ILSI North America

Food Safety Briefs

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E. Coli

Transfer of Escherichia coli O157:H7 from Simulated Wildlife Scat onto Romaine Lettuce during Foliar Irrigation

E.R. Atwill, J.A. Chase, D. Oryang, R.F. Bond, S.T. Koike, M.D. Cahn, et al.

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Link to full text: Click here

Significance: This study quantified the transfer coefficient between scat and adjacent heads of lettuce as a function of irrigation.

A field trial in Salinas Valley, California, was conducted to quantify the microbial load that transfers from wildlife feces onto nearby lettuce during foliar irrigation. Romaine lettuce was grown using standard commercial practices and irrigated using an impact sprinkler design. Five grams of rabbit feces was spiked with 1.29×108 CFU of Escherichia coli O157:H7 and placed - 3, - 2, and - 1 days and immediately before a 2-h irrigation event. Immediately after irrigation, 168 heads of lettuce ranging from ca. 23 to 69 cm (from 9 to 27 in.) from the fecal deposits were collected, and the concentration of E. coli O157:H7 was determined. Thirty-eight percent of the collected lettuce heads had detectable E. coli O157:H7, ranging from 1 MPN to 2.30×105 MPN/head and a mean concentration of 7.37×103 MPN/head. Based on this weighted arithmetic mean concentration of 7.37 × 103 MPN of bacteria/positive head, only 0.00573% of the original 5 g of scat with its mean load of 1.29×108 CFU was transferred to the positive heads of lettuce. Bacterial contamination was limited to the outer leaves of lettuce. Factors associated with the transfer of E. coli O157:H7 from scat to lettuce were distance between the scat and lettuce, age of scat before irrigation, and mean distance between scat and the irrigation sprinkler heads.

Distribution of Escherichia coli Passaged through Processing Equipment during Ground Beef Production Using Inoculated Trimmings

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Significance: Diversion to a safe end point (lethality or rendering) of the positive lot of ground beef, plus the lot before and lot after should remove contaminated ground beef, and as such provides support for the current industry practice.

This study determined how much ground beef sample must be discarded or diverted to lethality treatment when Escherichia coli O157:H7 is detected in the sample. Five 2,000-lb combo bins of beef trimmings were processed into

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10-lb chubs of raw ground beef, wherein the second combo of meat was contaminated with a green fluorescent protein (GFP)–expressing strain of E. coli. The GFP E. coli was tracked through the production of 10-lb chubs and the strain could not be detected after 26.5% more material (500 lb) and 87.8% more material (1,840 lb) followed the contaminated combo at each establishment, respectively. Three-pound loaves were no longer positive after just 8.6% more initially noncontaminated material (72 lb) was processed. The GFP strain could not be detected postprocessing in any residual meat or fat collected from the equipment used in the three trials.

Effect of Proximity to a Cattle Feedlot on Escherichia coli O157:H7 Contamination of Leafy Greens and Evaluation of the Potential for Airborne Transmission

E.D. Berry, J.E. Wells, J.L. Bono, B.L. Woodbury, N. Kalchayanand, K.N. Norman, et al.

Applied and Environmental Microbiology, Vol. 81, No. 3; pp. 1101–1110, 2015

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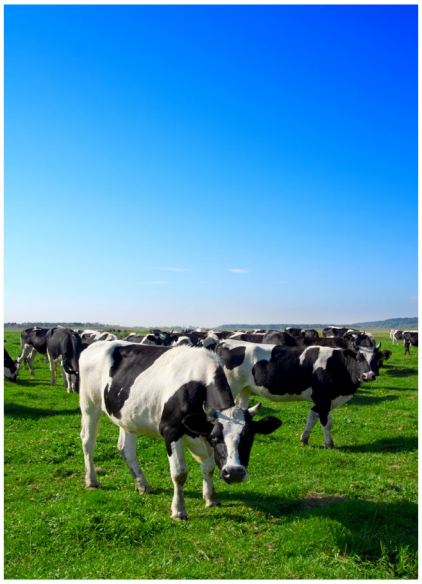
Link to full text: Click here



Significance: Current leafy green field distance guidelines of 120 m may not be adequate to limit the transmission of E. coli O157:H7 to produce crops planted near concentrated animal feeding operations.

The impact of proximity to a beef cattle feedlot on Escherichia coli O157:H7 contamination of leafy greens was examined. Leafy greens (270) and feedlot manure samples (100) were collected six different times from June to September for two years. Both E. coli O157:H7 and total E. coli bacteria were recovered from leafy greens at all plot distances. E. coli O157:H7 was recovered from 3.5% of leafy green samples per plot at 60 m, which was higher than the 1.8% of positive samples per plot at 180 m. Although E. coli O157:H7 was not recovered from air samples at any distance, total E. coli was recovered from air samples at the feedlot edge and all plot distances, indicating that airborne transport of the pathogen can occur. Results suggest that risk for airborne transport of E. coli O157:H7 from cattle production is increased when cattle pen surfaces are very dry and when this situation is combined with cattle management or cattle behaviors that generate airborne dust.

Listeria

Assessing the Survival of Listeria monocytogenes in a Domestic Freezer by Analyzing Subsequent Growth at 30°C Using a Novel Reference Method

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Link to full text: Click here

Significance: This technique could allow easy examination of the effect of frozen storage on given cultures, with respect to the effects of pH, water activity, and preservatives commonly used as extra hurdles in foods.

Listeria monocytogenes is a serious pathogen capable of extensive survival under frozen storage. Using optical density and multiple initial inocula in multiple identically prepared microtiter plates, the effect of storage time (up to 6 mos) at

–22°C on the subsequent growth at 30°C of the organism when defrosted was studied using a technique that compared the growth (through time to detection) of a test plate (previously frozen) with that of an identically prepared control plate, analyzed at the start of the experiment. As storage time increased, there was only a small relative increase in the lag and the variance in the time to detection observed. When compared with storage in 3% salt tryptic soy broth (TSB), which reduced the specific growth rate relative to growth in standard TSB, there were only marginally greater increases in lag and data variance. After 6 months storage in 3% salt TSB, there were some indications of inactivation equivalent to a 50% inactivation.

Salmonella

Modeling the Impact of Vapor Thymol Concentration, Temperature, and Modified Atmosphere Condition on Growth Behavior of Salmonella on Raw Shrimp

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Link to full text: Click here

Significance: This study will provide the food industry with insight into the potential safety risk of Salmonella growth on raw shrimp under stressed conditions.

This research modeled the impact of vapor thymol concentration (0, 0.8, and 1.6 mg/liter), storage temperature (8, 12, and 16°C), and modified atmosphere condition (0.04 as in the natural atmosphere and 59.5% CO2) against the growth behavior of a Salmonella cocktail (six strains) on raw shrimp. Lag time (hour) and maximum growth rate (log CFU/gram/hour), chosen as two growth indicators, were obtained through DMFit software and then developed into polynomial as well as nonlinear modified secondary models (dimensional and/or dimensionless), consisting of two or even three impact factors in the equations. The models were validated, and results showed that the predictive values from both models demonstrated good matches to the observed experimental values, yet the prediction based on lag time was more accurate than maximum growth rate.

Survival of Salmonella on Basil Plants and in Pesto

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Link to full text: Click here

Significance: The dilution of contaminated ingredients and the bactericidal effect of the pesto environment helped to further reduce the level of enteric organisms during storage, which may have applications for food safety.

This study investigated the survival of Salmonella on basil plants and in pesto. A mix of three Salmonella strains (Reading, Newport, and Typhimurium) was inoculated onto basil leaves and pesto and survived during the experimental period. Whereas the mix of Salmonella survived in pesto stored at 4°C for 4 days, Salmonella was recovered from inoculated leaves for up to 18 days at 20 to 22°C. Although the steady decline of Salmonella on leaves and in pesto suggests

a lack of growth, it appears that pesto is a hostile environment for Salmonella because the rate of decline in pesto was faster (0.29 log CFU/g/day) than on leaves (0.11 log CFU/g/day).

Foodborne Pathogens

Survival of Salmonella, Escherichia coli O157:H7, and Listeria monocytogenes on Raw Peanut and Pecan Kernels Stored at –24, 4, and 22°C

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Link to full text: Click here

Significance: In most cases during storage, pathogen counts obtained from pecans were higher than from peanuts.

Cocktails of lawn-collected cells were used to determine the survival of Salmonella, Escherichia coli O157:H7, and Listeria monocytogenes on the surface of raw peanut and pecan kernels. Kernels were inoculated with mixtures of four to five strains at 3 or 6 log CFU/g, dried at room temperature, and then stored at –24 ± 1, 4 ± 2, and 22 ± 1°C for 28 or 365 days. At 6 log CFU/g, populations of all pathogens were reduced by 0.5 to 1.6 log CFU/g during an initial 3-day drying period on both peanuts and pecans. The moisture content of peanuts and pecans remained stable at –24 ± 1 and 22 ± 1°C; at 4 ± 2°C, the moisture content increased from 3.8 to 5.6% on peanuts and from 2.6 to 3% on pecans over 365 days. Pathogen populations were stable on pecans stored under frozen and refrigerated conditions, except for L. monocytogenes, which declined at a rate of 0.03 log CFU/g/30 days at 4 ± 2°C. Salmonella populations were stable on peanuts stored at –24 ± 1 and 4 ± 2°C, but E. coli O157:H7 and L. monocytogenes declined at rates of 0.03 to 0.12 log CFU/g/30 days. At 22 ± 1°C, Salmonella, E. coli O157:H7, and L. monocytogenes declined at a rate of 0.22, 0.37, and 0.59 log CFU/g/30 days, respectively, on peanuts, and at 0.15, 0.34, and 1.17 log CFU/g/30 days, respectively, on pecans.

Food Allergy

Randomized Trial of Peanut Consumption in Infants at Risk for Peanut Allergy

G. Du Toit, G. Roberts, P.H. Sayre, H.T. Bahnson, S. Radulovic, A.F. Santos, et al. for the LEAP Study Team

New England Journal of Medicine, Vol. 372, No. 9; pp. 803–813, 2015

doi: 10.1056/NEJMoa1414850

Link to full text: Click here

Significance: The early introduction of peanuts significantly decreased the frequency of the development of peanut allergy among children at high risk for this allergy and modulated immune responses to peanuts.

This study evaluated strategies of peanut consumption and avoidance to determine which strategy is most effective in preventing the development of peanut allergy (PA) in 640 infants at high risk for the allergy. Participants with severe eczema, egg allergy, or both were randomly assigned to consume or avoid peanuts until 60 months of age. Participants, who were ≥4 months but <11 months

of age at randomization, were assigned to separate study cohorts on the basis of preexisting sensitivity to peanut extract. The primary outcome, which was assessed independently in each cohort, was the proportion of participants with PA at 60 months of age. Among the 530 infants in the intention-to-treat population who initially had negative results on the skin-prick test, the prevalence of PA at 60 months of age was 13.7% in the avoidance group (AG) and 1.9% in the consumption group (CG) (P<0.001). Among the 98 participants in the intention-to-treat population who initially had positive test results, the prevalence of PA was 35.3% in the AG and 10.6% in the CG (P=0.004). There was no significant between-group difference in the incidence of serious adverse events. Increases in levels of peanut-specific IgG4 antibody occurred predominantly in the CG; a greater percentage of participants in the AG had elevated titers of peanut-specific IgE antibody. A larger wheal on the skin-prick test and a lower ratio of peanut-specific IgG4:IgE were associated with PA.

Comparison of Six Commercial ELISA Kits for Their Specificity and Sensitivity in Detecting Different Major Peanut Allergens

S. Jayasena, M. Smits, D. Fiechter, A. de Jong, J. Nordlee, J. Baumert, et al.

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doi: 10.1021/jf504741t

Link to full text: Click here

Significance: Although Ara h 2 and Ara h 6 are known to be heat stable and more potent allergens, antisera specific to any of the four peanut proteins/allergens may serve as good markers for the detection of peanut residues.

Six commercial peanut enzyme-linked immunosorbent assay kits were assessed for their ability to recover peanut from the standard reference material 2387 peanut butter and also for their specificity in detecting four major peanut allergens, Ara h 1, Ara h 2, Ara h 3, and Ara h 6. The percentage recovery of peanut from peanut butter differed across different kits as well as at different sample concentrations. The highest recovery was observed with the Romer and R-Biopharm kits, while four other kits were found to underestimate the protein content of the reference peanut butter samples. Five of the kits were most sensitive in detecting Ara h 3 followed by Ara h 1, while hardly recognizing Ara h 2 and Ara h 6. The other kit showed the highest sensitivity to Ara h 2 and Ara h 6, while Ara h 1 and Ara h 3 were poorly recognized.

Heavy Metals

Postharvest Correlation between Swordfish (Xiphius gladius) Size and Mercury Concentration in Edible Tissues

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Significance: The models presented in this report give regulators valuable postharvest tools to use for rapid determination of the safety of swordfish intended for sale in commercial markets.

Total mercury was measured via thermal decomposition amalgamation atomic absorption spectroscopy in the muscle tissue of 82 swordfish originating in the Pacific Ocean and was found to range from 228 to 2,090 ppb. The relationships

between total mercury concentration and the size of the fish were analyzed. It was found that dressed weight (DW) was a better predictor of mercury concentration than cleithrum-to-caudal keel length in a single variable model, and DW was the only significant predictor of mercury concentration in a multivariable model. Based on these relationships, swordfish with a DW >96.4 kg (95% CI, 88 to 107 kg) will exceed 1,000 ppb of mercury—the action level in the United States, Canada, and Europe—and should not be sold in commercial markets. Additionally, a logistic regression model was created to illustrate the probability of a swordfish at any DW being unsafe to consume (i.e., containing more than 1,000 ppb of mercury). In this model, the probability of a swordfish being unsafe exceeds the probability of being safe at 94.6 kg.

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