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North America

Food Safety Briefs

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E. coli

Detection of Non-O157 Shiga Toxin–Producing *Escherichia coli* in 375 Grams of Beef Trim Enrichments across Multiple Commercial PCR Detection Platforms

S.R. Wheeler, P. Heard, C. Dufour, D. Thevenot-Sergentet, E. Loukiadis, R.S. Flowers, et al.

Journal of Food Protection, Vol. 78, No. 1; pp. 196–202, 2015

DOI: 10.4315/0362-028X.JFP-14-263

Link to full text: [Click here](#)

Significance: Detection of non-O157 STEC in beef trim can be performed by any of the three methods evaluated in the study.

This study compared commercial detection methods with the USDA reference method for detection of non-O157 Shiga toxin–producing *Escherichia coli* (STEC) in 375 g of beef trim using a limit of detection study design. Overall, the commercial platforms performed well, showing similar levels of sensitivity for detection of presumptive positives for O45, O26, O103, and O121 (PCR screen results only). For O111, one method that utilizes an integrated immunomagnetic separation and PCR approach was more sensitive than a PCR-only screen approach. Another method showed more presumptive and confirmed positives overall. Use of an immunomagnetic separation tool, such as antibody-coated beads, aided considerably with the confirmation procedures and is an important step when confirming suspect samples.

Listeria

Listeria monocytogenes in Retail Delicatessens: An Interagency Risk Assessment—Model and Baseline Results

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Journal of Food Protection, Vol. 78, No. 1; pp. 134–145, 2015

DOI: 10.4315/0362-028X.JFP-14-235

Link to full text: [Click here](#)

Significance: The risk assessment model predicts that cross-contamination with *Listeria monocytogenes* at retail predominantly results in sporadic cases.

The Interagency Risk Assessment—*Listeria monocytogenes* (Lm) in Retail Delicatessens provides a scientific assessment of the risk of listeriosis associated with the consumption of ready-to-eat (RTE) foods commonly prepared and sold in the delicatessen (deli) of a retail food store. The quantitative risk assessment (QRA) model simulates the behavior of retail employees in a deli department and tracks the Lm potentially present in this environment and in the food. Bacterial growth, bacterial inactivation, and cross-contamination are

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evaluated through a discrete event modeling approach. The QRA evaluates the risk per serving of deli-prepared RTE food for the susceptible and general population, using a dose-response model. This QRA considers six separate retail baseline conditions and provides information on the predicted risk of listeriosis for each. The risk assessment predicts that listeriosis cases associated with retail delicatessens result from a sequence of key events: the contaminated RTE food supports *Lm* growth; improper retail and/or consumer storage temperature or handling results in the growth of *Lm* on the RTE food; and the consumer of this RTE food is susceptible to listeriosis.

Salmonella

Effect of Overhead Spray and Brush Roller Treatment on the Survival of Pectobacterium and Salmonella on Tomato Surfaces

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Journal of Food Protection, Vol. 78, No. 1; pp. 51–56, 2015

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Link to full text: [Click here](#)



Significance: An overhead spray and brush roller system in packinghouses is effective in removing surface contamination and does not affect tomato quality or safety.

This study evaluated whether overhead spray and brush roller (OSBR) treatment had a negative effect on the safety and/or marketability of tomatoes by examining its effect on *Pectobacterium* and *Salmonella* survival. *Pectobacterium* survival was evaluated on inoculated tomatoes that were OSBR-treated with water or sanitizer (NaOCl, ClO₂, or peracetic acid). A 15-s OSBR treatment using water or sanitizer achieved a 3-log CFU/ml reduction in *Pectobacterium* levels. Survival of *Pectobacterium* and *Salmonella* on OSBR-treated, untreated, and puncture-wounded tomatoes stored at 25°C and 75 to 85 % relative humidity for 7 days was also assessed. Both *Pectobacterium* and *Salmonella* populations declined rapidly on OSBR-treated and untreated tomatoes, indicating that brushing does not damage tomato fruit to the extent of promoting better pathogen survival. The survival of both organisms was significantly higher on artificially wounded fruit. OSBR treatment does not increase the survival and growth of *Pectobacterium* or *Salmonella* on tomato surfaces and it is effective in reducing *Pectobacterium* levels on the surface of inoculated tomatoes.

Natural Surface Coating to Inactivate Salmonella Enterica Serovar Typhimurium and Maintain Quality of Cherry Tomatoes

J. Yun, X. Fan, X. Li, T.Z. Jin, X. Jia, J.P. Mattheis

International Journal of Food Microbiology, Vol. 193, 16 January 2015; pp. 59–67, 2015

DOI: 10.1016/j.ijfoodmicro.2014.10.013

Link to full text: [Click here](#)

Significance: Zein-based coating containing cinnamon oil might be used to enhance microbial safety and quality of tomatoes.

This study investigated the effectiveness of zein-based coatings in reducing populations of *Salmonella enterica* serovar Typhimurium and preserving quality of cherry tomatoes. Tomatoes were inoculated with a cocktail of *S. Typhimurium* LT2 plus three attenuated strains. Zein-based coatings with and

without cinnamon and mustard essential oil or a commercial wax formulation were applied onto tomatoes, and the treated fruits were stored at 10°C for up to 3 weeks. Populations of *S. Typhimurium* decreased with increased essential oil concentration and storage duration. *S. Typhimurium* populations on the smooth skin surface were reduced by 4.6 and 2.8 log colony forming units (CFU)/g by the zein coatings with 20% cinnamon and 20% mustard oil, respectively, 5 h after coating. The same coating reduced populations of *S. Typhimurium* to levels below detection limit (1.0 log CFU/g) on the stem scar area of tomato during 7 days of storage at 10°C. Compared with the control, loss of firmness and ascorbic acid during storage was prevented by all coatings except the zein coating with 20% mustard oil.

Foodborne Pathogens

Survival or Growth of Inoculated *Escherichia coli* O157:H7 and *Salmonella* on Yellow Onions (*Allium cepa*) under Conditions Simulating Food Service and Consumer Handling and Storage

V.M. Lieberman, I.Y. Zhao, D.W. Schaffner, M.D. Danyluk, L.J. Harris

Journal of Food Protection, Vol. 78, No. 1; pp. 42–50, 2015

DOI: 10.4315/0362-028X.JFP-14-281

Link to full text: [Click here](#)

Significance: Diced onions support pathogen growth and should be kept refrigerated.

Whole and diced yellow onions (*Allium cepa*) were inoculated with five-strain cocktails of rifampin-resistant *Escherichia coli* O157:H7 or *Salmonella* and stored under conditions to simulate food service or consumer handling. The inoculum was grown in broth or on agar plates. Both *E. coli* O157:H7 and *Salmonella* populations declined more rapidly on onion skins when the inoculum was prepared in broth rather than on agar. Agar-prepared *E. coli* O157:H7 and *Salmonella* declined by 0.4 and 0.3 log CFU/sample/day, respectively, at ambient conditions; at 4°C the rates of reduction were 0.08 and 0.06 log CFU/sample/day for *E. coli* O157:H7 and *Salmonella*, respectively. Populations of *E. coli* O157:H7 and *Salmonella* did not change over 6 days of storage at 4°C in diced onions. Lag times of 6 to 9 h were observed with freshly inoculated onion at ambient conditions. Growth rates at ambient conditions were 0.2 to 0.3 log CFU/g/h for *E. coli* O157:H7 and *Salmonella* in freshly inoculated onion and 0.2 log CFU/g/h in mixed product.

Enhanced Inactivation of Food-Borne Pathogens in Ready-To-Eat Sliced Ham by Near-Infrared Heating Combined with UV-C Irradiation and Mechanism of the Synergistic Bactericidal Action

J-W. Ha, D-H. Kang

Applied and Environmental Microbiology, Vol. 81, No. 1; pp. 2–8, 2015

DOI: 10.1128/AEM.01862-14

Link to full text: [Click here](#)

Significance: A near-infrared-UV combined process could be an innovative antimicrobial intervention for ready-to-eat meat products.

This study investigated the effect of the simultaneous application of near-infrared (NIR) heating and UV irradiation on inactivation of *Escherichia coli* O157:H7, *Salmonella enterica* serovar Typhimurium, and *Listeria monocytogenes* in



ready-to-eat (RTE) sliced ham and its effect on product quality. It also elucidated the underlying mechanisms of the synergistic bactericidal action of NIR heating and UV irradiation. With the inoculation amounts used, simultaneous NIR-UV combined treatment for 70 s achieved 3.62, 4.17, and 3.43 log CFU reductions of *E. coli* O157:H7, *S. Typhimurium*, and *L. monocytogenes*, respectively. For all three pathogens, the simultaneous application of both technologies resulted in an additional log unit reduction as a result of their synergism compared to the sum of the reductions obtained after the individual treatments. Additionally, NIR-UV combined treatment for a maximum of 70 s did not alter the color values or texture parameters of ham slices significantly.

Influence of Mycorrhizal Fungi on Fate of *E. Coli* O157:H7 and *Salmonella* in Soil and Internalization into Romaine Lettuce Plants

A.M. Nicholson, J.B. Gurtler, R.B. Bailey, B.A. Niemira, D.D. Douds

International Journal of Food Microbiology, 192, 2 January 2015; pp. 95–102, 2015

DOI: 10.1016/j.ijfoodmicro.2014.10.001

Link to full text: [Click here](#)



Significance: Arbuscular mycorrhizal fungi do not affect the internalization and/or survival of either *Salmonella enterica* or *Escherichia coli* O157:H7 in Romaine lettuce seedlings.

This study determined the influence of a symbiotic arbuscular mycorrhizal (AM) fungus on persistence of *Salmonella* and enterohemorrhagic *Escherichia coli* O157:H7 (EHEC) within soil, and survival within Romaine lettuce. Romaine seedlings were grown with or without AM fungi. Soil surrounding plants was inoculated with ca. 8 log CFU/plant of either *Salmonella enterica* or *E. coli* EHEC composites. Twenty-four hours after inoculation, populations of *Salmonella* and EHEC, respectively, were 4.20 and 3.24 log CFU/root, 2.52 and 1.17 log CFU/shoot, and 5.46 and 5.17 log CFU/g soil. By selective enrichment, samples tested positive for *Salmonella* or EHEC at day 22 at rates of 94 and 68% (shoot), 97 and 56% (root), and 100 and 75% (soil), respectively. *Salmonella* populations in soil remained as high as 4.35 log CFU/g by day 22, while EHEC populations dropped to 1.12 log CFU/g in the same amount of time. Ninety-two percent of all Romaine leaves were positive for internalized *Salmonella* from days 8 to 22 and remained as high as 1.26 log CFU/shoot on day 22 in AM fungi + Romaine plants.

Multiplex Real-Time PCR and Culture Methods for Detection of Shiga Toxin-Producing *Escherichia coli* and *Salmonella* Thompson in Strawberries, a Lettuce Mix and Basil

S. Delbeke, S. Ceuppens, K. Holvoet, E. Samuels, I. Sampers, M. Uyttendael

International Journal of Food Microbiology, Vol. 193, 16 January 2015; pp. 1–7, 2015

DOI: 10.1016/j.ijfoodmicro.2014.10.009

Link to full text: [Click here](#)

Significance: This study indicates the ability of PCR based screening methods for reproducible multi-detection of low numbers (10–70 cfu/25 g) of Shiga toxin-producing *Escherichia coli* and *Salmonella* in strawberries, lettuce and basil.

An appropriate approach of high throughput multi-screening was verified for Shiga toxin-producing *Escherichia coli* (STEC) and *Salmonella* spp. in strawberries, lettuce and basil. Sample replicates were inoculated with STEC O157 or O26 and *Salmonella* Thompson (ca. 10–70, 100–700 and 1000–7000 cfu/25 g) and analyzed after 1 and 5 days of storage. After 18–24 h of enrichment at 37 °C in buffered peptone water, detection was performed using the GeneDisc multiplex PCR (stx1, stx2, eae and iroB genes) and selective culture media for isolation of STEC (with immunomagnetic separation) and *Salmonella* spp. in parallel. After 1 day, the pathogenic strains were recovered from all samples for all inoculum levels, whereas reduced detection rates of STEC O157 and *S. Thompson* were observed after 5 days of storage in case of strawberries, in particular for the lowest inoculum level, suggesting superior survival potential for STEC O26.

Mycotoxins

Impact of Maximum Levels in European Legislation on Exposure of Mycotoxins in Dried Products: Case of Aflatoxin B1 and Ochratoxin A in Nuts and Dried Fruits

E. Van de Perre, L. Jacxsens, C. Lachat, F. El Tahan, B. De Meulenaera

Food and Chemical Toxicology, Vol. 75, January 2015; pp. 112–117, 2015

DOI: 10.1016/j.fct.2014.10.021

Link to full text: [Click here](#)

Significance: With the exception of figs, the maximum values of aflatoxin B1 in the European legislation are sufficient to be of a low health concern for consumers.

The impact of setting European criteria on exposure to aflatoxin B1 (AFB1) via nuts and figs and ochratoxin A (OTA) via dried fruits was evaluated. Two different scenarios were evaluated. In scenario 1, all collected literature data were considered, assuming that there is no border control nor legal limits in Europe. In the second scenario, contamination levels above the maximum limits were excluded. The results from scenario 1 demonstrated that if no regulation is in place, AFB1 and OTA concentrations reported in the analyzed food can have potential health risk to the population. The estimated exposure of OTA for scenario 2 is below the TDI of 5 ng/kg BW day, indicating that OTA concentrations accepted by EU legislation pose a low risk to the population. For AFB1, the MOE values of scenario 2 are above 10,000 and can be considered to be of low health concern, based on BDML10 for humans, except for figs (MOE = 5782).

Feasibility of Detecting Aflatoxin B1 on Inoculated Maize Kernels Surface using Vis/NIR Hyperspectral Imaging

W. Wang, G.W. Heitschmidt, W.R. Windham, P. Feldner, X. Ni, X. Chu

Journal of Food Science, Vol. 80, No. 1; pp. M116–M122, 2015

DOI: 10.1111/1750-3841.12728

Link to full text: [Click here](#)

Significance: Visible/near-infrared hyperspectral imaging technology combined with the principal components analysis-factorial discriminant analysis was a practical method to detect and differentiate different levels of aflatoxin B1 artificially inoculated on the maize kernels surface.



The feasibility of using a visible/near-infrared hyperspectral imaging system with a wavelength range between 400 and 1000 nm to detect and differentiate different levels of aflatoxin B1 (AFB1) artificially titrated on maize kernel surface was examined. Principal components analysis (PCA) was applied to reduce the dimensionality of hyperspectral image data, and then a stepwise factorial discriminant analysis (FDA) was performed on latent PCA variables. The results indicated that discriminant factors F2 can be used to separate control samples from all of the other groups of kernels with AFB1 inoculated, whereas the discriminant factors F1 can be used to identify maize kernels with levels of AFB1 as low as 10 ppb. An overall classification accuracy of 98% was achieved. Finally, the peaks of β coefficients of the discrimination factors F1 and F2 were analyzed and several key wavelengths identified for differentiating maize kernels with and without AFB1, as well as those with differing levels of AFB1 inoculation.

Anomericity of T-2 Toxin-glucoside: Masked Mycotoxin in Cereal Crops

S.P. McCormick, T. Kato, C.M. Maragos, M. Busman, V.M.T. Lattanzio, G. Galaverna, et al.

Journal of Agricultural and Food Chemistry, Vol. 63, No. 2; pp. 731–738, 2015

DOI: 10.1021/jf504737f

Link to full text: [Click here](#)

Significance: The naturally occurring T-2 toxin-glucoside from plants was found to be identical to T-2 toxin- α -glucoside prepared with *B. muscicola*.



T-2 toxin is a trichothecene mycotoxin produced when *Fusarium* fungi infect grains, especially oats and wheat. Cereal crops infected with mycotoxin-producing fungi form toxin glycosides, sometimes called masked mycotoxins, which are a potential food safety concern because they are not detectable by standard approaches and may be converted back to the parent toxin during digestion or food processing. This study addresses four aspects of T-2 toxin-glucosides: phytotoxicity, stability after ingestion, antibody detection, and the anomericity of the naturally occurring T-2 toxin-glucoside found in cereal plants. T-2 toxin- β -glucoside was chemically synthesized and compared to T-2 toxin- α -glucoside prepared with *Blastobotrys muscicola* cultures and the T-2 toxin-glucoside found in naturally contaminated oats and wheat. The anomeric forms were separated chromatographically and differ in both NMR and mass spectrometry. Both anomers were significantly degraded to T-2 toxin and HT-2 toxin under conditions that mimic human digestion, but with different kinetics and metabolic end products.

Infant Formula

Comparison of Desiccation Tolerance among *Listeria monocytogenes*, *Escherichia coli* O157:H7, *Salmonella enterica*, and *Cronobacter sakazakii* in Powdered Infant Formula

S. Koseki, N. Nakamura, T. Shiina

Journal of Food Protection, Vol. 78, No. 1; pp. 104–110, 2015

DOI: 10.4315/0362-028X.JFP-14-249

Link to full text: [Click here](#)

Significance: Storage temperature significantly influenced survival of each bacterium under the dry environment, where the bacterial inactivation became faster with increasing storage temperature.

The survival kinetics of *Listeria monocytogenes*, *Escherichia coli* O157:H7, *Salmonella enterica*, and *Cronobacter sakazakii* separately inoculated onto powdered infant formula as a model low-water activity (aw) food was compared during storage at 5, 22, and 35°C. No significant differences in the survival kinetics between *E. coli* O157:H7 and *L. monocytogenes* were observed. *Salmonella* showed significantly higher desiccation tolerance than these pathogens, and *C. sakazakii* demonstrated significantly higher desiccation tolerance than all other three bacteria studied. Thus, the desiccation tolerance was represented as *C. sakazakii* > *Salmonella* > *E. coli* O157:H7 = *L. monocytogenes*. The survival kinetics of each bacterium was mathematically analyzed, and the observed kinetics was successfully described using the Weibull model. To evaluate the variability of the inactivation kinetics of the tested bacterial pathogens, the Monte Carlo simulation was performed using assumed probability distribution of the estimated fitted parameters.

Norovirus

Batch Testing for Noroviruses in Frozen Raspberries

A. De Keuckelaere, D. Li, B. Deliens, A. Stals, M. Uyttendaele

International Journal of Food Microbiology, Vol. 192, 2 January 2015; pp. 43–50, 2015

DOI: 10.1016/j.ijfoodmicro.2014.09.024

Link to full text: [Click here](#)

Significance: The applied protocol for sequencing of the amplicon to confirm the specificity of the real-time reverse transcription PCR signal was successful for GI norovirus amplicons but often failed and provided an inconclusive result for GII norovirus amplicons.

Berries have been associated with multiple norovirus (NoV) outbreaks. In this study, 130 frozen raspberries were collected from 26 batches in four different raspberry processing companies. In two companies, bulk frozen raspberries serving as raw material for raspberry puree were used; in two other companies, bulk individually quick frozen (IQF) raspberries serving as raw material for frozen fruit mixes were used. Enumeration of *Escherichia coli* and coliforms and real-time reverse transcription PCR (RT-qPCR) detection of GI and GII NoV (in 2×10 g) were performed. Six out of 70 samples taken from 14 batches of frozen raspberries serving raspberry puree production provided a NoV RT-qPCR signal confirmed by sequencing. Four of these six positive samples clustered in one batch whereas the other two positive samples clustered in another batch from the same company. All six positive samples showed NoV RT-qPCR signals above the limit of quantification of the RT-qPCR assay and can be classified as insufficient sanitary quality. The mean NoV level in 20 g of these raspberry samples was 4.3 log genomic copies NoV GI/20 g. For the IQF raspberries, one batch out of 12 tested NoV positive, but only 1 out of 5 samples analyzed showed a positive RT-qPCR GI NoV signal confirmed by sequencing. The RT-qPCR signal was < 3.7 log genomic copies/20 g.

Food Allergy

Influence of Early-Life Exposures on Food Sensitization and Food Allergy in an Inner-City Birth Cohort

E.C. McGowan, G.R. Bloomberg, P.J. Gergen, C.M. Visness, K.F. Jaffee, M. Sandel, et al.

Journal of Allergy and Clinical Immunology, Vol. 135, No. 1; pp. 171–178, 2015



DOI: 10.1016/j.jaci.2014.06.033

Link to full text: [Click here](#)

Significance: The cumulative incidence of food allergy in this study was extremely high, especially considering the strict definition of food allergy that was applied and that only 3 common allergens were included.

This study examined sensitization and clinical reactivity or early-life exposures in 516 inner-city children in the Urban Environment and Childhood Asthma birth cohort who were followed through age 5. Household exposures, diet, clinical history, and physical examinations were assessed yearly; levels of specific IgE to milk, egg, and peanut were measured at 1, 2, 3, and 5 years of age. On the basis of sensitization (IgE \geq 0.35 kU/L) and clinical history over the 5-years, children were classified as having food allergy (FA) or being possibly allergic, sensitized but tolerant, or not allergic/not sensitized. Results showed that 55.4% of children were sensitized (milk, 46.7%; egg, 31.0%; and peanut, 20.9%), whereas 9.9% were categorized as having FA (peanut, 6.0%; egg, 4.3%; and milk, 2.7%; 2.5% to >1 food). The remaining children were categorized as possibly allergic (17.0%), sensitized but tolerant (28.5%), and not sensitized (44.6%). Eighteen (3.5%) reported reactions to foods for which IgE levels were not measured. Food-specific IgE levels were similar in children with FA versus sensitized but tolerant children, except for egg, levels of which were higher in patients with FA at ages 1 and 2 years.

Distinct Parameters of the Basophil Activation Test Reflect the Severity and Threshold of Allergic Reactions to Peanut

A.F. Santos, G. Du Toit, A. Douiri, S. Radulovic, A. Stephens, V. Turcanu, et al.
Journal of Allergy and Clinical Immunology, Vol. 135, No. 1; pp. 179–186, 2015

DOI: 10.1016/j.jaci.2014.09.001

Link to full text: [Click here](#)

Significance: CD63 peanut/anti-IgE and CD-sens values can be used to estimate the severity and threshold of allergic reactions during OFCs.

The utility of the basophil activation test (BAT) to predict the severity of the allergic reaction and threshold dose to peanut during oral food challenges (OFCs) was assessed. Skin prick tests, measurements of specific IgE to peanut and its components, and BATs to peanut were performed on the day of the challenge. Of the 124 children submitted to OFCs, 52 (median age, 5 years) reacted with clinical symptoms that ranged from mild oral symptoms to anaphylaxis. Severe reactions occurred in 41% of cases, and 57% reacted to \leq 0.1 g of peanut protein. The ratio of the percentage of CD63+ basophils after stimulation with peanut and after stimulation with anti-IgE (CD63 peanut/anti-IgE) was independently associated with severity, whereas the basophil allergen threshold sensitivity CD-sens ($1/EC_{50} \times 100$, where EC_{50} is half maximal effective concentration) value was independently associated with the threshold of allergic reactions to peanut during OFCs. Patients with CD63 peanut/anti-IgE levels of \geq 1.3 had an increased risk of severe reactions (RR=3.4; 95% CI, 1.8-6.2). Patients with a CD-sens value \geq 84 had an increased risk of reacting to \leq 0.1 g of peanut protein (RR=1.9; 95% CI, 1.3-2.8).

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