Scombrotoxin Food Poisoning Outbreak among Frozen Seafood Factory Workers Samut Prakan Province, Thailand, July 2007

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Introduction

Scombrotoxin (also called scombroid) food poisoning is caused by ingestion of high doses of histamine. It is the second most common type of seafood poisoning, mostly in tropical climates[1]. The largest scombroid food poisoning outbreak reported from East Asia occurred during 1997 in Taiwan, involving 94 kindergarten students[2]. A recent report from MMWR described two scombroid outbreaks in North America associated with fish imported from Vietnam and Indonesia[3]. However, few published articles describe the epidemiology of scombroid outbreaks in the Greater Mekong Region.

Scombroid poisoning manifests like other histamine-mediated illnesses, including allergic reactions. Scombroid patients may experience rash, parasthesia, nausea, vomiting, diarrhea or other symptoms. Usually the illness is mild and self limited. In severe cases, patients may experience hypotension, blurred vision, bronchospasm or angioedema of the tongue. We could find documented cases of severe scombroid poisoning, but no documented cases of fatal scombroid poisoning.

Scombrotoxin food poisoning usually occurs after eating non-refrigerated fish, particularly fish species (e.g. tuna and mackerel) in the *Scombridae* and *Scomberosocidae* families. Muscle tissues in these fish contain high levels of histidine which, in the absence of refrigeration, common bacteria may enzymatically decarboxylate into free histamine.

Although most common bacteria are killed in heating cooked foods, histamine is relatively resistant to heat[4], and fish and other foods containing high levels of histamine generally have no unusual taste or smell. The concentration of histamine produced depends upon factors such as type of bacteria producing the decarboxylation enzymes and the temperature or conditions under which fish are kept. Ingestion of fish containing histamine level more than 200ppm (20mg/100g) may lead to illness. The European Union standards state that the acceptable histamine level in frozen sea fish should not exceed 100ppm (10mg/100g)[5].

On 24 Jul 2007, the Bureau of Epidemiology (BOE) was notified that 28 frozen seafood factory workers were admitted to two local hospitals with symptoms consistent with food poisoning. A joint investigation was conducted by BOE staff and relevant provincial and local health personnel on 24-25 Jul 2007.

Methods

The investigation team interviewed medical staff and reviewed medical records of persons receiving medical treatment at the two hospitals nearest to the factory, Muang Samut Paknam Hospital and Samut Prakan Hospital. Team members used a standardized questionnaire to collect information on demographics, signs and symptoms, foods consumed during the three preceding days prior to onset of illness and the quantity of food items ingested.

The case definition was a worker of a frozen seafood factory with at least two major signs and symptoms, or only one major sign or symptom accompanied by at least one minor sign or symptom occurring on 21 Jul 2007.

Major signs and symptoms included watery stool at least once, nausea, vomiting, facial flushing, circumoral numbness, numbness of hands and feet, dry mouth and throat, rash, itching and swelling. Minor signs and symptoms were abdominal pain, fatigue, headache, diplopia and fever.

To evaluate risk factors, the team undertook a case control study. Controls were selected by systematic random sampling from the employee register. A 2:1 case control ratio was selected based on sample size calculations estimating 79 total cases. One in every four workers on the payroll of the factory was selected as a control. Controls were interviewed using the same questionnaire as the cases.

The SRRT conducted an environmental study by inspecting the outbreak site and observing conditions in the factory, including food processing

areas, kitchen and cafeteria. Samples of frozen raw tuna from the same lot as the fish used to prepare the implicated fermented tuna dish, as well as left-over fried fermented tuna were collected for laboratory analysis to determine the levels of chemical contents and identify bacterial pathogens.

Results

This export-oriented frozen seafood processing factory, located in Samut Prakan Province, about 30 km southeast of Bangkok, produces 1,800-2,000 tons of processed seafood annually. The first case had onset of symptoms at approximately 10:30am on 21 Jul 2007 while the last case had onset at 20:30pm (Figure 1). Mean incubation period was 120 minutes, ranging from 60-180 minutes.

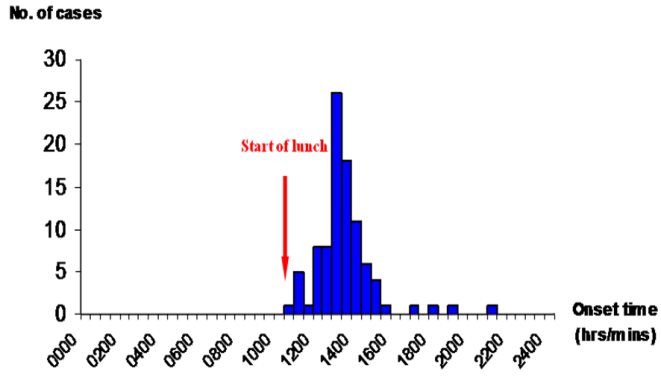

Figure 1. Epidemic curve of number of food poisoning cases by time of onset in frozen seafood factory, Samut Prakan Province

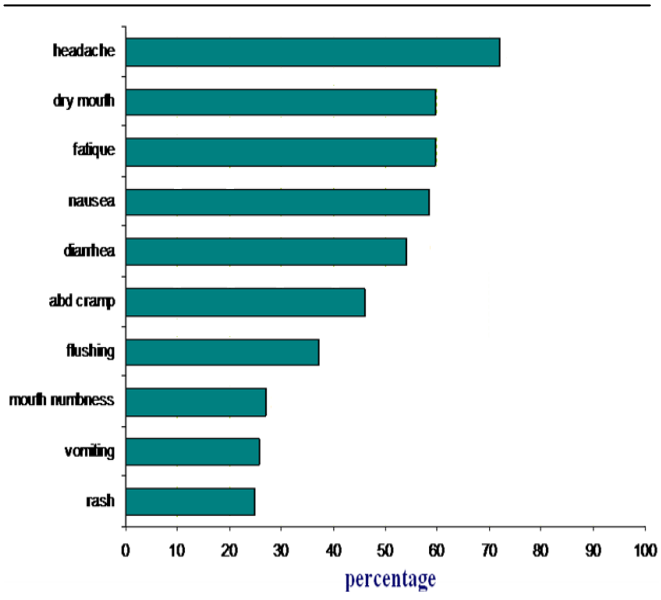

Figure 2. Clinical symptoms of food poisoning cases in frozen seafood factory, Samut Prakan Province (n=89)

The factory employed 1,054 workers. Of these, 196 were male and 858 female, all aged between 15–57 years. Employees bought their own breakfast and dinner outside the factory. The factory provided lunch for each worker as they were not allowed to leave the factory for lunch.

Table 1. Cases and morbidity rate by seafood factory department in frozen seafood factory, Samut Prakan Province

Departments	Cases (N)	Employees (N)	Attack Rate (%)
Bread crumb-covered fish fillet	41	430	9.5
Prawn	22	222	9.9
Squid	24	178	13.5
Others	5	224	2.2

Table 2. Cases and morbidity rate by gender in frozen seafood factory, Samut Prakan Province

Gender	Cases (N)	Employees (N)	Attack Rate (%)
Male	7	196	3.6
Female	85	858	9.9

Table 3. Age distribution of cases in frozen seafood factory, Samut Prakan Province

Age Group (years)	Cases (N)	Attack Rate (%)
11-20	1	1.1
21-30	37	40.2
31-40	43	46.7
>40	11	12.0
Total	92	100.0

Table 4. Cases and morbidity rate by food consumed in frozen seafood factory, Samut Prakan Province, Thailand, July 2007

Dishes	Cases (N)	Employees (N)	Attack Rate (%)
Fried fermented tuna	91	193	47.2
Som tam (spicy papaya salad)	19	67	28.4
Tai pla curry (fish entrails curry)	17	66	25.8
Red curry	10	37	27.0
Clear soup with bamboo shoot	32	118	27.1
Stir-fried Chinese kale with pork	24	89	27.0
Stir-fried bean sprout with chicken	13	40	32.5
Fish sauce and chopped chili	5	22	22.7
Steamed rice	77	216	35.7
Fried rice	3	14	21.4
Drinking water	91	255	35.7

The attack rates based on factory department, gender and age group are displayed in tables 1, 2 and 3 respectively. Among various food items consumed, fried fermented tuna has the highest attack rate (Table 4). Demographics of the 89 cases and 176 controls selected are shown in table 5.

Table 5. Population characteristics of case and control groups in frozen seafood factory, Samut Prakan Province

Population Characteristics	Cases	Controls
Interquartile range	31 yrs (30-33 yrs)	30 yrs (29-32 yrs)
Gender Percentage		
Female	92.4	70.5
Male	7.6	29.5
Worker Percentage by Department		
Fish	44.6	39.9
Prawn	23.9	17.9
Squid	26.1	14.5
Others	5.4	27.7

Univariate analysis of case control study results show that ingestion of fermented tuna was strongly associated with outbreak, and this association was statistically significant (Table 6). There was a strong dose-response relationship between amount of tuna ingested and risk of illness (Table 7).

Table 6. Univariate analysis: association between food items and food poisoning cases in frozen seafood factory, Samut Prakan Province

Risk Factors	Case (n=89)		Control (n=176)		OR	95% CI
	Exp	Non-exp	Exp	Non-exp		
Fermented tuna	88	1	105	71	59.5	9.8-2409.1
Papaya salad	17	72	50	126	0.6	0.3-11
Gang Tai-pla	16	73	50	126	0.6	0.3-1.1
Gang kua	10	79	27	149	0.7	0.3-1.6
Bamboo soup	31	58	87	89	0.6	0.3-1.0
Fried kana	22	67	67	109	0.5	0.3-1.0
Fried bean	14	75	26	150	1.1	0.5-2.3
Plain rice	76	13	140	49	1.5	0.7-3.3
Fried rice	3	86	11	165	0.5	0.1-2.1
Drinking water	85	4	160	16	2.1	0.7-9.0

Table 7. Dose-response relationship between fermented tuna consumption and food poisoning cases in frozen seafood factory, Samut Prakan Province

Number of Pieces	Case	Control	OR	95% CI
0	1	71	1.0	-
< 2	24	50	34.1	5.1-1420.4
2 -3	28	36	55.2	8.2-2288.4
≥ 4	36	19	134.5	19.2-5531.2

Chi-square for trend = 59.1, P value = < 0.00001

Environmental survey revealed that the production line was divided into three sections: fish, prawn and squid processing. Before starting work, it was mandatory for employees in each section to wash and clean their body, put on a uniform that covers the entire body, wear a hat and gloves, and have dirt and fallen hair removed. Raw materials were washed and rinsed by using tap water containing chlorine content of no less than 0.5ppm.

The factory kitchen and cafeteria were clean and well-ventilated. Foods were prepared daily from local fresh producer, and left-over foods were discarded. If factory frozen fish inventory were used for any lunches, cooks made requests one day in advanced to cold storage staff who provide frozen products the next morning.

The fermented tuna dish which had not previously been prepared by the factory chefs, contained raw tuna, garlic, roasted rice, and monosodium glutamate (MSG). The mixture was kept in a plastic food bag firmly tied with rubber bands. The bag was kept in a plastic bucket placed in the non-air-conditioned open kitchen space for three days, before the fermented foodstuff was fried on the morning of 21 Jul 2007 and served to workers during lunch later that day.

The results of histamine testing show a vast difference in the levels of histamine, from very high to low in respective order, between left-over fermented tuna and in frozen tuna inventory from the factory (Table 8).

Table 8. Histamine levels obtained through laboratory testing on frozen raw tuna and fried fermented tuna from frozen seafood factory, Samut Prakan Province

Sample	Histamine Level (ppm)	Bacteria Detected
Frozen raw tuna	3.9	*Bacillus cereus*
Fried fermented tuna	446.2	None

Discussion

This outbreak occurred in a specific setting after a consumption of limited supply of cooked food, fried fermented tuna. Early indications did not suggest that widespread contamination of processed fish had occurred. The epidemic curve spans only 10 hours, and is characterized by an abrupt increase in the number of cases until it reaches a single peak, then drops to zero. This suggests a common point source

of limited time duration is responsible for the outbreak.

Worker lunch schedules fitted within the usual incubation period of scombroid poisoning. The factory was generally well managed and organized. The fish used in the lunch dish was prepared differently from the canned tuna. Given this information, the source of the factory outbreak was more likely to have been a food item served at lunch than exposure to work-related risk factors. For this reason, we did not immediately halt factory production and recall canned products.

Our analytic results demonstrated a strong dose response association between amount of fermented tuna consumed and risk of scombroid poisoning. Histamine laboratory analysis of frozen raw tuna (3.92ppm) and fried fermented tuna (446.2ppm) confirmed that the frozen fish was safe and the outbreak source was fermented fish consumed locally.

Symptoms of scombroid poisoning are often mild and may be non-specific. Self report of illness by factory workers might lead to misclassification bias as some cases might overlook or neglect the symptoms they considered as unimportant. Our description of this outbreak may under report its true scope.

Public Health Action and Recommendations

The frozen seafood factory kept its raw seafood products refrigerated consistent with temperature guidelines. We had no further recommendations for this factory's commercial processes because factory fish was not implicated in the outbreak. Scombroid outbreaks occurring in this type of setting must be immediately and thoroughly investigated in order to prevent widespread dissemination of histamine contaminated fish. Ongoing surveillance yielded no new cases of scombroid poisoning in next seven days. Factory infirmary health staff were trained in the detection and treatment of scombroid poisoning cases.

Suggested Citation

Nalinee Hongchumpon, Ouppapong T, Pungsakul J, Hanta A, Pawan W, Chalamaat M, et al. Scombrotoxin food poisoning outbreak among frozen seafood factory workers Samut Prakan Province, Thailand, July 2007. OSIR. 2009 Sep;2(1):5-8. <http://www.osirjournal.net/issue.php?id=6>.

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