

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

Sasithorn Tikhamram¹, Prempre P¹, Thammavijya P¹, Seewilai U², Siri-arayaporn P¹

¹ Bureau of Epidemiology, Ministry of Public Health, Thailand

² Department of Agriculture, Ministry of Agriculture and Cooperatives, Thailand

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 old¹.

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 infection².

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.

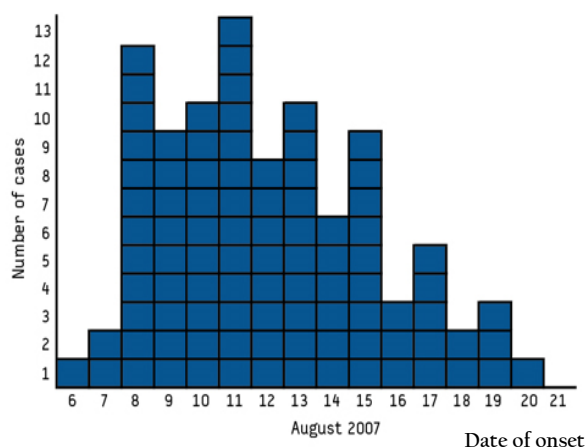


Figure 1. Epidemic curve of cases of *Shigella sonnei* infection in Denmark by onset of symptoms, 6-20 Aug 2007

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.

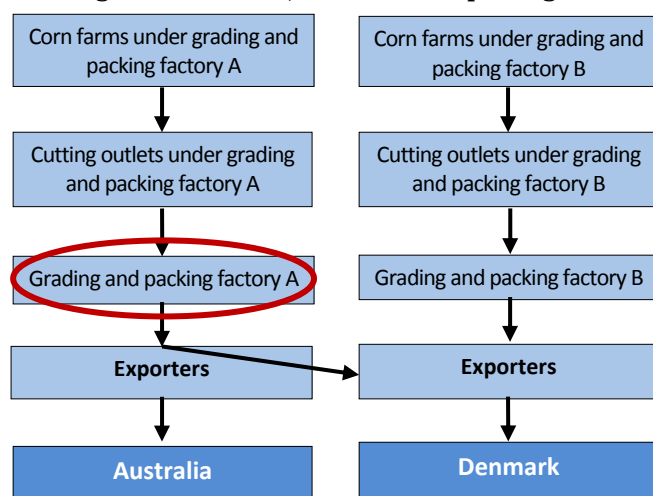


Figure 2. Manufacturing and exporting process of raw baby corn shipped to Denmark and Australia

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 A¹ (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 examination⁴. 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.

Suggested Citation

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