ILSI North America

# Food Safety Briefs

## April 2016

### Foodborne Pathogens

**Effectiveness of Broad-Spectrum Chemical Produce Sanitizers Against Foodborne Pathogens as In Vitro Planktonic Cells and on the Surface of Whole Cantaloupes and Watermelons**

*A. Svoboda, A. Shaw, J. Dzubak, A. Mendonca, L. Wilson, A. Nair, et al.*

*Journal of Food Protection*, Vol.79, No. 4; pp. 524–530, 2016

doi: 10.4315/0362-028X.JFP-15-490

Link to full text: Click here

**Significance:** This study provides guidance to the melon industry on the best produce sanitizers for use in implementing a broad spectrum pathogen intervention strategy.

This research evaluated the effectiveness of commercially available produce sanitizers against selected foodborne pathogens, both in cell suspensions and on the outer rind surface of melons. The sanitizers (chlorine, hydrogen peroxide, liquid chlorine dioxide, various hydrogen peroxide–acid combinations, organic acids, and quaternary ammonium) were tested against Escherichia coli O157:H7, Listeria monocytogenes, Salmonella, and non-O157 Shiga toxin–producing E. coli (O26, O45, O103, O111, O121, and O145). The cell suspension study revealed the ability of all tested sanitizers to reduce all selected pathogens by 0.6 to 9.6 log CFU/ml in vitro. In the melon study, significant differences in pathogen reduction were observed between sanitizers but not between melon types. The most effective sanitizers were quaternary ammonium and hydrogen peroxide–acid combinations for all pathogens. The other sanitizers were less effective in killing the pathogens.

**Effect of Exposure Time and Organic Matter on Efficacy of Antimicrobial Compounds Against Shiga Toxin–Producing Escherichia coli and Salmonella**

*N. Kalchayanand, M. Koohmaraie, T.L. Wheeler*

*Journal of Food Protection*, Vol.79, No. 4; pp. 561–568, 2016

doi: 10.4315/0362-028X.JFP-15-204

Link to full text: Click here

**Significance:** Organic matter and exposure time influenced the efficacy of antimicrobial compounds against pathogens, especially with oxidizer compounds.

The objective of this study was to evaluate effectiveness of time of exposure of various antimicrobial compounds against nine strains of Shiga toxin–producing Escherichia coli (STEC) and four strains of Salmonella in aqueous antimicrobial solutions with and without organic matter. Non-O157 STEC, STEC O157:H7, and Salmonella were exposed to the following aqueous antimicrobial solutions with or without beef purge for 15, 30, 60, 120, 300, 600, and 1,800 s: 2.5% lactic acid; 4.0% lactic acid; 2.5% Beefxide; 1% Aftec 3000; 200 ppm of peracetic acid; 300 ppm


**Contact Us**

ILSI North America
1156 15th Street, NW
Suite 200
Washington, DC 20005

Tel: 202.659.0074
Fax: 202.659.3859
ilsina@ilsi.org

www.ilsina.org

of hypobromous acid; and water as a control. In general, increasing exposure time to antimicrobial compounds significantly increased the effectiveness against pathogens tested. In aqueous antimicrobial solutions without organic matter, both peracetic acid and hypobromous acid were the most effective in inactivating populations of STEC and Salmonella, providing at least 5.0-log reductions with exposure for 15 s. However, in antimicrobials containing organic matter, 4.0% lactic acid was the most effective compound in reducing levels of STEC and Salmonella, providing 2- to 3-log reductions with exposure for 15 s.

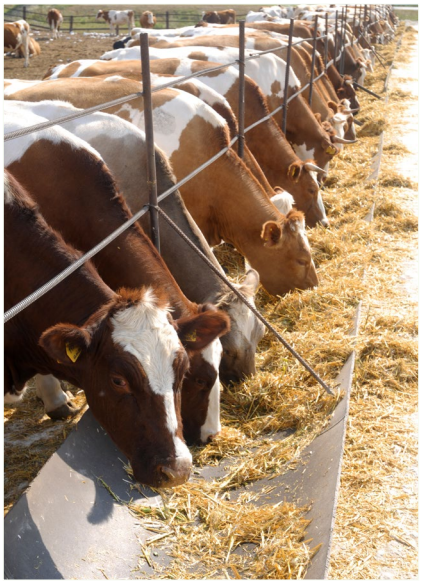
### Use of Metagenomic Shotgun Sequencing Technology to Detect Foodborne Pathogens Within the Microbiome of the Beef Production Chain

*X. Yang, N.R. Noyes, E. Doster, J.N. Martin, L.M. Linke, R.J. Magnuson, et al.*

*Applied and Environmental Microbiology*, Vol. 82, No. 8; pp. 2433–2443, 2016

doi: 10.1128/AEM.00078-16

Link to full text: Click here



**Significance:** Shotgun metagenomics can be used to evaluate not only the microbiome but also shifts in pathogen populations during beef production.

A metagenomic approach and shotgun sequencing technology were used as tools to detect pathogenic bacteria in environmental samples collected from the same groups of cattle at different longitudinal processing steps of the beef production chain: cattle entry to feedlot, exit from feedlot, cattle transport trucks, abattoir holding pens, and the end of the fabrication system. The log read counts classified as pathogens per million reads for Salmonella enterica, Listeria monocytogenes, Escherichia coli, Staphylococcus aureus, Clostridium spp. (C. botulinum and C. perfringens), and Campylobacter spp. (C. jejuni, C. coli, and C. fetus) decreased over subsequential processing steps. The normalized read counts for S. enterica, E. coli, and C. botulinum were greater in the final product than at the feedlots, indicating that the proportion of these bacteria increased within the remaining microbiome.

## Salmonella

### Application of Antimicrobial Agents via Commercial Spray Cabinet to Inactivate Salmonella on Skinless Chicken Meat

*J.L. Hawkins, B.Vimini, J.G. Schwarz, P. Nichols, S. Parveen*

*Journal of Food Protection*, Vol.79, No. 4; pp. 569–573, 2016

doi: 10.4315/0362-028X.JFP-15-248

Link to full text: Click here

**Significance:** Lauric arginate is a viable compound to reduce Salmonella Typhimurium on raw chicken meat and the order of application of antimicrobial agents plays a vital role.

This study determined the efficacy of three antimicrobial compounds against Salmonella enterica subsp. enterica serovar Typhimurium on raw chicken meat when applied individually and in combination using a commercial spray cabinet. Raw chicken thigh meat inoculated with 5 log CFU/g Salmonella Typhimurium ATCC 53647 was passed through a spray cabinet while being sprayed with 5% lauric arginate (LAE), 0.8% vinegar solution (VS), near-neutral electrolyzed water, or deionized water. The following three experiments were carried out: exposure

times (0, 15, 30, 45, and 60 s); storage at 4°C for 0, 1, 2, and 3 days after a 60-s exposure; and a combination of treatment with LAE and VS followed by storage at 4°C for 0, 1, 2, and 3 days. In comparing individual antimicrobials, the 60-s treatment time resulted in the greatest reduction of Salmonella Typhimurium, with LAE achieving the greatest reduction (2.07 log), followed by VS, near-neutral electrolyzed water, and deionized water (0.63, 0.56, and 0.53 log, respectively). After 3 days of storage, LAE significantly reduced Salmonella Typhimurium, by 1.28 log. The combination of VS and then LAE resulted in a significantly greater reduction than using LAE followed by VS (1.61 and 0.93 log, respectively).

### Irradiance and Temperature Influence the Bactericidal Effect of 460-Nanometer Light-Emitting Diodes on Salmonella in Orange Juice

*V. Ghate, A. Kumar, W. Zhou, H-G. Yuk*

*Journal of Food Protection*, Vol. 79, No. 4; pp. 553–560, 2016

doi: 10.4315/0362-028X.JFP-15-394

Link to full text: Click here

**Significance:** Blue light-emitting diodes demonstrate the potential to preserve fruit juices in the retail market and may be utilized in minimizing the risk of salmonellosis.

Blue light-emitting diodes (LEDs) were evaluated for their antibacterial effect on Salmonella in orange juice (OJ). A cocktail of Salmonella enterica serovars Gaminara, Montevideo, Newport, Typhimurium, and Saintpaul was inoculated into pasteurized OJ and illuminated with 460-nm LEDs at irradiances of 92, 147.7, and 254.7 mW/cm$^2$ and temperatures of 4, 12, and 20°C. Subsequently, linear, Weibull, and Gompertz models were fitted to the resultant survival curves. The color of the OJ during illumination was also monitored. It was observed that irradiance and temperature both influenced the inactivation of Salmonella, which ranged from 2 to 5 log CFU/ml. The inactivation kinetics was best described by the Weibull model. An irradiance of 92 mW/cm$^2$ and temperatures of 12 and 20°C were the most bactericidal combinations, with D-values of 1,580 and 2,013 J/cm$^2$, respectively. Significant color changes were also observed after illumination.

## Listeria

### Viability of Listeria monocytogenes on Boneless, Water-Added Hams, Commercially Prepared With and Without Food-Grade Chemicals, During Extended Storage at 4 and/or –2.2°C

*J.B. Luchansky, S.G. Campano, B.A. Shoyer, A.C.S. Porto-Fett*

*Journal of Food Protection*, Vol.79, No. 4; pp. 613–619, 2016

doi: 10.4315/0362-028X.JFP-15-431

Link to full text: Click here

**Significance:** Deep chilling hams was listericidal, and inclusion of antimicrobials in the formulation, suppressed outgrowth of L. monocytogenes during extended cold storage.

Viability of Listeria monocytogenes was monitored during refrigerated (4°C) and/or frozen (deep chilling at –2.2°C) storage on casing-cooked hams that were commercially prepared with and without potassium lactate and sodium diacetate (1.6%), buffered vinegar (2.2%), buffered vinegar and potassium lactate (1.7%), or a blend of potassium lactate, potassium acetate, and sodium diacetate (1.7%). A portion of these hams were subsequently surface treated with lauric arginate

ester (LAE; 44 ppm). Hams were sliced, inoculated, surface treated with LAE, and stored at either 4°C for 120 days or at –2.2°C for 90 days and then at 4°C for an additional 120 days. Without antimicrobials, the population of L. monocytogenes increased by ca. 5.9 log CFU/slice within 120 days at 4°C; however, pathogen levels increased only slightly for hams formulated with potassium lactate and sodium diacetate and decreased by ca. 1.2 log CFU/slice when formulated with the other antimicrobials. For slices held at –2.2°C and then stored at 4°C, but not treated with LAE, L. monocytogenes increased by ca. 4.5 log CFU/slice for controls, whereas when formulated with antimicrobials, pathogen levels decreased by ca. 1.4 to 1.8 log CFU/slice. For product treated with LAE, L. monocytogenes increased by ca. 4.0 log CFU/slice for controls, whereas when formulated with antimicrobials, pathogen levels decreased by ca. 0.9 to 1.9 log CFU/slice.

### Hygiene and Safety in the Meat Processing Environment From Butcher Shops: Microbiological Contamination and Listeria monocytogenes

*D.A.L. da Silva, M.R. Dias, M.V.C. Cossi, N.P.A. de Castilho, A.C. Camargo, L.A. Nero*

*Journal of Food Protection*, Vol. 79, No. 4; pp. 628–634, 2016

doi: 10.4315/0362-028X.JFP-15-482

Link to full text: Click here

**Significance:** The establishment of appropriate procedures to reduce microbial counts and control the spread of Listeria in the final steps of the meat production chain is of utmost importance, with obvious effects on the quality and safety of meat products for human consumption.

To identify the main sources of microbiological contamination in the processing environment of three butcher shops, surface samples were obtained from the hands of employees, tables, knives, inside butcher displays, grinders, and meat tenderizers (24 samples per point). All samples were subjected to enumeration of hygiene indicator microorganisms and detection of Listeria monocytogenes, and the obtained isolates were characterized by their serogroups and virulence genes. The results demonstrated the absence of relevant differences in the levels of microbiological contamination among butcher shops; samples with counts higher than reference values indicated inefficiency in adopted hygiene procedures. A total of 87 samples were positive for Listeria spp. (60.4%): 22 from tables, 20 from grinders, 16 from knives, 13 from hands, 9 from meat tenderizers, and 7 from butcher shop displays. Thirty-one samples (21.5%) were positive for L. monocytogenes, indicating the presence of the pathogen in meat processing environments. Seventy-four L. monocytogenes isolates were identified, with 52 from serogroups 1/2c or 3c and 22 from serogroups 4b, 4d, 4a, or 4c. All 74 isolates were positive for hlyA, iap, plcA, actA, and internalins (inlA, inlB, inlC, and inlJ).

## E. coli

### Influence of Extracellular Cellulose and Colanic Acid Production on the Survival of Shiga Toxin–Producing Escherichia coli on Spinach and Lettuce after Chlorine Treatment

*C-C. Lee, J. Chen, J.F. Frank*

*Journal of Food Protection*, Vol. 79, No. 4; pp. 666–671, 2016

doi: 10.4315/0362-028X.JFP-15-375

Link to full text: Click here

**Significance:** Extracellular polymers do not generally increase the ability of STEC to survive chlorine treatment and that any effects on survival are influenced by location of attachment, type of leafy green, and concentration of chlorine.

This study investigated the role of extracellular polymers on the tolerance of Escherichia coli (STEC) to chlorine treatment after attachment to lettuce and spinach. Four STEC strains, two wild-type cellulose-producing and their cellulose-deficient derivatives, were used. One strain pair produced colanic acid in addition to cellulose. Spinach and lettuce with attached cells were treated with chlorinated water. The production of the extracellular polymers by the planktonic cells had small, but significant, effects on the survival of the attached pathogen when subjected to chlorine treatment. On the lettuce surface, the colanic acid–producing, cellulose-negative mutant (49d) was most susceptible to the treatment, declining significantly in population by 0.9 and 1.4 log units after treatment with 50 and 150 ppm of chlorine, respectively. Chlorine treatment reduced populations of cellulose-deficient cells on the intact spinach surface 1.2 log units more than the wild type when treated with 150 ppm of chlorine ($P < 0.05$). However, populations of cellulose-producing cells were reduced by 1.5 log units more than their mutant counterparts when the cells also produced colanic acid ($P < 0.05$). A greater proportion of cells attached to the spinach leaf edge were injured by chlorine treatment compared with attached to the leaf surface.

### Influence of Cyclopropane Fatty Acids on Heat, High Pressure, Acid and Oxidative Resistance In Escherichia Coli

*Y.Y. Chen, M.G. Gänzle*

*International Journal of Food Microbiology*, 2 April 2016, Vol. 222; pp.16–22, 2016

doi: 10.1016/j.ijfoodmicro.2016.01.017

Link to full text: Click here

**Significance:** Cyclopropane fatty acids synthesis in E. coli increases heat, high pressure and acid resistance, and increases heat resistance in food.

This study investigated effects of cyclopropane fatty acids (CFAs) on stress tolerance in the heat- and pressure-resistant strain E. coli AW1.7 and the sensitive strain E. coli MG1655. Both wild-type strains consumed all the unsaturated fatty acids (C16:1 and C18:1) that were mostly converted to CFAs and a low proportion to saturated fatty acid (C16:0). Moreover, E. coli AW1.7 contained a higher proportion of membrane C19:0 cyclopropane fatty acid than E. coli MG1655 ($P < 0.05$). The Δcfa mutant strains did not produce CFAs, and the corresponding substrates C16:1 and C18:1 accumulated in membrane lipids. The deletion of cfa did not alter resistance to H2O2 but increased the lethality of heat, high pressure and acid treatments in E. coli AW1.7, and E. coli MG1655. E. coli AW1.7 and its Δcfa mutant were more resistant to pressure and heat but less resistant to acid stress than E. coli MG1655. Heat resistance of wild-type strains and their Δcfa mutant was also assessed in beef patties grilled to an internal temperature of 71 °C. After treatment, cell counts of wild type strains were higher than those of the Δcfa mutant strains.

## Aflatoxins

### The Toxic Effects of Combined Aflatoxins and Zearalenone In Naturally Contaminated Diets on Laying Performance, Egg Quality and Mycotoxins Residues in Eggs of Layers and the Protective Effect of Bacillus Subtilis Biodegradation Product

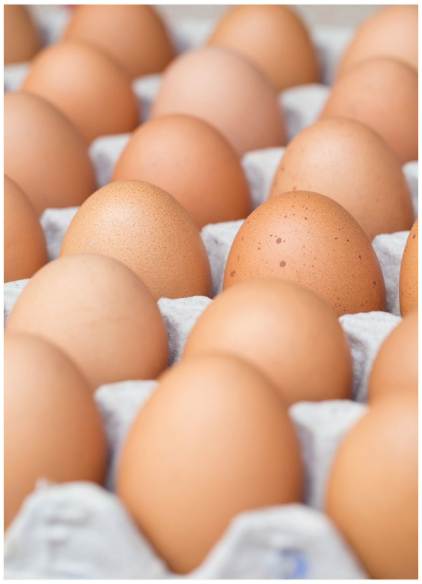
*R. Jia, M. Qiugang, Y. Fan, C. Ji, J. Zhang, T. Liu, et al.*

*Food and Chemical Toxicology*, Vol. 90; pp. 142–150, 2016

doi:10.1016/j.fct.2016.02.010

Link to full text: Click here

**Significance:** Bacillus subtilis biodegradation product has a protective effect on layers fed contaminated diets.



The toxic effect of aflatoxins (AF) and zearalenone (ZEA) and their combination on laying performance, egg quality and toxins residues in eggs, as well as the efficacy of Bacillus subtilis biodegradation product (BDP) for ameliorating these effects in layers were evaluated. Layers were submitted to a two phase experiment. The first phase was an intoxication period (18–23 wk) with birds fed 7 ($3 \times 2 + 1$) diets (3 treatments with mycotoxins: AF (123.0 μg/kg), ZEA (260.2 μg/kg), or AF + ZEA (123.0 + 260.2 μg/kg); 2 treatments with or without BDP (1000 g/t); and a control group contained no toxins nor BDP). The next phase was a recovery period (24–29 wk) in which birds were fed a toxin-free diet. In the intoxication period, AF and AF + ZEA groups exhibited lower egg production, feed intake and shell thickness, and higher AFB1, AFB2 and AFM1 residues as compared with the control group. In addition, AF and ZEA exerted synergistic effects on egg production and feed intake. Moreover, AF alone or combined with ZEA had a continuous toxic effect on laying performance in the recovery phase.

## Food Allergy

### A Randomized, Double-Blind, Placebo-Controlled Study of Omalizumab Combined With Oral Immunotherapy for the Treatment of Cow's Milk Allergy

*R.A. Wood, J.S. Kim, R. Lindblad, K. Nadeau, A.K. Henning, P. Dawson, et al.*

*Journal of Allergy and Clinical Immunology*, Vol. 137, No. 4; pp. 1103–1110.e11, 2016

doi: 10.1016/j.jaci.2015.10.005

Link to full text: Click here

**Significance:** In this trial of omalizumab in combination with food oral immunotherapy, significant improvements were found in measurements of safety but not in outcomes of efficacy (desensitization and sustained unresponsiveness).

This double-blind, placebo-controlled trial examined whether the addition of omalizumab to milk oral immunotherapy (OIT) reduces treatment-related reactions, improves outcomes, or both. Subjects (n=57) were randomized to omalizumab or placebo with no significant baseline differences in age, milk-specific IgE levels, skin test results, or oral food challenge (OFC) results. Open-label milk OIT was initiated after 4 months of omalizumab/placebo with escalation to maintenance over 22 to 40 weeks, followed by daily maintenance dosing through month 28. At month 28, omalizumab was discontinued, and subjects passing an oral food challenge (OFC) continued OIT for 8 weeks, after which OIT was discontinued with rechallenge at month 32 to assess sustained unresponsiveness (SU). At month

28, 88.9% omalizumab-treated subjects and 71.4% placebo-treated subjects passed the 10-g "desensitization" OFC (P=.18). At month 32, SU was demonstrated in 48.1% in the omalizumab group and 35.7% in the placebo group (P=.42). Adverse reactions were markedly reduced during OIT escalation in omalizumab-treated subjects for percentages of doses per subject provoking symptoms (2.1% vs 16.1%, P=.0005), dose-related reactions requiring treatment (0.0% vs 3.8%, P=.0008), and doses required to achieve maintenance (198 vs 225, P=.008).

### Skin Barrier Impairment at Birth Predicts Food Allergy at 2 Years of Age

*M.M. Kelleher, A. Dunn-Galvin, C. Gray, D.M. Murray, M. Kiely, L. Kenny, et al.*

*Journal of Allergy and Clinical Immunology*, Vol. 137, No. 4; pp. 1111–1116.e8, 2016

doi: 10.1016/j.jaci.2015.12.1312

Link to full text: Click here

**Significance:** Neonatal skin barrier dysfunction predicts food allergy at 2 years of age, supporting the concept of transcutaneous allergen sensitization, even in infants who do not have atopic dermatitis.

This study examined the relationship between early life skin barrier function and food allergy in infancy. Infants in the Babies After Scope: Evaluating the Longitudinal Impact Using Neurological and Nutritional Endpoints (BASELINE) birth cohort had transepidermal water loss (TEWL) measured in the early newborn period and at 2 and 6 months of age. At age 2 years, infants had food sensitization (FS)/food allergy (FA) screening with skin prick tests and oral food challenges. 1903 infants were enrolled; 1355 were retained to age 2 years, and 1260 underwent FS screening. FS was present in 6.27% (79/1260; 95% CI, 4.93% to 7.61%), and FA prevalence was 4.45% (56/1258; 95% CI, 3.38% to 5.74%). Egg was the most prevalent allergen (2.94%), followed by peanut (1.75%) and cow's milk (0.74%). Day 2 upper-quartile TEWL (>9 gwater/m2/h) was a significant predictor of FA at age 2 years (odds ratio [OR], 4.1; 95% CI, 1.5-4.8). Seventy-five percent of children with FA at 2 years of age had day 2 TEWL in the upper quartile. Even in those without atopic dermatitis (AD), infants with upper-quartile day 2 TEWL were 3.5 times more likely to have FA at 2 years than infants in the lowest quartile (95% CI, 1.3-11.1; P = .04).

### Long-Term Treatment With Egg Oral Immunotherapy Enhances Sustained Unresponsiveness That Persists After Cessation of Therapy

*S.M. Jones, A.W. Burks, C. Keet, B.P. Vickery, A.M. Scurlock, R.A. Wood, et al. for the Consortium of Food Allergy Research (CoFAR)*

*Journal of Allergy and Clinical Immunology*, Vol. 137, No. 4; pp. 1117–1127.e10, 2016

doi: 10.1016/j.jaci.2015.12.1316

Link to full text: Click here

**Significance:** Sustained unresponsiveness after egg oral immunotherapy is enhanced with longer duration of therapy and increases the likelihood of tolerating unbaked egg in the diet.

The efficacy and safety of egg oral immunotherapy (eOIT) in participants treated up to 4 years were evaluated. Children with egg allergy (5-18 years old) received eOIT (n = 40) <=4 years or placebo (n = 15) for <=1 year. The key outcome was the percentage of subjects achieving sustained unresponsiveness (SU) by year 4.

Safety and immunologic assessments were performed, and long-term follow-up questionnaires (LFQs) were administered after study conclusion (LFQ-1) and 1 year later (LFQ-2). Of 40 eOIT-treated subjects, 20 demonstrated SU by year 4. For those subjects still dosing during years 3 and 4, mild symptoms were present in 12 (54.5%) of 22 subjects. At the time of the LFQ, more subjects receiving eOIT (LFQ-1, 23/34 [68%]; LFQ-2, 21/33 [64%]) were consuming unbaked and baked egg versus placebo (LFQ-1, 2/11 [18%], P = .006; LFQ-2, 3/12 [25%], P = .04). Of subjects achieving SU, 18 (90%) of 20 completed the LFQ, with 18 (100%) of 18 reporting consumption of all forms of egg. When compared with subjects not achieving SU, subjects achieving SU had higher IgG4 values (P = .001) and lower egg skin prick test scores (P = .0002) over time and a lower median baseline ratio of egg-specific IgE to total IgE (1.1% vs 2.7%, P = .04).

### Effect of Avoidance on Peanut Allergy After Early Peanut Consumption

*G. Du Toit, P.H. Sayre, G. Roberts, M.L. Sever, K. Lawson, H.T. Bahnson, et al. for the Immune Tolerance Network LEAP-On Study Team*

*New England Journal of Medicine*, Vol. 374, No. 15; pp. 1435-1443, 2016

doi: 10.1056/NEJMoa1514209

Link to full text: Click here

**Significance:** Among children at high risk for allergy in whom peanuts had been introduced in the first year of life and continued until 5 years of age, a 12-month period of peanut avoidance was not associated with an increase in the prevalence of peanut allergy.

In a randomized trial, the early introduction of peanuts in infants at high risk for allergy was shown to prevent peanut allergy. In this follow-up study, whether the rate of peanut allergy remained low after 12 months of peanut avoidance was investigated among participants who had consumed peanuts during the primary trial (peanut-consumption group), as compared with those who had avoided peanuts (peanut-avoidance group). 556 of 628 eligible participants (88.5%) were enrolled from the primary trial; 98.9% had complete primary-outcome data. The rate of adherence to avoidance in the follow-up study was high (90.4% in the peanut-avoidance group and 69.3% in the peanut-consumption group). Peanut allergy at 72 months was significantly more prevalent among participants in the peanut-avoidance group than among those in the peanut-consumption group (18.6% [52 of 280 participants] vs. 4.8% [13 of 270], P<0.001). Three new cases of allergy developed in each group, but after 12 months of avoidance there was no significant increase in the prevalence of allergy among participants in the consumption group (3.6% [10 of 274 participants] at 60 months and 4.8% [13 of 270] at 72 months). Fewer participants in the peanut-consumption group than in the peanut-avoidance group had high levels of Ara h2–specific IgE and peanut-specific IgE; in addition, participants in the peanut-consumption group continued to have a higher level of peanut-specific IgG4 and a higher peanut-specific IgG4:IgE ratio.

## Norovirus

### Evaluation of High Hydrostatic Pressure Inactivation of Human Norovirus on Strawberries, Blueberries, Raspberries and in Their Purees

*R. Huang, M. Ye, L. Ji, M. Carwe, H. Chen*

*International Journal of Food Microbiology*, Vol. 223, 16 April 2016; pp. 17–24, 2016

doi:10.1016/j.ijfoodmicro.2016.02.002

Link to full text: Click here

**Significance:** The high hydrostatic pressure treatment of 550 MPa for 2 min at 0 °C could be a potential nonthermal intervention for human norovirus in berry purees without adversely affecting their sensory qualities and physical properties.

High hydrostatic pressure (HHP) inactivation of human norovirus (HuNoV) on fresh strawberries, blueberries, and raspberries and in their purees was investigated. Strawberry puree inoculated with HuNoV genogroup I.1 (GI.1) strain was HHP-treated at 450, 500 and 550 MPa for 2 min each at initial sample temperatures of 0, 4 and 20 °C. HuNoV GI.1 strain became more sensitive to HHP treatment as the temperature decreased from 20 to 0 °C. HuNoV GI.1 or genogroup II.4 (GII.4) strains were inoculated into three types of berries and their purees and treated at pressure levels from 250 to 650 MPa for 2 min at initial sample temperature of 0 °C. For the purees, the HHP condition needed to achieve > 2.9 log reduction of HuNoV GI.1 strain and > 4.0 log reduction of HuNoV GII.4 strain was found to be ≥ 550 MPa for 2 min at 0 °C. HHP treatment showed better inactivation effect of HuNoV on blueberries than on strawberry quarters and raspberries. HuNoV GI.1 strain was more resistant to HHP treatment than HuNoV GII.4 strain under different temperatures and environment. Color, pH and viscosity of blueberries and three berry purees showed no or slight changes after HHP treatment. Sensory evaluation demonstrated that HHP treatment of 550 MPa for 2 min at 0 °C did not significantly reduce the sensory qualities of three berry purees.





## About Us

*The North American branch of the International Life Sciences Institute (ILSI North America) is a public, non-profit scientific foundation that advances the understanding and application of science related to the nutritional quality and safety of the food supply.*

ILSI North America carries out its mission by sponsoring research programs, professional and educational programs and workshops, seminars, and publications, as well as providing a neutral forum for government, academic, and industry scientists to discuss and resolve scientific issues of common concern for the well-being of the general public. ILSI North America's programs are supported primarily by its industry membership.

ILSI North America

1156 15th Street, NW
Suite 200
Washington, DC 20005

Tel: 202.659.0074
Fax: 202.659.3859
ilsina@ilsi.org

www.ilsina.org