

Fall 2010

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Hettiarachchy Blends Research With Teaching Roles



Navam Hettiarachchy

When she joined the faculty at the University of Arkansas Department of Food Science in 1992, Navam Hettiarachchy was primarily a protein chemist. Within a few years she began pursuing food safety research when she saw that natural or green plant extracts could have potential antimicrobial activity. She continues working with proteins and finds it fits synergistically with her food safety research.

“Mine is an integrated approach of nutraceuticals including bioactives, natural plant extracts and novel delivery systems of multiple hurdle technologies to kill or prevent pathogens on produce and meat products,” Hettiarachchy said. Mechanism of action of such antimicrobials along the genetic and metabolic forefront of pathogens will also play a role in this research.

“We need to think in terms of what kind of defense systems the pathogens have when they invade the produce or meat products. If they are genetically controlled, then we need to see ways and means by which the plant or host is defending itself. Further, if addition of natural antimicrobials as a part of multiple hurdle technologies can augment the defensive function of host, debilitating the pathogen’s survival strategies genetically, it would form the basis to kill or prevent the pathogens and tackle any contamination issues in today’s industry.”

One of Hettiarachchy’s significant accomplishments of recent years is licensing of her 2007 edible films patent. The patent, “Organic acids incorporated edible antimicrobial films,” was licensed to a California company that is making several film products in Mexico for commercialization.

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Hettiarachchy Blends Research With Teaching Roles

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A patent filing is currently pending on her approach in using the inexpensive heat-stabilized defatted rice bran to generate several value-added nutraceutical ingredients, including bioactives that have health benefits in addition to yeast production. A new company, Nutraceutical Innovations LLC, was formed in 2007 to utilize rice bran for its value added uses. The company employed a UA food science undergraduate student and a research associate.

Hettiarachchy is proudest of her role as a teacher and that her students have had no problems finding jobs upon graduation. Her former students are working in universities, companies and government. “Seeing the many accomplishments that my past students have earned is very self-satisfying and rewarding, the most prestigious of all awards,” she said.

She emphasizes student learning so that they know how to use sound science to solve practical problems.

“I tell them not to cling to what they did before,” Hettiarachchy said. “Science moves very fast. They have to be in touch with the literature. My advice for them is to be creative, think scientifically and find practical viable solutions to the challenging problems.”

Food Science Team Wins National Product Contest

A team of food science students in the University of Arkansas Dale Bumpers College of Agricultural, Food and Life Sciences won a \$10,000 first place prize for developing a new food product in the nationwide Danisco Knowledge Award contest. Professor Navam Hettiarachchy, faculty advisor, said the students created “*i*-Chips, a healthy snack option,” as part of a University of Arkansas Division of Agriculture research project.

The snack product is gluten-free, sugar-free and low in sodium and fat, Hettiarachchy said. A company press release said, “The winning product squarely targets the tightrope consumers walk between healthy eating and indulgence.”

Team members were Sunil Perumala, Leo Attenberg, Mirna Khairallah, Nicole Marie Poquette, Srinivas J. Rayaprolu, Utkarsh Shah and Shruti Tripuraneni.

With headquarters in Copenhagen, Denmark, Danisco operates in more than 40 countries and is a world leader in food ingredients, enzymes and bio-based solutions for food, feed

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and industrial products.

Hettiarachchy provided the following product description:

“*i*-Chips are healthy baked chips made from unique, inexpensive gluten-free grains (amaranth and buckwheat). The uniqueness of *i*-Chips lies in the selection of gluten free, inexpensive grains; buckwheat and amaranth, and avoiding potato and corn in developing chips for smart snacking. Furthermore, use of Danisco functional ingredients added value to the dough base. Presently, there are no chips in the market made with a combination of buckwheat and amaranth. Buckwheat and amaranth have neutral and earthy flavors, which blend with most of the common flavors used and do not have a negative influence in mouth feel and after-taste. This shows versatility of *i*-Chips to combine with a variety of flavors and thus has a potential in developing future line-extensions with the dough base. *i*-Chips comes with an added advantage of a lower price as compared to its competitors. The wholesale prices of these chips are estimated to be approximately 27 cents per serving (based on current wholesale market prices).

The name of the product gives it identity and position. Since we wanted a product targeted to cover a wide range of consumers, we thought about relating it to one of the most popular gadgets (current and future) that the people use in their everyday life for effective communication. *i*-Chips will fit with other “i” products and will have a great potential in the market.

Nutritional profile: One serving of *i*-Chips (28 g) consists of about 18 Chips and contains 70 calories. The unique and novel features of *i*-Chips are low calorie (80% low calories in comparison to its competitors), baked not fried, inexpensive, low in sodium, no external fat added (low in fat), no MSG, lactose free, and low glycemic index. These attributes would appeal to a variety of consumers and maintain nutritional and smart snacking advantage over other snacks in the chips market.

Collaborators Explore Deli Food Safety Practices with NIFSI Grant Support

Several researchers in the UA Center for Food Safety are pursuing a three-year project to develop novel methods to minimize the transfer of pathogens from the environment to ready-to-eat food and test more effective ways to train delicatessen employees – particularly those for whom Spanish is their first language – so that they follow procedures that guard against contamination by *Listeria monocytogenes*.

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The project is supported by a \$600,000 grant from the U.S. Department of Agriculture National Integrated Food Safety Initiative. UA personnel are Phil Crandall, professor of food science and the lead principal investigator; Steven Ricke, director of the Center for Food Safety; John Marcy, Extension food scientist, and Cheryl Murphy, director of educational technology. Collaborating researchers from other institutions are Jay Neal of the Conrad Hilton School of Hotel and Restaurant Management at the University of Houston, Elliot Ryser, professor of food science at Michigan State University, and Brad Marks, professor of biosystems and agricultural engineering, also at Michigan State.

A recent risk assessment showed that of listeriosis cases associated with deli meats, 83 percent were attributed to those sliced at retail. “This suggests that cross-contamination from the retail environment is likely contributing to the plateau in reducing listeriosis in the U.S.,” said Janell Krause, director of the USDA Food Safety and Inspection Service Risk Assessment Division in an interview last year in Meatingplace.com.

The project aims to provide industry supervisors and food safety instructors an assessment of current retail food safety training platforms for deli managers and hourly programs. It will also assess new sanitation practices and develop online training modules on sanitation for young Hispanic deli employees. These modules will apply the research results to be learned from assessing sanitation practices.

“By combining the best practices for training non-English speaking workers with online training, deli operations may be more successful in their food safety training, therefore reducing the risk of foodborne illness from *L. monocytogenes*,” Crandall said.

A multimedia team will create four training modules and an online virtual deli orientation. It will target new employees and will focus on cross-contamination of known niches that harbor *L. monocytogenes*. The goal is to minimize cross-contamination after making changes in workers’ behavior and in sanitizing contaminated surfaces.

This project is part of a larger college-wide Retail Foods Initiative focusing research and educational efforts of researchers and educators to maximize the quality and safety of retail foods.

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UA Research Explores California Dried Plums as Natural Substitutes for Phosphates in Poultry Processing

California Dried Plum Board

Recent research conducted at the UA Division of Agriculture Food Science Department demonstrated that the addition of dried plum mixtures can be a good substitute for the phosphates currently being used in poultry processing. The research was under the direction of principal investigators Steven C. Ricke, director of the Center for Food Safety; Phil Crandall, professor of food science; Jean-Francois Meullenet, head of the Department of Food Science, and Ashley Clement, a food science research associate. Casey Owens, associate professor of poultry science, provided technical advice for the project.

All plum products (dried plum fiber, dried prune powder, plum juice concentrate, or a 1:1 mix plum fiber and prune powder) produced a more tender chicken breast fillet than did the traditional phosphate mixture. Consumers found no difference in the treatments when compared to the phosphate control. For consumer testing the original 5-point “just about right” (JAR) scale was collapsed to a 3-point scale, with 2 being “just about right.” While the consumers found the juiciness attribute less favorable for plum fiber or prune powder on the likeness scale (like extremely to dislike extremely), the plum fiber and prune powder "just about right" values were closer to 2 (just about right).

Water-holding capacity analysis showed that plum fiber marinade retained moisture as well as the phosphate control and had a lower amount of thaw loss but a slightly higher amount of cook loss. Color was comparable to the phosphate control. Prune powder had slightly lower marinade retention and thaw loss and slightly more cook loss compared to the phosphate control.

The results of this study continue to underscore results from prior university research on the efficacy of dried plums to naturally bind moisture in animal proteins. The ability of dried plums to function in this manner can be attributed to the high levels of fiber and sorbitol that naturally occur in the fruit. When these moisture-binding characteristics are considered along with dried plums' naturally occurring malic acid and high antioxidant capacity the benefits of incorporating dried plum ingredients into animal proteins become apparent.

The UA research is to be peer-reviewed for journal publication.

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Veterinary, Food Safety Education Improvements Targeted in Three-State Project

Steven Ricke, director of the Center for Food Safety, is a co-director of a three-state project to better educate veterinarians and food safety professionals in the “systems approach” to solving problems in the food supply chain. Ricke is a co-director with David Anderson of the Kansas State University College of Veterinary Medicine faculty. The lead project director is H. Scott Hurd of the Iowa State University College of Veterinary Medicine faculty.

The \$308,000 three-year project is supported by a U.S. Department of Agriculture higher education grant. “A veterinarian working in the food supply chain must understand the implications of decisions throughout the food, environment and public health system,” the team’s proposal said. “They must understand the ‘systems approach’ to problem solving. The systems approach is a holistic view of the elements and processes working together to produce a desired result.”

The project team proposed that rather than add more courses to veterinary education, it would modify the existing food animal topics to include systems methodology in the coursework and would do so with systems engineering principles. The plan calls for placing at each of the three universities at least one systems trainer who knows how to apply system engineering methods to veterinary medicine and food safety. Those trainers will work with faculty to modify their existing lectures so that they include new material about the systems approach in the food industry.

UEP Names Ricke to Council

United Egg Producers has named Steven Ricke, director of the UA Center for Food Safety, to its Food Safety Scientific Advisory Council. The council consists of scientists who assist the organization by suggesting research needs in aspects of laying production.

UEP is a cooperative of egg farmers from across the United States and represents the ownership of approximately 95 percent of all the nation's egg-laying hens. It recently decided to form the advisory council to serve as a scientific resource to guide its response to issues related to egg safety and regulatory compliance. Don Conner, head of the Auburn University poultry science department, will chair the council.

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Ricke Recognized by Department for Research Efforts



Jean-Francois Meullenet (left), UA Food Science Department head, presents Outstanding Research Award to Steven Ricke, director of the Center for Food Safety.

Steven Ricke, director of the Center for Food Safety, received the 2010 Outstanding Research Award from the UA Department of Food Science. Ricke joined the university in 2005 as the holder of the Donald “Buddy” Wray Endowed Chair in Food safety.

Department head Jean-Francois Meullenet noted Ricke’s significant impact on the department’s research productivity. “Look at his record of publications in the past five years,” Meullenet said, also acknowledging Ricke’s focus on generating

research grant funding.

Meullenet offered as an example of Ricke’s reputation in the food safety research community a recent award that Ricke received with the co-authors of an article published last year in the journal *Anaerobe*. The article – “Incidence and Ecology of *Campylobacter jejuni* and *coli* in Animals” – was recognized as among the 10 most cited articles in 2008-2010.

Anaerobe Paper Nets Top 10 Most Cited Ranking

An article published in the journal *Anaerobe* that included a UA Center for Food Safety author has been recognized as one of the 10 most cited articles that the journal published from 2008 to 2010.

“Incidence and Ecology of *Campylobacter jejuni* and *coli* in Animals” was published in Vol. 15 (2009), 18-25, of *Anaerobe* and was first made available online on Sept. 25, 2008. The authors are Shane Horrocks, Robin Anderson and David Nisbet, all of the USDA Agricultural Research Service Southern Plains Agricultural Research Center Food and Feed Safety Unit in College Station, Texas, and Steven Ricke, director of the UA Center for Food Safety.

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The article was published in a special issue of *Anaerobe*, “Foodborne and Gastrointestinal Pathogen Ecology and Control in the Intestinal Tract.” Ricke was guest editor of the issue.

According to the authors’ abstract, “Reduction of pathogens before arrival to the abattoir is also of interest because the implementation of pre-harvest interventions may complement existing post-harvest control techniques to further diminish possible retail sources of infection. Such multiple hurdle approaches that simultaneously utilize pre- and post-harvest control techniques are expected to be the most effective approach for decreasing human illness associated with foodborne pathogens.”

Anaerobe is the official journal of the Anaerobe Society of the Americas and the Japanese Association for Anaerobic Infection Research. The journal is multi-disciplinary and provides a forum for those investigating infections caused by anaerobic bacteria in humans and animals.

Texas A&M Food Safety Director Visits UA in Fact-Finding Tour



Steven Ricke (left) and Gary Acuff during Acuff’s visit to Fayetteville.

Recently installed as director of the Texas A&M University Center for Food Safety, Gary Acuff brought his fact-finding travels to Fayetteville in September to see how things are done at the University of Arkansas Center for Food Safety.

“I have six months to put together a strategic plan,” said Acuff, who previously served five years as head of the Texas A&M animal science department. “My plan is to go around and visit other

center to talk with directors. That gives me an opportunity to see what’s successful and what might work at A&M.”

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Several years ago at Texas A&M, Acuff was a colleague of Steven Ricke, the current director of the UA Center for Food Safety. Ricke said the UA center -- a considerably smaller unit than its Texas A&M counterpart -- operates with people working together on projects with joint funding and with an increasing interdepartmental component.

Acuff said he was impressed with the philosophy that guides smaller units such as the UA center.

During his visit to Fayetteville, Acuff also spoke to a food science department seminar about what to realistically expect from efforts to reduce pathogens in beef. In an interview before his talk, Acuff explained that there is a disagreement between industry and government in enumerating bacteria.

E. coli O157:H7 is considered by the government to be an adulterant in ground beef products and the federal agencies want industry to reduce the levels on beef by 3 to 5 logs. "Basically, there's zero tolerance for the organism," Acuff said. "What confuses the industry is they say we can get a 5-log reduction, but what if there's one organism left on the final product? There likely will be somewhere. The declaration of *E. coli* as an adulterant is well meaning but kind of misguided."

Acuff said regulatory agencies should provide industry an endpoint to determine what level of pathogen reduction is achievable. The endpoint now is to define a pathogen as an adulterant and place the optimum pathogen level at zero. "But zero is not possible," Acuff explained. "Until everyone acknowledges that zero is not possible, we're not going to be able to get to the endpoint."

Acuff sees the alternative as establishing the acceptable risk level in humans and then determining the endpoint. Then processors will be able to move from the initial contamination level on meat and down to the acceptable risk level.

"If the industry knows how much reduction is needed, then they'll achieve it," he said. "How much is achievable? It's whatever we have to achieve, but it can't be an impossible point. And that's what we have right now."

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Korean Visitors Confer With UA Center for Food Safety Personnel



Korean visitors at UA: From left, Si Hong (currently a UA doctoral student), Hyun Jung Kim of Iowa State University, Steven Ricke and Hae-Yeong Kim of Kyung Hee University.

The Center for Food Safety was host to two Korean guests in August. The visitors were Hae-Yeong Kim, director of the Institute of Life Sciences and Resources at Kyung Hee University, and Hyun Jung Kim, a postdoctoral associate at Iowa State University who was Hae-Yeong Kim's former student in Korea.

Hae-Yeong Kim met with Steven C. Ricke, director of the Center for Food Safety, to discuss potential collaboration on projects. The institute at Kyung Hee University has established its own food safety research center that is staffed with Korean scientists. Kim is

seeking to establish connections with international scientists who can work as partners on certain research projects.

Si Hong, who earned a master's degree in food science and biotechnology under Kim at Kyung Hee University, is now a doctoral student in cell and molecular biology at Arkansas and is a staff researcher at the Center for Food Safety under Ricke's supervision.

Hyun Jung Kim also met with Ricke to discuss potential project collaboration between Arkansas and Iowa State, where he is a researcher under Byron Brehm-Stecher. Brehm-Stecher is an assistant professor of food science who has led ISU projects with the Food Safety Consortium, a research alliance that also includes Arkansas and Kansas State University.

At Kyung Hee University, Kim's research includes detection and safety assessment of genetically modified organisms, identification and characterization of food pathogens and the isolation, identification and characterization of lactic acid bacteria from fermented foods. In addition to serving as the institute director, Kim also is a professor in the Food Science

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and Biotechnology Department. He is also a member of the GMO Safety Committee at the Korean Food and Drug Administration.

AAFP Conference Wraps Up Successful Year

Moving into its second year since being chartered, the Arkansas Association for Food Protection hosted nearly 100 people at its annual educational conference Sept. 28-29 at Tyson Foods in Springdale. A strong lineup of speakers from academic institutions, industry and government focused on the theme of “Enhancing Food Protection From Farm to Fork.”

Frank Yiannas, Walmart Stores vice president for food safety, told the group during his presentation that he has spoken to numerous affiliates of the International Association for Food Protection and that the Arkansas affiliate’s annual conference puts it among the nation’s best for achieving so much so soon.



Steven Ricke (left), incoming AAFP president, presents a certificate of appreciation to outgoing president Michael Sostrin.

The conference opened both days with a greeting by a University of Arkansas administrator. On the first day, Milo Shult, the UA vice president for agriculture who will retire later this year, explained the Division of Agriculture’s research role and its impact on industry and the state’s economy. Michael Vayda, the new dean of the UA Dale Bumpers College of Agricultural, Food and Life Sciences, opened the second day’s proceedings by telling the AAFP that the college wants “to produce the talent you need to contribute to the economy and vitality of the state of Arkansas.”

Faculty presenters from each of the three institutions of the Food Safety Consortium – Steven Ricke of the UA, Jim Dickson of Iowa State University and Kelly Getty of Kansas State University – each described an area of research at their respective university.

The agenda also included an informal dinner at the AQ Chicken House in Springdale.

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The conference ended with Michael Sostrin of Walmart Stores, AAFP's 2009-10 president, passing the leadership to Ricke, who will serve as the 2010-11 president. The chapter presented a certificate to Sostrin in recognition of his service as AAFP's first president.

Officers were installed as follows for the 2010-11 year. They are Steven Ricke, President, University of Arkansas Center for Food Safety; Mike Sostrin, Past President, Walmart Stores; Hillary Hagan, President-Elect, Tyson Foods; Jerri Lynn Pickett, Vice President Tyson Foods; David Edmark, Secretary, University of Arkansas Food Safety Consortium; Jennifer Ford, Treasurer, Tyson Foods; Natalie Dyenson, Director, Walmart Stores; Peggy Cook, Director, Safe Foods Corp., and Sandra Lancaster, Director, Arkansas Department of Health.

UA Food Science Students Win AAFP Poster Awards

The Arkansas Association for Food Protection recognized the work of six University of Arkansas food science graduate students in a research poster competition at the AAFP annual meeting in September. The AAFP, an affiliate of the International Association for Food Protection, presented these awards:



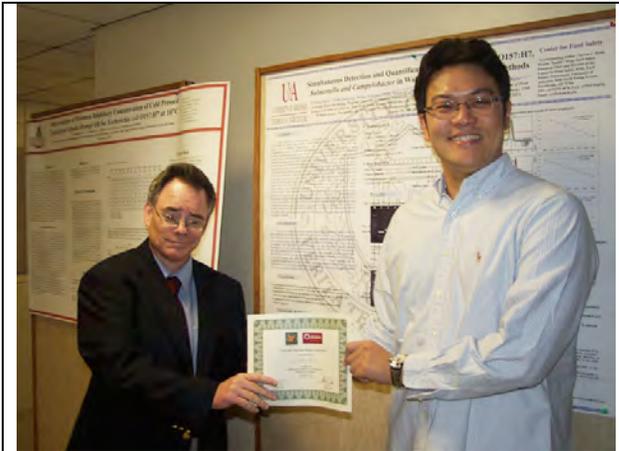
Steven Ricke and Jacob Lum

First place – Jacob D. Lum, “A More Specific and Sensitive Detection Method for Avian Influenza H5N1 Using Second Antibody Against N1 Subtype and Red Blood Cell Amplification in an Impedance Biosensor.” The objective of Lum’s study was to improve the specificity and sensitivity of an impedance biosensor for rapid screening of avian influenza virus H5N1 using a second antibody against N1 subtype and red blood cell (RBC) amplification. A rapid, sensitive, and specific screening method is needed for in-field or bedside testing of

AIV to implement quarantines and medications.

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Steven Ricke and Si Hong Park

Second Place – Si Hong Park ,
“Simultaneous Detection and Quantification of *Escherichia coli* O157:H7, *Salmonella* and *Campylobacter* in Water Samples Using PCR Methods.” The aim of this research was to develop two types of PCR assays that could detect and quantify three pathogens, *E. coli*, *Salmonella* and *Campylobacter*, in watershed samples. These pathogens can inhabit the gastrointestinal tract of agricultural animals, including cattle, swine and poultry, without causing any signs or symptoms of disease in the animals.



Steven Ricke and Erin Shannon

Third Place – Erin Shannon,
“Characterization of Cold Pressed Terpenless Valencia Oil Mechanism of Action Against *Listeria monocytogenes* Using Competitive Disc Diffusion and Growth Studies.” The study showed that disc diffusion plates containing CPTVO that were wrapped in Parafilm produced significantly larger zones of inhibition than unwrapped, leading to the hypothesis that a volatile component of CPTVO was likely at least partially responsible for its antimicrobial activity.

Certificates of merit were also presented for these students’ posters:

* Hua Bai, “Aptamer Selection and Aptamer-based SPR Biosensor for Detection of Avian Influenza Virus.”

* Damira Kanayeva, “Detection of *Listeria monocytogenes* Using Microfluidics and Interdigitated Microelectrode Based Impedance Immunosensor Coupled with Magnetic Nanoparticle-Antibody Conjugates.”

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* Ashley Clement, “Plum Marinade Effects on Chicken Breast Meat Are Comparable to Alkaline Phosphate Marinade.”

Judges for the poster competition were Raj Nayak of the FDA’s National Center for Toxicological Research, Karen Beers of SafeFoods Corp. and Sara Milillo and Michael Johnson, both of the UA Department of Food Science.

Hanning Accepts Tennessee Research Faculty Post

Irene Hanning, a Center for Food Safety postdoctoral associate, will leave the UA in December to accept an appointment as an assistant professor of molecular food microbiology at the University of Tennessee Department of Food Science and Technology. She was selected from among a pool of more than 50 applicants.

Since receiving her Ph.D. in cell and molecular biology from the UA in 2008, she has been a researcher in the laboratory of Center director Steven Ricke. Hanning has been at the UA since January 2003 when she began her doctoral studies under the supervision of Michael Slavik, professor of poultry science.



Irene Hanning

Before coming to the UA, she earned a bachelor’s degree in marine biology at Texas A&M University-Galveston and then worked for five years as a quality microbiologist at Gerber Products Co. in Fort Smith.

Hanning has been principal investigator on several USDA-CSREES (now NIFA) funded grants and has 16 publications. Her research interests include detection, identification, molecular epidemiology and molecular characterization of *Campylobacter jejuni*, bacterial ecology in environmental niches, including the gut and biofilms, evaluation of genomic, proteomic and phenotypic responses of foodborne pathogens due to environmental interactions and stresses, and whole genome characterization and mining to determine functional genomics.

Initially, she will have a 100 percent research appointment at Tennessee but will be involved in teaching at a later date.

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Handley Earns M.S., Starts Ph.D. Work While at Center, Tyson



John Handley

John Handley, a graduate student in food science, has wrapped up his work toward a master's degree this summer while having worked simultaneously for the Center for Food Safety and as a full-time microbiologist at Tyson Foods.

"I started the graduate program four years ago," said Handley, who finished his course work during the summer and received his degree in August. "This fall I started the Ph.D. program in cell and molecular biology."

Handley's work at Tyson, where he began his employment five years ago, has been coordinated with his UA research. While pursuing the master's degree, Tyson funded his Center for Food Safety research into temperature abuse of poultry carcasses and microflora.

As a doctoral student, Handley is examining a new topic at the Center for Food Safety. He is studying techniques for detecting microbial spoilage and how monitoring spoilage over time spans can inform food processors how to adjust elements such as shipping schedules.

Center Welcomes Three to Research Staff

Two new postdoctoral associates have joined the staff of the Center for Food Safety and a doctoral student from a university in Spain is on the staff for the current semester.

Kristen Gibson received her doctoral degree in environmental health engineering in May from the Johns Hopkins Bloomberg School of Public Health. At the Center for Food Safety she will examine the interface between the environment and food production and safety including the impact of foodborne viruses such as human norovirus. Her work includes the training component of a National Integrated Food Safety Initiative grant under which the Center for Food Safety is examining delicatessen food safety problems. She is also working on development of Good Agricultural Practices for small, fresh produce farmers and is studying the environmental impacts of pasture-based poultry systems.

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Ok Kyng Koo came to the UA after receiving her doctoral degree in food science this summer from Purdue University. At Purdue her advisor was Arun Bhunia, a former postdoctoral associate at the UA. Her research emphasis at the Center for Food Safety is the transfer and cross-contamination of *Listeria monocytogenes* in deli slicers and the attachment of bacteria to work surfaces. Her work is also in association with the Center's NIFSI grant.

Oswaldo Hernandez of Venezuela is a doctoral student in food science who is pursuing a degree through the Spanish National Research Council in Spain. He is visiting the Center for Food Safety to work on prebiotics and probiotics research as applied to *Salmonella* where he works under the direction of Arun Muthaiyan, a postdoctoral associate.

This is Hernandez's second time to work at the Center for Food Safety. He was here two years ago to work on a project with center director Steven Ricke. He said a researcher at the Madrid institute knew Ricke from a previous collaboration and recommended that he spend time at Arkansas.

Hernandez will return to Spain after December and expects to receive his doctoral degree in 2011.

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Workshops at the UA Institute of Food Science and Engineering

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. Registration details at

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

Sensory Evaluation of Foods – This workshop will be held June 2011. 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 in April 2011. 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

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