UF IFAS Extension UNIVERSITY of FLORIDA

FSHN14-11

Outbreaks of Foodborne Illness Associated with Melons[1]

Michelle D. Danyluk, Rachel McEgan, Ashley N. Turner, and Keith R. Schneider[2]

In recent years, foodborne illness outbreaks have become more prevalently associated with produce (Sivapalasingam et al. 2004). Melons, specifically—cantaloupe, honeydew, and watermelon—are popular commodities consumed around the world. Melons can be eaten alone; however, they are often combined into fruit and vegetable salads. Despite the manner in which they are prepared, melons are commonly consumed raw without a processing step which would eliminate pathogenic bacteria (FAO 2011).

Melons may be contaminated with foodborne pathogens during harvest, packing, shipping, or preparation for consumption. During production, melons may be in direct contact with the soil, a potential source of contamination, even if plastic mulch is used (Richards and Beuchat 2005). The characteristics of the melon rind can influence susceptibility to contamination and removal of surface contamination; netted surfaces (cantaloupes) create a favorable environment for bacteria to grow and make it difficult to remove pathogens (Ukuku and Fett 2002). Mechanical damage resulting in wounds (e.g., punctures, cracks, and bruising) may allow pathogen entry into the melon mesocarp tissue (edible flesh of the fruit) (Fleming, Pool, and Gorny 2005; Richards and Beuchat 2005). Pathogen infiltration and adherence at the stem scar tissue (the end of the melon where the vine was removed), especially in cantaloupe, also can be problematic for food safety (Richards and Beuchat 2004). Maturity of the melon also can play a role in susceptibility because ripe melons may allow for better growth and survival of pathogens on their surfaces (Suslow 1997). Contamination on the surface of a melon may then be able to spread to the inside of the fruit once the melon is cut (Gagliardi et al. 2003).

This document serves as a reference for those concerned about the safety of melons, including cantaloupe, honeydew, and watermelon in the fresh and fresh-cut market. Outbreaks associated with melons in the United States, Canada, and Europe are highlighted with information regarding the location, pathogen, and incidence of illness. Four tables are presented, representing different melon types (Table 1, cantaloupe; Table 2, honeydew; and Table 3, watermelon), and unspecified melon and mixed fruits including melon (Table 4).

References

Blostein, J. 1991. "An outbreak of *Salmonella* javiana associated with consumption of watermelon." *J. Environ. Health* 56:2931.

Centers for Disease Control and Prevention (CDC). 1979. "*Salmonella oranienburg* gastroenteritis associated with consumption of precut watermelons: Illinois." *Morb. Mortal. Wkly. Rep.* 28:522–523.

1. This document is FSHN14-11, one of a series of the Food Science and Human Nutrition Department, UF/IFAS Extension. Original publication date November 2014. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Michelle D. Danyluk, associate professor; Rachel McEgan, research assistant; and Ashley N. Turner, graduate student; Department of Food Science and Human Nutrition; Citrus Research and Education Center, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences (IFAS), University of Florida, Lake Alfred, FL 33850; and Keith R. Schneider, professor, Department of Food Science and Human Nutrition, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences (IFAS), University of Florida, Gainesville, FL 32611-0290.

Centers for Disease Control and Prevention (CDC). 1991. "Epidemiological notes and reports multistate outbreak of *Salmonella poona* infections—United States and Canada, 1991." *Morb. Mortal. Wkly. Rep.* 40:549–552.

Centers for Disease Control and Prevention (CDC). 2002. "Multistate outbreaks of *Salmonella* serotype Poona infections associated with eating cantaloupe from Mexico—United States and Canada, 2000–2002." *Morb. Mortal. Wkly. Rep.* 51:1044–1047.

Centers for Disease Control and Prevention (CDC). 2007. "*Salmonella* Oranienburg infections associated with fruit salad served in health-care facilities—Northeastern United States and Canada, 2006." *Morb. Mortal. Wkly. Rep.* 56:1025–1028.

Centers for Disease Control and Prevention (CDC). 2008a. "Multistate outbreak of *Salmonella* Litchfield infections linked to cantaloupe (final update)." http://www.cdc.gov/Salmonella/litchfield/.

Centers for Disease Control and Prevention (CDC). 2008b. "*Salmonella* Litchfield outbreak associated with a hotel restaurant—Atlantic City, New Jersey, 2007." *Morb. Mortal. Wkly. Rep.* 57:775–779.

Centers for Disease Control and Prevention (CDC). 2011. "Multistate outbreak of *Salmonella* Panama infections linked to cantaloupe." http://www.cdc.gov/salmonella/panama0311/062311/index.html.

Centers for Disease Control and Prevention (CDC). 2012. "Multistate outbreak of *Salmonella* Typhimurium and *Salmonella* Newport infections linked to cantaloupe (Final Update)." http://www.cdc.gov/salmonella/typhimurium-cantaloupe-08-12/.

Centers for Disease Control and Prevention (CDC). n.d. Foodborne Outbreak Online Database. http://wwwn.cdc.gov/foodborneoutbreaks/.

Deeks, S., A. Ellis, B. Ciebin, R. Khakhria, M. Naus, and J. Hockin. 1998. "*Salmonella* Oranienburg, Ontario." *Can. Comm. Dis. Rep.* 24:177–179.

Del Rosario B. A. and L. R. Beuchat. 1995. "Survival and growth of enterohaemorrhagic *Escherichia coli* O157:H7 in cantaloupe and watermelon." *J. Food Prot.* 58:105–107.

Donovan, K. 2007. "Nothing says summer like baseball, watermelon, barbecue, and Campylobacter." *Virginia Epidemiology Bulletin* 107(3):6. http://www.vdh.virginia.gov/Epidemiology/diseaseprevention/documents/pdf/VEBmarch07%204_30_07c.pdf.

Fleming, P., W. Pool, and J. Gorny, eds. 2005. *Commodity Specific Food Safety Guidelines for the Melon Supply Chain*, 1st edition. Produce Marketing Association and United Fresh Produce Association. http://www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/FruitsVegetablesJuices/GuidanceComplianceRegulatoryInformation/UCM168625.pdf.

Food and Agriculture Organization of the United Nations (FAO). 2011. "Microbial hazards and melons: Codex Committee on Food Hygiene Working Group on the development of an annex on methods for the Code of Hygienic Practice for fresh fruits and vegetables (CAC/RCP 53-2003)." ftp://ftp.fao.org/ag/agn/jemra/Microbiological_hazards_and_melons_Nov08.pdf.

Gagliardi, J. V., P. D. Millner, G. Lester, and D. Ingram. 2003. "On-Farm and Postharvest Processing Sources of Bacterial Contamination to Melon Rinds." *J. Food Prot.* 66:82–87.

Gayler, G. E., R. A. MacCready, J. P. Reardon, and B. E. McKernan. 1955. "An outbreak of salmonellosis traced to watermelon." *Public Health Rep.* 70:311–313.

McCollum, J. T., A. B. Cronquist, B. J. Silk, K. A. Jackson, K. A. O'Connor, S. Cosgrove, J. P. Gossack, S. S. Parachini, N. S. Jain, P. Ettestad, M. Ibraheem, V. Cantu, M. Joshi, T. DuVernoy, N. W. Fogg, J. R. Gorny, K. M. Mogen, C. Spires, P. Teitell, L. A. Joseph, C. L. Tarr, M. Imanishi, K. P. Neil, R. V. Tauxe, and B. E. Mahon. 2013. "Multistate outbreak of listeriosis associated with cantaloupe." *N Engl J Med.* 369:944–953.

Mohle-Boetani, J. C., R. Reporter, S. B. Werner, S. Abbott, J. Farrar, S. H. Waterman, and D. J. Vugia. 1999. "An outbreak of *Salmonella* serogroup Saphra due to cantaloupes from Mexico." *J. Inf. Dis.* 180:1361–1364.

Nielsen, C. F., A. Langer, J. Pringle, R. Heffernan, R. Klos, T. Monson, M. Rauch, J. Ball, M. Hoekstra, J. Archer, M. Sotir, and J. Davis. 2010. "First documented multistate outbreak of *Salmonella* Carrau infections—United States, 2009." Abstract. 59th Annual Epidemic Intelligence Service. 19–23 April, 2010. http://www.cdc.gov/eis/downloads/2010.EIS.Conference.pdf.

Public Health Agency of Canada (PHAC). 2009. "Update: *Salmonella* Carrau outbreak." http://www.phac-aspc.gc.ca/new-nouv-eng.php?year=2009&month=may.

Richards, G. M. and L. R. Beuchat. 2004. "Attachment of *Salmonella* Poona to cantaloupe rind and stem scar tissues as affected by temperature of fruit and inoculum." *J. Food Prot.* 67:1359–1364.

———. 2005. "Metabiotic associations of molds and *Salmonella* Poona on intact and wounded cantaloupe rind." *Int. J. of Food Microbiol.* 97:327–339.

Ries, A. A., S. Zaza, and C. Langkop. 1990. "A multistate outbreak of *Salmonella* chester linked to imported cantaloupe (Abstract)." In *American Society for Microbiology Program and Abstracts of the 30 Interscience Conference on Antimicrobial Agents and Chemotheraphy*, 238. Washington, DC: American Society for Microbiology.

Sivapalasingam, S., C. R. Friedman, L. Cohen, and R. V. Tauxe. 2004. "Fresh produce: a growing cause of outbreaks of foodborne illness in the United States, 1973 through 1997." *J Food Prot.* 67:2342–2353.

Suslow, T. V. 1997. "Postharvest chlorination basic properties and key points for effective disinfection 1997." Publication 8003. University of California, Davis Division of Agriculture and Natural Resources. http://ucanr.edu/datastoreFiles/234-404.pdf.

Ukuku, D. O. and W. F. Fett. 2002. "Effectiveness of chlorine and nisin-EDTA treatments of whole melons and fresh-cut pieces for reducing native microflora and extending shelf-life." *J. Food Safety* 22:231–253.

US Food and Drug Administration (FDA). 2009. "Chapter IV: Outbreaks Tables, Analysis and Evaluation of Preventive Control and Reduction/Elimination of Microbial Hazards of Fresh and Fresh-Cut Produce." http://www.fda.gov/Food/FoodScienceResearch/SafePracticesforFoodProcesses/ucm091270.htm

Table 1. Outbreaks of foodborne disease associated with cantaloupe, 1990–2012.

Year	Month	Location	Pathogen[a]	Location of Consumption	Cases (Deaths)	Food Vehicle	References[b]
1990	January	US (multistate)	*Salmonella* Chester	Restaurant salad bars	245(2)	Cantaloupe*	Ries, Zaza, and Langkop 1990
1991	June	US (IL, MI), and Canada	*Salmonella* Poona	Grocery stores, restaurants	400(0)	Cantaloupe*	CDC 1991
1997	Feb–May	US (CA)	*Salmonella* Saphra	Private home, grocery store, restaurant	24(0)	Cantaloupe	Moehle-Boetani et al. 1999
1997	NR[c]	US (OR)	*E. coli* O157:H7	Restaurant	9(0)	Cantaloupe*	FDA 2009
1998	May–June	Canada (ON)	*Salmonella* Oranienburg	Supermarket	22(0)	Cantaloupe*	Deeks et al. 1998
2000	April–June	US (multistate)	*Salmonella* Poona	Nursing home, home care, private home, restaurant, school	47(0)	Cantaloupe*	CDC 2002
2000	June	US (MN)	Norovirus	Workplace	33(0)	Cantaloupe, sandwich (turkey) *	CDC n.d.
2001	December	US (OR)	*Salmonella* spp.	Nursing home, home care, restaurant	2(0)	Cantaloupe*	CDC n.d.
2001	Apri-–May	US (multistate)	*Salmonella* Poona	Private home	50(2)	Cantaloupe*	CDC 2002
2001	March	US (MN)	Norovirus	Workplace	42(0)	Cantaloupe, pineapple*	CDC n.d.
2001	June	US (WA)	NR	Restaurant	4(0)	Cantaloupe, pineapple*	CDC n.d.
2002	March–May	US (multistate), Canada	*Salmonella* Poona	Nursing home, home care, private home	58(0)	Cantaloupe*	CDC 2002
2004	NR	US (NR)	*E. coli* O157:H7	NR	6(0)	Cantaloupe*	FAO 2011
2005	May	US (UT)	*Salmonella* spp.	Private home	126(0)	Cantaloupe, chicken, corned beef*	CDC n.d.
2007	December	US (CA)	*Salmonella* Litchfield	Private home	11(0)	Cantaloupe*	CDC n.d.
2008	August	US (CO)	*Salmonella* Newport	Private home	5(0)	Cantaloupe, hamburger meat*	CDC n.d.
2008	November	US (multistate)	*Salmonella* Javiana	NR	10(0)	Cantaloupe	CDC n.d.
2008	January–March	US (multistate), Canada	*Salmonella* Litchfield	Hospital, private home	51(0)	Cantaloupe*	CDC 2008a
2008	December	US (CA)	Norovirus	Restaurant	23(0)	Cantaloupe*	CDC n.d.
2011	February	US (multistate)	*Salmonella* Panama	Private home	20(0)	Cantaloupe*	CDC 2011
2011	August–October	US (multistate)	*L. monocytogenes*	Grocery retailer	147(33)	Cantaloupe	McCollum et al. 2013
2012	July–September	US (multistate)	*Salmonella* Typhimurium and *Salmonella* Newport	NR; all sourced from same farm	261(3)	Cantaloupe	CDC 2012

[a] Pathogens abbreviated and associated with outbreaks include *E.* (*Escherichia*), *L.* (*Listeria*)
[b] For outbreaks sourced from CDC (n.d.), no other reference is available.
[c] NR: Not Reported
*Denotes a suspected, not confirmed, food vehicle (suspected defined as being epidemiologically linked, but no isolate from the actual food source)

Table 2. Outbreaks of foodborne disease associated with honeydew, 1990–2010.

Year	Month	Location	Pathogen	Location of Consumption	Cases (Deaths)	Food Vehicle	References[a]
1998	August	US (IA)	Norovirus	Restaurant	41(0)	Honeydew, strawberries*	CDC n.d.
2001	January	US (CO)	Norovirus	Restaurant	100(1)	Honeydew, pineapple*	CDC n.d.
2002	April	US (DC)	*Staphylcoccus aureus*	NR	8(0)	Honeydew, cheese (pasteurized), potato (fried) *	CDC n.d.
2003	January	US (multistate)	*Salmonella* Newport	Grocery store, hospital, nursing home, restaurant	68(2)	Honeydew	CDC n.d.
2003	September	US (CO)	*Shigella sonnei*	Hotel restaurant	39(0)	Honeydew*	CDC n.d.
2007	NR[b]	US	*Salmonella* Litchfield	Private home, restaurant	11(0)	Honeydew*	FAO 2011

[a] For outbreaks sourced from CDC (n.d.), no other reference is available.
[b] NR: Not Reported
*Denotes a suspected, not confirmed, food vehicle (suspected defined as being epidemiologically linked, but no isolate from the actual food source)

Table 3. Outbreaks of foodborne disease associated with watermelon, 1950–2010.

Year	Month	Location	Pathogen[a]	Location of Consumption	Cases (Deaths)	Food Vehicle	References[b]
1950	NR[c]	US (MN)	*Salmonella* Bareilly	Roadside stand	6(0)	Watermelon, cut	Gayler et al. 1955
1954	June	US (MA)	*Salmonella* Miami	Supermarket	17(1)	Watermelon, cut	Gayler et al. 1955
1979	NR	US (IL)	*Salmonella* Oranienburg	Supermarket	6(0)	Watermelon	CDC 1979
1987	NR	Sweden	*Shigella sonnei*	Dinner party	15(0)	Watermelon	FAO 2011
1991	June	US (MI)	*Salmonella* Javiana	Indoor picnic/school party; Grocery retailer	39(0)	Watermelon	Blostein 1991
1993	NR	US	*Salmonella* Javiana	Private home, church	27(0)	Watermelon	Del Rosario and Beuchat 1995
2000	July	US (WI)	*E. coli* O157:H7	Restaurant	536(1)	Watermelon*	CDC n.d.
2002	June	US (DC)	NR	NR	11(0)	Watermelon, strawberries*	CDC n.d.
2005	July	US (ID)	Norovirus	Camp	18(0)	Watermelon*	CDC n.d.
2006	July	US (CA)	Norovirus	Other	14(0)	Watermelon*	CDC n.d.
2006	July	US (VA)	*Camplyobacter jejuni*	Picnic	15(0)	Watermelon*	Donovan 2007
2006	August	US (NY)	*Salmonella* Newport	Restaurant	20(0)	Watermelon*	CDC n.d.
2008	October	US (CA)	*Salmonella* Javiana	Multi-site daycare center program	594(0)	Watermelon	CDC n.d.
2010	July	US (MI)	*Salmonella*	Private home	17(0)	Watermelon*	CDC n.d.

[a] Pathogens abbreviated and associated with outbreaks include *E.* (*Escherichia*)
[b] For outbreaks sourced from CDC (n.d.), no other reference is available.
[c] NR: Not Reported
*Denotes a suspected, not confirmed, food vehicle (suspected defined as being epidemiologically linked, but no isolate from the actual food source)

Table 4. Foodborne Illness Outbreaks Associated with Unspecified Melons and Mixed Fruit (including melon).

Year	Month	Location	Pathogen	Location of Consumption	Cases (Deaths)	Food Vehicle	References[a]
1987	NR[b]	UK	Norovirus	NR	206(0)	Melon (unspecified)*	FDA 2009
1993	NR	US	*Campylobacter jejuni*	Food service	48(0)	Melon (unspecified), strawberries*	FAO 2011
1999	May	US (WI)	Norovirus	Restaurant	23(0)	Melon (unspecified), pineapple, watermelon*	CDC n.d.
1999	July	US (CA)	*Salmonella* Enteritidis	School	82(0)	Honeydew, watermelon	FAO 2011
1999	June	US (IA)	Norovirus	Restaurant	61(0)	Cantaloupe, honeydew, watermelon*	CDC n.d.
2000	May	US (IL)	*Bacillus cereus*, *Staphylococcus aureus*	Church, temple	55(0)	Melon (unspecified)*	CDC n.d.
2000	June	US (CO)	*Salmonella* Heidelberg	Restaurant	4(0)	Melon (unspecified)*	CDC n.d.
2001	March	US (FL)	NR	NR	33(0)	Melon (unspecified)*	CDC n.d.
2001	January	US (KS)	Norovirus	Restaurant	36(0)	Cantaloupe, honeydew, pineapple*	CDC n.d.
2001	June	US (CA)	*Salmonella* Poona	Daycare, picnic, private home, restaurant	23(0)	Cantaloupe, honeydew, watermelon*	CDC n.d.
2002	January	US (MN)	Norovirus	Restaurant	15(0)	Cantaloupe, pineapple*	CDC n.d.
2002	September	US (WA)	*Salmonella* Berta	Church	29(0)	Cantaloupe, grapes, watermelon*	CDC n.d.
2003	May	US (multistate)	*Salmonella* Muenchen	Daycare, private home	58(0)	Cantaloupe, honeydew*	CDC n.d.
2003	August	US (FL)	Norovirus	Nursing home	16(0)	Cantaloupe, banana, pineapple*	CDC n.d.
2004	April	US (CO)	Norovirus	Nursing home, home care	62(0)	Melon (unspecified), house salad, strawberries*	CDC n.d.
2004	June	US (WI)	Norovirus	Church	34(2)	Cantaloupe, honeydew, watermelon*	CDC n.d.
2004	November	US (CA)	Norovirus	NR	30(0)	Cantaloupe, honeydew, watermelon*	CDC n.d.
2004	March	US (KS)	Norovirus	Banquet facility	100(0)	Cantaloupe, honeydew, watermelon*	CDC n.d.
2006	June–July	US (multistate), Canada (ON)	*Salmonella* Oranienburg	Grocery store, health care facility, nursing home	41(0)	Cantaloupe, honeydew, fruit salad*	CDC 2007
2007	February	US (MI)	NR	Banquet facility	8(0)	Cantaloupe, watermelon*	CDC n.d.
2007	May–June	US (NJ)	*Salmonella* Litchfield	Hotel restaurant	30(0)	Fruit salad, honeydew*	CDC 2008b
2008	August	US (CO)	*Salmonella* Newport	Private home	3(0)	Cantaloupe, watermelon*	CDC n.d.
2009	February	US (multistate)	*Salmonella* Carrau	Private home	53(1)	Cantaloupe, honeydew, watermelon*	PHAC 2009; Nielsen et al. 2010

[a] For outbreaks sourced from CDC (n.d.), no other reference is available.
[b] NR: Not Reported
*Denotes a suspected, not confirmed, food vehicle (suspected defined as being epidemiologically linked, but no isolate from the actual food source)