



## Research Project: Validation of the Effect of Interventions and Processes on Persistence of Pathogens on Foods

**Location:** [Microbial Food Safety Research Unit](#)

**Title #1:** *Viability of Listeria monocytogenes on boneless, fully-cooked hams prepared without lactates and packaged in fibrous casings that were subsequently surface treated with lauric arginate using the SLIC® delivery method*

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**Publication Date:** May 17, 2009

**Abstract:**

Several studies have demonstrated lethality of lauric arginate (LAE) against *Listeria monocytogenes* (Lm) when applied directly to the surface of ready-to-eat (RTE) meat and poultry products including frankfurters, ham, deli-turkey, and roast beef logs. However, relatively little is known about the effect, if any, that the product casing may have on the antilisterial potential of LAE. Thus, the present study evaluated the viability of Lm on retail hams prepared without lactates and packaged in a fibrous casing following surface treatment with a 7.5- or 15-mL volume of a 5% or 10% concentration of CytoGuard (trademark) mixed in a carrier solution during subsequent refrigerated storage. Each ham (ca. 4,000 g each, ca. 180 inches squared) was surface inoculated with ca. 7.0 log<sub>10</sub> CFU/ham of a five-strain mixture of Lm using the sprayed lethality in container (SLIC®) delivery method. Three hams per treatment per sampling interval were evaluated. The product was massaged by hand for ca. 20 S to ensure for adequate coverage of the pathogen. The antimicrobial was pipetted into the corner of each package before the product was vacuum sealed, submerged in a hot water bath at 88 deg C for 3-5 S, and stored at 4 deg C. After 2 and 24 hr the pathogen was enumerated using the USDA package rinse/recovery method. Pathogen counts were lowered by 3 to 6 log<sub>10</sub> CFU/ham when treated with 7.5 mL of 5% or 15 mL of 10% LAE solution, respectively. These data validate that LAE is effective at appreciably reducing levels of Lm on boneless, fully-cooked hams within a fibrous casing during refrigerated storage.

**Citation:** Smith, J.L., Oser, A., Porto Fett, A.C., Call, J.E., Luchansky, J.B. 2009. Viability of *Listeria monocytogenes* on boneless, fully-cooked hams prepared without lactates and packaged in fibrous casings that were subsequently surface treated with lauric arginate using the SLIC® delivery method. Meeting Abstract. (P-105-P434).



**Title #2:** *Viability of Listeria monocytogenes surface inoculated onto slices of pork scrapple during storage at 4 Degrees, 10 Degrees, and 21 Degrees C*

**Publication Date:** May 17, 2009

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**Technical Abstract:** We evaluated the fate of *Listeria monocytogenes* on scrapple, a regionally-popular, ready-to-eat (RTE) savory mush of pork trimmings, cornmeal, and flour. We also conducted an informal survey to address consumer practices for storing and reheating scrapple. Regarding the survey, of some 125 consumers who responded, about half of the respondents (48%; 51 of 107) consider scrapple as RTE, almost all (87%; 84 of 97) store it in the refrigerator, typically for 2 to 60 days before eating, and almost all (87%; 110 of 126) prefer to re-heat it prior to consumption, with most respondents (75%; 95 of 126) reheating scrapple by pan frying it for 2.5 to 10 minutes per side at a medium to high temperature setting. Regarding pathogen behavior on scrapple, in each of three trials, slices (ca. 5.5 cm wide x 6.0 cm long x 1.0 cm thick; ca. 50 g each) of commercial scrapple made with pork were surface inoculated with ca. 2.0 log<sub>10</sub> CFU/g of a five-strain cocktail of *L. monocytogenes* and placed in nylon-polythene bags that were vacuum-sealed and held at 4 degrees, 10 degrees, and 21 degrees C for 60, 21, and 9 days, respectively. For scrapple stored at 4 deg, 10 deg and 21 deg C pathogen levels increased at a greater rate as temperature increased, with pathogen numbers increasing from 1.9 log<sub>10</sub> CFU/g to 7.8, 9.5, and 9.9 log<sub>10</sub> CFU/g, respectively, by the end of the storage period. These data suggest that scrapple could provide a favorable environment for the subsequent outgrowth of *L. monocytogenes* on the rare occasion that post-process contamination might occur. These data also highlight the importance of proper storage and handling of scrapple and suggest that further studies may be warranted to validate the reheating conditions practiced by those who responded to our survey to establish preferred time/temperature guidelines for reheating scrapple to further lessen the likelihood of listeriosis.

**Citation:** Adekunle, A., Porto Fett, A.C., Call, J.E., Shoyer, B.A., Gartner, K., Tufft, L., Luchansky, J.B. 2009. Viability of *Listeria monocytogenes* surface inoculated onto slices of pork scrapple during storage at 4 Degrees, 10 Degrees, and 21 Degrees C. Meeting Abstract. (P-044-P421).



**Title #3:** *Behavior of Listeria monocytogenes on frankfurters surface treated with lauric arginate and/or a liquid smoke extract delivered using the Sprayed Lethality in Container (SLIC®) technology*

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**Publication Date:** May 17, 2009

**Technical Abstract:** The objective of this study was to determine the viability of *Listeria monocytogenes* (LM) on commercially-produced frankfurters prepared without lactates that were surface treated with 0 or 4 mL of a blend of LAE (CytoGuard; 1.0% LAE final concentration) diluted in a concentrated liquid smoke extract, or LAE alone (1.0% LAE in dH<sub>2</sub>O), or the smoke extract alone. Each package of 10 links (ca. 454 grams) was surface inoculated with ca. 3.0 log<sub>10</sub> CFU/package of a five-strain mixture of Lm using the Sprayed Lethality In Container (SLIC®) technology. The package was then massaged by hand for ca. 20 seconds, the antimicrobial solutions were delivered by pipett into the corner of each package, and each package was vacuum sealed and stored at 4 degrees C for up to 120 days. The pathogen was enumerated throughout storage using the USDA package rinse/recovery method and three packages per treatment per sampling interval in each of two trials. Compared to inoculated but untreated controls, pathogen numbers in packages treated with 4 mL of the LAE and smoke blend, LAE alone, or smoke extract alone decreased by ca. 2.0, 1.2, and 0.7 log<sub>10</sub> CFU/package, respectively, within 24 h. For the next 30 days Lm numbers remained relatively unchanged in treated samples, but increased by 1.0 log<sub>10</sub> CFU/package in untreated packages. From day 30 to day 65 pathogen numbers increased ca. 2.2, 2.5, and 3.9 log<sub>10</sub> CFU/package in the LAE and smoke blend, LAE alone, and control treatments, respectively, while counts decreased 0.2 log<sub>10</sub> CFU/package when treated with smoke extract alone. At day 120, maximum population densities achieved were 11.2, 9.0, 9.4, and 7.0 log<sub>10</sub> CFU/package in the control, LAE and smoke blend, LAE alone, and smoke extract alone treatments, respectively. Compared to untreated samples, these data validate that LAE alone, smoke extract alone, or a blend of these two food grade chemicals are effective at inhibiting Lm during extended refrigerated storage of lactate-free frankfurters.

**Citation:** Smith, J.L., Oser, A., Luchansky, J.B. 2009. Behavior of *Listeria monocytogenes* on frankfurters surface treated with lauric arginate and/or a liquid smoke extract delivered using the Sprayed Lethality in Container (SLIC®) technology. Meeting Abstract. P-119



**Title #4:** *Behavior of Escherichia Coli O157:h7, Listeria Monocytogenes, and Salmonella Typhimurium in Teewurst, a Raw Spreadable Sausage*

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**Publication Date:** April 1, 2009

**Interpretive Summary:** Escherichia coli O157:H7, Listeria monocytogenes, and Salmonella Typhimurium are bacterial pathogens that have been associated with outbreaks of illness in a variety of meat products. Teewurst is a traditional sausage of Germanic origin that is made with raw pork and beef and is characterized by a soft and spreadable texture. Recently, consumption of teewurst has caused illness due to the presence of Escherichia coli O157:H7 and Listeria monocytogenes in the product. Thus, this study was conducted to examine the behavior of these three pathogens placed either into teewurst batter or onto the surface of the finished product that were then stored at refrigeration and abuse temperatures. The results showed that when the pathogens were placed into the batter, in general, the higher the storage temperature, the greater the reduction in pathogen levels. When placed onto the surface of sliced finished product, the results also showed a significant decrease for E. coli O157:H7, S. Typhimurium, and L. monocytogenes, respectively, over the course of about a month. Our data establish that teewurst does not support growth of these pathogens.

**Technical Abstract:** The fate of Listeria monocytogenes, Salmonella Typhimurium, or Escherichia coli O157:H7 were separately monitored both in and on teewurst, a traditional raw and spreadable sausage of Germanic origin. Multi-strain cocktails of each pathogen (ca. 5.0 log CFU/g) were used to separately inoculate teewurst that was stored at 1.5 degree, 4 degree, 10 degree, and 21 degree C. When inoculated into commercially-prepared batter just prior to stuffing, in general, the higher the storage temperature, the greater the reduction in pathogen levels. Depending on the storage temperature,



pathogen levels in the batter decreased by 2.3 to 3.4, ca. 3.8, and 2.2 to 3.6 log CFU/g for *E. coli* O157:H7, *S. Typhimurium*, and *L. monocytogenes*, respectively, during storage for 30 days. When inoculated onto both the top and bottom faces of sliced commercially-prepared finished product, the results for all four temperatures showed a decrease of 0.9 to 1.4, 1.4 to 1.8, and 2.2 to 3.0 log CFU/g for *E. coli* O157:H7, *S. Typhimurium*, and *L. monocytogenes*, respectively, over the course of 21 days. With the possible exceptions for salt and carbohydrate levels, chemical analyses of teewurst purchased from five commercial manufacturers revealed only subtle differences in proximate composition for this product type. Our data establish that teewurst does not provide a favourable environment for the survival of *E. coli* O157:H7, *S. Typhimurium*, or *L. monocytogenes* inoculated either into or onto the product.

**Citation:** Dourou, D., Porto Fett, A.C., Shoyer, B.A., Call, J.E., Nychas, G.E., Illg, E.K., Luchansky, J.B. 2009. BEHAVIOR OF ESCHERICHIA COLI O157:H7, LISTERIA MONOCYTOGENES, AND SALMONELLA TYPHIMURIUM IN TEEWURST, A RAW SPREADABLE SAUSAGE. *International Journal of Food Microbiology*. 130 245-250.