Winter 2011

Center for Food Safety, Winter 2011

University of Arkansas (System). Division of Agriculture. Center for Food Safety

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

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INSIDE:

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Sirsat Examines *Salmonella's* Ability to Survive

Sujata Sirsat

If *Salmonella* Typhimurium is hurt, but not killed, by high temperatures when poultry is being cooked, the surviving pathogens might emerge strong enough to contribute to foodborne disease. That scenario became apparent from studies led by Sujata Sirsat, a food safety researcher in the University of Arkansas Division of Agriculture who earned a doctoral degree in poultry science with major advisor Steven C. Ricke in December after investigating the issue.

Sirsat, who worked on various research projects for the three-state Food Safety Consortium and the UA Center for Food Safety, found that using sublethal levels of heat on poultry affected particular genes in the bacterium. "The results indicated a role of physiological stress in *S.* Typhimurium in promoting microbial virulence and host cell vulnerability to infection," Sirsat said.

The pathogen's survival is aided by the stress that it endures, Sirsat explained. The genes that are crucial to the bacterium's survival are induced so that they thrive and strengthen *S.* Typhimurium.

Sirsat's experiments included a combination of two antimicrobials, lactic acid and lauric arignate, to determine what impact they would have on *S.* Typhimurium in poultry. No significant effect was detected, likely because of a lack of synergy when they each induce or repress certain genes within the pathogen. The key lesson is that food processors would need to screen potential antimicrobials to determine their likelihood of enabling a pathogen to resist them. Sirsat said future studies should be

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designed to explore the value of using other antimicrobials in combination with lactic acid and lauric arginate.

Ricke stated that molecular assays such as microarrays offer a potentially intriguing tool for broad spectrum screening to identify not only the best antimicrobial candidates for practical applications but perhaps how and when to apply them.

"A key to Sujata's research is that by using a microarray approach she could assess gene responses from the entire genome of *Salmonella* in a single step," Ricke said. "Generating data in such a comprehensive manner will hopefully get us much closer to a better understanding of pathogens in food environments and in turn increase our ability to limit the impact of these pathogens in food systems."

Georgia Food Scientist Links *Salmonella*, Organics

Walid Alali (right) of the University of Georgia Center for Food Safety visits Steven Ricke, director of the UA Center for Food Safety.

Salmonella is more prevalent on farms where poultry is grown conventionally than on farms where organic methods are used, according to a study led by Walid Alali, an assistant professor at the University of Georgia Center for Food Safety. Alali discussed his findings in November during a visit to the University of Arkansas Division of Agriculture Center for Food Safety.

During a presentation to UA faculty and students, Alali reported the results of a study of three organic farms and four conventional farms. The organic farms showed a *Salmonella* prevalence of 4.3 percent while the conventional farms' level was 28.8 percent.

Alali also noted that the prevalence of fecal and feed *Salmonella* was found to be lower in organically-raised birds than in conventionally-raised birds. The prevalence of antimicrobial-resistant *Salmonella* was higher in the conventionally-raised birds than in the organically-raised birds.

Broilers certified as organic by the U.S. Department of Agriculture are raised without the use of antibiotics, fed organic dietary supplements, consume all organic feed free of animal by products, and have access to outside environment.

"We also wanted to look at the feed as one of the main sources of (*Salmonella*) infection in the conventional broiler," Alali said. "We wanted to look at *Salmonella* survival for conventional feed versus organic."

Alali looked into one possible reason for higher *Salmonella* prevalence in conventional feed. His hypothesis was that the presence of contaminated animal protein meals in the feed was responsible and that *Salmonella* may survive differently in the conventional feed than in the organic feed.

So Alali's research examined whether changing to a protein feed based all on plants would affect the colonization and shedding of *Salmonella* in broilers. He found that all-plant-based protein meal diets (soybean and canola) did not significantly reduce the environmental contamination with *S.* Heidelberg compared to commercial diets containing animal protein meal. He also found that all-plant-based protein meal diets did not reduce the concentration and proportion of positive *S.* Heidelberg in contact (unchallenged) and seeder (challenged) birds compared to commercial diet containing animal protein meal.

Alali said his future research will cover alternatives to antibiotic use in poultry production that maintain healthy gut microflora and whether the focus shoul d be on breeders and broilers to reduce the shedding and colonization of pathogens.

Goodridge Shows How the Phast Swab Finds *L. monocytogenes*

Lawrence Goodridge's lab at Colorado State University has pared down the time to detect *Listeria monocytogenes*. His research team came up with a device the size of a pen to deliver the necessary biochemical tests. It's called the Phast Swab (derived from "phage" – the virus that infects bacteria – and "fast").

Goodridge, an associate professor of food microbiology at CSU, explained his work at a seminar in October at the UA Center for Food Safety.

Goodridge said there are three methods for detecting. *L. monocytogenes*: cultural and

Lawrence Goodridge (left) of Colorado State University meets with Phil Crandall of the UA Center for Food Safety faculty.

immunological methods, which each take from 24 to 48 hours before the results come in and molecular methods, which require operator training. Goodridge's lab met the need for a better method by developing the Phast Swab, an optical biosensor that rapidly detects the pathogen on food contact and on-contact surfaces.

Tests using the Phast Swab showed that it correctly identified 74 out of 77 *L. monocytogenes* isolates and detected 100 colony-forming units of ready-to-eat deli slice of turkey in 15 hours. "It delivers fairly sensitive results," Goodridge said.

Goodridge joined the CSU research faculty in 2006 after receiving his doctoral degree at the University of Guelph and serving on the University of Wyoming faculty. He is currently focused on the development of novel diagnostics and methods for control of foodborne pathogens, particularly detection methods for *E. coli* O157:H7. He was awarded Colorado Space Grant research seed funds through the CSU Department of Mechanical Engineering to support his work on rapid detection of pathogens on space missions.

Kuwait Visitors Receive Training at UA Center

Two scholars from Kuwait spent a week in November at the Center for Food Safety being trained on the use of probiotics in poultry and cattle. The visitors were Balta Al-Mutairi and Haya Al-Sammar, both research associates at the Kuwait Institute for Scientific Research where they work in the biotechnology department of the food resources and marine sciences division.

Their week of training included the use of molecular techniques for probiotic bacteria

From left, Balta Al-Mutairi, Steven C. Ricke and Haya Al-Sammar.

and tours of feed mills and poultry farms. Steven C. Ricke, Center for Food Safety director, and Irene Hanning, a postdoctoral associate at the center, arranged the training.

The Kuwaiti researchers also spent two weeks in training at the University of Georgia. They were directed to Arkansas after they contacted Michael Doyle, director of the University of Georgia Center for Food Safety in search of training programs to meet their needs. At Georgia, their training was supervised by Walid Alali, an assistant professor who directed them to Arkansas for additional training. (Alali accompanied them to the UA for their trip and delivered a presentation at the Food Science Department.)

In Kuwait, Al-Mutairi and Al-Sammar are researching the application of probiotics to poultry feed and lactic acid as a probiotic additive to feed.

Plum Ingredients Facilitate Poultry Marination

To accommodate consumers' preferences for more natural ingredients and to maintain sensory attributes at the same level, researchers at the University of Arkansas Center for Food Safety have found that substituting plum ingredients in place of alkaline phosphates is an acceptable way of marinating raw poultry meat.

The project, led by CFS director Steven Ricke and professor Phil Crandall, was supported by the California Dried Plum Board.

As consumer demand for poultry grows, the research team said, "there will be increasing incentive to replace chemical additives such as phosphates with more natural products."

The current dominant practice is for processors to marinate raw poultry meat in a mixture of water, salt and phosphate to increase the meat's water-holding capacity. The UA researchers wanted to find out if using natural products such as plums instead of phosphates would have any adverse impact on the product. They reviewed the physical and sensory attributes of vacuum marinated boneless breast meat using dried plum ingredients instead of the phosphate marinade.

Among consumers, tests with breast fillet samples showed that they perceived only minimal differences in the sensory characteristics of the poultry marinated with plums and the samples that were marinated with phosphate.

With regard to the poultry's water-holding capacity, the breast fillets marinated in plum were comparable to those marinated in phosphate. There was also no significant difference found in pH and color values between the two types of marinating. The two treatments also showed little difference on tenderness values as determined by a consumer panel.

Shannon Probes Orange Derivatives to Fight *L. monocytogenes*

Erin Shannn

Both the bacteriocin nisin and a natural derivative from orange peels are known to inhibit the spread of *Listeria monocytogenes*. Combining them with the right technologies can serve as a natural alternative to chemically based antimicrobials, according to research conducted by Erin Shannon in the University of Arkansas Division of Agriculture Center for Food Safety. Shannon investigated the topic and delivered a seminar presentation as part of her work toward the master of science degree in food science that she received in December.

The orange peel derivative is a natural antimicrobial known as cold pressed terpeneless Valencia oil (CPTVO). To evaluate its potential synergism with nisin, Shannon tested a sequential hurdle technique when combining the two antimicrobials. Hurdle technology generally uses combinations of different techniques to prevent the survival and regrowth of pathogens. Both nisin and CPTVO have similar targets for their inhibitive traits, including *L. monocytogenes*.

Shannon's work showed that not only does direct contact of the combined antimicrobials inhibit *L. monocytogenes*, but also that the exposure to CPTVO's vapors inhibits the pathogen.

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Hanning Honored at Farewell Event

Irene Hanning displays gifts at farewell luncheon.

Irene Hanning examines the gifts she received during a pot luck luncheon in November where colleagues wished her well upon her pending move to the University of Tennessee. Hanning left in December after eight years at the UA, where she earned a doctoral degree in cell and molecular biology and then served as a postdoctoral associate at the Center for Food Safety. She began work at Tennessee in January as an assistant professor of molecular food microbiology in the UT Department of Food Science and Technology.

Workshops at the UA Institute of Food Science and Engineering

Microbiological Laboratory Logistics and Fundamentals - This workshop will be held on several dates (March 15-17, April 12-14, May 17-19, June 14-16, July 12-14, Aug. 16-18, Sept. 13-15 and Oct. 11-13, 2011). See http://www.uark.edu/ua/foodpro/Workshops/Micro_Lab.html

Molecular Biology and Biotechnology; Workshop for Beginners - This workshop will be held on several dates (to be determined in 2011). See http://www.uark.edu/ua/foodpro/Workshops/Molecular-lab.html

Better Process Control School - This 3.5-day workshop will be held Nov. 1-4, 2011. For more information and registration form, go to http://www.uark.edu/depts/ifse/bpcsrev1.html

New Product Development Workshop - This workshop will be held May 24-25, 2011 at the Food Science Building at the University of Arkansas. This workshop is for people wanting to know more about developing and marketing new food products. See

http://www.uark.edu/ua/foodpro/Workshops/New_Product_Development_Workshop.html

Food and Nutritional Labeling Workshop – This workshop will be held in June 2011 in Kansas City, Mo. Details will be available at a later date. See http://www.uark.edu/ua/foodpro/Workshops/Food_Labeling_Workshop.html Steve Seideman has several copies of the workshop manuals available for sale for $60. E-mail for details at seideman@uark.edu.

Sensory Evaluation of Foods – This workshop will be held June 2012. For details and registration information, see http://www.uark.edu/ua/foodpro/Workshops/Sensory_Evaluation_Workshop.html

Food Protection Workshop - This workshop will be held April 4-5, 2011 in Springdale, Ark. It involves both Food Safety and Food Defense. For more details and registration, see http://www.uark.edu/ua/foodpro/Workshops/Food_Safety_Defense_Workshop.html

CFS Publications and Presentations

Publications

O'Bryan, C.A., D.M. Johnson, K. Shores-Ellis, P.G. Crandall, J. A. Marcy, S.C. Seideman, and S.C. Ricke. 2010. Designing an affordable usability test for E-Learning modules. J. Food Sci. Educ. 9: 6-10.

Patterson, J.A., V.I. Chalova, R.B. Hespell, and S.C. Ricke. 2010. Dilution rates influence ammonia assimilating enzyme activities and cell parameters of *Selenomonas ruminantium* strain D in continuous (glucose-limited) culture. J. Appl. Microbiol. 108: 357-365.

Churi, A., V.I. Chalova, I.B. Zabala-Díaz, C.L. Woodward, and S.C. Ricke. 2010. Increased temperature influences *hilA* gene fusion expression in a *Salmonella* Typhimurium poultry isolate. Food Biotechnol. 24: 51-61.

Burr, G., M. Hume, S. Ricke, D. Nisbet, and D. Gatlin III. 2010. In vitro and in vivo evaluation of the prebiotics GroBiotic® – A, inulin, mannanooligosaccharide, and galactooligosaccharide on the digestive microbiota and performance of hybrid striped bass (*Morone chrysops x M. Saxatilis*), Microbial Ecol. 59: 187-198.

Lungu, B., J.C. Saldivar, S.C. Ricke, and M.G. Johnson. 2010. The combination of energy-dependent internal adaptation mechanisms and external factors enable *Listeria monocytogenes* to express a strong starvation survival response during multiple-nutrient starvation. Foodborne

Pathogens Dis. 7: 499-505.

Zabala Diaz, I.B., V.I. Chalova, C. A. O'Bryan, P.G. Crandall, and S.C. Ricke. 2010. Effect of soluble maillard reaction products on *cadA* expression in *Salmonella* Typhimurium. J. Environ. Health. B45: 162-166.

Milillo, S.R. and S.C. Ricke. 2010. Synergistic reduction of *Salmonella* in a model raw chicken media using a combined thermal and organic acid salt intervention treatment. J. Food Sci. 75: M121-M125.

Dowd, S.E., T.L. Crippen, Y. Sun, V. Gontcharova, E. Youn, A. Muthaiyan, R.D. Wolcott, T.R. Callaway, and S.C. Ricke. 2010. Microarray analysis and draft genomes of two *Escherichia coli* O157:H7 lineage II cattle isolates FRIK966 and FRIK2000 investigating lack of Shiga toxin expression. Foodborne Pathogens and Dis. 7: 763-773.

Chalova, V.I., P.G. Crandall, and S.C. Ricke. 2010. Microbial inhibitory and radical scavenging activities of cold-pressed terpeneless Valencia (*Citrus sinensis*) orange oil in different dispersing agents. J. Sci Food Agric. 90: 870-876.

Martin, E.M., C.A. O'Bryan, R.Y. Lary Jr., C.L. Griffis, K.L.S. Vaughn, J.A. Marcy, P.G. Crandall, and S.C. Ricke. 2010. Spray application of liquid smoke to reduce or eliminate *Listeria monocytogenes* surface inoculated on frankfurters. Meat Sci. 85: 640-544.

Van Loo, E., S.C. Ricke, S.R. Milillo, S. Seideman, and P.G. Crandall. 2010. Consumer food safety perceptions of ready-to-eat deli foods in Northwest Arkansas. Food Prot. Trends 30: 635-643.

Crandall, P.G., E.C., Friedly, E.C., M. Patton, C.A. O'Bryan, A. Gurubaramurugeshan, S. Seideman, S.C. Ricke, and R. Rainey. 2010. Estimating the demand for organic foods by consumers at farmers' markets in Northwest Arkansas. J. Agric. and Food Info. 11: 185-208.

Crandall, P.G., C.A. O'Bryan, E.M. Martin, S. Pendleton, E. Shannon, J. Marcy, and S.C. Ricke. 2010. Dry thermal inactivation of *Listeria innocua* on deli slicer components. Food Prot. Trends 30: 588-592.

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Handley, J.A., I. Hanning, S.C. Ricke, M.G. Johnson, F.T. Jones, and R.O. Apple. 2010. Temperature and bacterial profile of post chill poultry carcasses stored in processing combo held at room temperature. J. Food Sci. 75: M515-M520.

Biswas, D., Herrera, P., L. Fang, R.R. Marquardt, and S.C. Ricke. 2010. Cross-reactivity of anti-*Salmonella* egg-yolk antibodies to *Salmonella* serovars. J. Environ. Sci. Health, Part B, 45: 790-795.

Ganseh**,** V., N.S. Hettiarachchy, M. Ravichandran, M.G. Johnson**,** C.L. Griffis, E.M. Martin, J.-F. Meullenet and S.C. Ricke. 2010. Electrostatic sprays of food-grade acids and plant extracts are more effective than conventional sprays in decontaminating *Salmonella* Typhimurium on spinach. J. Food Science 75: M574-M579.

Melendez, S.N., I. Hanning, J. Han, R. Nayak, A.R. Clement, A. Wooming, P. Hererra, F.T. Jones, S.L. Foley, and S.C. Ricke. 2010. *Salmonella enterica* isolates from pasture-raised poultry exhibit antimicrobial resistance and class I integrons. J. Appl. Microbiol. 109: 1957-1966.

O'Bryan, C.A, R.S. Dittmar, V.I. Chalova, M.M. Kundinger, P.G. Crandall, and S.C. Ricke. 2010**.** Assessment of a food microbiology senior undergraduate course as a potential food safety distance education course for poultry science majors. Poultry Science 89: 2542-2545.

Božic, A.A., R.C. Anderson, T.R. Callaway, D.J. Nisbet, S.C. Ricke, P.G. Crandall, and C.A. O'Bryan. 2010. In vitro comparison of nitroethane, 2-nitro-1-propanol, lauric acid, lauricidin®, and the Hawaiian marine algae, *Chaetoceros*, for potential broad spectrum control of anaerobically grown *Staphylococcus aureus*. J. Appl. Res. Vet. Med. 8: 180-184.

Over, K. F., N.S. Hettiarachchy, A.V.S. Perumalla, M.G. Johnson, J-F. Meullenet, J.S. Dickson, M.J. Holtzbauer, S.E. Niebuhr, B. Davis. 2010. Antilisterial Activity and Consumer Acceptance of Grape Seed and Green Tea Extracts and Tartaric Acid Vacuum-Infused into Chicken Breast Meat. Journal of Food Science. 75(7): M455–M461.

Ganesh, V. N.S. Hettiarachchy, M. Ravichandran, M.G. Johnson, C.L. Griffis, E.M. Martin, J-F Meullenet, S.C. Ricke. 2010. Electrostatic Sprays of Food-grade Acids and Plant Extracts are More Effective than Conventional Sprays to Decontaminate *Salmonella* Typhimurium on Spinach. J Food Sci. 75 (9): M574-M579.

Calhoun, L.N., and Y. M. Kwon. 2010. Proteomic analysis of *Salmonella* enterica serovar Enteritidis following propionate adaptation. BMC Microbiolgy 10, 249.

Wolfenden R.E., S.L. Layton, A.D. Wolfenden, A. Khatiwara, G. Gaona-Ramírez, N. R. Pumford, K. Cole, Y. M. Kwon, G. Tellez, L. R. Bergman and B. M. Hargis. 2010. Development and evaluation of candidate recombinant *Salmonella*-vectored Salmonella vaccines. Poultry Science, 89, 2370-9.

Calhoun, L.N., and Y.M. Kwon. 2011. Structure, function, and regulation of the DNA-binding protein Dps and its role in stress resistance in *Salmonella* enterica serovar Typhimurium: A review. J. Appl. Microbiol. 110, 375-386.

Calhoun, L.N., and Y. M. Kwon. 2010. The effect of long term propionate adaptation on the stress resistance of Salmonella Enteritidis. J. Appl. Microbiol. 109, 1294-300.

Presentations

Kwon, Y.M. 2010. Genomic approaches to study gene functions and adaptive mutations in Salmonella, Korean Society of Life Science (KSLS), 51th Annual meeting, Jinju, South Korea, Oct. 22, 2010.

Kwon, Y.M. 2010. Genomic approaches to study *Salmonella* biology, Seoul National University, Seoul, Korea, Jan. 24, 2011.

Ricke, S.C. 2010. UA Center for Food Safety Role and Vision for NW Arkansas. Walmart Food Safety Core Group, Food Science Dept., University of Arkansas, Fayetteville, AR, Oct. 12, 2010.

Ricke, S.C. 2010. Limiting *Salmonella* Enteritidis During Molt: Dietary Strategies. Poultry Diagnostic and Research Center, University of Georgia, Athens, GA, Nov. 1, 2010.

Ricke, S.C. 2010. *Salmonella* and the Food Production Environment. Center for Food Safety, University of Georgia, Griffin, GA, Nov. 1, 2010.

Ricke, S.C. 2010. USDA Food Safety Tri-State Consortium Special Project. UA-OSU Agricultural Traceability Team Meeting, Agricultural Hall Conference Room 106, Oklahoma State University, Stillwater, OK, Nov. 12, 2010.

Food Protection Workshop

Co-sponsored by the Food and Drug Administration (FDA), University of Arkansas Food Science Department and the Ozark Food Processors Association (OFPA).

The term "food protection" encompasses the areas of both food safety and food defense. This workshop provides awareness, planning and coordination of food defense to meet food safety and defense audits criteria. It is also considered training for food defense coordinators. Is your company in need of annual food defense training?

Workshop Details:

Date:
April 4, 2011 (8am - 5pm) &
April 5, 5011 (8am - 2pm)

Location:
Holiday Inn
1500 South 48th Street
Springdale, AR 72762
(479) 751-8300
holidayinn.com/hotels/us/en/reservation#home.com
*A block of rooms are available at a reduced rate. Choose Northwest Arkansas Regional Airport for air travel.

Registration:
Registration Deadline: March 18, 2011

Seating is limited and will be filled in order of receipt registration. A note of confirmation will be sent to you once accepted into course. Please notify 7 days prior to workshop if special accommodations are needed.

Forms:
Online or mail in registration available at:
www.uark.edu/ua/foodpro/workshops/
food_safety_defense_workshop.html.

Fees:
$300 (cover cost of facilities, materials, speakers and breaks)
Check or money order is to be mailed with form or if submitting online, please bring to workshop. *

Topics to be Discussed:

- Food Defense Plans
- Good Manufacturing Practices (GMPs)
- Hazard Analysis Critical Control Points (HACCP)
- Reportable Food Registry
- Good Agricultural Practices (GAP)
- Food Recalls
- Food Safety Modernization Act
- Pathogens of Public Health Concern
- Risk Management and Vulnerability Assessments
- Food Allergens
- Agroterrorism
- FBI in Food Defense
- Quality systems & other methods to insure food safety/third party audits

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*Please submit registration and fee to above address