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Contents

Traceback of Thai Baby Corn Implicated in Danish and Australian Shigellosis Outbreaks: Findings and Implications for Control, August 2007

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Introduction

Shigellosis is a food-borne illness caused by infection by bacteria of the genus *Shigella*. Humans and other primates are the primary reservoirs for this agent. Also known as bacillary dysentery, the most virulent strains of shigellosis are associated with 10-15 per cent case fatality proportion among untreated people. In developing countries, shigellosis causes more than one million deaths each year, mostly among children under 10 years old[1].

Shigellosis can be transmitted through foods, including raw vegetables, salad ingredients (potato, tuna, shrimp, macaroni, chicken), dairy products and meat. Contamination of those foods is usually through the fecal-oral route. Fecal contaminated water and unsanitary handling by food handlers are the most common causes of contamination.

Symptoms may range from mild abdominal discomfort to full-blown dysentery characterized by cramps, diarrhea, fever, vomiting, blood, pus, mucus in stools or tenesmus. Incubation period is 12 to 50 hours.

Multinational outbreaks of shigellosis have been previously reported. A foodborne outbreak of *Shigella sonnei* infection in airline passengers in 2004, involved 47 confirmed and 116 probable cases travelling on 12 flights landing in Japan, Australia, multiple US states, and American Samoa. Food histories and review of food menu identified raw carrots served onboard as the likely vehicle of infection[2].

In 2007, outbreaks of shigellosis in Denmark on 6-20 Aug and Australia's Queensland and Victoria states on 9-27 Aug were reported to Thailand Ministry of Public Health (MOPH) on 4 and 13 Sep 2007 respectively. Epidemiological investigations in both countries suggested that the probable source of the outbreaks was contaminated raw baby corn imported from Thailand in late July 2007.

A joint investigation by International Food Safety Authorities Network (INFOSAN) and Department of Disease Control, Department of Agriculture and local Surveillance and Rapid Response Teams (SRRTs) of Thailand was conducted on 4-20 Sep 2007 in order to determine the source of the contaminated baby corn, elucidate the specific production steps where contamination occurred and put local control measures in place to minimize future risk of contamination.

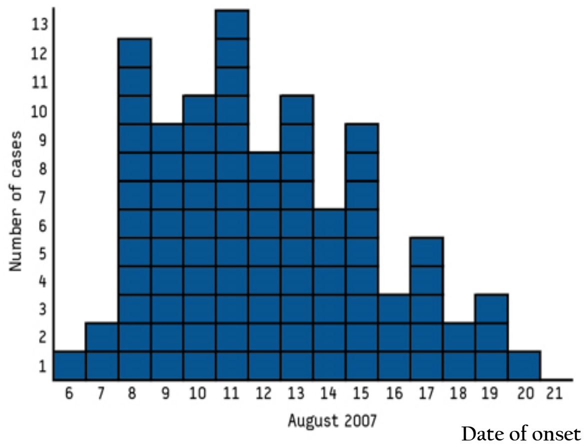

Figure 1. Epidemic curve of cases of *Shigella sonnei* infection in Denmark by onset of symptoms, 6-20 Aug 2007

Methods

Investigators obtained agricultural export documents and queried vegetable export companies about exportation data in order to illustrate epidemiological links from specific corn farms to Danish and Australian grocery stores.

After determining common links to Denmark and Australia groceries, on-site investigations were performed at facilities in the production line, ranging from farming and processing to packaging in order to determine potential steps associate with contamination. All workers at these sites were interviewed by standardized questionnaire regarding on health status, job type and other demographics.

Stool samples were collected from all interviewees. Samples of baby corn, water, farm and factory settings were cultured for bacteria.

A second investigation focused on shipping routes of exported baby corn was conducted later in an effort to evaluate possible transport-related causes of contamination of the corn products.

Results

In traceback results which investigated into production lines as well as transport routes through which baby corn was exported from Thailand to Denmark and Australia, company A which mainly produced baby corn and asparagus was implicated as a common link between the outbreaks in both countries.

Baby corns processing and packaging facility of company A which also processed and packed raw asparagus has been certified by Department of Agriculture, Ministry of Agriculture and Cooperatives, for Good Agricultural Practices (GAP) as well as Hazard Analysis and Critical Control Point (HACCP).

Baby corns processed by company A, located outside Bangkok, was distributed to several exporters for shipments to Taiwan, Denmark, Japan, Australia, and Dubai, with Taiwan being a major export market over the past 12 years. Company A started exporting raw baby corn to Denmark and Australia in 2007.

Production steps include 1) picking raw baby corn from company owned farms or local farmers and sending to collecting houses; 2) removing husks and silks; 3) sorting by size; 4) placing the corn in baskets; 5) transporting to packing houses; 6) washing corn in chlorinated water; 7) refrigerating overnight; 8) cutting and trimming corn to uniform size; 9) placing baby corn on small foam trays; 10) covering foam trays with plastic wrap; 11) puncturing plastic wrap for ventilation; 12) storing in refrigerated shelves; and 13) transporting.

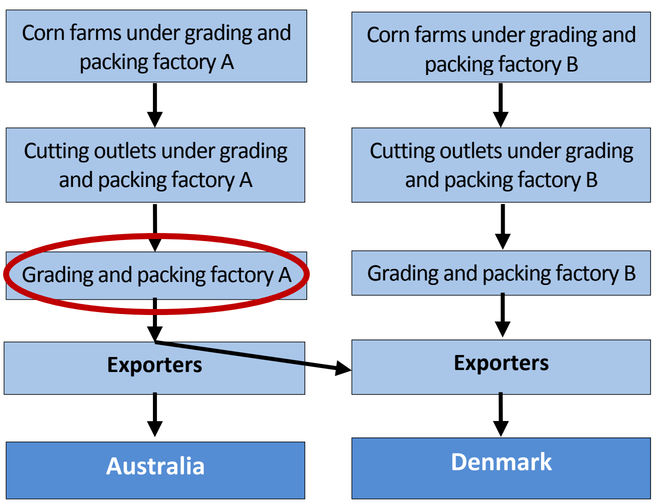

Figure 2. Manufacturing and exporting process of raw baby corn shipped to Denmark and Australia

Environmental survey yielded several possible mechanisms of contamination. The problems were found in various steps of the production, including the cutting process in which corns were unloaded and laid on cement floors before the husks and silks were removed by seven to ten workers who did not wear gloves, as shown in figure 3. Company A imposed no requirements on workers to wash their hands with antiseptics while performing duties.

Figure 3. Workers without glove during process of cutting and removing baby corn husk and silk in a cutting outlet of company A[1] (n = 94)

Later in the afternoon, raw baby corns with removed husk and silk were transported in non-refrigerated trucks to a plant for sorting by size and packaging. The corns were sterilized by being soaked in water with 100ppm chlorine for two to three minutes before being kept refrigerated overnight at 4 degree celcius.

In the next step, workers wearing gloves and aprons then cut and trimmed the corns as the final step, before placing them on small foam trays and wrapping them with clear plastic sheets, which were punctured for ventilation purpose. Workers from the wrapping process did not wear gloves and aprons, but they did not touch the processed baby corns. The products were sent to exporters in two days.

One of 119 workers interviewed reported to have diarrhea in early July 2007. This worker was involved in size sorting and placing corn in baskets. Specimens collection by rectal and hand swabs were conducted from 119 workers, 109 of whom from grading and packaging factory and 10 others from corn cutting outlets. Other samples were taken from three sets of raw baby corns before sterilization, 11 sterilized baby corn samples, one sample of water and 27 samples of equipments and surrounding areas.

The test results of all specimens did not identify *Shigella sonnei*, but *Staphylococcus aureus* was detected in one of the sterilized baby corn samples, while rectal swab from employee with reported diarrhea detected *Aeromonas sobria*. This worker, however, worked in the size sorting and packaging step, with tasks mainly involving in moving packed baby corns from production lines to storage rooms pending exportation, thus, having no chance of having direct contact with baby corns.

Discussion

The investigation results from three relevant locations - Denmark, Australia and Thailand - showed the same information that the shigellosis outbreaks were possibly linked to consumption of baby corns produced by company A based in Thailand.

During the early stages of outbreak investigation in Thailand, there were no reports of concurrent outbreaks in Australia, but ongoing shigellosis outbreaks were occurring in Denmark. In verification of export destinations of company A, it was, however, found that its baby corn products were actually exported to several countries including Australia. While outbreak investigation was underway in Thailand, health authorities received notification of shigellosis incidence in Australia, with results of investigation also relating to company A.

During initial investigation, there were two companies linked with the outbreak in Denmark, however the final investigation found that only company A linked with both Denmark and Australia outbreaks. Apart from epidemiological linkage that suggested company A as the most likely source, a comparison made between company A and company B in various aspects in their manufacturing process showed that company B, which had earlier exported baby corns to European countries for many years, had much better hygiene measures, especially during the steps involving cutting, size sorting and packaging.

On the contrary, company A's cutting outlets was found to have been most vulnerable to contamination because the workers did not wear gloves or wash their hands properly while removing corn husks, exposing their direct contact with baby corns.

In case of the worker who reported diarrhea, it was likely that organisms might have been transmitted from hands to baby corns. Apart from this, the chlorine content in the water used during the sterilization process during size sorting and packing factory was not sufficient to completely kill microorganisms, in the possible event of a high level of contamination. Company A generally used water with 100ppm of chlorine to sterilize baby corns for two to three minutes while relevant studies in foreign countries indicated that the use of 200ppm chlorine for a five-minute duration was necessary to substantially reduce up to 10^6 colonies/gm of *Shigella spp.*

Results of laboratory tests on suspected batches of baby corns in Denmark identified high levels of *Salmonella enterica* and *Escherichia coli*. In Australia, the results from tests performed on raw baby corns from the same company showed unacceptable levels of *Escherichia coli*.

The detection of high levels of *Escherichia coli* in samples of raw baby corns exported to Denmark and Australia indicated possible flaws in the sterilization process as well. Naturally, *E. coli* is highly sensitive to chlorine. Despite a high level of contamination from upstream process, once baby corns are immersed in 100ppm chlorine, a significant amount of microorganisms should have been eliminated or could not have survived in an amount that is harmful to human health. The incident indicated the possibility of substantially low level of or virtually no chlorine content in the water during the sterilization process of size sorting and packaging factory.

Company A normally exported baby corn products to Taiwan, Japan, and Dubai as well, where no dysentery outbreaks were reported. This could be due to different in eating culture of Asians who usually prefer to eat cooked or heated baby corns, a condition under which microorganisms are usually killed or incapacitated. On the other hand, westerners usually use raw or undercooked baby corns as an ingredient in salads, thus exposing more contamination to them.

Although *Shigella sonnei* was not detected in samples of raw baby corn produced by company A by Danish, Australian or Thai authorities, our traceback results suggested that these products were the probable source of the outbreaks in both countries. This is primarily due to characteristics of *Shigella sonnei*, only 10-100 organisms are capable of causing infections while at least 1,000 organisms are required for detection through specimen examination[4]. Thus, it is difficult to culture the strain from environmental samples and those of raw baby corns. Therefore, there is a slim chance of detecting this pathogen from a specimen.

This also explains why a number of cases were identified but no pathogenic bacteria were detected from samples of suspected batches of baby corn.

Moreover, a delay in outbreak notification nearly one month also resulted in delayed collection of specimens, which in turn significantly reduced the chance of detecting causative agents.

Public Health Actions and Recommendations

After the investigation, company A has increased the chlorine level in the disinfectant used to wash baby corn and other farm products while setting up a new rule which excuses workers with diarrhea or other illnesses from works. A number of on-site quality control measures are later adopted by the agricultural authorities to further monitoring of the production process. After all, Australia and Denmark still import baby corn from Thailand, either produced by various companies or company A whose products are also still exported to other countries, without new outbreak of shigellosis or other food-borne diseases.

To minimize the risk of possible shigellosis outbreak in Thailand in the future or to prevent a recurrence of the outbreaks in Australia, Denmark and elsewhere, surveillance efforts during production processes should be implemented by public health authorities in high risk areas for early detection of shigellosis and other food-borne bacterial contaminations. And post-production random examination should be routinely carried out to detect contamination before local distributions and overseas transports.

A study should be conducted to determine proper and effective sterilization process for agricultural products in general. Relevant authorities should register baby corn growers and cutting outlets as a regulation, and more attempts should be made to ensure that production of farm products, from farming to processing steps, meet GAP and GHP standards.

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Suggested Citation

Tikhamram S, Prempree P, Thammavijya P, Seewilai U, Siri-arayaporn P. Traceback of Thai baby corn implicated in Danish and Australian shigellosis outbreaks: Findings and implications for control, August 2007. OSIR. 2009 Sep;2(1):1-4.
<http://www.osirjournal.net/issue.php?id=7>.

References

1. Lewis HC, et al. Outbreaks of shigellosis in Denmark and Australia associated with imported baby corn, August 2007 – final summary. Euro Surveill. 2007;12(40): pii=3279. <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3279> (accessed 10 Sep 2009).

2. Gaynor K, et al. International foodborne outbreak of *Shigella sonnei* infection in airline passengers. Epidemiol Infect. 2009 Mar;137(3):335-41. Epub 2009 Feb 9. <http://www.ncbi.nlm.nih.gov/pubmed/18177516> (accessed 10 Sep 2009).

3. Rice EW, Clark RM, Johnson CH. Chlorine inactivation of *Escherichia coli* O157:H7. Emerg Infect Dis. May 1999; 5(3): 461-3. <http://www.cdc.gov/ncidod/EId/vol5no3/rice.htm> (accessed 10 Sep 2009).

4. Shigellosis - profile for healthcare workers: Infective dose and infectivity. Arizona Department of Health Services of United States. Bureau of Emergency Preparedness and Response. <http://www.azdhs.gov/phs/edc/edrp/es/profshigellosis.htm> (accessed 10 Sep 2009).

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.

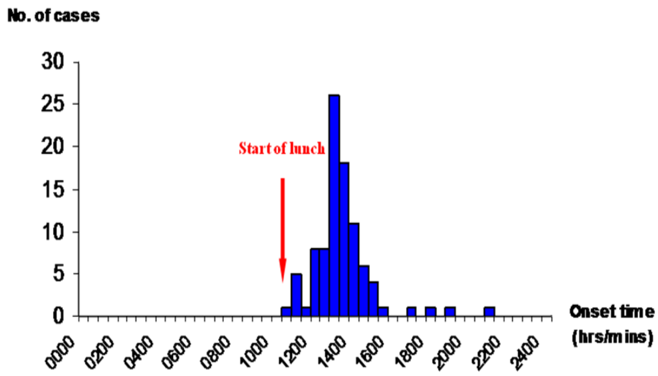

Figure 1. Epidemic curve of number of food poisoning cases by time of onset in frozen seafood factory, Samut Prakan Province

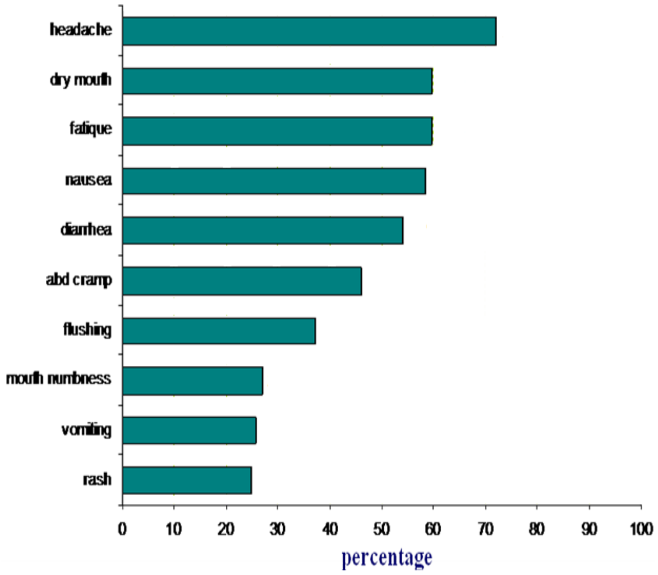

Figure 2. Clinical symptoms of food poisoning cases in frozen seafood factory, Samut Prakan Province (n=89)

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

Hongchumpon N, 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>.

References

1. Wikipedia. Scombroid food poisoning. <http://en.wikipedia.org/wiki/Scombrotoxin> (accessed 10 Sep 2009).

2. Bremer PJ, Fletcher GC, Osborne C. Scombrotoxin in seafood. New Zealand Institute for Crop and Food Research; 2003 May. <http://www.crop.cri.nz/home/research/marine/pathogens/Scombrotoxin.pdf> (accessed 10 Sep 2009).

3. Wu SF, Chen W. An outbreak of scombroid fish poisoning in a kindergarten. Acta Paediatr Taiwan. 2003 Sep-Oct;44(5):297-9. <http://www.ncbi.nlm.nih.gov/pubmed/14964987?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum> (accessed 10 Sep 2009).

4. Hunter BT. Histamine reaction from foods, NOHA NEWS. 1990;15:2. <http://www.nutrition4health.org/nohanews/NNW90HistamineReactions.htm> (accessed 10 Sep 2009).

5. Huss HH, Ababouch L, Gram L. Assessment and management of seafood safety and quality. The Food and Agriculture Organization of the United Nations (FAO). Rome, 2004. <ftp://ftp.fao.org/docrep/fao/006/y4743e/y4743e00.pdf> (accessed 10 Sep 2009).

Jellyfish Envenomation Events in Selected Coastal Provinces of Thailand 1998-2008

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Introduction

Anecdotal evidence suggests jellyfish envenomation occurs commonly in coastal Thailand. Envenomation injuries are not currently included in national disease surveillance, so quantitative data are limited. One severe jellyfish envenomation and three lethal envenomation events reported to the MOPH within the past six years have raised concern about the scope of jellyfish envenomation events in Thailand.

Jellyfish usually contain venom within a coiled hollow thread-like structure called nematocysts on their tentacles. Discharge of venom typically causes local irritation or burning, but is not very dangerous to humans. The venom from a few species can cause severe burning and scarring and is potentially lethal to humans. Jellyfish envenomation has caused at least 100 documented fatalities worldwide[1]; northeastern Australia is the epi-center of lethal envenomation. Members of the Cubozoa class, known as box jellyfish, are thought to be responsible for the majority of lethal envenomation.

In 2002, two fatalities following jellyfish envenomation occurred in Koh Phangan, Surat Thani Province, Thailand. In January 2008, a four-year-old boy was severely injured after jellyfish envenomation in Koh Chang, Trat Province. In April 2008, an eleven-year-old girl died from a jellyfish envenomation in Koh Lanta, Krabi Province.

Teams from the Bureau of Epidemiology conducted investigations in three coastal provinces in 2003[2] and in two additional provinces in 2008. Results from the investigations were presented at conferences[3]. In this work, we present results from medical records review of jellyfish envenomation events for five year periods in five provinces. Areas included in this review included coastal regions of both the Gulf of Thailand and the Andaman Sea.

Methods

Thailand has 23 coastal provinces; tourist areas can be divided into three regions: the eastern coast, the southern coast along the Gulf of Thailand and the southern coast along the Andaman Sea. Total coastal length is 2,815 kilometers.

We used data from five provinces in Thailand with histories of jellyfish envenomation events. We conducted a descriptive study in coastal health facilities in Trat Province: Trat provincial hospital, Bangkok-Trat hospital, Lam Ngob community hospital, Koh Chang community hospital, Ban Klong Phrao health center; and in Krabi Province: Krabi provincial hospital, Ao Luk community hospital, Koh Lanta community hospital and Sala Dan health center. We reviewed both outpatient and inpatient medical records, both from log books and electronic databases, dependent on availability. Medical records from 1 Jan 2003 through 31 Dec 2007 were reviewed from Trat Province. Medical records from 1 Jan 2003 through 30 Jun 2008 were reviewed from Krabi Province.

We identified cases of jellyfish envenomation in two ways. We included cases with ICD-10 diagnostic codes X26 (contact with venomous marine animals and plants) and T63.6 (toxic effect of contact with other marine animals). We also searched for jellyfish envenomation cases in hand written patient registration logbooks for emergency room visits and hospital admissions where logbooks were available.

We included in our analysis 1998-2002 hospital data from Hua Hin District (Prachuap Khiri Khan Province), Cha-um District (Phetchburi Province), and Koh Samui District and Koh Pha-ngan District (Surat Thani Province) collected by researchers from Thailand's Bureau of Epidemiology in 2003[2]. These sites and the ones from our study are shown in figure 1.

The study team used chief complaint data from hospital log books and ICD-9 and ICD-10 codes to identify cases of jellyfish envenomation.

We collected data from each record including age, sex, nationality, address, dates of injury, injured parts of body, symptoms and signs, date and type of treatment. Injuries were divided into three categories: lethal, severe (admitted patients) and mild (outpatients).

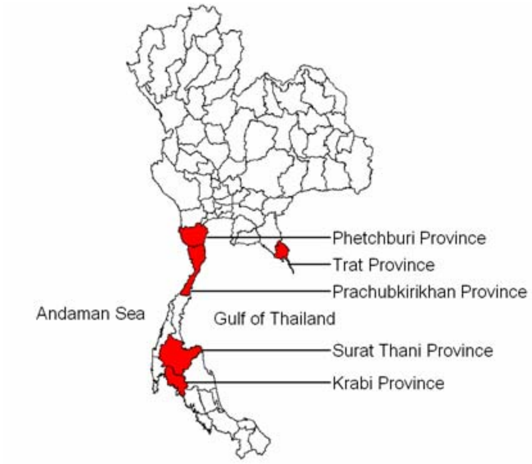

Figure 1. Data collection sites

We interviewed local fishermen who fishing in the Andaman Sea about occurrence of jellyfish envenomation among local people and jellyfish species they had observed in local waters. In the first three investigations, we collected specimens submitted by local fishermen or netted by snorkelers swimming close to the envenomation sites. In the Koh Lanta investigation, we collected jellyfish specimens two to four kilometers from the coast using a shrimp net submerged for 15-20 minutes in the sea at depths of three to four meters.

We used descriptive statistics to summarize information on envenomation events including demographic information on cases, envenomation rates, injury characteristics, and treatments administered. Denominators in our envenomation rate calculations were obtained from the Tourism Authority of Thailand[4] and hospital admission data.

Results

From medical record reviews, we identified 587 cases of jellyfish envenomation. Cases ranged in age from 4 to 75 years, the median age was 26. In terms of anatomic site of envenomation, leg is the most common part while face is at the least (Figure 2).

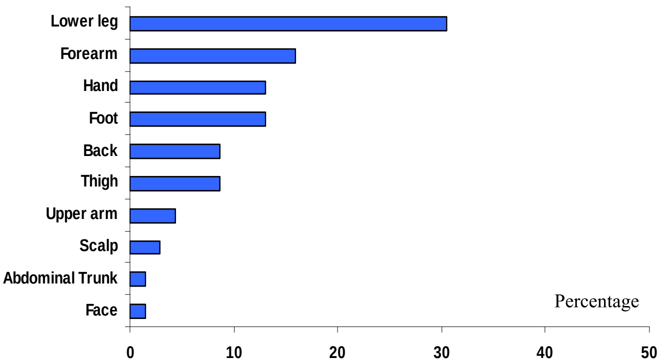

Figure 2. Anatomic sites exposed jellyfish envenomation in Thailand, 1998-2008

Burning sensation and pain were common symptoms and some of cases develop symptoms not relate to sting area such as chest discomfort, abdominal pain and nausea (Figure 3).

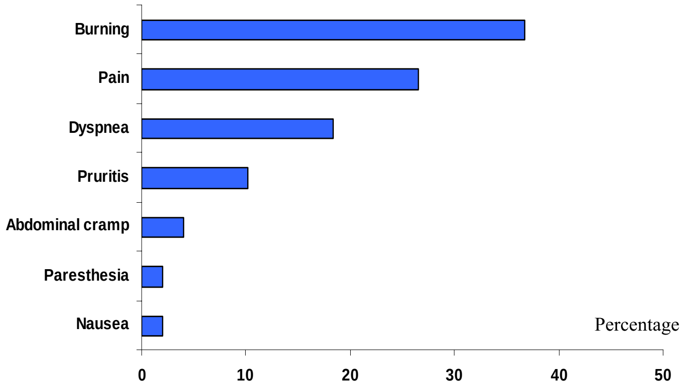

Figure 3. Symptoms of jellyfish envenomation cases in Thailand, 1998-2002

Patients usually present sign of erythematous rash, followed by burn wound and swelling (Figure 4).

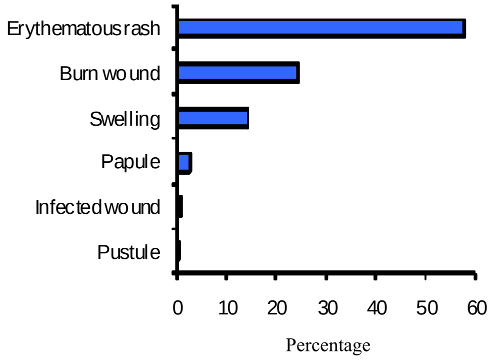

Figure 4. Percentage of signs of jellyfish envenomation cases in Thailand, 1998-2002

Rates of severe and lethal envenomation are presented per 1 million tourists and per 1,000 hospital admissions are shown in table 1. Since envenomation from box jellyfish can be fatal but proper first aid can effectively safe life, we present the first aid treatment in table 2.

Table 1. Characteristics of cases in jellyfish envenomation

Envenomation Attack Rate	Trat	Krabi
Tourist (per 1 million tourists)	0.5	1.5
Hospitalized cases (per 1,000 hospitalized cases)	0.1	0.1

In Surat Thani in 2003, the team collected 2 venomous jellyfish specimens which were identified as *Cubozoan* jellyfish of the *Carybdeid* family. In Koh Lanta, the team collected 12 venomous jellyfish specimens which were preliminarily classified into two species: *Cubozoan, Chyrasanum*.

Table 2. Types of treatment in jellyfish envenomation

No.	Type of Treatment
1	If cardiorespiratory compromise, immediate anti-venom where available.
2	Flood the area with 2-5% acetic acid (household vinegar) to keep undischarged nematocysts from firing. This does not relieve pain, but prevents discharge of additional venom.
3	Irrigate exposed eyes with copious amounts of room temperature tap water for at least 15 minutes.
4	Pluck off any vinegar-soaked tentacles with a stick or other tool.
5	If the victim has shortness of breath, weakness, muscle cramps, palpitations or any other generalized symptoms, take them to an emergency room.

Figures 5 and 6 show jellyfish collected in these investigations. Four local fishermen were interviewed; the anecdotal evidence showed existing of venomous jellyfish in local water. One fisherman experienced Cubozoan jellyfish envenomation. Since venomous jellyfish population by seasonality in Thai water had never been studied, further survey is needed.

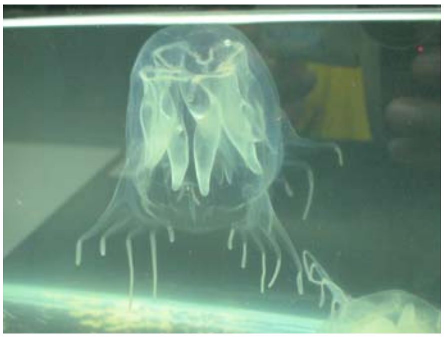

Figure 5. Jellyfish collected from Lanta island, Krabi Province

Figure 6. Jellyfish collected in an investigation near Samui island, Surat Thani Province in 2003

Discussion

Though there are fewer serious envenomation events in Thailand than in Australia, Thailand faces a more challenging control problem. As demonstrated by our data, envenomation events happen across broad expanses of Thailand's coast whereas Australia's high risk area is limited to the northeast. Australia's greater economic resources have also allowed scientists to collect data on jellyfish population dynamics and more thoroughly explore and document envenomation events.

The public health challenge for Thailand requires consideration of multiple factors: rarity of severe envenomation injury, uncertainty about changes in the burden of envenomation injury, limited utility of treatment options, and the importance of Thailand's tourism industry.

In our study, prevalence of jellyfish envenomation was likely underestimated as some jellyfish envenomation cases were misclassified and medical records were occasionally missing. Also affecting prevalence estimates is the reality that many mild cases of jellyfish envenomation do not present at a health facility for treatment. Most Thai cases who were local fishermen or lived near the coast did not visit health facilities after being stung, choosing instead to self-administer first-aid or use traditional medicine. Even taking this underestimation of prevalence into account, it is clear that rates of envenomation are low which has implications for the amount of resources devoted to this problem.

If jellyfish populations continue to grow and possibly expand into territory in which they have not historically been found, there may be an increase in the risk of envenomation. Thailand is also receiving greater numbers of tourists every year which may also result in increasing risk.

Prevention is a key in controlling jellyfish envenomation; treatment of severe cases may not be possible given the speed at which death occurs. The average time from envenomation to death in our study was about 10 minutes; most cases will not be able to reach health facilities in time. In addition, although antivenin is available for certain species of jellyfish, the cost of keeping it stocked in all coastal health facilities is prohibitive.

In recent years, tourism in Thailand has generated approximately seven billion U.S. dollars per year, a figure that represents roughly six percent of the country's GDP[4]. Intense public health campaigns about the risk of envenomation must be tempered with appreciation of the overall very low risk of serious injury from jellyfish and the importance of the tourist industry.

Data in the earlier study were collected in a slightly different way than our more recent investigation due to the availability of various data sources including electronic databases and hard copies of medical records. This limits our ability to look at trends and compare rates across time.

Public Health Action and Recommendations

Most cases of jellyfish envenomation develop mild symptoms and can be treated as outpatients or with only first-aid. Vinegar disrupts discharge of venom through denaturing nematocyst proteins on jellyfish tentacles and should be made available at beaches, in boats and in coastal accommodations. The most commonly injured body parts were lower extremities, followed by the arms and hands; these areas should be protected by clothing while in the water. Australia requires the use of protective "stinger suits" in high risk areas though expense makes this an unlikely intervention in Thailand and suitable alternatives should be encouraged.

The high season for tourists, both Thai and foreign, in the Gulf of Thailand is from October to May and in the Andaman Sea, November to May. Especially during these times, prevention methods such as posted warning signs in high risk areas and protective nets to reduce interactions between venomous jellies and swimmers should be used.

Health officers who work in coastal areas should be trained to recognize and manage jellyfish envenomation cases. However, we emphasize prevention as a more effective intervention than treatment.

We recommend that jellyfish envenomation be included in Thailand's non-communicable disease surveillance and advocate routine surveying of fishermen and other populations unlikely to seek medical care. The collection of these data will provide information on the burden of envenomation which in turn will facilitate an appreciation of potential changes in envenomation patterns. Continued collaboration with marine scientists is strongly recommended to identify venomous jellyfish species and monitor their populations.

Some evidence suggests that jellyfish numbers are increasing worldwide, perhaps due to global warming and overfishing[6]. Jellyfish envenomation events have led to beach closures in Hawaii and Spain and posting of warning signs in Borneo and elsewhere. Protective "stinger suits" and anti-jellyfish nets surrounding swimming areas are used to reduce risk of envenomation in Australia.

Suggested Citation

Sonthichai C, Tikumrum S, Smithsuwan P, Bussarawit S, Sermgew T, O'Reilly M, et al. Jellyfish envenomation events in selected coastal provinces of Thailand 1998-2008. OSIR. 2009 Sep;2(1):9-12.
<http://www.osirjournal.net/issue.php?id=11>.

References

1. Williamson J, Fenner P, Burnett J, Rifkin J. Eds. Venomous and poisonous marine animals: a medical and biological handbook. Sydney: University of New South Wales Press; 1996.

2. Tanit S, Jiraphongsa C. Morbidity and mortality of jellyfish envenomation in 4 seaside districts, southern Thailand, 1998-2002 TEPHINET Global Scientific Conference. 2004.

3. Sonthichai C, O'Reilly M, Smithsuwan P, Bussarawit S. Jellyfish envenomation situation in Thailand, 2003-2008. Proceedings of the ESCAIDE Conference; 2008.

4. Tourism Authority of Thailand, Tourism Statistics. <http://www2.tat.or.th/stat/web/static_index.php> (accessed 18 Sep 2008)

5. The National Science Foundation News. <http://www.nsf.gov/news/news_summ.jsp?cntn_id=111598> (accessed 18 Sep 2008)

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