Outbreak report

CLUSTER OF *SALMONELLA* ENTERITIDIS IN SWEDEN 2005-2006 – SUSPECTED SOURCE: ALMONDS

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Previous outbreaks of *Salmonella* Enteritidis in Canada and the United States have been associated with the consumption of almonds. From December 2005 to August 2006 a cluster of 15 cases of *Salmonella* Enteritidis NST 3+ was reported in Sweden. A case-control study was performed to identify the source of transmission. Three controls per case were randomly selected, matched on sex, age and place of residence. Cases and controls were interviewed by telephone and data were analysed with a conditional logistic model. The results showed that eating almonds was a risk factor for infection with *Salmonella* Enteritidis NST3+ (unmatched odds ratio 45.0, 95% confidence interval: 4.8-421.8). No *Salmonella* was isolated from almonds tested in the study. In conclusion, almonds could be the source of the outbreak and should be considered when investigating outbreaks as well as sporadic cases of *Salmonella* Enteritidis.

Introduction

From December 2005 to August 2006, a total of 15 non-travel-related cases of *Salmonella* Enteritidis NST 3+ were reported in Sweden (NST means that in Sweden this pattern has no specific name, 3+ means that the isolate reacts with three different phages). This phage type is unusual, with a total of four sporadic cases previously reported in Sweden, including the first two cases that were identified in western Sweden in January 2003 (SMI statistics - unpublished).

Following an alert to Enter-net on 22 February 2006, information was obtained indicating that no similar increase of *Salmonella* Enteritidis NST 3+ was reported within the network under the same time period. However, in Canada a large outbreak of *Salmonella*

Enteritidis had previously been reported with the same phage type pattern (called *Salmonella* Enteritidis phage type 30) in the winter 2000-2001 [1]. In the Canadian outbreak, 168 cases were reported, including 11 cases in United States citizens, and the outbreak was related to almonds originating from California with a calculated odds ratio (OR) of 21.1 (95% CI: 3.6-∞). It was the first time almonds were identified as the source of a food-borne outbreak. Another *Salmonella* Enteritidis outbreak associated with almonds occurred in 2003-2004 in Canada and the United States with 29 confirmed cases [2]. The Swedish isolates from the recent cluster, however, had a different PFGE pattern than the ones in previous outbreaks reported in Canada and United States.

Methods

To investigate the cluster seen in Sweden, the patients were interviewed with a general (trawling) questionnaire regarding exposure to a variety of food items two weeks prior to the date of onset of illness. The first six patients were interviewed in March when the cluster was detected, whereas the other cases were questioned as soon as they were reported. On the basis of the initial results a few exposures to particular food items were suspected as the possible source of infection and an abbreviated version of the questionnaire was made. A case-control study with three controls per case was conducted for 12 of the cases in cooperation with the County Medical Offices. The first controls were interviewed in March when the study began and the rest were interviewed when cases were reported. Controls were randomly selected from the population register matched on sex, age and place of residence, and questioned about the food items eaten during two weeks prior to the interview.

FIGURE

Date of onset illness. Cluster of *Salmonella* Enteritidis NST3+, 15 December 2005 - 10 August 2006, Sweden (n=15)

TABLE

Intake of food items among cases and controls (analysis of 12 cases). Cluster of *Salmonella* Enteritidis NST3+, 15 December 2005 - 10 August 2006, Sweden

	Cases who ate the food item n=12 (%)		Controls who ate the food item n=34 (%)		Matched odds ratio (95% confidence interval)		P value
Eggs							
Soft-cooked eggs	2	(18)	14	(41)	0.4	(0.1-2.1)	0.26
Scrambled eggs/omelette	5	(45)	6	(18)	5.4	(1.0-29.0)	0.05
Raw eggs	2	(17)	4	(12)	1.7	(0.2-14.0)	0.64
Hard cheese	11	(92)	32	(94)	0.8	(0.1-8.6)	0.83
Pork/pork steak/pork sausage	6	(55)	29	(85)	0.3	(0.1-1.7)	0.18
Cooking sausage/cocktail sausage/ Frankfurter	8	(73)	24	(71)	1.6	(0.3-9.1)	0.59
Nuts/seeds							
Almonds	10	(83)	6	(18)	45.0*	(4.8-421.8)*	<0.01*
Hazelnuts	3	(25)	7	(21)	1.3	(0.2-7.6)	0.76
Walnuts	1	(9)	3	(9)	1.0	(0.1-9.6)	1.00
Pistachio nuts	0	(0)	3	(9)	-		-
Pine nuts	0	(0)	3	(9)	-		-
Sesame seeds	1	(11)	5	(16)	0.5	(0.1-5.0)	0.55

*Unmatched analysis

The final data analysis was performed in October 2006. Items in the abbreviated questionnaire were individually analysed with a conditional logistic model to take into consideration the matching. For items where we could not find any case with a discordant control (i.e. an exposed case with at least one unexposed control, or an unexposed case with at least one exposed control), unmatched odds ratio were calculated instead. Unmatched odds ratio in a matched design will be biased towards the null hypothesis of OR=1. Proc Logistic in SAS v.9.1 was used for calculating all odds ratios.

Salmonella identified in the stool samples provided by case-patients were serotyped and phagetyped at the reference laboratory at SMI. Cultures from almond samples and isolates from the cases were tested by serological assays according to the Kauffmann-White scheme and phage typing according to the HPA Colindale method.

Results

The 15 patients came from seven different regions in the south and centre of Sweden and were aged between 11 and 87 years, with an average age of 46 years. Eleven were women. The patients fell ill between 15 December 2005 and 10 August 2006 (Figure). The results of the case-control study are shown in the Table.

Ten patients reported having consumed ready-to-eat untreated almonds and one could not recall eating them or not, whereas among the controls only six had eaten almonds. One patient who had only eaten cooked almonds was considered as unexposed. The

controls matched to this case, however, had not eaten almonds either, so we could not find any pairs consisting of an unexposed case and at least one exposed control. For this reason unmatched odds ratio was instead calculated; the estimated odds ratio was 45.0 (P value < 0.01). The almonds consumed by the patients were of various brands. Of the other food items, only scrambled eggs were consumed more frequently by patients than by controls. However, this exposure would only explain 45% of the cases and is more likely to be a chance finding (P value = 0.05).

Thirty-two samples of almonds were tested for *Salmonella*, including samples taken from opened packages from two patients' households, as well as samples taken from unopened packages collected from different supermarkets. No *Salmonella* was isolated from these samples. The *Salmonella* isolates obtained from the cases were sent to the Laboratory of Enteric Pathogens at the Health Protection Agency in Colindale, United Kingdom, where it was found that the phage type was the same as the phage type from the outbreak of 2000-2001 in Canada and the United States.

Discussion

This case-control study showed a high OR for almonds, which suggests that almonds were a risk factor for infection with *Salmonella* Enteritidis NST 3+. Even though the patients consumed different brands of almonds, it has been indicated that the majority of almonds sold in Sweden originate from California, the region where nearly 80% of the world production of almonds come from and where outbreaks of *Salmonella* Enteritidis with the same phage type have previously occurred [2]. In the outbreak described in

this paper, no *Salmonella* was isolated from the almonds, however, only a few samples could be collected directly from the patients' households.

The first patients were interviewed several weeks after the onset of disease, which could lead to recall bias. To reduce recall bias for controls, they were asked about exposure to specific food items in the period of two weeks prior to the interview. This could have led to a seasonal variation between the first cases and their controls. However, due to the small number of cases this is not considered to have significantly influenced the results. Almonds as a possible source of transmission of *Salmonella* should be considered when investigating outbreaks as well as sporadic cases. Interventions to control *Salmonella* in almonds are well motivated and accordingly the Agricultural Marketing Service at the US Department of Agriculture is currently proposing a mandatory program to reduce the potential for *Salmonella* bacteria in almonds [3].

We conclude that almonds could be the source of infection for the cluster of *Salmonella* Enteritidis NST 3+ recently reported in Sweden. However, as no *Salmonella* was detected in the tested almonds and the statistical analysis was interpreted with caution because of the small sample size, no control measures were put in

place. No further cases of *Salmonella* Enteritidis NST 3+ have been reported in Sweden after August 2006.

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