SALMONELLA ENTERICA SEROTYPE PARATYPHI B
VAR. JAVA GASTROENTERITIS OUTBREAK
ASSOCIATED WITH UNPASTEURIZED TEMPEH —
NORTH CAROLINA, 2012

Nicole Lee, MPH
North Carolina Division of Public Health

InFORM Conference
November 20, 2013
THE OUTBREAK

- March 30, 2012

- 8 cases of gastroenteritis
  - Restaurant X, County A
  - 5 *Salmonella* Paratyphi B var. Java

- No common food item
- No further cases
April 24, 2012

10 additional cases
- *Salmonella* Paratyphi B var. Java
- County A

15 laboratory confirmed cases
- Identical pulsed field gel electrophoresis (PFGE)
- “Outbreak strain”
SALMONELLA SPECIES

- Second most common causative agents among foodborne outbreaks

- Leading cause of foodborne outbreak-related hospitalizations
SALMONELLA PARATYPHI B VAR. JAVA

- Gastroenteritis
  - Fever
  - Abdominal Pain
  - Diarrhea

- *Salmonella* Paratyphi B
  - Paratyphoid Fever

- Distinguished by ability to ferment tartrate
- Paratyphi B var. (L)+ tartrate +
OBJECTIVES

- Determine extent of outbreak
- Identify the source
- Implement control measures
METHODS AND RESULTS

- Case finding and hypothesis generation
- Identification of the vehicle
- Identification and trace-back of the source
CASE FINDING

- **Active Surveillance**
- **Enhanced Passive Reporting**
  - Media
  - Clinician memos
  - Health alert networks
CASE DEFINITION

- **Probable**
  - Gastroenteritis
  - Epidemiologically linked to a confirmed case

- **Confirmed**
  - *Salmonella* Paratyphi B var. Java
  - Outbreak strain

- No time or geographic limits
- Novel PFGE pattern
LABORATORY METHODS

- Stool culture
- Salmonella serotyping
- PFGE
HYPOTHESIS GENERATION

- Patient interviews

- Salmonellosis Reporting Form
  - Clinical Symptoms
  - Travel History
  - Food
  - Water
  - Animal
CASES BY DATE OF SYMPTOM ONSET (N=89)

- Feb 29
- March
- April 26
- May 8

Date of Symptom Onset

Cases (no.)

N=89
### Case Characteristics (N=89)

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmed</td>
<td>87</td>
<td>98</td>
</tr>
<tr>
<td>Probable</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>51</td>
</tr>
<tr>
<td>Median age, years (range)</td>
<td>24 (4–74)</td>
<td>–</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Died</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
CASE DISTRIBUTION

MAP OF USA WITH CASE DISTRIBUTION: 1 in Michigan, 81 in North Carolina, 3 in Georgia.
## CLINICAL SYMPTOMS (N=89)

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>86/86</td>
<td>100</td>
</tr>
<tr>
<td>Abdominal Cramps</td>
<td>70/82</td>
<td>85</td>
</tr>
<tr>
<td>Fever</td>
<td>69/84</td>
<td>82</td>
</tr>
<tr>
<td>Vomiting</td>
<td>33/84</td>
<td>39</td>
</tr>
<tr>
<td>Bloody Diarrhea</td>
<td>30/82</td>
<td>37</td>
</tr>
</tbody>
</table>
COMMON EXPOSURES

- 93% reported travel or residency in County A
- No common food, water, animal exposures
- Restaurants X, Y, and Z
- Vegetarian cuisine
Presumptive positive – *Salmonella*

Tempeh Product

Produced in County A
Presumptive positive – *Salmonella*

Tempeh Product

Produced in County A

“Brand A Tempeh”
TEMPEH

- Soybeans, seeds, other legumes
- Fermented with mold to produce a firm cake
- Usually pasteurized
- Meat substitute

(Image: Flickr member FotoosVanRobin licensed under Creative Commons)
IDENTIFICATION OF THE VEHICLE

- Meat substitutes not on standard reporting form

- Outbreak-specific questionnaire
  - Food history
  - Meat substitutes (tempeh, tofu)
  - Restaurants in County A

- First 50 cases identified
RESTAURANT SITE VISITS

- Interviewed staff
- Observed food preparation
- Collected product invoices
QUESTIONNAIRE RESULTS

- Complete interviews on 41/50 cases
- 82% response rate
<table>
<thead>
<tr>
<th>Food Item</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Fruits</td>
<td>40</td>
<td>98</td>
</tr>
<tr>
<td>Fresh Vegetables</td>
<td>38</td>
<td>93</td>
</tr>
<tr>
<td>Eggs</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td>Tofu</td>
<td>21</td>
<td>51</td>
</tr>
<tr>
<td>Tempeh</td>
<td>18</td>
<td>44</td>
</tr>
<tr>
<td>Veggie Burgers</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Seitan</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Textured Vegetable Protein</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>
# COMMON FOODS (N=41)

<table>
<thead>
<tr>
<th>Food Item</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Fruits</td>
<td>40</td>
<td>98</td>
</tr>
<tr>
<td>Fresh Vegetables</td>
<td>38</td>
<td>93</td>
</tr>
<tr>
<td>Eggs</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td>Tofu</td>
<td>21</td>
<td>51</td>
</tr>
<tr>
<td>Tempeh</td>
<td>18</td>
<td>44</td>
</tr>
<tr>
<td>Veggie Burgers</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Seitan</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Textured Vegetable Protein</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>
OPPORTUNITIES FOR CROSS CONTAMINATION

- Uncooked tempeh prepared on cutting boards with ready to eat (RTE) foods
- Failure to perform hand hygiene after handling uncooked tempeh
- Bare hand contact with RTE foods
PRODUCT INVOICES

Distributor X

County A

X Y Z
PRODUCT INVOICES

Brand A Tempeh

Distributor X

County A

X

Y

Z
PRODUCT INVOICES

Brand A Tempeh

Distributor X

County A

X Y Z

35 restaurants
PRODUCT INVOICES

Brand A Tempeh

Distributor X

Grocery Stores, Southeastern US

County A

X Y Z
- Obtained list of distribution sites
- 100% cases eaten at a restaurant or venue serving Brand A Tempeh
BRAND A TEMPEH

- Operation since 2009
- Shared kitchen in County A
- Not pasteurized
SHARED KITCHEN

- Interviewed staff
- Reviewed production methods
- Obtained food samples for testing
BRAND A TEMPEH STAFF

- 6 Staff Members
- No reported illnesses
- No international travel
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas + Vinegar
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas + Vinegar + Rhizopus
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas + Vinegar + Rhizopus → Tempeh
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas + Vinegar + Rhizopus → Tempeh

Outbreak Strain
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas

Vinegar

Rhizopus

Tempeh

Outbreak Strain
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas

Vinegar

\textbf{Not tested}

\textbf{Outbreak Strain}

\textbf{Negative}

Rhizopus

Tempeh
TEMPEH PRODUCTION

Soybeans, Black Beans, Black-eyed Peas

+ Vinegar

+ Rhizopus

→ Tempeh

Negative

Not tested

Outbreak Strain

Outbreak Strain
RHIZOPUS TRACE BACK

Brand A Tempeh

Distributor X

County A

Grocery Stores, SE United States

X Y Z
RHIZOPUS TRACE BACK

Online Vendor 2  
Brand A Tempeh  
Grocery Stores, SE United States  
Distributor X  
County A

Jan 2012
RHIZOPUS TRACE BACK

Online Vendor 1 → Online Vendor 2 → Brand A Tempeh → Distributor X → Grocery Stores, SE United States → County A

X Y Z
RHIZOPUS TRACE BACK

Online Vendor 1 → Online Vendor 2 → Brand A Tempeh → Distributor X

Domestic and International Distribution → Grocery Stores, SE United States → County A

X Y Z
CONCLUSIONS

- *Rhizopus* culture was the source
- Brand A Tempeh was the vehicle
- Transmission occurred
  - Direct consumption
  - Cross-contamination of RTE foods
LIMITATIONS

- Targeted first 50 cases for re-interview
- Incomplete case finding
Fungal growth encouraged

Favorable conditions for pathogens

Unpasteurized
  ▪ No opportunity to reduce pathogenic load
RECOMMENDATIONS

- Designated cutting boards
- Separation from RTE foods
- Frequent hand hygiene
PUBLIC HEALTH ACTIONS

- *Rhizopus* culture recalled
- Brand A Tempeh recalled
- Education on proper handling of uncooked, unpasteurized tempeh
- Consider pasteurization
ACKNOWLEDGMENTS

Buncombe County Health Department
Gibbie Harris, Jennifer Mullendore
Ellis Vaughan, Sue Ellen Morrison
Susan Creede, David Mease, Marc Fowler,
Gaylen Ehrlichman

North Carolina Department of Agriculture and Consumer Services
Joan Sims, Janna Spruill, Jim Melvin, Dan Ragan

North Carolina Division of Public Health
Megan Davies
Denise Griffin
Debra Springer
Jean-Marie Maillard
Zack Moore
Anita Valiani
David Sweat
Nicole Lee
Leslie Wolf
Samuel Merritt
Evelyn Foust

*Coauthors listed in red.

CDC/OSELS/SEPDPO/EFAB
Edward Weiss

CDC/OID/NCEZID
Thai-An Nguyen
Stacey Bosch
Matt Mikoleit
Anna Newton
Brendan Jackson

CDC – NC DPH
Aaron Fleischauer
Jennifer MacFarquhar
Thank you