

Fighting *Listeria*: Why Food Processors Must Beware the Resurgent Bug

Try going for a couple of weeks without food and see what shape you're in, or if you're around at all by then. Let some dangerous bacteria do the same thing, and there's a chance they may do more than survive; they can grow stronger and remain as virulent as ever.

The bug is *Listeria monocytogenes*, a pathogenic foodborne bacterium the Centers for Disease Control estimates causes about 2,500 illnesses and 500 deaths nationwide each year. When these bacteria get a foothold, it's difficult to eliminate all of them. It has led Michael Johnson's Food Safety Consortium research team at the University of Arkansas Division of Agriculture to examine what keeps these bacteria going and what it takes to bring them down.

"The question is how do these cells survive when there's nothing for them to live on," said Johnson, a food science professor. "One of the presumptions is that they're living on some of the breakdown products of the cells in the population that die. That's supported by the results that the cells sitting in the original waste material survive better than do those which have their buffer changed every four days."

Bwalya Lungu, one of Johnson's doctoral students, explored the issue in a paper she presented in May at



Michael Johnson

the American Society for Microbiology conference in Toronto. She examined the survival of *L. monocytogenes* bacteria after 28 days and found that even after significant numbers of the pathogen cells are eliminated, those that survived appeared to do so because they make efficient use of the dead cells' waste. Also, Johnson noted, the cells go into a suspended state of animation

and are not actively metabolizing.

"They're in a resting stage — not growing, not dying," Johnson said. "You and I can't stop our metabolic train, but this organism apparently has figured out

Continued on page 2

Awareness of GM Wheat is Low; So Is Opposition

Genetically modified wheat hasn't yet been introduced into the U.S. market. When that happens, public acceptance of the product may depend on what people know about it. Currently, they don't know much.

A Food Safety Consortium survey conducted by Kansas State University indicated that most respondents had little to no prior knowledge about biotechnology, but about the same number of people said they would still purchase genetically modified (GM) wheat products. But



Sean Fox

when provided information about opposition to GM products, respondents were more likely to refrain from buying GM products.

"GM wheat has been on hold for a few years, but I think it's eventually going to be a reality," said Sean Fox, the KSU professor of agricultural economics who supervised the survey.

The cause for potential concern among marketers is that wheat is a crop directly consumed by humans, so some inherent opposition to genetic modi-

fication could hamper willingness to buy products with GM wheat in them. Fox noted that GM versions of corn, soybeans, canola and cotton have not generally been used for direct human consumption, so little opposition has arisen from consumer advocacy groups.

Fox's survey of households in metropolitan Kansas City included a definition of GM as "a process in which a plant or animal's genetic makeup is altered by implanting genes from other organisms." Everyone received that definition. Then the survey was split these ways:

- Half the households received a survey containing a statement about

Continued on page 2

Fighting Listeria... continued

ways to shut down its metabolism.”

The cells that die first leave behind the waste products that somehow enable survivors to hang on longer. If more waste nutrients can be eliminated up front, the remaining cells have less opportunity to find something on which to live.

For processors, the situation points to the need for diligent efforts at sanitation. If, for example in a worst-case scenario, a space has about 10 million *L. monocytogenes* cells, then eliminating 90 percent of them would seem to be quite an accomplishment. However, that still leaves behind 1 million cells, enough to seek out some nutrients to ensure their own survival before they go on to do some damage.

Eliminating 99.999 percent of the original cells still would leave behind 100 cells. That would appear to be an even greater accomplishment, except for persons who are at risk because of low tolerance of infection.

“We don’t know what an infectious dose of *Listeria* is for the susceptible

population,” Johnson explained. “About 25 percent of the population is immunocompromised due to being pregnant, being an organ transplant patient, having chemotherapy for cancer or being 65 years or older.

Those are all situations that could compromise the ability for such persons to fight invading bacteria.”

The result is that the federal Food and Drug Administration has declared a zero-tolerance policy on the presence of *L. monocytogenes* in ready-to-eat foods such as ice cream or deli meat and poultry items. That means there should be no detectable *L. monocytogenes* cells in a 25-gram portion of such foods, Johnson said.

The researchers’ findings about the durability of *L. monocytogenes* are based on results of work in the laboratory, but they are applicable to the situation that food processing plants face daily, Johnson noted.

“We can’t say explicitly, but if the

bacteria can survive like this in liquid then it’s less of a mystery how they also can survive when they get airborne,” he said.

“In food processing plants, when people thoroughly clean down the equipment the floor drains are places without a lot of nutrients left. But there’s still potential for a little residue there. Bottom line:

It’s very hard to reduce *Listeria* in plants when you have sanitation programs that leave surfaces wet. Keep it dry after you clean.”

That’s when all the instructions about keeping things clean start to hit home. Johnson said cleaning crews use chemicals to cut through the food waste film on surfaces and then apply sanitizer chemicals ideally to destroy any bacteria left. But if any bacteria persist and water is left standing anywhere, then the bacteria have a helping hand toward their survival even if there are no nutrients left. ■

This organism apparently has figured out ways to shut down its metabolism.

Awareness of GM Wheat... continued

opposition to GM that said “consumer and environmental groups such as the Organic Consumer Association, Friends of the Earth and Greenpeace are very opposed to GM technology because they believe it creates significant health risks for consumers and will damage the environment.”

▪ The other half of households received a survey that had this informative statement: “Current crops that are produced with GM technology include soybeans, corn and canola. These crops are processed into ingredients that are frequently used in bread.”

▪ One-fourth of the households received both of the above statements; another one-fourth received neither.

Among all the households, 68 percent said they would purchase GM wheat-based products, although 67 percent of the households indicated they

had not heard about GM processing or knew little about it. The respondents were given the opportunity to decide whether they would pay more to buy a non-GM version of a wheat-based product, and 72 percent said they would not.

But the households who received the survey containing the statement about opposition to GM products were less likely to accept

GM-processed wheat products and were willing to pay an additional 12 cents a loaf of bread to avoid GM wheat.

“Providing them with information about opposition made them more likely, or increased their willingness to pay, to avoid it,” Fox said.

The information provided with the survey noted that the U.S. Depart-

ment of Agriculture and the United Nations World Health Organization had approved of GM and considered it safe. The survey also told households that although GM wheat is not yet avail-

able, the varieties currently in development would provide benefits to wheat producers.

Telling consumers that many wheat products already contain some GM ingredients didn’t affect their decision

whether or not to purchase those products, regardless of whether they were told about the opposition to GM.

“It’s probably difficult to find food products that don’t contain some GM ingredients,” Fox said. “Not a lot of people are aware of that. But telling them that didn’t make a lot of difference.

Continued on page 7

Telling consumers wheat products contain GM ingredients didn’t affect their decision to purchase.

Mitigating the Incidence of *E. coli* in Produce

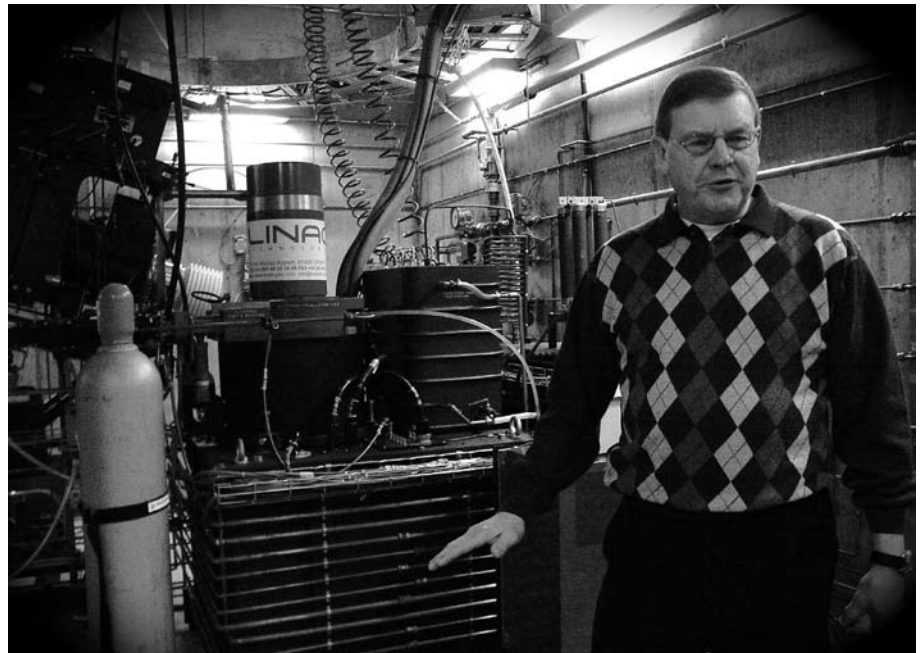
Courtesy of Food Safety and Security Update, Iowa State University

The recent outbreaks of *E. coli* in the United States have led to increased consumer awareness and heightened concern about the safety of fresh fruits and vegetables. In September 2006, an outbreak of *E. coli* traced to packaged spinach infected 199 people in 26 states and led to 102 hospitalizations and three deaths. In December 2006, an *E. coli* outbreak traced to iceberg lettuce distributed to Taco Bell restaurants in the northeastern United States infected 71 people, 53 of whom were hospitalized (www.fda.gov/ecoli). Smaller outbreaks were also reported across the country later, demonstrating that these are not isolated incidents.

With evidence that *E. coli* is becoming a problem in ready-to-eat foods, consumers are asking what can be done to address this problem. Dennis Olson, an animal sciences professor and affiliated faculty member at the Iowa State University Institute for Food Safety and Security, may have a solution: irradiation. Olson is professor-in-charge of the ISU Linear Accelerator Facility, a commercial-sized irradiation facility. He said that irradiation is the only definitive way to eliminate pathogens such as *E. coli* in ready-to-eat products.

“Right now, ready-to-eat products, such as spinach and lettuce, are rinsed with chlorinated water to kill any bacteria on the surface,” explained Olson. “The problem is that with the outbreaks of *E. coli* last year the bacteria were not just on the surface but inside the product.” In that case, he said, irradiation would be the only solution for killing the bacteria.

Ionization works because it disrupts the DNA of the living organism.



Dennis Olson at ISU Linear Accelerator Facility

The process of irradiation can be done using the linear accelerator, which Olson said works “like a TV tube.” The filament heats up and boils the electrons, which are then accelerated to almost the speed of light. Because electrons have a

small mass, they can be controlled using magnets. The linear accelerator uses a magnet to sweep the electrons over a conveyor, creating a shower of electrons.

The food product is then moved below the shower of electrons, absorbing the electrons’ energy and resulting in ionization.

“Ionization works because it disrupts the DNA of the living organism,” said Olson. “The net effect is only on living organisms, such as bacteria. It does not affect the meat cell at all, because the meat cell is no longer a living organism.”

While irradiation seems to be an

effective solution for killing bacteria in ready-to-eat foods, currently the FDA has not approved the technology for this use. The FDA has, however, approved irradiation to kill pathogens in pork, beef, poultry and eggs. Additionally, irradiation can be used to eliminate insects from wheat, potatoes, flour, spices, tea, fruits and vegetables.

Olson hopes that the FDA will soon approve the technology for ready-to-eat foods. “There has been a petition in the FDA for the past six years to approve irradiation for ready-to-eat products,” said Olson, adding that the recent outbreaks and public concern may help move the process along. “Technology tends to not move forward unless there is a catastrophe.” ■

Employees Are First Line of Defense Against Bioterrorism

When Rod Wheeler looks around food processing facilities to assess their security, he might find a small problem or two: an open door, a lax procedure on granting entry. Those problems would be enough to do significant damage for a determined terrorist or disgruntled person.

Whether food is deliberately contaminated on the farm, at the processing plant, at a distribution center, at a retail outlet or in the home, the outcome stands to be the same. “Anywhere in the food chain: if we’re vulnerable, we’re vulnerable everywhere,” Wheeler said.

Wheeler performs “vulnerability assessments” for the food industry as part of his job as food defense specialist with the American Institute of Baking. He assists food processing and manufacturing companies with development and implementation of food safety and security plans designed to guard against

deliberate tampering with the product. He spoke May 24 at an advanced food defense workshop at the University of Arkansas.

Wheeler recalled in 2004 that Tommy Thompson, then the secretary of health and human services, said he was surprised that there had not been a terrorist attack on the food supply because of the relative ease with which it could be done. That statement was accurate then, Wheeler said, but improvements across the industry since then have made the food supply less vulnerable.

“That’s our goal as industry professionals. Don’t make it easy for them,” Wheeler said.

Potential aggressors include criminals, terrorists, disgruntled employees and people who want to protest a company. The points of entry are numerous.

“Bioterrorism attacks could be directed at many targets in the farm-to-

fork continuum,” according to a 2003 Government Accounting Office report that Wheeler cited. During the “life” of a McDonald’s Big Mac, there are 250 points at which it could be contaminated deliberately, Wheeler said, including making the special sauce, processing of the hamburger and preparing the animal feed, among others.

Access by non-employees to the facilities is a major factor in potential sabotage. Wheeler recounted that a plant he visited on assignment gave him a visitor’s badge without requesting identification. In one plant he could walk around at will where raw ingredients were being mixed into products without having checked into the front office to meet an escort. An alert employee noticed he wasn’t wearing a hair net and escorted him out of the room.

“The front-line employee is better than any camera system,” Wheeler said.

Wheeler warned food businesses to have a written plan in place that sets out what they should do if the government announced an elevated terrorism alert. He cited other immediate steps that businesses can take to safeguard their food processing and supply:

- Companies should establish a food security/crisis management team that follows a crisis incident food defense plan.
- Develop procedures for investigating a food tampering incident.
- Use risk and vulnerability assessments in plants. “What are your weaknesses?” Wheeler asked. “What about inappropriate design? Are you vulnerable there? Inadequate equipment or deficient security procedures?”
- Establish real relationships with local first responders.
- Evaluate policies regarding the screening of personnel provided by outside contractors. ■



Rod Wheeler

Fung Cited for Service by Magazine, Company

A Kansas State University professor who is an international expert in microbial food safety received the inaugural Outstanding Educator in Food Safety Award in July from *Food Safety* magazine and ConAgra Foods.

Daniel Y. C. Fung, professor of food science and animal sciences and industry at K-State, received the award at the annual meeting of the International Association of Food Protection in Orlando, Fla. Fung is a principal investigator for the Food Safety Consortium.

The new award recognizes an individual who has made extraordinary contributions to food safety education, both in and out of the classroom. According to the award criteria, recipients must do more than teach but must also inspire.

Fung was selected for his out-

standing service and contributions in advancing food safety during his nearly 40 years as an educator. Fung has taught more than 18,000 undergraduate and graduate students, distance learning students and professionals around the world through classroom teaching, symposia, seminars, workshops and meetings on microbial food safety.

He leads the annual International Workshop on Rapid Methods and Automation in Microbiology, which just completed its 27th session, at K-State. The popular workshop has attracted about 4,000 participants from 60 countries to Manhattan, Kan., to be trained



Daniel Fung

in the latest technologies in detecting microbes and controlling them for food safety and security.

At last May's commencement ceremony for K-State's Graduate School, Fung marked the graduation of his 100th graduate student. He has served as the major professor to 34 doctoral students and 66 master's students.

Fung has published more than 800 research papers, books, proceeding articles and abstracts since beginning his career in 1969 at Penn State University. He has been a K-State faculty member since 1978. ■

Food Safety Magazine Honors Theno, Masters

The publishers of *Food Safety* magazine presented the 2007 Food Safety Distinguished Service Awards to food safety pioneers David M. Theno and Barbara J. Masters at the annual meeting of the International Association for Food Protection in July.

The *Food Safety* Magazine Distinguished Service Award honors individuals who best exemplify the characteristics of the dedicated food safety professional. Those honored are recognized by members of the profession for their collective works in promoting or advancing science-based solutions for food safety issues.

"This year's recipients are truly inspiring, and we are pleased to recognize Dr. Theno and Dr. Masters for their outstanding contributions to advance food safety in industry and govern-

ment," said Julie Larson Bricher, editorial director of *Food Safety* magazine. "Their efforts and advocacy of food safety science and management have had widespread impact throughout the supply chain."

Theno, senior vice president, quality and logistics at Jack in the Box, Inc., was recognized for his outstanding service and contributions in advancing food safety by developing Jack in the Box's food safety programs and leading efforts industry-wide to improve food safety measures in industry and reduce the incidence of foodborne illness in the U.S. Under his direction, *Food Safety* said, Jack in the Box's food safety systems have become the gold standard against which other food service establishments benchmark the quality of their food protection management programs.

Masters, senior policy advisor at Olsson, Frank and Weeda, P.C., was recognized for her outstanding service and contributions in advancing food safety with the U.S. Department of Agriculture's Food Safety Inspection Service for more than 17 years, most recently as FSIS Administrator. Masters' efforts in the development and implementation of FSIS HACCP (Hazard Analysis and Critical Control Points) and SSOP (Sanitation Standard Operating Procedures) rules, regulations and guidelines, as well as her leadership and commitment to building an effective science-based policy infrastructure at FSIS, have contributed to improved food safety measures in industry and the reduction of foodborne illness in the U.S. ■

Li Named to Tyson Endowed Chair at UA

Dean Greg Weidemann of the Dale Bumpers College of Agricultural, Food and Life Sciences at the University of Arkansas announced in July that UA professor Yanbin Li has been named the Tyson Endowed Chair in Biosensing Engineering.

Li, a principal investigator for the Food Safety Consortium, is one of the world's leading scientists in the development of biosensing technology for food safety and quality applications, Weidemann said. He has developed a prototype portable biosensor system that can detect the H5N1 avian influenza virus in poultry samples in less than one hour at an estimated cost of less than \$10 per sample. H5N1 is the "bird flu" virus that has been transmitted from poultry to humans in more than 300 cases in Asia, Africa and Europe.

A \$1.5 million endowment for the new chair was provided by the Tyson Foods Foundation from a gift announced in May 2005 and the UA Matching Gift Program previously endowed by the Walton Family Charitable Trust, Weidemann said. Investment earnings from the endowment will help support Li's research in the department of biological and agricultural engineering and the Center of Excellence for Poultry Science, which is a unit of the University of Arkansas System's state-wide Division of Agriculture.

Li is principal investigator on a recent grant of \$375,000 from the U.S. Department of Agriculture's National Research Initiative to refine and test the H5N1 biosensor system. Co-investiga-



Yanbin Li (left) receives a plaque from Mark Cochran at University of Arkansas ceremony.

tors are Billy Hargis, Steve Tung and Ronghui Wang at the University of Arkansas and Luc Burghman at Texas A&M University.

Mark Cochran, associate vice president for research in the UA Division of Agriculture, said the patent-pending H5N1 biosensor system would be much faster, more reliable, easier and cheaper than currently available tests, which are either poor in specificity, low in sensitivity, time consuming, expensive or require a laboratory and a highly trained technician.

In other research, Li has been the lead scientist in developing systems using nanoparticles and biosensors for rapid detection of pathogenic bacteria in food products. He also has developed risk-assessment models for pathogens in

food processing and methods of killing bacteria during poultry processing.

Li joined the university faculty in 1994. Among his several awards are the Arkansas Alumni Association Distinguished Faculty Achievement in Research and Service Award in 2003, the John Imhoff Research Award in the College of Engineering in 2006, and the Gamma Sigma Delta Outstanding Researcher Award and Outstanding Agricultural Engineer Award from the Arkansas Section of the American Society of Agricultural Engineers in 2002.

Li is editor of the journal, *Biological Engineering*, associate editor for *Transactions of the ASABE*, and an editorial board member for the *Journal of Food Protection* and the *Journal of Sensing and Instrumentation*

for *Food Safety and Quality*. He is also adjunct professor of Zhejiang University and China Agricultural University.

Li has a doctoral degree in agricultural engineering from Pennsylvania State University and bachelor's and master's degrees, respectively, from Shenyang Agricultural University and the University of Nebraska-Lincoln. ■

Bwalya Lungu, Arkansas, presented a paper on “The role of protein synthesis in the starvation survival responses of *L. monocytogenes* 10403S and *sigB* mutant” at the American Society for Microbiology annual meeting in May in Toronto. She was selected as one of eight graduate students to present their research in a special oral presentation session in the Food Microbiology Division. University of Arkansas food science department faculty, post-doctorate researchers and graduate students presented 10 papers at the meeting.

Lungu, a doctoral student of **Michael Johnson**, also won an American Society for Microbiology Travel Award to present her research.

Michael Johnson, Arkansas, received a plaque from Tyson Foods recognizing his more than 20 years of service to Tyson and the food industry. The plaque was presented by Neal Apple, Tyson vice president for food safety and laboratory services.

Johnson reported publication of the following three articles:

- Heo, Seok Andy, R. Nannapaneni, R. Story and M.G. Johnson. 2007. Characterization of new hybridoma clones producing monoclonal antibodies reactive against both live and heat-killed *Listeria monocytogenes*. *Journal of Food Science*, 2006-0215, R1, published online December 2006, and in hard cover as Vol. 72 (No. 1): M 8-15 in January-February 2007 issue.
- Sivarooban, T., N.S. Hettiarachchy and M.G. Johnson. 2007. Inhibition of *L. monocytogenes* using nisin with and grape seed extract turkey frankfurters stored at 4^o and 10^o C. *Journal of Food Protection*, 70 (No. 4): 1017-1020.
- Pradham, A., J. Marcy, M.G. Johnson, M. Tamplin and Y. Li. 2007. Pathogen kinetics and heat and mass transfer based predictive models for *Listeria innocua* in irregular shaped poultry products during thermal processing.

Journal of Food Protection, 70 (No. 3): 607-615.

Yanbin Li, Arkansas, reported the following two articles were published:

- Varshney, M., and Y. Li. 2007. Interdigitated array microelectrode based impedance biosensor coupled with magnetic nanoparticle-antibody conjugates for detection of *Escherichia coli* O157H:7 in food samples. *Biosensors & Bioelectronics*, 22 (11): 2408-2424.
- Wang, H., Y. Li and M. Slavik. 2007. Rapid detection of *Listeria monocytogenes* using quantum dots and nanobeads based optical biosensor. *Journal of Rapid Methods and Automation in Microbiology*, 15: 67-76.

Li also reported the following two presentations:

- Li, Y., B. Hargis, S. Tung, L. Bergham and W. Bottje. 2007. A prototype of impedance biosensor for rapid screening of avian influenza virus H5N1 in poultry samples. Institute of Biological Engineers Annual Meeting, March 29-April 1, 2007, St. Louis.
- Su, X., Q. Sun, Z. Ye, L. Bielke and Y. Li. 2007. A versatile multichannel immunoassay instrument for food safety and quality. PITTCON Annual Meeting, Feb. 25-28, 2007, Chicago.

Daniel Fung, Kansas State, presented a lecture on “Meat Safety From Abattoir to Consumer” during the week of Feb. 14 in Valencia, Spain; was the keynote speaker at the Missouri Milk, Food and Environmental Health Association Annual Educational Conference April 4-6 in Columbia, Mo.; and was the keynote speaker at the XII International IUPAC Mycotoxin and Phycotoxin Symposium and Workshop May 21-28 in Istanbul, Turkey. Fung also received the 2007 Professional Performance Award from Kansas State University. In June, Fung was interviewed by KSU Radio about the 2007 International Workshop on Rapid Methods and Automation in Microbiology that he directs each summer at KSU.

Curtis Kastner, Kansas State, reported the following article was published:

Hijaz, F., J.S. Smith and C.L. Kastner. 2007. Evaluation of various ammonia assays for testing of contaminated muscle food products. *Journal of Food Science*, June-July 2007, 72 (5): 253-257.

Awareness of GM Wheat... continued

It really didn't enhance their acceptance of GM wheat. But the overall acceptance was pretty high.”

Under current U.S. regulations, it isn't necessary for product labels to indicate if the ingredients are genetically modified. If GM wheat goes on the market and into bread, that fact won't need to be noted on the label unless federal regulations change. “Most bread right now contains some GM ingredients because it contains soy oil or soy flour,” Fox said. “It doesn't have to be labeled.”

Fox pointed out that consumer activist groups opposed to GM have targeted GM wheat if moves are made to put it on the market. Although the KSU survey seems to show that domestic wheat consumption might not be harmed by introduction of genetic modification, exports could be another matter.

Overseas opposition to GM products of any kind could hurt American exports. About half of U.S.-grown wheat is exported to other countries for sale, and some U.S. wheat producers are worried about warnings from Asian wheat buyers and consumers who say they won't buy imported GM wheat. ■

Food Safety Digest

by Dave Edmark

China says it's getting serious about food safety, with a year to go before the 2008 Olympics get under way in Beijing. A government agency, the general Administration of Quality Supervision, Inspection and Quarantine, announced in July that it would monitor food from production through distribution.

The Associated Press reported that China, with "a dubious product safety record," has taken steps to turn things around. It even executed the head of the State Food and Drug Administration for taking bribes and gifts in exchange for letting substandard products onto the market, including an antibiotic that led to 10 deaths.

New initiatives include increased monitoring of food in mess halls by the Chinese military. The People's Liberation Army said it would ban the use of fake or substandard products because unsafe food can adversely affect combat readiness.

Approval of new drugs will go through a tightened procedure. A special

panel instead of a single person or department will approve proposed new drugs before they are allowed on the market. The SFDA will also make surprise spot checks on drug producers.

HACCP — Hazard Analysis and Critical Control Points — has been the standard for food processors to prevent the occurrence of contamination by zeroing in on points in the process where a problem might be likely to happen. Much of the system is geared toward keeping pathogenic microbials from finding their way onto food being processed. But here's another point that might not have seemed as obvious: workers' clothing.

Al Baroudi, president of Food Safety Institute, wrote in the June-July edition of *Food Quality* magazine that although uniforms and garments aren't the weakest link in food safety for a business, they still can have an impact.

"When looking at the role played by uniforms and garments in a plant's HACCP program, customers should expect more than just clean garments," Baroudi wrote. "Uniform and work apparel companies must offer specialized HACCP-conscious uniform programs to companies whose success is dependent on food safety. Uniform companies should adopt a HACCP mentality so their customers have one less control point to address."

In the United Kingdom, a report by the Red Meat Industry Forum indicated that international food safety requirements can help make processors more efficient. Food Quality News.com reported that the RMIF joined with the Meat Training Council to demonstrate to 100 small- and medium-size meat businesses that the European Union's HACCP rules are good for business.

Martin Grantley-Smith, the RMIF chief executive, said additional food safety laws should not be viewed by the industry as a cost. "Additional legal requirements in the red meat industry are often seen as increasing cost, without the opportunity to recover the cost from the market through added value," he said. "HACCP is a case in point. Consumers take good hygiene practice as a given and do not expect to pay more for it."

Industry benefits because the implementation of efficient procedures saves employees' time in monitoring, recording and reporting what is happening and taking corrective action when necessary, Grantley-Smith said. Also, he added, the overall management of a business is improved in the process and waste is eliminated.

"Evidence of continuing professional development not only reassures existing customers, but is also a great selling point for attracting new businesses," Grantley-Smith added. ■

The Food Safety Consortium Newsletter

is a production of the three member schools of the consortium:
University of Arkansas,
Iowa State University and
Kansas State University.
Your comments are welcome.

David Edmark, Editor
110 Agriculture Building
University of Arkansas
Fayetteville, AR 72701-1201
Voice: 479-575-5647
FAX: 479-575-7531
E-mail: fsc@cavern.uark.edu
World Wide Web:
<http://www.fsconsortium.net>

The Food Safety Consortium

110 Agriculture Building
University of Arkansas
Fayetteville, AR 72701-1201

ADDRESS SERVICE REQUESTED

NON-PROFIT ORGANIZATION
U.S. POSTAGE
PAID
PERMIT NO. 278
FAYETTEVILLE, AR 72701-1201