Food-borne Botulism in Samui, Thailand

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24 April, 2014

Field Epidemiology Training Program
Bureau of Epidemiology, Department of Disease Control
Ministry of Public Health, Thailand
Topics:

- Overview of botulism
- Background of the outbreak
- Objectives of investigation
- Methods
- Results
- Limitations
- Conclusions and discussions
- Actions taken
- Recommendations
Botulism

An intoxication caused by botulinum toxin produced by *Clostridium botulinum*

**Four types:** food-borne, infant, wound, and undetermined

- Incubation period: 12-36 hrs. (6 hrs.–14 days)
- Early symptoms and signs are marked fatigue, weakness and vertigo, followed by blurred vision, dry mouth, and neurological symptoms (symmetrical cranial nerve palsy descend through the body)
- Treatment: Botulism antitoxin and supportive care, particularly respiratory support
- 5-10% case-fatality
**Clostridium botulinum**

- Anaerobic spore-forming, gram-positive, rod-shaped
  - Spores are widely distributed in soils, sediments in fresh and coastal waters, GI tract of fish and mammals.
  - Toxin prevent the release of acetylcholine at neuromuscular junction.
    - Heat labile toxin (80 °C, 30 mins or 100 °C, 10 mins)
    - Spores are difficult to destroy, need to high temperature for long time (e.g., 120 °C for 15 mins)
Geographical distribution of botulism outbreaks in Thailand, 1997-2011
Geographical distribution of botulism outbreaks in Thailand, 1997-2011

2011 (Saraburi)

Samui Island
### Suspected food causing botulism outbreaks

**Thailand, 1997-2011**

<table>
<thead>
<tr>
<th>Year</th>
<th>Suspected food</th>
<th>Cases (death)</th>
<th>Case-fatality rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>Canned bamboo shoots</td>
<td>6 (1)</td>
<td>16.7</td>
</tr>
<tr>
<td>1998</td>
<td>Canned bamboo shoots</td>
<td>13 (2)</td>
<td>15.4</td>
</tr>
<tr>
<td>2003</td>
<td>Canned bamboo shoots</td>
<td>10 (2)</td>
<td>20.0</td>
</tr>
<tr>
<td>2005</td>
<td>Sour pork</td>
<td>8 (1)</td>
<td>12.5</td>
</tr>
<tr>
<td>2006</td>
<td>Canned bamboo shoots</td>
<td>180 (0)</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>Raw deer meat</td>
<td>42 (0)</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>Sour pork</td>
<td>3 (0)</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>Fermented soybeans</td>
<td>3 (0)</td>
<td>0</td>
</tr>
<tr>
<td>2011</td>
<td>Sour pork</td>
<td>3 (1)</td>
<td>33.3</td>
</tr>
</tbody>
</table>

*Source: Disease Surveillance System, Bureau of Epidemiology, Thailand*
Background of Outbreak

• On 31 October 2012, two suspected cases of food-borne botulism in Samui hospital was notified to Bureau of Epidemiology. One of them was a chef of a famous hotel in Samui Island

• FETP and Provincial Health Office investigated this outbreak because:
  – This was the first outbreak of botulism in the southern region
  – Botulism has a high case fatality
  – Are there more cases of botulism?
Objectives

1. To verify the diagnosis and occurrence of an outbreak
2. To describe epidemiological characteristics of the outbreak
3. To identify sources of the outbreak and possible method of food contamination
4. To recommend prevention and control measures
Methods

- Descriptive study
- Environmental study
- Laboratory study
Descriptive study

• Established case definition
• Interviewed cases and their relatives
  • Event description, risk behavior and possible sources of food contamination
• Reviewed medical records
  • Patient’s history, doctor order/treatment, patient progress
• Conducted active case finding in the communities
Case definitions

Suspected case:
• Stayed in Samui Island during 10-30 October, 2012
• At least 3 of the following signs & symptoms in the past two weeks:
  – diarrhea, nausea/vomit, dry mouth, blurred vision, diplopia, dysphagia, oral numbness, muscle weakness, descending paralysis.

Probable case: A suspected case who had epidemiological linkage with confirmed cases.

Confirmed case: A suspected case with laboratory test positive for at least one of the following
  - stool culture for toxin producing Clostridium botulinum
  - botulinum toxin in sera
Environmental study

• **Patient’s house and surrounding areas:**
  – Inspected cooking area
  – Observed food storage
  – Searched for suspected food items

• **Patient’s workplace (Hotel A):** cooking area, food schedule, hotel food item on 24 Oct 2012 (before index case got sick), hand washing facility

• **Food, cooking processes including ingredients:** sources and its materials, preparing or preserving methods, products, storage and transportation, and cooking process (for soil contamination)
Results
Descriptive study

- 2 Cases (1 confirmed, 1 probable)
- Husband and wife
- Lived in Village on Samui Island
- **Age:** 41 (husband) and 37 (wife) years old
- **Occupations:**
  - **Male:** bakery chef
  - **Female:** own grocery
Index case: Thai male, 41 years old, chef

11:00 pm: nausea and vomit at home

Oct 23 24 25 26 27 28 29 30 ...

Dinner: 8.00 pm

Nov 22 2012
Index case: Thai male, 41 years old, chef

11:00 pm: nausea and vomit at home

9:00 am: nausea, vomit, glossospasm, blur vision, weakness. Went to hospital **Dx: food allergy**
12:50 pm: referred to Samui hospital as **Acute gastroenteritis**

<table>
<thead>
<tr>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>...</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>Dinner:</td>
<td>8.00 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nov</td>
</tr>
</tbody>
</table>

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4:00 pm: patient could not breath - > intubation in ICU
Dx: GBS, R/O Botulism

23  24  25  26  27  28  29  30  ...  22
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8:20pm: **botulism anti-toxin**

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~70 hrs.

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Report hospital-acquired pneumonia

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<th>...</th>
<th>22</th>
</tr>
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<tr>
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<td>Dinner: 8.00 pm</td>
<td>~70 hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Clinical improved, Discharged**

**Final Dx:** Botulism and hospital acquired pneumonia
Second case: Thai female, 37 years old (wife of index case)

9:00 am: nausea, vomit, dysarthria, dysphagia, weakness, at hospital taking care of husband

Dinner: 8.00 pm

| Oct | Dinner: 8.00 pm | 23 | 24 | 25 | 26 | 27 | 28 | ... | 14 | Nov | 2012 |
Second case: Thai female, 37 years old (wife of index case)

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6:58 am: nausea, blur vision, dysphagia, **Dx: HT**
4:05 pm: ptosis -> admitted

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<th>...</th>
<th>14</th>
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<td>8.00 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nov</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<th>25</th>
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<th>...</th>
<th>14</th>
<th>Nov 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>...</td>
<td>14</td>
<td>Nov 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>~60 hrs.</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>...</td>
<td>14</td>
</tr>
</tbody>
</table>

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~60 hrs.
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8:15 pm: botulism anti-toxin

Clinical improved, discharged
**Final Dx:** Botulism
<table>
<thead>
<tr>
<th>Date</th>
<th>Meal</th>
<th>Index case (Husband)</th>
<th>Second case (Wife)</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Oct</td>
<td>Breakfast</td>
<td>Hotel food</td>
<td>No breakfast</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td>Hotel food</td>
<td>Did not remember</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dinner</td>
<td>Pork BBQ at restaurant</td>
<td></td>
<td>3 people</td>
</tr>
<tr>
<td>23 Oct</td>
<td>Breakfast</td>
<td>Hotel food</td>
<td>No breakfast</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td>Hotel food</td>
<td><strong>Home: unpeeled-steamed bamboo shoot</strong>, shrimp paste dip with fish, bamboo shoot salad</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dinner</td>
<td><strong>Home: unpeeled-steamed bamboo shoot, preserved spider flower</strong>, spicy catfish salad</td>
<td></td>
<td>2 people</td>
</tr>
<tr>
<td>24 Oct</td>
<td>Breakfast</td>
<td>Hotel food</td>
<td>No breakfast</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td>Hotel food</td>
<td><strong>Home: spicy crispy pork with Chinese broccoli</strong></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dinner</td>
<td><strong>Home: papaya salad with preserved crab and fermented fish, preserved spider flower</strong>, sausage, pork salad</td>
<td></td>
<td>4 people</td>
</tr>
</tbody>
</table>
## Food-specific Attack Rates

<table>
<thead>
<tr>
<th>Food items</th>
<th>Ate</th>
<th>Sick</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papaya salad (with fermented fish &amp; crab*)</td>
<td>3</td>
<td>2</td>
<td>67%</td>
</tr>
<tr>
<td>Unpeeled-steamed bamboo shoot *</td>
<td>3</td>
<td>2</td>
<td>67%</td>
</tr>
<tr>
<td>Preserved spider flower *</td>
<td>3</td>
<td>2</td>
<td>67%</td>
</tr>
<tr>
<td>Sausage (market)</td>
<td>5</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Pork salad (market)</td>
<td>5</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Shrimp paste dip with fish (market)</td>
<td>4</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Catfish in spicy salad (market)</td>
<td>5</td>
<td>2</td>
<td>40%</td>
</tr>
</tbody>
</table>

* Airtight package sent from relative living in Udon Thani Province
Active Case Finding (case/total)

- Patients’ family member: 2/4
  - First case (Husband)
  - Second case (Wife)
  - Two daughters
- Neighbors (4 persons who joined dinner before onset of symptoms): 0/4
- Workplace of index case: 0/11
- Trace back – older sister family (food sender): 0/2

“No more case found”
Trace-back food items

Since 3 food items sent from sister who lives in Udon Thani had the highest food-specific attack rate, we conducted a trace back of these food items to determine if preparation of these foods could lead to botulism outbreak including:

- Fermented crab
- Unpeeled-steamed bamboo shoots
- Preserved spider flowers
Environmental study
Patients’ House in Samui Island

Front side

Grocery minimarket

Extended covered backyard porch
Patient’s workplace: Hotel A

- Hotel provides food for workers on working days
- Cooking area is separated for workers and guests
- Workers are not allowed to take any item of food home.
Preserved foods transported by pick-up truck from Udon Thani to Samui Island – 1,344 km – 3 days
Preserved foods transported by pick-up truck from Udon Thani to Samui Island – 1,344 km – 3 days
### Fermented-crab prepared by Sister

<table>
<thead>
<tr>
<th>Materials</th>
<th>Amount</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. plastic bottle</td>
<td>1</td>
<td>market</td>
</tr>
<tr>
<td>2. crab</td>
<td>80-100</td>
<td>paddy field</td>
</tr>
<tr>
<td>3. salt</td>
<td>½ cup</td>
<td>market</td>
</tr>
<tr>
<td>4. fish sauce</td>
<td>1 bottle</td>
<td>market</td>
</tr>
<tr>
<td>5. sugar</td>
<td>1 tsp.</td>
<td>market</td>
</tr>
</tbody>
</table>
Sister’s rice field, Udon Thani
Fermented crab in fish sauce

1. Clean live crabs with water and leave them in bucket for 2 days.
2. Add little salt to water and boil for 10-20 minutes.
3. Let water cool to room temperature and pour water in plastic bottle.
4. Put live crabs into bottle with boiled salt water.
5. Add fish sauce into bottle for flavor.
6. Seal bottle and let ferment for at least 7 days.
Stream bamboo shoots preparation

Peeled- bamboo shoot

Unpeeled- bamboo shoot

Steaming
Checking Temperature During Steaming
Temperature in plastic bag of bamboo-shoot during steaming

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st bag</td>
</tr>
<tr>
<td>10</td>
<td>51.8</td>
</tr>
<tr>
<td>20</td>
<td>82.0</td>
</tr>
<tr>
<td>30</td>
<td>91.2</td>
</tr>
</tbody>
</table>

Recommended temp higher than 80 °C for 30 minutes to destroy botulinum toxin
1. Clean fresh spider flowers with water

2. Drain out water, leave it until almost dry

3. Prepare a small jar with 1 cup of water, put salt and sugar into water, stir with spoon until salt and sugar are dissolved

4. Add all spider flowers into a jar and press it under water solution

5. Leave it for 3 days, then place preserved spider flowers in a plastic bag and seal with rubber band
Laboratory Study and Sample Collection
Sample collection

• Specimens from cases
  – Sera from both cases (before & after botulinum antitoxin was given)
  – Stool sample (index case, after botulinum antitoxin was given)

• Food & ingredients
  – Fermented crab (3 lots)
  – Fermented fish
  – Peeled-steamed bamboo shoot

All sample were send for botulinum toxin laboratory testing at National Institute of Health, Thailand
Fermented crab
Unpeeled – steamed bamboo shoot
Preserved spider flower

Food arrived and Patients’ ate and got sick 1 day later

Sera sample (index case)
Sera sample (2nd case)
Food sample
Stool sample (index case)

Botulinum antitoxin
## Laboratory results from two cases

<table>
<thead>
<tr>
<th>Items</th>
<th>First case</th>
<th>Second case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stool</td>
<td>Serum</td>
</tr>
<tr>
<td>Date of specimen collection</td>
<td>1/11/2012</td>
<td>26/10/2012</td>
</tr>
<tr>
<td></td>
<td>26/10/2012</td>
<td>1/11/2012</td>
</tr>
<tr>
<td></td>
<td>1/11/2012</td>
<td>1/11/2012</td>
</tr>
<tr>
<td>Date send to NIH</td>
<td>3/10/12</td>
<td>3/10/12</td>
</tr>
<tr>
<td></td>
<td>3/10/12</td>
<td>3/10/12</td>
</tr>
<tr>
<td></td>
<td>3/10/12</td>
<td>3/10/12</td>
</tr>
<tr>
<td>Toxidity test (Mouse bioassay)</td>
<td>Positive</td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td>ELISA (A,B,E,F)</td>
<td>-</td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
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<td></td>
<td></td>
<td>Neg</td>
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<tr>
<td>Isolation</td>
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<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td>BoNT/B subtyping</td>
<td>B2</td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td>Items</td>
<td>Steamed bamboo shoot</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peeled</td>
<td>Unpeeled</td>
</tr>
<tr>
<td>Date of food preserved</td>
<td>-</td>
<td>3/10/12</td>
</tr>
<tr>
<td>Food sent</td>
<td>-</td>
<td>20/10/12</td>
</tr>
<tr>
<td>Food received</td>
<td>-</td>
<td>23/10/12</td>
</tr>
<tr>
<td>Patient ate</td>
<td>No</td>
<td>23/10/12</td>
</tr>
<tr>
<td>Collected sample for lab</td>
<td>Yes</td>
<td>Have no leftover Sample</td>
</tr>
<tr>
<td>Lab result (C. botulinum toxin)</td>
<td>Neg</td>
<td>-</td>
</tr>
</tbody>
</table>
## Suspected food and lab results

<table>
<thead>
<tr>
<th>Items</th>
<th>Preserved crab</th>
<th>Fermented fish</th>
<th>Preserved spider flower</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Backyard porch</td>
<td>Refrigerator</td>
<td></td>
</tr>
<tr>
<td>Date of food preserved</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Food sent</td>
<td>N/A</td>
<td>20/10/12</td>
<td>20/10/12</td>
</tr>
<tr>
<td>Food received</td>
<td>N/A</td>
<td>23/10/12</td>
<td>23/10/12</td>
</tr>
<tr>
<td>Patient ate</td>
<td>24/10/12</td>
<td>-</td>
<td>24/10/12</td>
</tr>
<tr>
<td>Collected for lab</td>
<td>yes</td>
<td>Yes</td>
<td>yes</td>
</tr>
<tr>
<td>Lab result</td>
<td>Positive</td>
<td>Neg</td>
<td>Neg</td>
</tr>
</tbody>
</table>

*C. Botulinum* toxin
Study Limitations

• Stool sample was not available from the second case (wife).

• All Unpeeled-steamed bamboo shoot and preserved spider flower were eaten and therefore could not be tested.
Conclusions and Discussions I

Diagnosis
• First case was confirmed food-borne botulism from clinical symptoms, exposure history and laboratory toxicity test.
• Second case was identified as probable case based on neurological sign and symptoms of patient. Incubation period also met case definition of botulism but toxicity test was found to be negative.

Outbreak
• This is the first outbreak of botulism reported in the Southern region of Thailand and Samui Island. No previous case has been reported before.
• Epidemiologic linkage was identified since 2 cases are spouse who shared botulism contaminated foods.
Outbreak verifications

- We determined that this outbreak of botulism, which resulted in one confirmed and one probable case, was caused by improperly fermented crab.

- The crab was fermented in fish sauce in mid-October in Udon Thani, transported for three days to Samui Island, added to a papaya salad and apparently eaten by three people on October 24; within 18 hours, two of whom developed symptoms of botulism.
Diagnosis and Treatment

- Inexperienced of diagnosing botulism may have caused the delay in diagnosis.
- Patients received antitoxin treatment after 72 hours from clinical diagnosis due to difficulty in obtaining authorization from the National Health Security Office.
- Index case had a longer hospital stay with a delay recovery due to secondary pulmonary pneumonia acquired during hospitalization in the ICU.
Source of the outbreak (1)

- Lab finding confirmed botulinum toxin type B in preserved crab and stool sample of index case.
- Lab test confirmed the infection of patient from stool sample even we collected stool sample four days after botulinum antitoxin was given.
- Preserved crab and steamed bamboo shoot were stored in air-tight package providing appropriate germination of *Clostridium botulinum* spores.
Source of the outbreak (2)

- Although canned bamboo shoot was previously reported as the source of botulism outbreaks, we were unable to identify botulinum toxin in steamed bamboo shoots.
- Spider flowers were eaten three days after preserved, it is less likely that it could be the source of this botulism outbreak.
Actions taken

• We asked patients to destroy all suspected food in their house

• Confirmed the outbreak
  – FETP collected food samples and Thai National Laboratory Center reported positive for botulinum toxin

• Ruled out possible sources of outbreak
  – Hotel food and public food

• Provided health education about botulism
  – Health officer: how to conduct botulism investigation, specimen collection, disease prevention and control
  – Lab officer: how to collect specimen for botulism and process of sending specimen for laboratory confirmation
  – Provided education to the communities
Recommendations

• Health officer should be updated on some uncommon diseases in the region in order to provide appropriate management of disease investigation.

• UdonThani Provincial Health Office should provide health education related to food-borne diseases particularly botulism which is commonly occur in this region.

• National Health Security Office should provide a system to expedite accessibility to antitoxin.
Acknowledgements

• Patients and their relatives
• Dr. Chalermpong Sukonthaphon, Director of Samui Island hospital
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• National Institutes of Health (NIH)
• Udon Thani provincial health officer
• All BoE Staffs
• Dr. Chuleeporn Jiraphongsa, FETP, BoE
• Dr. Tippavan Nagachinta, CDC/CGH/DGHP
• Dr. Alden Henderson, CDC/CGH/DGHP
Thank you for your attention
Back up Slide
## Laboratory guideline for botulism

<table>
<thead>
<tr>
<th>Sample</th>
<th>Toxin</th>
<th>Culture</th>
<th>Amount</th>
<th>Sample/specimen packing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>/</td>
<td></td>
<td>5-10 cc</td>
<td>Sterile tube with cool temp. (4 ℃)</td>
</tr>
<tr>
<td>Stool</td>
<td>/</td>
<td>/</td>
<td>25-50 gm</td>
<td>Sealed containers with cool temperature (4-8 ℃)</td>
</tr>
<tr>
<td>Vomitus, gastric aspirate</td>
<td>/</td>
<td>/</td>
<td>200-300 cc</td>
<td>Sealed containers with cool temperature (4-8 ℃)</td>
</tr>
<tr>
<td>Food</td>
<td>/</td>
<td></td>
<td>50-200 gm</td>
<td>Sealed containers with cool temperature (4-8 ℃)</td>
</tr>
</tbody>
</table>

*Reference: Sample and specimen collection for laboratory study, NIH Thailand*
Laboratory test for botulism

Food/Stool

- centrifuge
  - supernatant
  - pellet

ELISA: for neurotoxin type A,B,E

Direct mouse assay

Culture (egg yolk agar/Enrichment broth)

Pure culture

Neutralization test - botulinum toxin

Serum sample

- Monotype anti-toxin
  - inject

Mouse bioassay (Toxicity test)

PCR
For A, B toxin gene

Phenotyping (BoNT/B subtyping)
Sample screening was performed on the basis of isolation and identification methods of Dowell and Hawkins (1), biochemical testing as described by Holdeman et al. (2), toxin assessment using a mouse bioassay (3), and assessment using enzyme-linked immunosorbent assay (ELISA) (CDC).

Toxin detection procedure also included a neutralization test using a mouse bioassay. Isolated bacteria were identified by botulinum neurotoxin genes (boNT) and BoNT/B subtyping according to the methods of Lindström et al. (4) and Umeda et al.

Neurotoxin assessment using a mouse bioassay was recommended as the diagnostic standard method due to its high sensitivity (0.01 ng/ml of specimen eluate). Naturally, the prevalence of viable C. botulinum spore contamination in food samples is generally relatively low (10–1,000 spores/kg), and the unsuitable growing conditions such as low pH, moisture content, NaCl content, inappropriate temperature, and growth of other bacterial species could act to suppress C. botulinum viability and may have led to the failure of C. botulinum detection in the suspected food specimens (6).

In addition, toxin-type can differ in any of the multiple steps between toxin ingestion and nerve receptor binding, including the rate of absorption from the gut or the speed of toxin binding to the nerve terminals (7). We concluded that the etiological agent of foodborne infection in Surat Thani Province was due to infection of C. botulinum type B2.
Botulinum anti-toxin: can prevent muscular paralysis but no effect after paralysis; specified on *C.botulinum* spp.

**Effectiveness of botulinum anti-toxin:**
- Depend on timeliness of treatment and disease progression
- Effectiveness of antitoxin usually within 24 hrs. after onset

**Orphan drug** is a pharmaceutical agent that has been developed specifically to treat a rare medical condition.
- Manage and distributed by NHSO
- Difficult to find/access in non-experience hospital
- Access at web site: http://drug.nhso.go.th/Antidotes
Appropriate criteria for botulism

• Soil contamination
• Sub-standard of food preparation
• An-aerobic environment
• Improper re-heat or cook before eat.