankton composition. Water samples were mixed with Lugol's solution in 100:1 ratio for the fixing and preservation of phytoplankton (Saraceni and Ruggiu, 1974). The mixtures were kept in the dark for a week and then sedimented phytoplankton were checked under the high power of microscope for toxigenic micro algal species.

Results

Case No.1.

An active fishermen of 73 years, lived at Rajawatte, Balapitiya had collected mussels from the near by sea, and consumed after boiling at 14 hours on 25th December 1999. Within half an hour, he had developed vomiting, sweating and had complained about tingling sensation, numbness, drowsiness, confusion, difficulty in breathing, severe epigastric pain and headache. He was admitted to the hospital soon and the medical officers had further noticed that his blood pressure was low and the skin was cold. The patient died within two hour after admittance to the hospital.

Postmortem findings

- Petechiae were found on sclera, forehead, both cheeks and neck
- Lungs had pulmonary oederna.
- Extremities were cyanosed
- Internal organs were congested.
- Stomach contained about 100g of undigested mussels.

Case No.2.

She was a 30 years old breast feeding mother of two children, lived at Heenatiya, Balapitiya. She had bought mussels from a mobile fish seller, and consumed after boiling at 16 hours on 25th December 1999. She also had developed same symptoms as in the above case. Then she was admitted to the same hospital, but died within three hour. Both clinical and postmortem findings revealed the same as in the above case.

Both victims were used to have mussels infrequently, but none of them were suffered any allergic reactions for mussels before. Their family members and many other people who consumed mussels from the same lot had not complained about any health problems. But during the further questioning, some people who consumed mussels from the same lot revealed that they also developed local tingling, numbness, burning sensation, dizziness and drowsiness after having mussels, but it had recovered after few hours. Both victims who died were found to be asthmatics having frequent attacks (one to two attacks per week). But they were not suffering from asthma or any other health problem when they consumed mussels previously. Samples of the same mussel species consumed by the two victims, were collected from the same area and identified in the laboratory as *Perna perna*.

Almost all the phytoplankton samples extracted from sea water were co dominated by Bacilariophytes, Raphidophytes, Prymnesiophytes and Chlorophytes. The density and abundance of Phyrrophytes or dianoflagellates were comparatively low. *Gymnodinium* sp. as athecate dianoflagelates and *Allexandrium* sp. and *Pyrrodinium* sp. as thecate dianoflagellates were observed among Pyrrophytes, but their abundance was highly variable particularly over the time. *Psedo-nitzscia* speces were also observed infrequently among diatoms.

Discussion

As many other mussel species, *Perna perna*, the species consumed by the two victims is not reported as inherently toxic species. If they become toxic, it is merely due to the bio accumulation of algal toxins, which contained in their feed. Algal toxins responsible for most shellfish poisonings are water-soluble, heat and acid-stable, and are not inactivated by ordinary cooking methods (Shumway *et. al.* 1995). The rate of detoxication or depuration is also depends on the site of toxin storage. eg toxins in gastrointestinal tract is eliminated much more easily than toxins in tissues (Li *et. al.* 2005). But superficial investigations on the deaths of these two victims may not lead to conclude toxic effects as a cause, because many others including even members of same families had consumed shellfish from the same lot, but not complained about health problems. Therefore deaths could be assigned to some allergic reactions created by shellfish. But possibility for such a severe allergic reactions is low because deaths were so fast and symptoms common to general allergic reactions were not prominent in these cases. Clinical symptoms and rapidity of death are strong evidence to infer that the both deaths were caused by shellfish poisoning due to accumulated algal toxins. It is more similar to PSP, but the possibility of ASP or NSP or a combination of more than one type cannot be

discarded. However, still there is an argument against this inference, as other people who consumed shellfish from the same lot had no complain. The possible reason could be that the concentrations of algal toxin contained in shellfish diets were not high enough to administer a lethal dose for healthy people. But, according to the family members, the two victims who died were well known asthma patients implying the possibility for that their respiratory systems were functioning at sub optimum level, even though they didn't feel it when they consume shellfish. Then the dose of toxins administered to their bodies may become a lethal dose in the face of sub optimal respiratory function. The tingling, numbness, burning sensation, dizziness and drowsiness of the other people who consumed shellfish from the same lot also support this hypothesis. The presence of toxigenic dianoflagellate species in seawaters of Sri Lanka is also support the hypothesis. A higher concentration of algal toxins in shellfish cannot be expected from Sri Lanka as red tides (i.e. dianoflagellate blooms) are not reported and the density of toxigenic dianoflgellate species observed in this study was low and variable. However the phytoplankton survey was not extensive enough to cover short-term peaks in the abundance of toxigenic species. Shellfish poisonings due to algal toxins are reported from east and west coast of India also, confirming that the Indian Ocean is not free from toxic micro algae (Maclean, 1989). Special mechanisms described in Hallegraeff and Bolch (1991) may not necessary to distribute toxic algae from India to Sri Lanka, as the distance is very short.

Although shellfish poisoning was not reported from Sri Lanka before, poisonings by some other seafood have been reported. As an example, Chandrasiri *et. al.* (1988) describes autopsy findings in turtle flesh poisoning in southern Sri Lanka pointing out algal toxins as a possible origin of the toxic substances responsible. However, studies on any of the seafood poisoning reported in Sri Lanka, including the two cases described here, was not extended to identify causative toxins, probably as necessary facilities are not available in Sri Lanka. Nevertheless, the possibility of algal toxins as a root cause of shellfish poisoning is much higher as shellfish species directly feed on algae including toxic species and bioaccumulation of algal toxins in shellfish tissues are well established (Hallegraeff and Bolch, 1991; Hallegraeff, 1995; Li *et. al.*, 2005)

This study suggests that shellfish poisonings by algal toxins can occur not only after a red tide, but also under low densities of causative micro algae and it could be lethal particularly for people with respiratory disorders. Even the general public particularly in coastal areas should be aware on this, in order to avoid misguidance by similar cases where only one or few people may show toxic symptoms out of

hundreds of people who consumed shellfish from the same lot. People in coastal areas may continue the practice to collect and consume naturally grown shellfish as it is an easy and cheaper seafood. Furthermore, mussel cultures in natural waters targeting a market in tourism industry are going on in Sri Lanka at least in small scale. The findings of this study could be considered by such sectors as a warning with paramount importance to take necessary precautions.

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