

## E. Coli

### **Efficacy of Slightly Acidic Electrolyzed Water in Killing or Reducing *Escherichia coli* O157:H7 on Iceberg Lettuce and Tomatoes under Simulated Food Service Operation Conditions**

P. Pangloli, Y-C. Hung

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**Significance:** Application of slightly acidic electrolyzed water to wash and chill lettuce and tomatoes could minimize cross-contamination and reduce the risk of *E. coli* O157:H7 present on the produce.

This study evaluated the efficacy of slightly acidic electrolyzed (SAEO) water in killing or removing *Escherichia coli* O157:H7 on iceberg lettuce and tomatoes by washing and chilling treatment simulating protocols used in food service kitchens. Whole lettuce leaves and tomatoes were spot-inoculated with 100  $\mu$ L of a mixture of 5 strains of *E. coli* O157:H7. Washing lettuce with SAEO water for 15 s reduced the pathogen by 1.4-1.6 log CFU/leaf, but the treatments did not completely inactivate the pathogen in the wash solution. Increasing the washing time to 30 s increased the reductions to 1.7-2.3 log CFU/leaf. Sequential washing in SAEO water for 15 s then chilling in SAEO water for 15 min also increased the reductions to 2.0-2.4 log CFU/leaf, and no cell survived in chilling solution after treatment. Washing tomatoes with SAEO water for 8 s reduced *E. coli* O157:H7 by 5.4-6.3 log CFU/tomato. The reductions were increased to 6.6-7.6 log CFU/tomato by increasing the washing time to 15 s.

### **The Effect of Calcinated Calcium and Chlorine Treatments on *Escherichia coli* O157:H7 87–23 Population Reduction in Radish Sprouts**

L. Fransisca, B. Zhou, H. Park, H. Feng

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**Significance:** The seed sanitation treatment with 20000 ppm chlorine solution was found to be ineffective in eliminating inoculated pathogenic cells.

The effect of calcinated calcium (CC) spray on *Escherichia coli* O157:H7 87–23 population reduction during radish sprout production was studied. Artificially inoculated radish seeds were soaked in sodium hypochlorite (NaOCl) solutions (200 and 20000 ppm), rinsed in distilled water, and sprayed with water or a CC solution during sprouting. Results showed that the active compound in the CC was calcium oxide. The treatment of 200 ppm NaOCl soaking followed by 0.04% CC spray resulted in no microbial growth after a 72-h sprouting, while maintaining a high germination rate. The 0.4% CC spray significantly reduced the germination rate. Soaking the seeds in a 20000 ppm

chlorine solution achieved the highest *E. coli* count reduction (1.65 log CFU/g). However, the *E. coli* cells that survived the 20000 ppm chlorine soak grew to 6 log CFU/g sprouts after a 72-h sprouting. The SEM microimages showed that the bacteria were mostly located in the roots of the radish sprouts and all across the seed surface. The *E. coli* O157:H7 87–23 cells appeared to be located in biofilms or embedded into the radish sprout tissues during sprouting.

### **Surface Roughness of Stainless Steel Influences Attachment and Detachment of *Escherichia coli* O157**

R.M. Goulter-Thorsen, E. Taran, I.R. Gentle, K.S. Gobius, G.A. Dykes

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Link to full text: <http://www.ingentaconnect.com/content/iafp/jfp/2011/00000074/00000008/art00021>

**Significance:** Bacterial interactions with common food grade stainless steel are complex and less easily predicted than those with stainless steel of other finishes, including unpolished surface and polished smooth surface.

This study evaluated the interactions of six *Escherichia coli* strains (four O157:H7, one O157:H12, and one O1:H7) with stainless steel (SS) type 304 finishes of various surface roughness: 2B (unpolished surface), 4 (common food grade SS), and 8 (polished smooth surface). In attachment assays (exposure to cell suspensions with periodic swirling), bacteria were enumerated by epifluorescence microscopy, and in detachment assays a blotting technique and atomic force microscopy (AFM) were used. Attachment data suggest that *E. coli* attach in greater numbers to significantly smoother SS8; however, detachment assays and AFM data suggest cells are more easily removed from this finish. Attachment to SS2B was lower, and AFM data suggest that *E. coli* O157 may adhere more strongly to this finish. Attachment and detachment data for SS4 was variable. SS4 is the most common material used in food processing facilities.

## **Salmonella**

### **Effect of Irradiation on *Salmonella* Survival and Quality of 2 Varieties of Whole Green Onions**

L. Murugesan, D. Williams-Hill, A. Prakash

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**Significance:** Irradiation can be used to enhance safety without adverse effects on quality.

Two varieties of green onions, Banner and Baja Verde, were inoculated with a cocktail of 3 *Salmonella* strains and irradiated at 0, 0.3, 0.6, 0.9, and 1.2 kGy. *Salmonella* survivors were enumerated. The *D* values were in the range of 0.26-0.32 kGy depending on variety. For the quality study, both varieties of green onions were irradiated at 0, 1.5, 2.0, and 2.5 kGy and evaluated for changes in microbial counts, color, texture, and visual quality during storage at 4 °C. Irradiation reduced total plate counts and psychrotrophs by 3 logs. No significant difference was observed in color and texture between irradiated samples and control. The control maintained good visual quality for about 13 d

as compared to 15 d for 1.5 and 2.5 kGy samples. The 2.0 kGy samples maintained good visual quality for 17 d suggesting that irradiation can increase shelf life by reducing spoilage microorganisms but higher doses can be detrimental to quality. At the dose levels required to achieve a 5-log reduction in *Salmonella*, the shelf life of whole green onion can be extended.

### ***Salmonella* Typhimurium Infections Associated with Peanut Products**

E. Cavallaro, K. Date, C. Medus, S. Meyer, B. Miller, C. Kim, et al. for the *Salmonella* Typhimurium Outbreak Investigation Team

*New England Journal of Medicine*, Vol. 365, No. 7; pp. 601-610, 2011

Link to full text: <http://www.nejm.org/doi/full/10.1056/NEJMoa1011208>

**Significance:** Contaminated peanut butter and peanut products caused a nationwide salmonellosis outbreak.

Beginning in 11/2008, a nationwide outbreak of salmonella infections was investigated. A case was defined as laboratory-confirmed infection with the outbreak strain of *Salmonella* Typhimurium occurring between 9/1/2008 and 4/20/2009. Two case-control studies, product “trace-back,” and environmental investigations were conducted. Among 714 case patients identified in 46 states, 166 (23%) were hospitalized and 9 (1%) died. In study 1, illness was associated with eating any peanut butter (OR=2.5; 95% CI, 1.3-5.3), peanut butter-containing products (OR=2.2; 1.1-4.7), and frozen chicken products (OR=4.6; 1.7-14.7). Investigations of focal clusters and single cases associated with nine institutions identified a single institutional brand of peanut butter (brand X) distributed to all facilities. In study 2, illness was associated with eating peanut butter outside the home (OR=3.9; 1.6-10.0) and two brands of peanut butter crackers (brand A: OR=17.2; 6.9-51.5; brand B: OR=3.6; 1.3-9.8). Both cracker brands were made from brand X peanut paste. The outbreak strain was isolated from brand X peanut butter, brand A crackers, and 15 other products. A total of 3918 peanut butter-containing products were recalled between 1/10/2009 and 4/29/2009.

## **Listeria**

### **Quantitative Risk Assessment of Listeriosis Due to Consumption of Raw Milk**

A.A. Latorre, A.K. Pradhan, J.A. Van Kessel, J.S. Karns, K.J. Boor, D.H. Rice, et al.

*Journal of Food Protection*, Vol. 74, No. 8; pp. 1268-1281(14), 2011

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**Significance:** A greater risk of listeriosis was associated with consumption of raw milk obtained from retail and farm stores as compared with milk obtained from bulk tanks.

This study estimated the risk of illness for raw milk consumers due to *Listeria monocytogenes* in raw milk sold by permitted dealers, and the risk for people on farms who consume raw milk. Three scenarios were evaluated for raw milk sold by dealers: raw milk purchased directly from bulk tanks, from on-farm stores, and from retail. The

number of listeriosis cases/year was compared where no raw milk testing was done, only a screening test to issue a permit was conducted, and routine testing was conducted and milk was recalled if it was *L. monocytogenes* positive. The median number of listeriosis cases associated with consumption of raw milk from bulk tanks, farm stores, and retail for an intermediate-age population was  $6.6 \times 10^{-7}$ ,  $3.8 \times 10^{-5}$ , and  $5.1 \times 10^{-5}$  cases/year, respectively. In populations with high susceptibility, the estimated median number of cases/year was  $2.7 \times 10^{-7}$  (perinatal) and  $1.4 \times 10^{-6}$  (elderly) for milk purchased from bulk tanks,  $1.5 \times 10^{-5}$  (perinatal) and  $7.8 \times 10^{-5}$  (elderly) for milk from farm stores, and  $2.1 \times 10^{-5}$  (perinatal) and  $1.0 \times 10^{-4}$  (elderly) for milk from retail. For raw milk consumed on farms, the median number of listeriosis cases was  $1.4 \times 10^{-7}$  cases/year.

## Foodborne Pathogens

### Use of Organic Acids to Inactivate *Escherichia coli* O157:H7, *Salmonella* Typhimurium, and *Listeria monocytogenes* on Organic Fresh Apples and Lettuce

S-H. Park, M-R. Choi, J-W. Park, K-H. Park, M-S. Chung, S. Ryu, et al.

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Link to full text: <http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2011.02205.x/full>

**Significance:** Organic acids have a potential as sanitizers for organic fresh produce.

This study investigated the antimicrobial effect of organic acids against *Escherichia coli* O157:H7, *Salmonella* Typhimurium, and *Listeria monocytogenes* on whole red organic apples and lettuce. Apples and lettuce were inoculated with a cocktail of 3 strains each of 3 foodborne pathogens and treated with 1% and 2% organic acids for 0, 0.5, 1, 5, and 10 min. After 10 min of treatment with 1% and 2% organic acids in apples, propionic (0.92 - 2.75 log reduction), acetic (0.52 - 2.78 log reduction), lactic (1.69 - >3.42 log reduction), malic (1.48 - >3.42 log reduction), and citric acid (1.52 - >3.42 log reduction) exhibited significant antibacterial effects against 3 foodborne pathogens compared to the control treatment. In lettuce, propionic (0.93 - 1.52 log reduction), acetic (1.13 - 1.74 log reduction), lactic (1.87 - 2.54 log reduction), malic (2.32 - 2.98 log reduction), and citric acid (1.85 - 2.86 log reduction) showed significant effects compared to the control treatment.

### Activity of Citrus Essential Oils against *Escherichia coli* O157:H7 and *Salmonella* spp. and Effects on Beef Subprimal Cuts under Refrigeration

C.I. Pittman, S. Pendleton, B. Bisha, C.A. O'Bryan, K.E. Belk, L. Goodridge, et al.

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Link to full text: <http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2011.02253.x/full>

**Significance:** Cold-pressed terpeneless Valencia orange oil (3%) could be used as an additional intervention against *E. coli* O157:H7 and *Salmonella* spp. at the refrigerated storage stage of processing.

This study investigated the use of naturally occurring compounds citrus essential oils (CEOs) extracted from orange peel to reduce or eliminate *Escherichia coli* O157:H7 and *Salmonella* spp. at the chilling stage of processing, or during fabrication. Brisket flats were spot inoculated with approximately 6 log of surrogate generic *E. coli* cocktail (previously shown to be identical in growth and survival parameters to *E. coli* O157:H7 and *Salmonella* spp.). Following drying, CEOs were applied by spraying at concentrations of 3% and 6% to the surface of different pieces of meat. The CEOs significantly reduced the concentration of *E. coli* on the brisket flats in comparison to inoculated no spray or water sprayed controls over a period of 90 d, while causing an initial reduction of approximately 1.4 log units. Total aerobic bacteria and psychrotrophic counts were also reduced on uninoculated briskets following treatment.

## Norovirus

### Differences in the Binding of Human Norovirus to and from Romaine Lettuce and Raspberries by Water and Electrolyzed Waters

P. Tian, D. Yang, R. Mandrell

*Journal of Food Protection*, Vol. 74, No. 8; pp. 1364-1369(6), 2011

Link to full text: <http://www.ingentaconnect.com/content/iafp/jfp/2011/00000074/00000008/art00022>

**Significance:** Use of acidic electrolyzed water shows a significant decrease in the removal of human norovirus from contaminated produce compared with other water rinses.

The effectiveness of removing inoculated human norovirus (hNoV) from the surfaces of raspberries and romaine lettuce by a simple wash in tap water and in different forms of electrolyzed water (EW), including acidic EW (AEW), neutral EW (NEW), and basic EW (BEW) was evaluated. A simple rinsing or soaking in water was able to remove >95% of hNoV from surface-inoculated raspberries. In contrast, only 75% of hNoV was removed from surface-inoculated romaine lettuce by rinsing in tap water. An AEW wash enhanced the binding of hNoV to raspberries and lettuce. Only 7.5% ( $\pm 10\%$ ) and 4% ( $\pm 3.1\%$ ) of hNoV were removed by AEW wash from surface-inoculated raspberries and lettuce, respectively. When raspberries and lettuce were prewashed with NEW or BEW prior to surface inoculation, an AEW wash likewise resulted in significantly less removal of hNoV compared with untreated samples. A prewash with AEW significantly decreased the removal of hNoV from raspberries and lettuce when they were washed with NEW, from 90.6% to 51% and from 76% to 51.3%, respectively.

## Infant formula

### Effect of a Partially Hydrolyzed Whey Infant Formula at Weaning on Risk of Allergic Disease in High-Risk Children: A Randomized Controlled Trial

A.J. Lowe, C.S. Hosking, C.M. Bennett, K.J. Allen, C. Axelrad, J.B. Carlin, et al.

*Journal of Allergy and Clinical Immunology*, Vol. 128, No. 2; pp. 360-365, 2011

Link to full text: [http://www.jacionline.org/article/S0091-6749\(10\)00740-2/fulltext](http://www.jacionline.org/article/S0091-6749(10)00740-2/fulltext)

**Significance:** Despite current dietary guidelines, there is no evidence to support recommending the use of partially hydrolyzed whey formula at weaning for the prevention of allergic disease in high-risk infants.

This single-blind (participant) randomized controlled trial determined whether feeding infants partially hydrolyzed whey formula (pHWF) reduces their risk of allergic disease. Allergic outcomes were compared between infants fed a conventional cow's milk formula, a pHWF, or a soy formula. Before birth, 620 infants with a family history of allergic disease were recruited and randomized to receive the allocated formula at cessation of breast-feeding. Skin prick tests to 6 common allergens (milk, egg, peanut, dust mite, rye grass, and cat dander) were performed at 6, 12, and 24 months. The primary outcome was development of allergic manifestations (eczema and food reactions) measured 18 times in the first 2 years of life. Follow-up was complete for 93% (575/620) at 2 years and 80% (495/620) at 6 or 7 years of age. There was no evidence that infants allocated to the pHWF (OR=1.21; 95% CI, 0.81-1.80) or the soy formula (OR=1.26; 95% CI, 0.84-1.88) were at a lower risk of allergic manifestations in infancy compared with conventional formula.

### **Survival of *Salmonella* Typhi and *Shigella dysenteriae* in Dehydrated Infant Formula**

J.B. Day, D. Sharma, N. Siddique, Y-Y.D. Hao, E.A. Strain, R.J. Blodgett, et al.

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Link to full text: <http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2011.02268.x/full>

**Significance:** *Salmonella enterica* serovar Typhi and *Shigella dysenteriae* can remain viable for prolonged periods of time in powdered infant formula, and the presence of nitrogen enhances survival.

To better predict the risk of *Salmonella enterica* serovar Typhi and *Shigella dysenteriae* infection from consumption of infant formula, this study was undertaken to determine survival of these microorganisms in dry infant formula under varying atmospheric conditions. A 2-strain cocktail of *S. Typhi* and a 3-strain cocktail of *S. dysenteriae* were stored for  $\leq 12$  wk in dehydrated infant formula in an ambient air or nitrogen atmosphere. Viable counts of *S. Typhi* at 12 wk in infant formula revealed a 2.9- and 1.69-log decrease in ambient air and nitrogen atmosphere, respectively. Viable counts of *S. dysenteriae* at 12 wk in infant formula revealed a 0.81- and 0.42-log decrease in ambient air and nitrogen atmosphere, respectively.

## **Polychlorinated Biphenyls**

### **Prenatal Exposure to Polychlorinated Biphenyls and Dioxins is Associated with Increased Risk of Wheeze and Infections in Infants**

S.B. Stølevik, U.C. Nygaard, E. Namork, M. Haugen, H.E. Kvalem, H.M. Meltzer, et al.

*Food and Chemical Toxicology*, Vol. 49, No. 8; pp. 1843-1848, 2011

Link to full text: <http://www.sciencedirect.com/science/article/pii/S0278691511001864>

**Significance:** Prenatal dietary exposure to dioxins and polychlorinated biphenyls may increase the risk of wheeze and infectious diseases during the first year of life.

The birth cohort BraMat ( $n=205$ ; a sub-cohort of the Norwegian Mother and Child Cohort Study (MoBa)) was established to study whether prenatal exposure to toxicants from the maternal diet affects immunological health outcomes in children. We here report on the environmental pollutants polychlorinated biphenyls (PCBs) and dioxins, as well as acrylamide generated in food during heat treatment. The frequency of common infections, eczema or itchiness, and periods of >10 days of dry cough, chest tightness or wheeze (called wheeze) in the children during the first year of life was assessed by questionnaire data ( $n=195$ ). Prenatal exposure to PCBs and dioxins was found to be associated with increased risk of wheeze and exanthema subitum, and also with increased frequency of upper respiratory tract infections. No association was found between prenatal exposure to acrylamide and the health outcomes investigated.

## Acrylamide

### Acrylamide Formation in Almonds (*Prunus dulcis*): Influences of Roasting Time and Temperature, Precursors, Varietal Selection, and Storage

G. Zhang, G. Huang, L. Xiao, J. Seiber, A.E. Mitchell

*Journal of Agricultural and Food Chemistry*, Vol. 59, No. 15; pp 8225–8232, 2011

Link to full text: <http://dc-pubs.acs.org/doi/full/10.1021/jf201595q>

**Significance:** Short-term elevated temperature storage may be another approach for mitigating acrylamide levels in roasted almonds.

This paper describes two sensitive and reliable LC-(ESI)MS/MS methods for the analysis of acrylamide and common acrylamide precursors (i.e., glucose, fructose, asparagine, and glutamine) in raw and roasted almonds. These methods were used to evaluate the impact of roasting temperatures (between 129 and 182°C) and times on acrylamide formation. Controlling the roasting temperature  $\leq 146^\circ\text{C}$  resulted in acrylamide levels below 200 ppb at all roasting times evaluated. Six varieties of almonds collected in various regions of California over two harvest years and roasted at 138°C for 22 min had acrylamide levels ranging from 117 $\pm$ 5  $\mu\text{g}/\text{kg}$  (Sonora) to 221 $\pm$ 95  $\mu\text{g}/\text{kg}$  (Butte) with an average of 187 $\pm$ 71  $\mu\text{g}/\text{kg}$ . A weak correlation between asparagine content in raw almonds and acrylamide formation was observed ( $R^2 = 0.6787$ ). Stability studies on roasted almonds indicated that acrylamide levels decreased by 12.9–68.5% (average of 50.2%) after 3 days of storage at 60°C.