Case Study: Evidence of Foodborne Outbreaks Associated with Pizza

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About case studies

The Environmental and Occupational Health team responds to specific requests for scientific and technical advice and support from the health care system, the Government of Ontario, and most commonly from Ontario's local public health units. Based on requests received, we have identified questions, issues and topics that may be of relevance to a broader audience. Therefore, we have created the Case Study series to better share information on the diverse environmental health issues we have encountered, and encourage dialogue in these areas.

This response was originally produced on November 2014. Note that the specifics about the location and requestor involved have been removed.

The following was selected as a case study because pizza is a commonly consumed food in Ontario. This review examined if there is any evidence of foodborne outbreaks associated with pizza.

Background

The Oxford English dictionary defines pizza as a dish of Italian origin, consisting of a flat round base of dough baked with a topping of tomatoes and cheese, typically with added meat, fish and vegetables.[1] Pizza is a readily available food item in Ontario food establishments. Traditionally, in Ontario, pizza toppings were mostly limited to pepperoni and cheese, so pizza was considered low risk based on its potential to cause foodborne illnesses. (1999 letter from Ontario Ministry of Health and Long Term Care to Ontario public health units; unreferenced)

Currently, with the progress of culinary art, pizza dishes are becoming more varied. They include various toppings such as chicken, seafood, egg, ground meat and vegetables. The following write-up has been prepared in response to a request from health units for a rapid literature review (peer reviewed and grey literature) on the evidence of foodborne outbreaks associated with pizza. The following is the result of the review. It should be noted that foodborne illnesses and outbreaks are

greatly under-reported and the results shared in this report do not represent all related outbreaks associated with pizza, but rather the portion that has been identified through this search.

Method

A literature search using two databases (MEDLINE and Ovid Embase) was performed by library services; results were limited to English language, and duplicate records were removed. The search strategy included vocabulary on disease outbreaks or illness, relevant pathogens, temperature and time factors, foodborne diseases and food safety/preservation practices combined with "pizza or pizzeria" as a keyword. The search was not limited specifically to pizza toppings as it included results on outbreaks/illness and pizza as a whole. Similarly, since there was very little literature related specifically to pizza, the search was expanded to include results related to fast/retail food services in addition to pizza. Additional information was found by checking references of obtained articles.

A grey literature search on outbreaks/illness associated with pizza (toppings) was performed. It should be noted that due to a 32-word limit imposed by Google, several combinations of the vocabulary were searched to ensure any relevant results were not missed. Due to the limited amount of literature available on this topic, information on general policies and regulations for food services, jurisdictional food codes, and guidelines related to holding time and holding temperature in retail food establishments was also included.

Foodborne outbreak data from the Centers for Disease Control and Prevention's National Outbreak Reporting System (NORS) and Foodborne Outbreak Online Database, from 2008 to 2012, were reviewed for evidence of outbreaks associated with pizza. In addition, PHO contacted the Public Health Agency of Canada (PHAC) and inquired about any reports of foodborne outbreaks associated with pizza in their database: "Outbreak Summaries (OS)". OS is a secure, web-based application, introduced by the PHAC, for summarizing and sharing results of outbreak investigations. It is hosted on the Canadian Network for Public Health Intelligence (CNPHI) and contains enteric outbreak data for PHAC-led outbreaks and outbreaks from participating jurisdictions. The participating jurisdictions are British Columbia; Manitoba; Nova Scotia; Newfoundland and Labrador; and Prince Edward Island.

The information obtained was evaluated for their relevance and 15 records were included in this report.

Results

Pizza is a common food in urban centres in Ontario. It is a high moisture food with water activity of 0.99 for pizza and 0.94 to 0.95 for pizza crust.[2] Pizza toppings vary depending on the type of pizza and may include a number of different food including vegetables, herbs, nuts, seafood, meats and cheese. Most often the meat ingredients are precooked prior to being added to the pizza in an attempt to decrease the bacterial load.

The New South Wales Food Authority in Australia considers pizza to be a potentially hazardous food.[3] The Canadian Food Inspection Agency (CFIA) Food Retail and Food Services Regulation define a "potentially hazardous food" as a "food in a form or state which is capable of supporting the growth of pathogenic microorganisms or the production of toxins."[4] Pizza, being a potentially hazardous food, can be contaminated by pathogens and support the growth or survival of them. In a baseline study done in the Czech Republic, 879 various food samples were examined for the presence of *staphlyoccocal* enterotoxin genes. Two samples of pre-packed pizza tested positive.[5] In 2010, in Australia, a total of 1,263 retail food samples were examined for *Bacillus cereus*. The pathogen was identified in one of 63 uncooked pizza bases (mean $\log_{10}$ count of 2.2 cfu/g) and 8 of 175 cooked pizzas (mean $\log_{10}$ count of 3.4

cfu/g). The minimum mean $\log_{10}$ count of *B. cereus* estimated to be required to cause an illness is over 5.0 log cfu/g. While the concentration found in this study does not pose a health risk, storing food at temperatures within the danger zone (4°C - 60°C) will allow the growth of *B. cereus* and the production of toxins.[7]

Reported Foodborne Outbreaks Associated with Pizza

This review identified a number of reports of foodborne outbreaks associated with pizza (pizza toppings).[3,6,8–10] A retrospective study of the database for the microbiological analysis of food samples in Brazil (2000–2010) has identified the ready-to-eat food group as the most prevalent food group involved in the outbreak investigation. Of 126 outbreaks, 60 were associated with ready-to-eat foods. Pizza was included in this group.[6] In 2004 in Australia, an outbreak of *Salmonella* Typhimurium 9 was linked to a pizza restaurant. A number of pizza toppings including ham, salami, cooked chicken pieces, and marinara mix tested positive. Cross contamination, inadequate hand washing and cleaning were identified as risk factors for this outbreak.[11] In 2000, Ontario saw an outbreak of Norovirus in a school that resulted in 207 cases. The suspected food item was pizza. Detailed information on ingredients and risk factors were not available.[12] An *E. coli* 0157:H7 outbreak in the U.S. in 2007 was associated with eating frozen pizza that contained contaminated pepperoni.[13] In 2008, a Norovirus outbreak in Kansas, U.S., was associated with a pizza shop.[14] For most of the outbreaks reported, detailed information on specific risk factors such as time temperature abuse or cross contamination, was not readily available. Also, information on the type of pizza (contaminated ingredients) that was associated with the outbreak was not consistently available.

Table 1 summarizes outbreaks reported in U.S. (2008–2012) associated with pizza, while Table 2 provides a summary of reported international foodborne illness outbreaks associated with pizza (2001–2012).

Table 1: United States reported foodborne illness outbreaks associated with pizza (2008-2012)[8]

Year	Pathogen	Location of Consumption	Total Ill	Suspect Food Vehicle	Contaminated Ingredient
2008	Unknown	Private home	6	Pizza	
2008	Norovirus Genogroup I (Suspected)	Restaurant	3	Bun, Unspecified Cheese, Ground Beef Hamburger, Pizza, Potato Chips	
2008	Norovirus (Confirmed)	Restaurant	13	Pizza	
2008	Norovirus Genogroup I (Suspected)	Private home	8	Pizza	

Year	Pathogen	Location of Consumption	Total Ill	Suspect Food Vehicle	Contaminated Ingredient
2008	Unknown	Private home	3	Pizza	
2008	*Staphylococcus* (Suspected)	Restaurant	2	Pizza	
2008	Unknown	Restaurant	5	Oriental Chicken, Salad, Pizza	
2008	Norovirus Genogroup I (Suspected)	Private home	7	Pizza	
2008	Norovirus Genogroup II (Confirmed)	Office setting	13	Pizza	
2008	Norovirus Genogroup II (Confirmed)	Restaurant	15	Pizza	
2009	Unknown	Private home	4	Cheesy Bread Stick, Meat Pizza	
2009	Unknown	Private home	5	Meat & Vegetable Pizza	
2009	Norovirus (Suspected)	Private home	10	Vegetable Pizza	Mushrooms
2009	*Bacillus cereus* (Confirmed)	Private home	4	Pizza	
2009	Unknown	Private home, Picnic	10	Cheese Pizza	
2010	*Bacillus cereus* (Confirmed)		10	Pizza	
2009	Norovirus (Confirmed)	Private home	14	Pizza	
2010	Unknown	Private home	2	Meat Pizza	
2010	Norovirus	Restaurant	26	Guacamole, Vegetable	

Year	Pathogen	Location of Consumption	Total Ill	Suspect Food Vehicle	Contaminated Ingredient
	(Confirmed)			Pizza	
2010	Norovirus Genogroup II (Confirmed)	Restaurant	10	Vegetable Pizza	
2011	Unknown	Daycare centre	14	Pizza	
2011	Norovirus (Suspected)	Workplace	57	Vegetable Pizza	
2011	*E. coli* 0157:H7 (Confirmed)	Restaurant	22	Tostada Pizza, Submarine Sandwich,	Lettuce
2011	Unknown	Private home	4	Meat Pizza	
2012	Unknown	Restaurant	12	Cheese Pizza,	
2012	Norovirus (Suspected)	Workplace	9	Chicken Rustico Pizza & Mediterranean Salad	
2012	Norovirus (confirmed)	Private Home	15	Pizza	
2012	Norovirus Genogroup II (confirmed)	Private home	5	Pizza Unspecified	
2012	Unknown	Restaurant	6	Pizza Unspecified, Salad and Sandwich	Lettuce, Mesclun Mix, Romaine Lettuce & Tomato
2012	Unknown		6	Pizza Unspecified	
2012	Norovirus Genogroup II (confirmed)	Private home, restaurant	103	Antipasto, Ice, Unspecified Pizza & salad	
2012	Unknown	Restaurant	4	Meat and Vegetable Pizza	
2012	Unknown	Private Home	3	Meat and Vegetable Pizza	

Table 2: Reported international foodborne illness outbreaks associated with pizza[9,11,15]

Year	Pathogen	Country	Location of Consumption	Total Ill	Suspect Food Vehicle
2001	*Salmonella* Tyhimurium 126	Australia	Takeout Restaurant	2	Chicken pizza
2002	Unknown	Australia	Takeout Restaurant	4	Pizza
2002	Unknown	Australia	Takeout Restaurant	5	Pizza
2002	*Staphylococcus aureus*	Australia	National franchised fast food	8	Pizza
2003	Unknown	Australia	Private home	18	Pizza
2004	Norovirus	Austria	Restaurant	3	Mushroom Pizza
2004	*Salmonella* Typhimurium	Australia	Restaurant	90	Pizza and Pasta
2004	Unknown	Australia	National franchised fast food	5	BBQ Meat Pizza
2004	*Clostridium perfringens*	Australia	National franchised fast food	6	Meat Pizza
2005	Unknown	Australia	Restaurant	9	Ham Pizza
2005	*B. cereus*	Denmark	Restaurant	16	Pizza
2005	*B. cereus*	Norway	Restaurant	3	Pizza
2005	*Salmonella*	Belgium		3	Pizza
2005	*S.* Enteritidis pt 21	Austria	Restaurant	3	Pizza
2005	*S.* Enteritidis pt 4	Croatia		3	Fish Pizza

Year	Pathogen	Country	Location of Consumption	Total Ill	Suspect Food Vehicle
2005	*S.* Enteritidis pt 4	Austria	Home	3	Salami Pizza
2005	*S. aureus*	Norway	Restaurant	5	Pizza
2006	Unknown	Australia	Restaurant	2	Chicken Pizza
2006	*S.* Enteritidis pt 4	England	Home	10	Meat pizza
2004	*Salmonella* Typhimurium 9	Australia	Restaurant	90 (41 Confirmed, 49 Probable)	Pizza (Ham, Salami, Chicken & Marinara Mix)
2011	*C. botulinum*	Argentina	Restaurant	2	Pizza Containing Home-canned Vegetables
2011	Norovirus	United Kingdom	Restaurant	4	Pizza

Summary

Pizza is a potentially hazardous food.[3] It is capable of supporting the growth of pathogenic microorganisms or those that produce toxins causing illness. The North Carolina Department of Environment and Natural Resources requires, when time is used as a control measure, that pizza slices not be held on display for more than two hours.[16]

This rapid literature review identified evidence of foodborne outbreaks associated with pizza.

Norovirus was the most frequently reported pathogen related to foodborne outbreaks associated with consumption of pizza in United States from 2008 to 2012. *Bacillus cereus, E. coli* 0157:H7 and *Staphylococcus* were also reported during this time. Internationally (2001–2012), *Salmonella*, *Staphylococcus aureus*, Norovirus and *Bacillus cereus* were the most frequently reported pathogens associated with pizza identified by this review.

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