ILSI North America

# Food Safety Briefs

## October 2015

### Salmonella

**Survival of Salmonella enterica in Dried Turkey Manure and Persistence on Spinach Leaves**

*R.A. Oni, M. Sharma, R.L. Buchanan*

*Journal of Food Protection*, Vol. 78, No. 10; pp. 1791–1799, 2015

doi: 10.4315/0362-028X.JFP-15-047

Link to full text: Click here

**Significance:** Aerosolized manure particles could be a potential vehicle for Salmonella dispersal to leafy greens if the microorganism is present in the dry manure.

This study investigated the survival of Salmonella enterica in dust particles of dehydrated turkey manure and how association with manure dust may enhance the survival of salmonellae on leafy greens in the field. The survival of a cocktail of multiple Salmonella serotypes in the dried fecal material of various particle sizes (125 to 500 µm) was examined at varying moisture contents (5, 10, and 15%). Survival times of the pathogen were inversely related to moisture content and particle size of manure dust, with viable Salmonella still detectable for up to 291 days in the smallest particle size (125 µm) with 5% moisture. Association with manure dust particles increased the survival of Salmonella when subjected to UV light both under laboratory conditions and on the surface of spinach leaves in a greenhouse setting.

**Exposure of Salmonella enterica Serovar Typhimurium to Three Humectants Used in the Food Industry Induces Different Osmoadaptation Systems**

*S. Finn, L. Rogers, K. Händler, P. McClure, A. Amézquita, J.C.D. Hinton, et al.*

*Applied and Environmental Microbiology*, Vol. 81, No. 19; pp. 6800–6811, 2015

doi: 10.1128/AEM.01379-15

Link to full text: Click here

**Significance:** The response of Salmonella Typhimurium to different humectants does not simply reflect reduced water activity and likely involves systems that are linked to specific humectants.

This study examined the response of Salmonella enterica serovar Typhimurium 4/74 to NaCl, KCl, and glycerol at three time points, using a constant water activity level, compared with the response of a control inoculum. All conditions induced the upregulation of gluconate metabolic genes after 6 h of exposure. Bacteria exposed to NaCl and KCl demonstrated the upregulation of the osmoprotective transporter mechanisms encoded by the proP, proU, and osmU (STM1491 to STM1494) genes. Glycerol exposure elicited the downregulation of these osmoadaptive mechanisms but stimulated an increase in lipopolysaccharide and membrane protein-associated genes after 1 h. The most extensive changes in gene


**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

expression occurred following exposure to KCl. Because many of these genes were of unknown function, further characterization may identify KCl-specific adaptive processes that are not stimulated by NaCl.

## Listeria

### Behavior of Listeria monocytogenes in Sliced Ready-to-Eat Meat Products Packaged under Vacuum or Modified Atmosphere Conditions

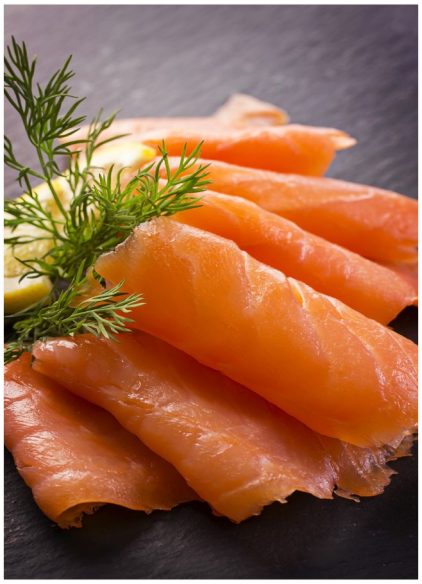
*R.A. Menéndez, E. Rendueles, J.V. Sanz, R. Capita, C. García-Fernández*

*Journal of Food Protection*, Vol. 78, No. 10; pp. 1891–1895, 2015

doi: 10.4315/0362-028X.JFP-15-103

Link to full text: Click here

**Significance:** Vacuum or modified atmosphere conditions may be of use for enhancing the safety of ready-to-eat meat products.



This study determined the behavior of Listeria monocytogenes in three types of sliced ready-to-eat meat products packaged under vacuum or modified atmosphere conditions and stored at three temperatures. Slices of about 25 g of chorizo (a fermented dry pork sausage), jamón (cured ham), and cecina (a salted, dried beef product) were inoculated with L. monocytogenes NCTC 11994. Slices were packaged in a vacuum or in a modified atmosphere (20% CO2, 80% N2). After packaging, samples were stored for 6 months at three temperatures: 3, 11, or 20°C. Microbiological analyses were performed after 0, 1, 7, 15, 30, 45, 90, and 180 days of storage. The type of meat product, the type of packaging, the temperature, and the day of storage all influenced microbial levels ($P < 0.001$). L. monocytogenes counts decreased throughout the course of storage in samples of chorizo (quick decrease) and jamón (gradual decrease). In cecina samples, counts of L. monocytogenes increased from day 0 to day 1 of storage and then remained constant until day 90 of the study.

### Transcriptomic Analysis of the Adaptation of Listeria monocytogenes to Growth on Vacuum-Packed Cold Smoked Salmon

*S. Tang, R.H. Orsi, H.C. den Bakker, M. Wiedmann, K.J. Boor, T.M. Bergholz*

*Applied and Environmental Microbiology*, Vol. 81, No. 19; pp. 6812–6824, 2015

doi: 10.1128/AEM.01752-15

Link to full text: Click here

**Significance:** Specific transcriptional profiles of Listeria monocytogenes growing on vacuum-packaged cold smoked salmon were identified, which may provide targets for the development of novel and improved strategies to control L. monocytogenes growth on this ready-to-eat food.

Transcriptome sequencing (RNA-seq) was used to understand the transcriptional landscape of Listeria monocytogenes strain H7858 grown on cold smoked salmon (CSS; water phase salt, 4.65%; pH 6.1) relative to that in modified brain heart infusion broth (MBHIB; water phase salt, 4.65%; pH 6.1) at 7°C. Significant differential transcription of 149 genes was observed (false-discovery rate [FDR], <0.05; fold change, ≥2.5), and 88 and 61 genes were up- and downregulated, respectively, in H7858 grown on CSS relative to the genes in H7858 grown in MBHIB. In spite of these differences in transcriptomes under these two conditions, growth parameters for L. monocytogenes were not significantly different between CSS and MBHIB,

indicating that the transcriptomic differences reflect how L. monocytogenes is able to facilitate growth under these different conditions. Differential expression analysis and Gene Ontology enrichment analysis indicated that genes encoding proteins involved in cobalamin biosynthesis as well as ethanolamine and 1,2-propanediol utilization have significantly higher transcript levels in H7858 grown on CSS than in that grown in MBHIB.

### Application of a Novel Antimicrobial Coating on Roast Beef for Inactivation and Inhibition of Listeria Monocytogenes During Storage

*L. Wang, L. Zhao, J. Yuan, T.Z. Jin*

*International Journal of Food Microbiology,* Vol. 211, 15 October 2015; pp. 66–72, 2015

doi: 10.1016/j.ijfoodmicro.2015.07.007

Link to full text: Click here

**Significance:** The effect of the novel antimicrobial solution was dependent on both the initial inoculation levels and storage times.

The antilisterial efficacy of novel coating solutions made with organic acids, lauric arginate ester, and chitosan was evaluated in a three-stage study on inoculated roast beef. The meat surface was inoculated with five-strain Listeria monocytogenes cocktail inoculums at two different levels, ~ 3 and 6 Log CFU/cm$^2$ and treated with the stock solution (HAMS), the 1:5 diluted solution (MAMS), and the 1:10 diluted solution (LAMS) (stage 1). During the 20 min contact time, the antimicrobial coatings reduced the Listeria populations by approximately 0.9–0.3 Log CFU/cm$^2$. The higher the concentrations of the antimicrobial solution, the better the antilisterial effects. The treated inoculated beef samples were then stored at 4°C for 30 days. While no growth was seen from the HAMS-treated samples, the MAMS-treated, LAMS-treated, and NoAMS-treated samples showed increases of 1.6 Log CFU/cm$^2$, 4.6 Log CFU/cm$^2$, and 5.7 Log CFU/cm$^2$, respectively, on Day 30 (~ 3 Log CFU/cm$^2$ inoculation level). In stage 2, the impact of the roast beef storage time on solution's antilisterial effect was evaluated. In stage 3, the effect of the antimicrobial solution on roast beef quality was studied and minor changes in color, pH, and water activity were found.

## E. Coli

### Proliferation of Escherichia coli O157:H7 in Soil-Substitute and Hydroponic Microgreen Production Systems

*Z. Xiao, G. Bauchan, L. Nichols-Russell, L. Luo, Q. Wang, X. Nou*

*Journal of Food Protection*, Vol. 78, No. 10; pp. 1785–1790, 2015

doi: 10.4315/0362-028X.JFP-15-063

Link to full text: Click here

**Significance:** Contaminated seeds led to systematic contamination of whole plants, including both edible and inedible parts, and seed coats remained the focal point of E. coli O157:H7 survival and growth throughout the period of microgreen production.

Radish (Raphanus sativus var. longipinnatus) microgreens were produced from seeds inoculated with Escherichia coli O157:H7 by using peat moss–based soil-substitute and hydroponic production systems. E. coli populations on the edible and inedible parts of harvested microgreen plants (7 days postseeding) and

in growth medium were examined. E. coli O157:H7 was shown to survive and proliferate significantly during microgreen growth in both production systems, with a higher level in the hydroponic production system. At the initial seed inoculation level of 3.7 log CFU/g, E. coli O157:H7 populations on the edible part of microgreen plants reached 2.3 and 2.1 log CFU/g (overhead irrigation and bottom irrigation, respectively) for microgreens from the soil-substitute production system and reached 5.7 log CFU/g for those hydroponically grown. At a higher initial inoculation of 5.6 log CFU/g seeds, the corresponding E. coli O157:H7 populations on the edible parts of microgreens grown in these production systems were 3.4, 3.6, and 5.3 log CFU/g, respectively.

## Norovirus

### Recovery and Disinfection of Two Human Norovirus Surrogates, Feline Calicivirus and Murine Norovirus, from Hard Nonporous and Soft Porous Surfaces

*T. Yeargin, A. Fraser, G. Huang, X. Jiang*

*Journal of Food Protection*, Vol. 78, No. 10; pp. 1842–1850, 2015

doi: 10.4315/0362-028X.JFP-14-515

Link to full text: Click here

**Significance:** Both virus and surface types significantly influence recovery efficiency and disinfection efficacy.

In this study, both the recovery and inactivation of two human norovirus surrogates, feline calicivirus (FCV) and murine norovirus (MNV), on hard nonporous surfaces (glass) and soft porous surfaces (polyester and cotton) were evaluated by both plaque assay and reverse transcription quantitative PCR method. Two disinfectants, sodium hypochlorite (8.25%) and accelerated hydrogen peroxide (AHP, at 4.25%) were evaluated for disinfection efficacy. FCV at an initial titer of ca. 7 log PFU/ml was recovered from glass, cotton, and polyester at 6.2, 5.4, and 3.8 log PFU/ml, respectively, compared with 5.5, 5.2, and 4.1 log PFU/ml, respectively, for MNV with an initial titer of ca. 6 log PFU/ml. The use of sodium hypochlorite (5,000 ppm) was able to inactivate both FCV and MNV (3.1 to 5.5 log PFU/ml) below the limit of detection on all three surface types. AHP (2,656 ppm) inactivated FCV (3.1 to 5.5 log PFU/ml) below the limit of detection for all three surface types but achieved minimal inactivation of MNV (0.17 to 1.37 log PFU/ml). Reduction of viral RNA by sodium hypochlorite corresponded to 2.72 to 4.06 log reduction for FCV and 2.07 to 3.04 log reduction for MNV on all three surface types. Reduction of viral RNA by AHP corresponded to 1.89 to 3.4 log reduction for FCV and 0.54 to 0.85 log reduction for MNV.

### Attachment and Localization of Human Norovirus and Animal Caliciviruses in Fresh Produce

*E. DiCaprio, A. Purgianto, Y. Ma, J. Hughes, X. Dai, J. Li*

*International Journal of Food Microbiology,* Vol. 211, 15 October 2015; pp. 101–108, 2015

doi: 10.1016/j.ijfoodmicro.2015.07.013

Link to full text: Click here

**Significance:** Washing with 200 ppm chlorine is ineffective in removing human norovirus from fresh produce, and different viruses vary in their localization patterns to different varieties of fresh produce.

The attachment of human norovirus and animal caliciviruses (murine norovirus, MNV-1; Tulane virus, TV) to fresh produce was evaluated, using both visualization and viral enumeration techniques. It was found that a human NoV GII.4 strain attached efficiently to Romaine lettuce leaves and roots and green onion shoots, and that washing with PBS or 200 ppm of chlorine removed <0.4 log of viral RNA copies from the tissues. In contrast, TV and MNV-1 bound more efficiently to Romaine lettuce leaves than to the roots, and simple washing removed <1 log of viruses from the lettuce leaves and 1–4 log PFU of viruses from roots. The location of virus particles in fresh produce was visualized using a fluorescence-based Quantum Dots (Q-Dots) assay and confocal microscopy. It was found that human NoV virus-like particles (VLPs), TV, and MNV-1 associated with the surface of Romaine lettuce and were found aggregating in and around the stomata. In green onions, human NoV VLPs were found between the cells of the epidermis and cell walls of both the shoots and roots. However, TV and MNV-1 were found to be covering the surface of the epidermal cells in both the shoots and roots of green onions.

### Ultraviolet-C Efficacy Against a Norovirus Surrogate and Hepatitis A Virus on a Stainless Steel Surface

*S.Y. Park, A-N. Kim, K-H. Lee, S-D. Ha*

*International Journal of Food Microbiology,* Vol. 211, 15 October 2015; pp. 73–78, 2015

doi: 10.1016/j.ijfoodmicro.2015.07.006

Link to full text: Click here

**Significance:** Low doses of ultraviolet radiation light on food contact surfaces could be effective to inactivate human norovirus and hepatitis A in restaurant, institutional, and industrial kitchens and facilities.

The effects of 10–300 mWs/cm$^2$ of ultraviolet radiation (UV-C) at 260 nm were investigated for the inactivation of two foodborne viruses: murine norovirus-1 (MNV-1; a human norovirus [NoV] surrogate) and hepatitis A virus (HAV). An experimentally contaminated stainless steel surface was used to examine the effects of low doses of UV-C radiation on MNV-1 and HAV titers. The modified Gompertz equation was used to generate non-linear survival curves and calculate dR-values as the UV-C dose of 90% reduction for MNV-1 ($R^2$ = 0.95, RMSE = 0.038) and HAV ($R^2$ = 0.97, RMSE = 0.016). Total MNV-1 and HAV titers significantly decreased ($p<0.05$) with higher doses of UV-C. MNV-1 and HAV were reduced to 0.0–4.4 and 0.0–2.6 log10PFU/ml, respectively, on the stainless steel surfaces by low-dose UV-C treatment. The dR-value, 33.3 mWs/cm2 for MNV-1 was significantly lower than 55.4 mWs/cm$^2$ of HAV. Therefore, the present study shows that HAV is more resistant to UV-C radiation than MNV-1.





## 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