



## Seeking Alternatives: *Lactobacillus* Reduces Pathogens, Shows Promise for Small Farmers

Antibiotics have made the world a healthier place by destroying illness-causing bacteria in humans and animals. But scientists have become worried in recent years about the development of resistance to antibiotics, so effective alternatives are always welcome. The situation applies to food safety issues because antibiotics are frequently used to maintain the health of animals that are eventually headed for the processing plant.

So as an alternative to antibiotics, Food Safety Consortium researchers at Iowa State University are feeding pigs yogurt cultures fermented with *Lactobacillus*, an organism that is believed to have beneficial effects on health. Tests have indicated that in some cases, the *Lactobacillus* cultures have led to a significant reduction in *Salmonella* levels in the swine.

“There’s a huge level of concern worldwide on the use of low-level

antibiotics in animal feeds,” said D.L. (Hank) Harris, an Iowa State microbiology professor and FSC researcher. “The most obvious concern is that the use of those antibiotics may generate organisms that are resistant to them and those same organisms would find their way into the human population and cause disease in humans that would not be treatable.”

For the past 15 years, Harris continued, there has been a sustained effort not to use the same drugs in animals that are used in humans. But the prospect remains that organisms could develop resistance to drugs that are used to treat humans.

With that backdrop, Harris’ research



*D.L. (Hank) Harris of Iowa State sees possibilities for small swine producers’ organic operations to be aided by use of *Lactobacillus*.*

group looked into the use of *Lactobacillus*. The initial results weren’t consistent. Not all swine tested experienced a reduction in *Salmonella*. More experiments with additional organisms are planned.

The inconsistent results mean that although the yogurt cultures are capable of reducing the pathogen levels, it is premature to use the procedure in swine production pending further research. But Harris is looking ahead to possibilities, particularly with

regard to small-scale swine producers.

As the livestock industry consolidates, Harris explained, opportunities increase for organic pork producers. “Those producers definitely need probiotic

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## Steam Pasteurization Lessens the Risk for Ready-to-Eat Meats

The popularity of ready-to-eat meat products is a testament to their convenience, but meat processors know they must guard against contamination of the product after it is cooked and packaged in the plants. Food Safety Consortium investigators at Kansas State University have found that steam pasteurization is a good way of protecting the packaged meats from *Listeria monocytogenes*. It can also

prolong the shelf life on some meats.

KSU had already tested the effectiveness of steam pasteurization on beef carcasses moving through processing plants. But the tests of steam blasts on ready-to-eat meats broke some new ground.

“By doing this, we are eliminating the problem of recontamination of the product after packaging,” said Harshavardhan Thippareddi, a Food

Safety Consortium researcher in the KSU animal sciences department. “If you treat frankfurters directly with steam, you are killing whatever *Listeria* is present there, but then subsequent to that you have to package them. So that means you have subsequent handling steps where you might recontaminate the product. We’re trying to eliminate that possibility by packaging the product

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*Seeking Alternatives ... continued*

products because they want to avoid antibiotics entirely as part of the natural food trend,” Harris said. “So there is going to be quite an opportunity of demand to supply them with compounds of substances that are natural. The idea of using simple milk cultures was trying to address the need of that particular growing industry, thinking the

*More research is needed to determine the effectiveness of Lactobacillus in pathogen reduction.*

farmer himself could do this.” Farmers running small organic operations could grow the *Lactobacilli* overnight in milk cultures and feed it to the pigs the next day, a process that wouldn’t be practical for a farm with thousands of pigs, Harris noted. As the research is further developed, the possibility remains that the natural approach could still be made applicable to larger pork producers. Harris said the use of yogurt cultures

would likely remain a specific application for small organic producers. “But it could lead to products where it could be administered to large operations, be it through feed or via water systems,” he said. “You might be able to modify this model to a format so it would be marketable.” For example, a large company might want to adopt the process so it could figure out how to convert it to large-scale situations. ■

*Steam Pasteurization ... continued*

and then applying the steam.” The KSU tests covered packaged, cooked ready-to-eat frankfurters, ham, roast beef, turkey breast, turkey kielbasa and beef salami. All tests showed substantial reductions of *Listeria monocytogenes* in the meat products. For the frankfurters, Thippareddi’s research team took the additional step of adding acetic and lactic acid to the treatment. The result showed an extra margin of safety along with the steam pasteurization process, thanks to what Thippareddi called a synergy between the two procedures working together.



*Harshavardhan Thippareddi*

“We killed a certain number of (pathogenic bacteria) cells and we injured some cells,” he said. “Some of the injured cells might be easier to kill in a temperature treatment like steam

pasteurization after the acid treatment. We’re trying to see if there is synergistic activity there.” The researchers are also exploring the effects of other antimicrobials such as sodium and potassium lactates and buffered sodium. The steam process could kill most of the *Listeria* cells but leave a few injured survivors. “If we have a secondary barrier like the lactates, that will prevent this one cell or a very low number of cells from growing to very high levels during the shelf life of the product,” Thippareddi said. The research team’s work is also exploring the benefits of steam

pasteurization to the meat products’ shelf life. “We are hoping for a week or two weeks additional shelf life to what they get right now, about 60 days or so,” Thippareddi said.

*The researchers are also exploring the effects of other antimicrobials such as sodium and potassium lactates and buffered sodium.*

The KSU group has been discussing the findings with two major meat processors who are interested in the procedures. “We are working with the processors to see if using their products we can reduce the levels of *Listeria* to acceptable levels or zero levels,” he said. ■

# Scientists Enlist Bacteria to Fight Food Contamination

University of Arkansas scientists are using harmless intestinal bacteria to ward off illness-causing bacteria, like *Salmonella* and *Campylobacter*, that can contaminate processed poultry.

The process, called “competitive exclusion,” is not a new concept, said UA poultry scientist Billy Hargis, a Food Safety Consortium researcher. “It’s been around since 1907 and was proven in chickens in 1973.”

Antibiotics have been the dominant anti-bacterial agents since they were discovered in the 1940s, Hargis said. But recent concerns about the consequences of widespread use may lead to restrictions on their use in animal production. “Competitive exclusion is another, safer weapon in the arsenal to fight harmful bacteria,” he said.

The study, conducted at the Arkansas Agricultural Experiment Station, has shown competitive exclusion to be effective in preventing and controlling bacterial infections. It also accelerates the birds’ natural immunity to harmful bacteria.

“It’s established that birds get more resistant to infection as they get older,” Hargis said. “Competitive exclusion can accelerate the development of resistance by making birds resistant to infection at an earlier age.”

When he began this research, Hargis wanted to develop a treatment that would be inexpensive to produce using

batch cultures. He wanted it to be therapeutically effective, so it could be used to treat sick birds as well as keep healthy birds from getting sick. The product also needed to be tolerant of

freezing and exposure to oxygen so that it could be stored and transported without losing effectiveness.

“We screened 4 million to 8 million bacteria for their ability to meet these criteria and compete with *Salmonella*, then screened out pathological bacteria,” Hargis said. “We were

left with 23 organisms — and have added some since then — that we can use together to protect chickens.”

Hargis and his research team have a patent pending for this competitive exclusion “cocktail.” Four million doses can be produced for less than a dollar.

“I’m optimistic that, if we get this right, we won’t even miss the antibiotics,” he said.

“Competitive exclusion is environmentally friendly,” Hargis said. “It’s non-polluting in both production and use, produces very low amounts of waste, and is not harmful to animals, plants or humans.

“It’s a totally organic, biodegradable alternative for poultry health care.” ■

*Competitive exclusion can make birds resistant to infection at an earlier age.*



*University of Arkansas graduate student Stacy Higgins adds beneficial bacteria to drinking water for research on using competitive exclusion to fight food contamination in poultry.*

# Report from the Coordinator



Gregory J. Weidemann

Here's some good news for everyone concerned about food safety: The overall incidence of seven bacterial foodborne illnesses has declined by 23 percent since 1996. The Foodborne Disease Surveillance Network (FoodNet), which is monitored at 10 locations across the nation by the Federal Centers for Disease Control and Prevention (CDC), released the figures earlier this year.

Among the individual pathogens, the figures break down this way: Illnesses caused by *Campylobacter* were down by 27 percent, *Salmonella* down by 15 percent, *Listeria* down by 35 percent, *Yersinia* down by 49 percent and *Shigella* down by 35 percent, all from 1996 to 2001. Measurements of illnesses caused by *E. coli* O157:H7 from 2000 to 2001 showed a 21 percent decrease. Incidence of *Vibrio* infections were 83 percent higher from 1996 to 2001.

So, what went right? Agriculture Secretary Ann Veneman gave credit to "modern, science-based food inspection systems" such as the HACCP programs now in effect throughout the nation's

processing plants.

The authors of the CDC report pointed out that while the rate of infection for several foodborne diseases has decreased, the overall incidence of foodborne diseases is still high. They suggest some ways to bring the numbers down: Reduce the prevalence of pathogens in their respective animal reservoirs, such as cattle for *E. coli* O157:H7, egg-laying chickens for *Salmonella enteritidis* and seafood for *Vibrio*. "Implementation of nationwide, consistent on-farm preventive controls would reduce the risk for human illness from *S. enteritidis* eggs," the report said.

There are other interventions that CDC suggests are responsible for the decrease in illness rates, such as egg quality assurance programs, better agricultural practices, regulation of fruit and vegetable juice, industry's introduction of intervention techniques, food safety education and increased regulation of imported food.

This information tells us that a partnership of industry, government, education and research brought about

these encouraging numbers. The numbers also tell us that there is more to be done, which for the Food Safety Consortium means more research to help our partners carry out their respective parts of the task.

FSC investigators have pursued many projects in recent years seeking ways to improve on-farm production practices, HACCP intervention procedures and consumer education, among others. As the sum of food safety's body of knowledge accumulates, we see the results come in. The past several years have marked a significant period in food safety awareness and effort. A particularly gratifying element is that the payoff has begun to arrive sooner rather than later. Results such as these should tell us that the long-term future can be even brighter. ■

## FSIS Strengthens Import Inspection System

The federal government is strengthening its reinspection program for meat and poultry imports. The U.S. Department of Agriculture Food Safety and Inspection Service (FSIS) is applying a new systems approach to inspection that provides a more accurate picture of a nation's food safety regimen. FSIS will use new computers capable of better reporting and trend analysis and oversight of the inspection force.

"FSIS is continually working to improve its public health food safety programs for both domestic and imported meat and poultry products," said Garry L. McKee, FSIS administrator. "This new approach to import

inspection will provide a more accurate overview of foreign inspection systems and more quickly pinpoint problems when they occur."

The new system, which has been in use with Canada, will focus on a foreign country's inspection system as a whole rather than on individual plants. A new statistically-based sampling program based on the annual volume of shipments from the exporting country will be used to select import shipments for reinspection. Previously, for all countries except Canada, reinspection was assigned at random based on the compliance history of the establishment that exported the products.

FSIS has also modernized the

Automated Import Information System (AIIS) to reflect the systems approach to import reinspection. The upgraded AIIS-3 computer system links inspectors at all points-of-entry, allowing information on shipments and violations to be shared immediately. The computers will assist in trend analysis and identifying problems in establishments that export to the United States. While all imported products are inspected in the country of origin and reinspected visually before being released by FSIS, the AIIS-3 selects shipments for additional reinspection verification. The additional reinspection tasks could include testing for residues, microbiology or food chemistry.

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# ISU Establishes Food Security Center

A \$1 million federal grant to Iowa State University's College of Veterinary Medicine has established a center to increase national preparedness for accidental or intentional introductions of disease agents that threaten public health or food production.

The Center for Food Security and Public Health (CFSPH) will integrate animal health activities with the Centers for Disease Control and Prevention's (CDC) ongoing veterinary medicine and zoonotic disease activities.

A zoonotic disease affects both animals and humans. A majority of the biological agents designated by CDC as potential bioterrorism agents infect both man and animals.

"Medical and public health professionals, veterinarians and others who own or work with animals need to be better informed about these zoonotic pathogens, their symptoms and methods for control," said Dr. Jim Roth, who will direct the center. Roth is a distinguished professor of veterinary microbiology and preventive medicine and assistant dean for international programs.

The funding for the center was part of the health appropriations bill passed earlier this year by Congress. Sen. Tom Harkin of Iowa, who chairs the appropriations subcommittee that funds labor, health and education programs, helped ensure funding for Iowa initiatives to combat bioterrorism.

"Since Sept. 11, there's been an increase in the attention given to the biological agents that could threaten the safety and security of the nation's public health and food supply," Harkin said. "With some of the most talented and

respected veterinary scientists in the world right here in Iowa, we are uniquely poised to lead efforts that address the growing need for information and better preparedness. That's why I'm so glad to have secured this funding."

The highest priority for CFSPH will be to organize a public health support team willing to be called upon to assist CDC in a public health emergency.

"It will be a kind of public health national guard. We will organize a group of former CDC and public health employees, catalog their specialties and skills, and train them to assist in public health emergencies," Roth said. "In the event of a public health emergency, CDC will have a pool of expert emergency responders to assist with all aspects of investigation, containment and control."

The center also will establish a train-the-trainer program to provide basic information about zoonotic diseases to veterinarians and animal workers and owners. Two veterinarians in each state — one specializing in small animal medicine and one specializing in large animal medicine — will be trained to give presentations on zoonotic diseases to veterinary associations and animal owners in their respective states.

"Typically, veterinarians and livestock producers are not familiar with these diseases because we haven't seen them in the U.S. We want to improve their basic awareness of symptoms and knowledge of the appropriate response to these

potentially devastating diseases," Roth said.

The CFSPH will work with the American Veterinary Medical

Association and state veterinary associations to train the trainers at a national conference in January.

In addition, the center will provide five graduate fellowships for veterinarians pursuing advanced degrees in public health and infectious diseases at Iowa State. "There's a need for more public health professionals nationwide and for more

veterinarians who research zoonotic diseases," Roth said.

Roth said the center will also host two international scientific meetings to gather research information on current vaccines and vaccines under development for important foreign animal diseases and emerging zoonotic diseases. "U.S. federal agencies need to know what vaccines are available, safe and effective for diseases we aren't accustomed to dealing with," Roth said. The first meeting was held Sept. 16-18 at Iowa State.

Under the guidance of Manjit Misra, professor of agricultural and biosystems engineering and director of Iowa State's Seed Science Center, the CFSPH will conduct a comprehensive study of the potential for plant diseases to impact public health. Roth said the bioweapons that target crop production could have an impact on human health by altering the safety of plant and animal foods. ■



Jim Roth

*'It will be a kind of public health national guard.'*  
— Jim Roth

# Committee Concludes Performance Standards Are Important Verification Tools

The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) concluded in a final report released in October that performance standards are valuable tools for verifying process control at slaughter and ground beef establishments. The committee made the conclusions after addressing several questions relating to performance standards from the U.S. Department of Agriculture's Food Safety and Inspection Service.

The NACMCF includes scientists with expertise in microbiology, risk assessment, epidemiology, public health and food science. The committee provides scientific advice and recommendations to the secretary of agriculture and the secretary of health and human services on public health issues relative to the safety and wholesomeness of the U.S. food supply, including the development of microbiological criteria, review and evaluation of risk assessment data and methodologies for assessing microbiological hazards in foods.

"The committee has determined that

performance standards are a valuable measure of total process control. We value their role in helping FSIS and industry evaluate the effectiveness of preventive measures," said Elsa Murano, undersecretary for food safety.

The NACMCF noted that existing public health statistics make it difficult to specifically attribute reductions in enteric (intestinal) diseases to performance standards. In addition, the committee noted that before new standards or approaches are adopted, more research should be done and alternative standards or approaches need to be examined. The committee made the following recommendations related to research needs:



*Salmonella enteritidis*

- Annual studies

to determine the prevalence of *Salmonella*, coliforms, *E. coli* O157:H7 and other indicator organisms, so that appropriate standards can be developed to verify process control;

- Additional studies to investigate decontamination procedures and determine if existing treatments can be further enhanced;

- Studies to determine the steps from farm through distribution where new technologies could be introduced to further reduce the frequency of pathogens in meat; and

- Studies to determine if the intervention steps targeted to reduce *Salmonella* are beneficial in reducing contamination by other enteric pathogens.

The National Academy of Sciences (NAS) is expected to release a report on performance standards in the spring of 2003. Murano said that both the NACMCF and the NAS reports will be carefully considered as USDA continues to evaluate strategies on the use of performance standards.

Copies of the committee's report are available at [http://www.fsis.usda.gov/OPHS/nacmcf/2002/rep\\_stand2.pdf](http://www.fsis.usda.gov/OPHS/nacmcf/2002/rep_stand2.pdf). ■

*Before new standards are adopted, more research is needed and alternatives should be examined.*

## FSIS Strengthens ... continued

The updated AIFS can capture more information, such as markings and certification numbers, that will allow FSIS to better track shipments of meat and poultry products once they enter the country. In addition, inspectors will be allowed to conduct more examinations on all shipments randomly selected for re-inspection, thus allowing for increased emphasis on food safety

related tasks. The revised system is user-friendly for inspection personnel and allows managers to have easier access to inspection reports.

FSIS held a public meeting in June 2001 to discuss possible changes to the way it selects meat and poultry product shipments for reinspection.

All countries that export meat and poultry products to the United States must have an inspection system

equivalent to the U.S. system. FSIS conducts a vigorous document and on-site review process to determine if a foreign country is eligible to export to this country. FSIS maintains equivalency determinations by conducting periodic audits and reinspectings imported meat and poultry shipments at U.S. ports-of-entry. ■

## Poster Winners Cited at FSC Annual Meeting

Three teams of Food Safety Consortium researchers were honored for displaying outstanding posters during the FSC's annual meeting in Manhattan, Kan., in October. The poster competition was the first for the FSC, which attracted more than 40 posters from researchers at its three member universities.

The winners are:

- First place: Sally Foong, Glenda Gonzales and James Dickson, Iowa State University, for their poster, "Reduction and Survival of *Listeria monocytogenes* in Ready-to-Eat Meat After Irradiation;"
- Second place: Jill Bieker, Randall K. Phebus, Curtis L. Kastner and Angie R. Reicks, Kansas State University, for their poster, "Efficacy of a Unique Quaternary/Peroxide Foaming Sanitizer Against Spoilage and Pathogenic Foodborne Microorganisms;"
- Third place: Ira Zakaiadze and Yanbin Li, University of Arkansas, for their poster, "A Quantitative Process Risk Model for *Salmonella typhimurium* in Broiler Processing."

A committee chaired by Daniel Fung of Kansas State judged the posters, with committee members evaluating posters from universities other than their own. ■



Poster contest winners at the FSC annual meeting accepting their awards are (from left) Jill Bieker of Kansas State, Sally Foong of Iowa State and Ira Zakaiadze of Arkansas. The judging committee was chaired by Daniel Fung (far right) of Kansas State.

## Papers & Presentations

**Michael Johnson**, Arkansas, was interviewed on the "Science Update" radio program produced by the American Association for the Advancement of Science. Johnson discussed research that he and **Marlene Janes**, Arkansas, conducted on edible coating to control *Listeria* on chicken.

**Dong Ahn**, Iowa State, discussed his research on irradiation at a news conference during the American Chemical Society (ACS) meeting in August in Boston, which was covered by Bloomberg News. Ahn also was interviewed in August about irradiation's effect on meat quality by a writer from the University of Minnesota Center for Infectious Disease Research and Policy.

At the ACS meeting Ahn delivered a presentation on "Mechanisms and Prevention of Off-Odor Production and Color Changes in Irradiated Meat." At

Intertech's International Food Safety Conference: Food Irradiation 2002 in Dallas, Ahn delivered a presentation on "Causes and Remedies of Off-Odor Production and Color Changes in Irradiated Meat."

**Dong Ahn, Aubrey Mendonca, Irene Wesley** and **Joseph Cordray**, Iowa State, received a \$530,608 grant from the U.S. Department of Agriculture National Integrated Food Safety Initiative for study of "Effect of Dietary and Irradiation Interventions on the Pathogen Reduction and Quality of Turkey Meat."

**Evelyn Dean-Nystrom**, National Animal Disease Center, delivered a presentation on "Role of EHEC in Cattle and Humans" in August at the World Buiatrics Congress in Hanover, Germany. She also received an American Meat Institute Foundation grant with

**Alison D. O'Brien** of the Uniformed Services University of the Health Sciences for research on "*E. coli* O157:H7 Intimin Expressed by Transgenic Plant Cells as a Candidate Oral Vaccine for Cattle."

**Curtis Kastner**, Kansas State, presented a paper in October on "Food Safety Initiatives at K-State: Solutions for a New Era" at the annual conference of the Kansas Association of Sanitarians and at the annual KSU Research and Extension Conference.

**Leslie Thompson**, Kansas State, was awarded third place in the Developing Scientist Oral Competition of the International Association for Food Protection for her presentation on "Effects of Dried Plum Purees on Suppression of Growth of Foodborne Pathogens in Uncooked Pork Sausage."

**Beth Ann Crozier-Dodson**, Kansas State, was an invited speaker at the International Association for Food Protection's Dairy Workshop. She also delivered a presentation on "Recovery of Airborne Microorganisms Using Thin Agar Layer Media." ■

# Food Safety Digest

by Dave Edmark

**O**ne more time on zero tolerance: Elsa Murano, the undersecretary of agriculture for food safety, wants it to be known that USDA is not backing off its policy of zero tolerance for *E. coli* O157:H7 in raw ground beef or *Listeria monocytogenes* and *Salmonella* in ready-to-eat products. Murano said some remarks she made in April have been taken out of context.

In April she said “zero tolerance ... does not equal zero risk, because you can say you have zero tolerance, but you cannot test the problem away.”

Elaborating on the topic during a speech in July to the Meat Processors and Suppliers Exhibition, Murano said policies of zero tolerance and testing for pathogens “are not enough to ensure safety.” A step to kill pathogens is necessary to reduce risk to zero, she said. “Rather, the production process must be under control, and testing is most appropriately used to verify that such control exists within a HACCP framework.”

Microbial testing is a risk management tool that is useful for some purposes, Murano said, such as verifying whether a food safety program can control contamination and pointing inspectors to the need for in-depth

reviews of a plant.

But because pathogenic bacteria are not distributed evenly in food and are found in a small percentage of samples, “a negative sample can give us the false impression that the entire lot is safe when in fact it might not be.”

■ ■ ■

**New Head at FSIS:** Garry L. McKee has assumed duties as administrator of the USDA Food Safety and Inspection Service. His appointment was announced in July by Agriculture Secretary Ann Veneman.

McKee previously served as director and cabinet secretary of the Wyoming Department of Health and chief of the Oklahoma Department of Health public health laboratory. He has also been a lieutenant commander in the U.S. Public Health Service Reserve.

■ ■ ■

**Irradiating at DQ:** Irradiated hamburgers are now available at Dairy Queen restaurants in the Minneapolis-St. Paul area. American Dairy Queen Corp. announced the move in July, making it the first national quick-service restaurant chain to do so. It had been testing customer receptivity to the product in a few restaurants since February.

This is the second time in two years that Minnesota has been a pioneer in retail availability of irradiated beef. In 2000, Huisken Meats of Chandler, Minn., began shipping irradiated beef patties to grocery stores around the

Upper Midwest, with the first going to 80 Minneapolis-St. Paul stores. Huisken’s appearance in these stores’ display cases marked the nation’s first point of sale of irradiated hamburgers.

■ ■ ■

**Give HACCP a Chance:** David L. Meeker of the National Turkey Federation (NTF) says that since HACCP became a required component in the nation’s meat processing plants in 1996, “the system has been met with resistance, misunderstanding and implementation difficulty.”

Meeker, the NTF vice president for scientific and regulatory affairs, wrote in the Aug. 19 edition of *Feedstuffs* that “consumer groups just don’t seem to understand or trust the transition from command-and-control regulation, including end-of-the-line inspection screening for defects. ... Incentives should greatly increase a company’s own testing; the opposite result is obtained when the ‘gotcha’ system demanded by the most vocal consumer groups is applied.”

Meeker also wrote that labor groups should support the science-based inspection system, but that’s not the case partly because HACCP has been layered “on top of an old, outdated set of regulations,” which leaves the workforce confused.

“Hopefully, USDA will be able to improve implementation by moving in the direction of more government-industry cooperation rather than less,” Meeker wrote. ■

## 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.

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