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Red tide and outbreak of paralytic shellfish poisoning in Sabah

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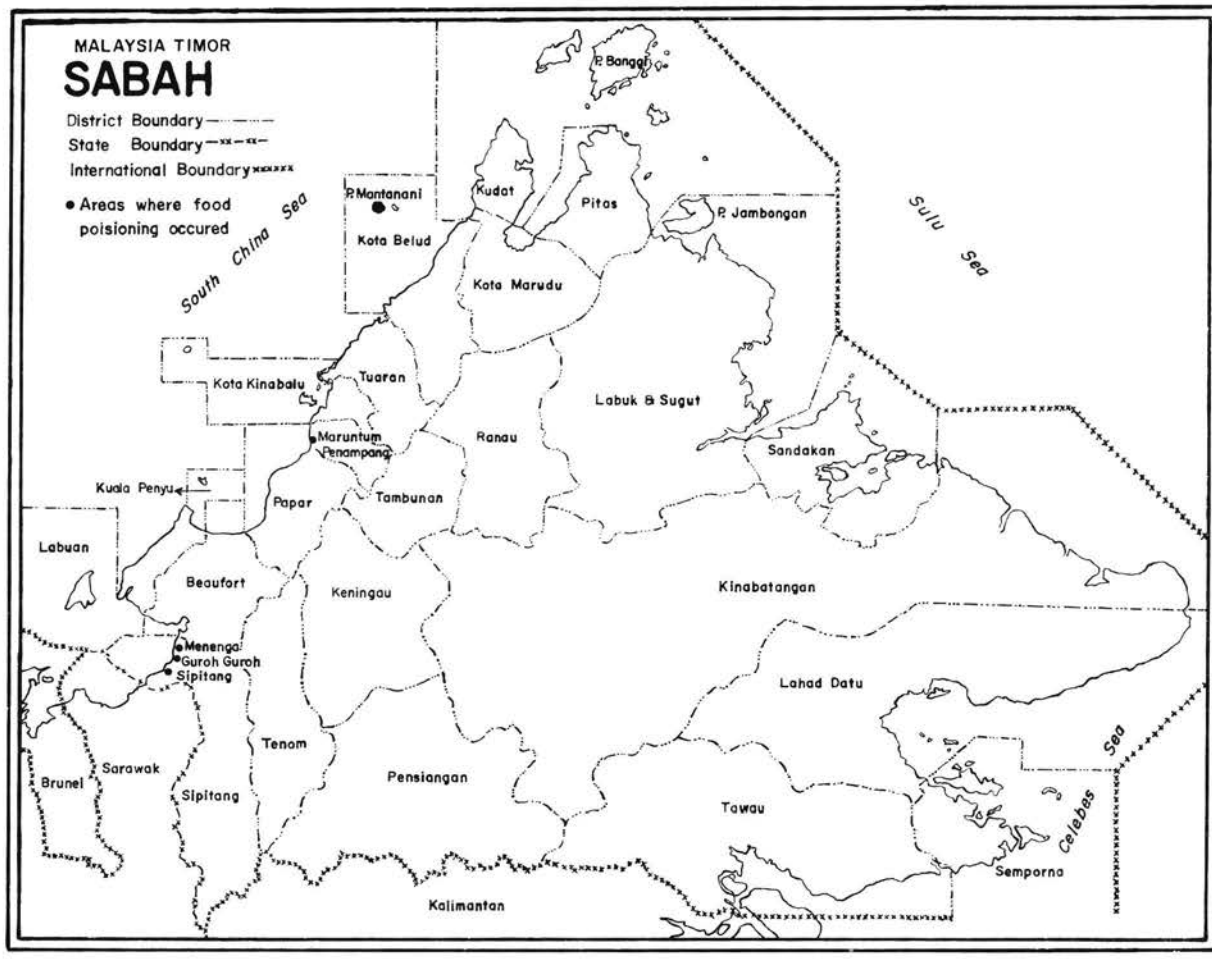
SABAH is one of the thirteen states of Malaysia and occupies the northern part of the island of Borneo, between 5 degrees and 7 degrees north of the Equator. It covers an area of 29,388 square miles with a coastline of about 900 miles; South China Sea on the West and North and the Sulu and Celebes seas on the East. The population of Sabah, though small is made up of many races. The August 1970 census recorded a total population of 655,295. The population has been growing at a rate of about three percent and it has been estimated that by the end of 1975 population rose up to 800,000. Seventy six percent of the population lives in the rural areas.

Economy of Sabah is agrarian and most of the people depend on rice farming and small scale coconut, rubber and oil palm plantation and fishing. Fishing forms one of the main occupations and only source of income for many people living in the coastal areas and on many small islands.

The staple diet of the population is rice. Other foods grown include maize, tapioca, yam and sweet potatoes. Other items of food are fish, shellfish, livestock, pigs, buffaloes and poultry. Adequate quantities of fish, shellfish such as mussels, oysters and crabs, shrimps and lobsters are available from the coastal waters. Animals flesh and poultry are not however available in sufficient quantity to form a regular feature of the local daily diet especially in rural areas. Dairy farming is unknown in the State. Therefore fresh milk is not available and people depend upon imported milk. Most of the protein component of the diet of the rural people is derived from fish, shellfish especially in coastal areas. Salted and dried fish and meat from wild games occasionally form parts of the meals of people living in interior residencies and in the hinterland of the country. As a matter of fact fish and shellfish form the staple diet of the rural people in the coastal regions. The fish and shellfish have been consumed for generations without having any ill effects whatsoever until few cases of suspected food poisoning due to consumption of clams were reported in January, 1976. Between 15th and 16th January, 1976 a total of 8 cases of suspected food poisoning from Kampong Maruntum, a coastal village close to Kota Kinabalu were admitted to the Queen Elizabeth Hospital. One of the cases a child aged 7 years died immediately after admission and it was reported at the time of admission that his sister aged 4 years had died before she could be brought to the hospital. History revealed that all the cases including the child who died at the house belonged to 3 families living in the same village who collected clams from the shallow water in the bay along their kampong in the early hours of the morning. Between 9 a.m. and 11 a.m. all the members of their families ate cooked shellfish with rice and vegetables. On the same evening all the children in the 3 families became very sick and ill with nausea, vomiting and giddiness, one of the children became so acutely ill suddenly that she died before she could be taken to the hospital and the other child of the same family died within a few hours of admission into the hospital. The doctor who attended the child reported that she died of respiratory paralysis. Although paralytic type shellfish poisoning is known to have occurred in many parts of the world it has been unknown in Sabah.

In March 1976 about two months after the first occurrence suddenly there was an acute out-



break of food poisoning in the 3 villages in the coastal district of Sipitang. A total of 186 members of the 50 families residing in 3 neighbouring kampongs (villages) close to the coastal area were affected. 105 persons were so acutely ill that they had to be transported to the district hospital about 24 miles away where two children died within a short period of admission. Two other children died in their homes. The day before the outbreak of the food poisoning members of these families went to the beach close to their villages and collected large number of clams. The people of the coastal villages have been used to eating clams, mussels and crabs collected from these areas. But they never had the experience of finding such large number of clams appearing on the sandy beach in the past. The clams which they are used to collect usually remain buried in the sand. But this time they found them on the surface and collected them in large numbers. Of the 50 families who collected clams 41 families who consumed clams were affected. Some of them became acutely ill, some only had minor symptoms, gravity of the illness being more acute among children then adults. At the same time appearance of red patches and large number of dead fish floating in the coastal water of Brunei Bay were noticed. For the first time an association between appearance of red tide and shellfish noisoning was suspected. Collecting and selling of shellfish and catching of fish in Brunei Bay were prohibited. People became panicky and stopped eating fish even in other parts of the State where there was no evidence of such phenomenon. Within 3 weeks of the occurrence of this outbreak of food poisoning in the Sipitang district there was another outbreak of food poisoning due to consumption of cooked shellfish among 7 members of the two families residing in a small island close to the West Coast within the administra-

tive district of Kota Belud. Distribution of outbreak of food poisoning due to consumption of shellfish is shown in the map. At the same time more brick red patches appeared in the coastal waters of the South China Sea along the West Coast. Food poisoning and appearance of red patches were also reported from the neighbouring state of Sarawak and also from Brunei.

Table I and II show the distribution of food poisoning cases by sex and age.

Table I

Distribution of Cases by Age and Sex in Kampong Maruntum, Putatan: 15th January, 1976

Age/Years	Male	Female
0 – 4*		1
5 – 9*	4	2
10 – 14		
15 – 19		2
20 – 24		
25+		
All Ages	4	5

*Two children died: one aged 4 years and the other 7 years.

Of the 7 cases of food poisoning occurring due to consumption of cooked shellfish in the island of Mantanani in Kota Belud district 4 were children under 14 years of age. One of them a boy aged 6 years died about 8 hours after the meal containing cooked shellfish; others were admitted to the district hospital where they gradually recovered from the illness. The illness which so suddenly affected a large section of the people could be completely and readily controlled by preventing people from eating marine food from the areas where red tide was observed.

The Characteristics of the Illness:

Symptoms and signs appeared to be varied. The time of onset and symptomatology also varied with the size of meals and the amount of clams taken and the age of the person. Children appeared to have suffered more acute symptoms and signs, and all the fatalities occured among them. Tingling about the lips and tongues and throat followed by numbness and heaviness developed immediately and at any time within a period of 6 to 12 hours. The most common symptoms and signs were tingling about lips and tong es and throat followed by numbness and heaviness around the mouth. In some cases initial symptoms and signs had been nausea and vomiting. Vomitus contained, depending upon the time of onset of the illness, undigested food mixed with clams and in some cases there was only a bilious vomiting. In other cases muscles of the mouth, cheek and throat appeared to be spastic and the patient found difficulty in swallowing. Many patients became lethargic and there was generalised weakness; some patients developed weakness of the limbs and also ataxia. Paresthesia was also observed in the limbs. The child patients developed distension of abdomen and retention of urine. Paralysis of the respiratory muscles was the cause of cyanosis and death. Diarrhea was uncommon. There was

Table II

Distribution of Cases by Age and Sex in Kampongs Menangah, Guroh-Guroh and Pantai in the Sipitang District: 5th March, 1976

Age/Years	Kg. Menangah		Kg. Guroh-Guroh		Kg. Pantai		Total
	M	F	M	F	M	F	
0 – 4*	8	3	2	–	–	–	13
5 – 9*	6	4	–	–	2	–	12
10 – 14*	8	13	2	2	1	–	26
15 – 19	5	8	–	–	–	1	14
20 – 24	4	8	–	–	–	–	12
25+	11	14	1	1	–	1	28
All Ages	42	50	5	3	3	2	105

*4 children died, two of them aged 11 years and the other two aged 4 and 6 years.

slight or no rise of temperature. Recovery occurred gradually and most of the patients recovered within a period of about 12 to 24 hours. Most of the patients were discharged from the hospital within 24 hours of their admissions. However, generalised weakness remained for a longer period.

Etiology:

The paralytic type of shellfish poisoning is known to be caused by certain toxic species of planktonic dinoflagellates which are ingested by filter feeding clams and molluscs such as sand mussels, black mussels and oysters. The ingested toxin is accummulated in the body of the clams and molluscs concentrating particularly in the digestive organs. Usually this does not cause any harm to the clams or molluscs. But in Sipitang area the toxin appears to have also affected clams causing their deaths. The U.S. Food and Administration has established the maximum human tolerance of paralytic shellfish poison at 1200 Sommer mouse units. A mouse unit is the amount of toxin that will kill a 20 gm mouse in 15 minutes. The dose of toxin needed to cause symptoms in most people seems to be 5000 units or more; death of an average adult usually means that at least 30,000 units have been ingested. Smaller dose of toxin could be fatal to children as evidenced in the recent occurrence of food poisoning when all the fatalities occurred among children. Results of bioassay and feeding of animals have shown action of the poison similar to that isolated from shellfish in other parts of the world. The intestine of the clams were examined and many dinoflagellates had been found. Examination of the sea water containing red patches along the coastal region have shown dinoflagellates in abundance. Both red water and shellfish poisoning have been known for many centuries in many parts of the world although their association was not scientifically recognized until Sommer and his colleagues established their relationship in 1937.

There are many species of dinoflagellates of which some species have been identified to be the cause of shellfish poisoning. Ganyaulax catanella was the source of poisoning in California, Ganyaulax tamarensis in the Atlantic coast of Canada, Ganyaulax Actanella in the Pacific coast of Canada, Prorocentrum micans in Portugal. In Japan a species of Prorocentrum has been suspected being the source of poison of mussels. Ganyaulax Actanella has also been implicated being the source of poison of mussels in the Philippines. Gonyaulax Polyhedra and Gymnodinium brevis have also been known to be the source of poison in the Pacific Coast of the U.S.A. Gonyaulax tamarensis was found to be the cause of mussel poisoning in Britain in 1968.

Species of dinoflagellates implicated in the poisoning of the shellfish in Sabah have been identified as being Pyrodinium Bahamense.

Public Health and Economic Hazards:

Sudden outbreak of food poisoning due to consumption of shellfish in the rural areas of the West Coast area of Sabah and appearance of thousands of dead fish in the coastal waters due to blooming of dinoflagellates resulting appearance of red tide created a public health problem; so fishing in the coastal waters was prohibited. About 4,100 fishermen and fishmongers lost their employment and their only means of livilihood for an indefinite period of time. Prawn fishing and export industry was also affected. As a result about 20,000 of the rural population, for their subsistence, had to depend on the financial assistance from the Government. Shellfish and fish which form the main protein component of the food of the population of Sabah became unobtainable to them. Fortunately however red tide gradually started disappearing within about two months of its first appearance and the large number of dead fish which was noticed earlier also gradually became less. Since bioassay results showed very little or no toxin in fish flesh the ban on fishing and selling of fish was lifted.

It has been known in North America that most species of molluscs retain toxicity for about two months after toxification. But some species may even retain a significant level of toxicity for about 3 years.

The unfortunate phenomenon triggering bloom of dinoflagellates has posed a real public health hazard and also an economic problem for the fishermen and the fishing industry. Moreover the ability of the shellfish especially bivalve molluscs to accumulate the very toxic paralytic poison for indefinite period will make it essential for the Fisheries and Medical Departments to organise and implement a monitoring system in order to determine toxin content of the shellfish and to prevent consumption of shellfish whenever toxin content appears higher than the level considered safe; levels above 8 μg per 100 g of shellfish meat are considered unsafe.

Treatment and Prevention:

No specific antidote is known. The treatment of shellfish poisoning is primarily symptomatic and supportive. After ingestion unabsorbed toxin may be removed by emesis. Since toxin becomes unstable in alkaline media, stomach wash with solution of sodium bicarbonate is of considerable value in shellfish poisoning. Diuresis may be instituted. In case of respiratory embarrassment artificial

respiration is essential to get over the acute phase of the paralytic condition. Anticuerare drugs such as neostigmine have been found to be useful in aiding artificial respiration. Oximes such as pralidoxime may be used to reactivate acetylcholine esterase. Noradrenaline, ephidrine and amphetamine have also been used.

The exact mechanism which triggers the bloom of dinoflagellates leading to red tide phenomenon and production of toxin in shellfish is not known. However, it is believed that disturbance in ecological balance in the sea due to dumping of materials, dredging, blasting of sea bed and construction or natural substrata disturbance may trigger such phenomenon. In recent years much construction work, blasting of coastal sea bed for collection of corals, reclamation and also exploration for oil and gas have been carried out in the sea along the West Coast of Sabah. Despite much research conducted in many countries so far no chemical has been found which could be used to control bloom of dinoflagellates without jeopardizing the human and marine life or which would be economically feasible. It must also be noted that shellfish may even become poisonous long before bloom of dinoflagellates becomes sufficiently high to produce red patches in the sea. It will therefore be necessary to carry out testing of shellfish for toxicity at regular intervals. The diagnosis and prevention of the red tide associated diseases require the awareness of the problem by the physicisns, public health authority and Fisheries Department.

Summary:

Sabah is one of the thirteen states of Malaysia and occupies northern part of the island of Borneo. It covers an area of 29,388 square miles with about 900 miles coastline. It has a population of about 800,000.

Economy of Sabah is agrarian. Staple diet of the population is rice. Most of the protein content of the diet is derived from fish and shellfish especially in coastal areas.

Between 15th January to 10th April, 1976 a total of 201 cases of paralytic food poisoning occurred due to consumption of shellfish in three different areas at different times in the West Coast region of the State. Appearance of red tide in the sea in the coastal water of West Coast region was also noticed for the first time in the memorable history of Sabah.

The exact mechanism which triggers the bloom of dinoflagellates leading to red tide phenomenon and production of toxin in shellfish is not known. No specific antidote is known; treatment is symptomatic and supportive. For prevention of occurrence of paralytic shellfish poisoning it is essential for the Fisheries and Medical Departments to organise and implement monitoring system in order to determine toxin content of the shellfish and to prevent consumption of shellfish whenever toxin content appears higher than the level considered safe; levels above 8 μg per 100 g of shellfish meals are considered unsafe.

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