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North America

# Food Safety Briefs

March 2015

## E. coli

### Antimicrobial Interventions for O157:H7 and Non-O157 Shiga Toxin-Producing Escherichia coli on Beef Subprimal and Mechanically Tenderized Steaks

Y.-T. Liao, J.C. Brooks, J.N. Martin, A. Echeverry, G.H. Loneragan, M.M. Brashears

*Journal of Food Protection*, Vol. 78, No. 3; pp. 511–517, 2015

DOI: 10.4315/0362-028X.JFP-14-178

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

**Significance:** The reduction of pathogens on surface populations was not sufficient enough to eliminate the pathogen's detection following vacuum storage, mechanical tenderization, and cooking.

The objectives of this study were to: (1) evaluate effects of the spray treatments—ambient water, 5% lactic acid (LA), 200 ppm of hypobromous acid (HA), and 200 ppm of peroxyacetic acid (PA)—on the reduction of Escherichia coli O157:H7 or non-O157 Shiga toxin-producing E. coli (STEC) (O26, O103, O111, and O145) with high (106 log CFU/50 cm<sup>2</sup>) or low (102 log CFU/50 cm<sup>2</sup>) levels on beef subprimals after vacuum storage for 14 days and (2) evaluate the association of the antimicrobial treatments and cooking (50 or 70°C) on the reduction of the pathogens in blade-tenderized steaks. Treatment effects were only observed on samples taken immediately after spray intervention following inoculation with a high level of O157:H7. The LA and PA treatments significantly reduced low-inoculated non-O157 STEC after spray intervention and resulted in significant reductions of non-O157 STEC on the low-inoculated samples after storage. Although cooking effectively reduced the detection of pathogens in internal steak samples, internalized E. coli O157:H7 and non-O157 STEC were able to survive in steaks cooked to a medium degree of doneness (70°C).

### Transmission of Escherichia coli O157:H7 to Internal Tissues and Its Survival on Flowering Heads of Wheat

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*Journal of Food Protection*, Vol. 78, No. 3; pp. 518–524, 2015

DOI: 10.4315/0362-028X.JFP-14-298

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

**Significance:** This study demonstrated the ability of E. coli O157:H7 to reach the phylloplane in wheat.

The study determined (1) whether Escherichia coli O157:H7 could be translocated into the internal tissues of wheat (*Triticum aestivum*) seedlings from contaminated seed, soil, or irrigation water and (2) whether the bacterium could survive on flowering wheat heads. One hundred plants per treatment were

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sown in pot trays with 50 g of autoclaved soil or purposely contaminated soil, watered every day with 5 ml of water, and harvested 9 days postinoculation. In a fourth experiment, flowering wheat heads were spray inoculated with water containing 4.19 log CFU/ml *E. coli* O157:H7 and analyzed for survival after 15 days, near the harvest period. Results showed that internalization was possible using contaminated seed, soil, and irrigation water in wheat seedlings, with internalization rates of 2, 5, and 10%, respectively. In the head contamination experiment, all samples tested positive, showing the ability of *E. coli* O157:H7 to survive on the wheat head.

### Airborne Dissemination of *Escherichia coli* in a Dairy Cattle Farm and its Environment

S. Sanz, C. Olarte, R. Martínez-Olarte, E.V. Navajas-Benito, C.A. Alonso, S. Hidalgo-Sanz, et al.

*International Journal of Food Microbiology*, Vol. 197; pp. 40–44, 2015

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

**Significance:** The comparison of genetic profiles suggested that the strains isolated from inside and outside the farm were related, leading to the conclusion that the air is an important vehicle for *E. coli* dissemination.



The airborne dissemination of *Escherichia coli* from the inside of a dairy cattle farm to the immediate environment was investigated. The air samples were taken inside the farm (area 0) and from the immediate outside farm surroundings at distances of 50, 100 and 150 m in four directions (north, south, east, and west), at different heights (40 cm, 70 cm and 1 m) and in November and July. *E. coli* was isolated in both inside and outside air, even in samples taken 150 m from the farm. A seasonal effect was observed with more bacterial isolates when temperature was higher. Regarding the distribution of the isolates, wind direction appeared as a determining factor. In order to verify that *E. coli* strains isolated from animal housing facilities were identical to those isolated from the air of the immediate farm environment, their genomic DNA profiles were analyzed by pulsed-field gel electrophoresis (PFGE) after digestion with the endonuclease XbaI.

### Salmonella

#### Fate of *Salmonella enterica* in a Mixed Ingredient Salad Containing Lettuce, Cheddar Cheese, and Cooked Chicken Meat

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*Journal of Food Protection*, Vol. 78, No. 3; pp. 491–497, 2015

DOI: 10.4315/0362-028X.JFP-14-187

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

**Significance:** Rapid growth of bacterial enteric pathogens may occur in mixed ingredient salads; therefore, strict temperature control during the manufacture, distribution, handling, and storage of these products is critical.

A model system was developed to examine the fate of *Salmonella enterica* (inoculum consisting of *S. enterica* serovars Agona, Typhimurium, Enteritidis, Brandenburg, and Kentucky) on the surface of romaine lettuce tissues incubated alone and in direct contact with Cheddar cheese or cooked chicken. *S. enterica* survived but did not grow on lettuce tissues incubated alone or in contact with

Cheddar cheese for 6 days at either 6 or 14°C. In contrast, populations increased from  $2.01 \pm 0.22$  to  $9.26 \pm 0.22$  CFU/cm<sup>2</sup> when lettuce washed in water was incubated in contact with cooked chicken at 14°C. Populations on lettuce leaves were reduced to  $1.28 \pm 0.14$  CFU/cm<sup>2</sup> by washing with a chlorine solution (70 ppm of free chlorine) but increased to  $8.45 \pm 0.22$  CFU/cm<sup>2</sup> after 6 days at 14°C. Experimentation with a commercial product in which one third of the fresh-cut romaine lettuce was replaced with inoculated lettuce revealed that *S. enterica* populations increased by 4 log CFU/g during storage for 3 days at 14°C.

### Evaluation of the Effects of a Mixture of Organic Acids and Duration of Storage on the Survival of Salmonella on Turkey Carcasses

A. Mikołajczyk

*Journal of Food Protection*, Vol. 78, No. 3; pp. 585–589, 2015

DOI: 10.4315/0362-028X.JFP-14-135

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

**Significance:** Treatment of raw turkey breasts with a mixture of organic acids is a promising option for reducing the risk of the presence of Salmonella.

The first part of the study concerned analysis of the influence of the mixtures of organic acids (acetic, ascorbic, citric, lactic, and tartaric) over 15 or 30 min on *Salmonella* Enteritidis on turkey carcasses. Turkey breast samples were inoculated with *Salmonella* Enteritidis at 3.7, 2.7, 1.7, 0.7, and 0.07 log CFU. The antibacterial effectiveness of the organic acids differed depending on the initial population of *Salmonella* on the turkey carcasses. *Salmonella* was most sensitive to mixtures of equal parts of 1% ascorbic, 1% citric, and 1% tartaric acids. The second part of the study involved determining the influence the organic acid mixtures had on survival of *Salmonella* Enteritidis on turkey meat stored at 4°C for 2, 4, or 6 days. *Salmonella* Enteritidis was inoculated into a nutrient broth, incubated at 37°C for 24 h, and then added to the diluent in which the turkey breast samples were immersed for 5 min. During storage at 4°C, the *Salmonella* level in the meat samples decreased. The largest decrease occurred at 4°C after 6 days with equal parts of 1% acetic acid, 1% lactic acid, and 1% tartaric acid.



## Foodborne Pathogens

### Functional Properties of Peanut Fractions on the Growth of Probiotics and Foodborne Bacterial Pathogens

M. Peng, E. Bitsko, D. Biswas

*Journal of Food Science*, Vol. 80, No. 3, pp. M635–M641, 2015

DOI: 10.1111/1750-3841.12785

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

**Significance:** Peanut white kernel might assist in improving human gut flora as well as reducing enterohemorrhagic *E. coli* O157:H7.

The effects of peanut white kernel and peanut skin on 3 strains of *Lactobacillus* and 3 major foodborne enteric bacterial pathogens were investigated. Significant growth stimulation of *Lactobacillus casei* and *Lactobacillus rhamnosus* was observed in the presence of 0.5% peanut flour (PF) made from peanut white kernel, whereas 0.5% peanut skin extract (PSE) exerted the inhibitory effect on

the growth of these beneficial microbes. Within 72 h, PF inhibited growth of enterohemorrhagic *Escherichia coli* O157:H7 (EHEC), while PSE significantly inhibited *Listeria monocytogenes* but promoted the growth of both EHEC and *Salmonella* Typhimurium. The cell adhesion and invasion abilities of 3 pathogens to the host cells were also significantly reduced by 0.5% PF and 0.5% PSE.

### Efficacy of Antimicrobial Compounds on Surface Decontamination of Seven Shiga Toxin–Producing *Escherichia coli* and *Salmonella* Inoculated onto Fresh Beef

N. Kalchayanand, T.M. Arthur, J.M. Bosilevac, J.W. Schmidt, R. Wang, S. Shackelford, et al.

*Journal of Food Protection*, Vol. 78, No. 3; pp. 503–510, 2015

DOI: 10.4315/0362-028X.JFP-14-268

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

**Significance:** Several antimicrobial compounds have been used in commercial meat processing plants for decontamination of pathogens on beef carcasses, but there are many commercially available, novel antimicrobial compounds that may be more effective and suitable for use in beef processing pathogen-reduction programs.



Sixty-four prerigor beef flanks (cutaneous trunci) were used to determine whether hypobromous acid, neutral acidified sodium chlorite, and two citric acid–based antimicrobial compounds effectively reduce seven Shiga toxin–producing *Escherichia coli* (STEC) serogroups and *Salmonella* on the surface of fresh beef. Two cocktail mixtures (STEC serogroups O26, O103, O111, O145, and O157 and STEC serogroups O45, O121, and O157 and *Salmonella*) were inoculated onto prerigor beef flank surfaces. The inoculated fresh beef flanks were subjected to spray treatments with four antimicrobial compounds. Following antimicrobial treatments, both control and treated fresh beef samples were either enumerated immediately or were stored for 48 h at 4°C before enumeration. All four antimicrobial compounds caused 0.7- to 2.0-log reductions of STEC, *Salmonella*, aerobic plate counts, and Enterobacteriaceae. The four antimicrobial compounds were as effective at reducing the six non-O157 STEC strains as they were at reducing *E. coli* O157:H7 on the surfaces of fresh beef. The recovery of all seven STEC strains and *Salmonella* in a low-inoculation study indicated that none of the four antimicrobial compounds eliminated all of the tested pathogens.

### The Microbiological Quality of Ready-to-Eat Salads in Turkey: A Focus on *Salmonella* spp. and *Listeria monocytogenes*

Z. Gurler, S. Pamuk, Y. Yildirim, N. Ertas

*International Journal of Food Microbiology*, Vol. 196; pp. 79–83, 2015

DOI: 10.1016/j.ijfoodmicro.2014.11.021

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

**Significance:** Hygienic rules should be implemented in the production chain of ready-to-eat foods to ensure microbiological safety and to improve shelf life.

In this study, *Listeria monocytogenes* and *Salmonella* spp. were isolated from 15(6%) and 21(8%) samples respectively out of 261 ready-to-eat (RTE) foods commercialized in Turkey. *Escherichia coli* was present in 10(4%) samples analyzed. Psychrotrophic aerobic populations > 6 log CFU/g were found in 36 (14%) of the samples, while total coliforms were detected in 155 (59%) of samples

analyzed. All of the *Salmonella* spp. and *L. monocytogenes* isolates tested, exhibited resistance to one or more antimicrobial agents used. For *Salmonella* spp. isolates, resistance to penicillin (69%), erythromycin (38%), gentamicin (36%), tetracycline (36%) neomycin (33%), ampicillin (33%), amikacin (33%), vancomycin (33%), streptomycin (29%) cefotaxime (9%) and oxacillin (9%) was observed. For *L. monocytogenes* isolates, resistance to erythromycin (23%) and cephalothin (20%) was evident. The presence of pathogens and the relatively high resistance among the bacteria tested in RTE foods could pose public health and therapeutic problems in consumers.

## Food Allergy

### Administration of a Probiotic with Peanut Oral Immunotherapy: A Randomized Trial

M.L.K. Tang, A.-L. Ponsonby, F. Orsini, D. Tey, M. Robinson, E.L. Su, et al.

*Journal of Allergy and Clinical Immunology*, Vol. 135, No. 3; pp. 737–744.e8, 2015

DOI: 10.1016/j.jaci.2014.11.034

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

**Significance:** Probiotic and peanut oral immunotherapy was effective in inducing possible sustained unresponsiveness and immune changes that suggest modulation of the peanut-specific immune response.

This double-blind, placebo-controlled randomized trial evaluated a combined therapy of the probiotic *Lactobacillus rhamnosus* CGMCC 1.3724 and peanut oral immunotherapy (OIT) (probiotic and peanut oral immunotherapy [PPOIT]) in children (1-10 years) with peanut allergy. The primary outcome was induction of sustained unresponsiveness 2 to 5 weeks after discontinuation of treatment (referred to as possible sustained unresponsiveness). Secondary outcomes were desensitization, peanut skin prick test (SPT), and specific IgE and specific IgG4 measurements. Sixty-two children were randomized and stratified by age ( $\leq 5$  and  $> 5$  years) and peanut SPT wheal size ( $\leq 10$  and  $> 10$  mm); 56 reached the trial's end. Possible sustained unresponsiveness was achieved in 82.1% receiving PPOIT and 3.6% receiving placebo ( $P < .001$ ). Nine children needed to be treated for 7 to achieve sustained unresponsiveness (number needed to treat, 1.27; 95% CI, 1.06-1.59). Of the subjects, 89.7% receiving PPOIT and 7.1% receiving placebo were desensitized ( $P < .001$ ). PPOIT was associated with reduced peanut SPT responses and peanut-specific IgE levels and increased peanut-specific IgG4 levels (all  $P < .001$ ). PPOIT-treated participants reported a greater number of adverse events, mostly with maintenance home dosing.



## Mycotoxins

### Ochratoxin A in Stored U.S. Barley and Wheat

J.A. Kuruc, P. Schwarz, C. Wolf-Hall

*Journal of Food Protection*, Vol. 78, No. 3; pp. 597–601, 2015

DOI: 10.4315/0362-028X.JFP-14-418

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

**Significance:** Ochratoxin A is detectable in stored barley and wheat destined for animal feed and human consumption in the U.S.

Ochratoxin A (OTA) is a mycotoxin of significant health concern that is present in a variety of cereal grains and other foods around the world. Although OTA contamination can occur prior to harvest, it is largely considered a storage issue that can be controlled through the implementation of proper storage practices. Barley, durum, and hard red spring wheat samples that had been stored for various lengths of time were collected ( $n = 262$ ) over a period of 2 years by multiple commercial grain companies located in the northwestern and northern Great Plains regions of the United States. Samples were analyzed for OTA concentration using high-performance liquid chromatography with fluorescence detection. OTA was detected in 12.2% of the samples, and of those samples, 81.3% had been stored for  $\geq 6$  months. One sample of barley and four samples of wheat exceeded 5 ng/g of OTA.

## Norovirus

### Consumer Education Needed on Norovirus Prevention and Control: Findings from a Nationally Representative Survey of U.S. Adults

S.C. Cates, K.M. Kosa, J.E. Brophy, A.J. Hall, A. Fraser

*Journal of Food Protection*, Vol. 78, No. 3; pp. 484–490, 2015

DOI: 10.4315/0362-028X.JFP-14-313

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



**Significance:** There is the need to educate consumers about how to prevent and control norovirus infection.

A nationally representative Web-enabled panel survey of U.S. adults ( $n = 1,051$ ) was conducted to collect information on consumers' awareness and knowledge of noroviruses (NoVs). Respondents who had heard of NoVs were asked 22 true-and-false questions on the transmission, prevention, and control of NoVs. Respondents (47%) reported awareness of NoVs, and 85% had heard of the terms "cruise ship virus," "the stomach bug," or "the stomach flu," which are commonly used to describe NoVs. Of those respondents who had previously heard of NoV or other terms used by consumers to describe NoV ( $n = 948$ ), 36% correctly answered 11 or more of the 22 true-and-false questions, suggesting that consumers have limited knowledge on how to prevent and control NoV infection. Most consumers do not understand that the primary mode of transmission for NoV infection is fecal to oral, and many have the misperception that meat and poultry are sources of NoV infection.

### Effect of Temperature and Relative Humidity on the Survival of Foodborne Viruses during Food Storage

S.J. Lee, J. Si, H.S. Yun, G.P. Ko

*Applied and Environmental Microbiology*, Vol. 81, No. 6; pp. 2075–2081, 2015

DOI: 10.1128/AEM.04093-14

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

**Significance:** Major foodborne viruses such as hepatitis A and human norovirus can survive over prolonged periods of time with a limited reduction in numbers.

This study investigated the survival of hepatitis A virus (HAV) and viral surrogates of human norovirus (HuNoV) (bacteriophage MS2 and murine norovirus [MNV]) in food over time. HAV, MNV, and MS2 were inoculated onto either the digestive gland of oysters or the surface of fresh peppers, and their survival

was measured under various temperature (4°C, 15°C, 25°C, and 40°C) and relative humidity (RH) (50% and 70%) conditions. Inoculated viruses were recovered from food samples and quantified by a plaque assay at predetermined time points over 2 weeks (0, 1, 3, 7, 10, and 14 days). Virus survival was influenced primarily by temperature. On peppers at 40°C and at 50% RH, >4- and 6-log reductions of MNV and HAV, respectively, occurred within 1 day. All three viruses survived better on oysters. In addition, HAV survived better at 70% RH than at 50% RH. The survival data for HAV, MS2, and MNV were fit to three different mathematical models (linear, Weibull, and biphasic models). Among them, the biphasic model was optimum in terms of goodness of fit.

### **A Quantitative Exposure Model Simulating Human Norovirus Transmission During Preparation of Deli Sandwiches**

A. Stals, L. Jacxsens, L. Baert, E. Van Coillie, M. Uyttendael

*International Journal of Food Microbiology*, Vol. 196; pp. 126–136, 2015

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

**Significance:** Good handling practices such as washing hands after a restroom visit, hand gloving, hand disinfection and surface disinfection in deli sandwich bars were an effective way to prevent human norovirus contamination of the prepared foods.

This study aimed to simulate human norovirus (HuNoV) transmission during the preparation of deli sandwiches in a sandwich bar. A quantitative exposure model was developed that included three food handlers working during a three hour shift on a shared working surface where deli sandwiches are prepared. The model consisted of three components: one simulated the preparation of the deli sandwiches and contained the HuNoV reservoirs, locations within the model allowing the accumulation of NoV and the working of intervention measures; another one covered the contamination sources being (1) the initial HuNoV contaminated lettuce used on the sandwiches and (2) HuNoV originating from a shedding food handler; and the third one included four possible intervention measures to reduce HuNoV transmission: hand and surface disinfection during preparation of the sandwiches, hand gloving and hand washing after a restroom visit. A single HuNoV shedding food handler could cause mean levels of  $43 \pm 18$ ,  $81 \pm 37$  and  $18 \pm 7$  HuNoV particles present on the deli sandwiches, hands and working surfaces, respectively. Introduction of contaminated lettuce as the only source of HuNoV resulted in the presence of  $6.4 \pm 0.8$  and  $4.3 \pm 0.4$  HuNoV on the food and hand reservoirs. The inclusion of hand and surface disinfection and hand gloving as a single intervention measure was not effective in the model as only marginal reductions of HuNoV levels were noticeable in the different reservoirs. High compliance of hand washing after a restroom visit did reduce HuNoV presence substantially on all reservoirs.

## **Special Report**

### **A Risk-Based Strategy for Controlling Chemical Contaminants as Relevant Hazards in Food Ingredients**

P.R. Hanlon, J.J. Hlywka, J.A. Scimeca

*Food Protection Trends*, Vol. 35, No. 2; pp. 89–100, 2015

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

**Significance:** This paper provides a science-based approach that can serve as an assessment tool to measure, modify and improve management strategies for chemical contaminants in food ingredients and ultimately ensures food safety and regulatory compliance.



The global sourcing of ingredients and distribution of products has dramatically increased over the past decade and so have challenges of food safety. While regulatory values for chemical contaminants can be a guide, formulating a comprehensive program to address chemical contaminants can be complex because of differences in priorities between regulatory agencies. Factors such as the source of contamination, the origin of ingredients, production of contaminants through manufacturing processes and adulteration of food for economic purposes, necessitate considerable effort to control contaminants. Establishing criteria that use scientific principles could be the basis for development of a risk-based program to manage chemical contaminants in ingredients. This would allow for compliance to global regulatory requirements and ensure the production of safe products. Therefore, this paper outlines the use of scientific principles to define the criteria associated with the severity of toxicity caused by chemical contaminants and the probability that a chemical contaminant would be present. Furthermore, the application of science-based criteria to generate rationalized target lists of chemical contaminants specific to ingredient categories can guide the development of analytical methods critical for the control of chemical contaminants.

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