THE FOOD SAFETY CONSORTIUM NEWSLETTER

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Bacteriocins: The 'Competitive Edge in Nature'

Marlene Janes examines test results of bacteriocin preparations at Arkansas.

Scientists employ several tools against pathogenic bacteria that threaten foods and people who eat them. One weapon against such harmful bacteria is the use of safe food fermentation organisms to produce inhibitory proteinaceous compounds termed "bacteriocins."

"Bacteriocins occur in nature," said Michael Johnson, a food science professor at the University of Arkansas who leads a Food Safety Consortium team exploring ways to use these bacteriocin-producing bacteria. Bacteriocins provide what Johnson calls "a competitive edge in nature." Bacteriocins are produced by safe bacteria, which grow and survive in part by producing materials that inhibit the growth of other harmful bacteria.

Some bacteriocins can be used as food preservatives because they inhibit the growth of pathogens and organisms that can lead to the spoilage of food during processing and fermentation. One such bacteriocin is called Bifidocin B, which is produced by a type of bacterium known as *Bifidobacterium bifidum* that inhabits the gastrointestinal tracts of breast-fed infants and healthy adults.

The UA research team of Johnson and food science graduate students Zeliha Yildirim and Marlene Janes found that Bifidocin B and some other bacteriocins inhibit the

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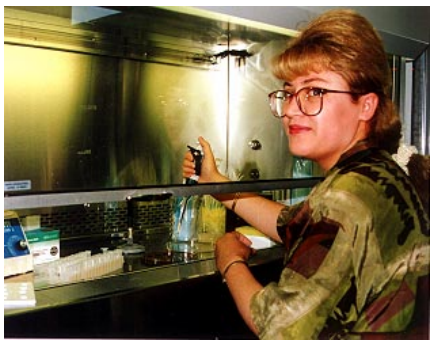
Food Safety Initiative Under Review

The Clinton Administration is asking Congress to consider its $43.2 million initiative designed to improve food safety. The proposal concentrates on improving inspection procedures, emphasizing public education and making greater use of scientific research to reduce foodborne illnesses. It would direct additional federal dollars to research, risk assessment and surveillance of pathogens.

The proposal would be effective for the 1997-98 federal fiscal year beginning Oct. 1 if approved by Congress. The funds were requested by the administration in its budget message earlier this year. More specific details on plans for the expenditures were revealed in May when Vice President Al Gore announced a five-point food safety program (see accompanying article). The program stems from a report of recommendations that the president requested in January from the U.S. Department of Agriculture, the Food and Drug Administration and the Environmental Protection Agency.



Food safety at work: Zeliha Yildirim processes a Biofidocin preparation at Arkansas.

The new proposal encourages

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Five-Point Food Safety Plan

The five-point plan proposed by the Clinton administration to improve food safety would include $43.2 million in new funds in the fiscal 1998 federal budget if approved by Congress. The plan consists of these goals:

• Improve inspections and expand preventive safety measures: FDA will use $8.5 million of the new funds, in part, to hire additional Food and Drug Administration (FDA) inspectors for seafood plants and to expand the Hazard Analysis and Critical Control Point (HACCP) approach to the fruit and vegetable juice industries. U.S. Department of Agriculture (USDA) will propose preventive measures, including HACCP, this year for egg products.

• Increase research to develop new tests to detect foodborne pathogens and to assess risks in the food supply: The agencies will target $16.5 million to critical research needs, such as giving federal, state and local food safety officials new tools to detect these pathogens, some of which — like the Hepatitis A virus and cyclospora — cannot now be detected in many foods.

• Build a national Early Warning System to detect and respond to outbreaks of foodborne illness earlier, and to give us the data we need to prevent future outbreaks: With $13.7 million of the new funds, USDA, FDA, and Centers for Disease Control and Prevention will increase the number of active "sentinel sites" across the country from 5 to 8 (current sites are in Northern California, Oregon, Minnesota, Georgia and Connecticut; new sites added this year are in New York and Maryland, and the eighth will open next year) and will equip these sites with new technology to identify the diseases and their sources and to communicate these findings nationwide rapidly.

• Establish a national education campaign that will improve food handling in homes and retail outlets. FDA, USDA, CDC, and the Department of Education will launch a new public-private partnership with industry, producer and consumer groups, and states to raise public awareness of safe food practices. Using public and private funds, the partnership will develop, disseminate, and evaluate a single food-safety slogan and several standard messages. USDA and FDA will use $4 million of the new 1998 funds to support this and other education activities.

• Strengthen coordination and improve efficiency: USDA, CDC, FDA and EPA will form a new intergovernmental group to improve federal, state and local responses to outbreaks of foodborne illnesses. Working with all stakeholders, the agencies will develop a strategic plan to further improve coordination, use resources more efficiently, and measure progress toward our common goal of reducing foodborne illness.

Bacteriocins Continued . . .

growth of the pathogenic bacterium *Listeria monocytogenes* and two organisms that spoil cooked food, *Enterococcus faecalis* and *Enterococcus faecium*.

The use of bacteriocins has become an increasingly attractive way to fight foodborne disease partly because of consumer resistance to highly processed foods, Johnson said. Food processors are now developing more minimally processed foods. Such foods, however, can have the drawback of compromising previous safeguards and may carry some risks. Minimally processed refrigerated foods have arrived on the scene about the same time that scientists have discovered that refrigeration by itself isn't always enough to prevent the growth of certain cold-loving pathogenic microorganisms on those foods. *Listeria monocytogenes*, for example, has been found capable of growing at refrigeration temperatures. Bacteriocins properly applied in sufficient amounts can effectively head off this pathogen in these situations.

Bacteriocin-producing bacteria can be isolated also from natural plant extracts. "We go to Mother Nature to find niches where the good bacteria might be growing and from which we could isolate the beneficial bacteriocin-producing strains," Johnson said.

Non-harmful bacteria *Lactococcus* and *Lactobacillus* are among the organisms that have been used in fermentation for hundreds of years, Johnson said. The UA research team is examining the benefits of isolates similar to these bacteria, which have been found on radishes, yucca, garlic, ginger and corn silk.

"Those are plant niches," Johnson explained. "Some are root crops. They are the breeding ground for bacteria able to grow in competition with other bacteria. By and large they don't cause any harm to the plant. The question is what lets them persist in these plant environments. Bacteria will figure out how to feed in nature at a 'common table' and have some ability to perpetuate themselves in an environment. We think that one of the ways these good bacteria persist is to have material they produce — a bacteriocin — that helps them compete and maintain their presence 'at the table' in a mixed culture."

Pediocins are one type of bacterio-

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Bacteriocins Continued . . .

cin that can serve as protective coatings for food. With fewer foods being packaged in the aseptic environment of cans, the potential use of pediocins is rising. Many ready-to-eat products such as fully-cooked chicken, smoked salmon and sandwiches are packaged, but they are potentially susceptible to contamination between the cooking stage and the packaging stage. Pediocins can prevent such recontamination by the pathogen *Listeria monocytogenes* from growing on these foods.

Experiments conducted by James H. Goff, a UA food science graduate student, showed that when a pediocin is present, *Listeria monocytogenes* cannot grow on cooked chicken during refrigerated storage. But without the pediocin the pathogen grows. The pediocin material used to treat poultry products did not contain any acid products that would adversely affect the food flavor. This pediocin may be suitable for incorporation into the batter or breading operations or as a marinade ingredient.

"So this offers a protective barrier in the distribution chain against pathogen growth on foods that aren't receiving a sterilizing heat process in a sealed metal can," Johnson said. "If every food were heat processed in a sealed metal can, we wouldn't have a need for bacteriocins."

Studies are also being made in other labs in the nation on the feasibility of applying bacteriocins to food packaging materials. Johnson and Navam Hettiarachchy, a UA associate professor of food science, are starting to evaluate some food films made in Hettiarachchy's lab for use with these bacteriocins. "That would be another barrier to the growth of pathogens and you wouldn't have to add it directly to the food, just add it to the packaging," Johnson said.

Plastics are used as barriers to serve as watertight containers and to keep pathogens from entering food. But the use of plastics raises ecological problems as landfills continue to receive those materials that don't break down. Johnson and Hettiarachchy are studying how to couple bacteriocins to protective films made out of soy, rice, wheat or other types of biodegradable

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Food Safety Initiative Continued . . .

further implementation of Hazard Analysis Critical Control Point (HACCP) systems, science-based procedures that are used to identify sources of potential contamination in food production, processing and transportation followed by the use of preventive measures. The USDA already requires HACCP programs in the meat and poultry industry and the FDA requires HAACP in the seafood industry. Under the new plan, the USDA will propose HAACP programs for egg products and the FDA will propose HAACP programs for the manufacture of fruit and vegetable products.

Additional funds requested will include provisions to add FDA inspectors to implement the seafood HACCP system and to expand its program for development of additional agreements with U.S. trading partners. Those agreements would ensure that imported foods are produced and manufactured under systems with safety measures comparable to those in the U.S. The FDA would use the new funds to provide technical assistance to foreign countries on safe growing and handling practices.

The new funds in the budget request would also be used to open an eighth National Early Warning System sentinel site. Two new sites were added during the past year in New York and Maryland. The new money would also allow the existing sites to update their technology and build a database of bacterial DNA, enabling food safety experts to clear geographic hurdles and quickly identify contaminated foods determined to be the sources of foodborne illnesses.

Research efforts funded under the initiative would be aimed at developing quick and reliable scientific methods for detecting contamination and exploring how pathogens become resistant to traditional food preservation techniques such as heat and refrigeration.

The new initiative would also bring the EPA, FDA and CDC into closer collaboration with state and local health departments on research to predict and control outbreaks of waterborne microbial contaminants, such as cryptosporidium.

The agencies' report to the president recommended that a long-term strategic plan be developed to address future challenges. "Federal agencies, consumer groups and industry have worked together to incorporate HACCP into meat, poultry and seafood regulatory programs," the report said. "And there is now a broad recognition of the need to carefully implement these programs, and to consider how to apply preventive measures in other areas of concern. A strategic planning effort could build on this common ground and tackle some of the difficult public health, resource and management questions facing federal food safety agencies."

Developing and implementing the plan will be accomplished by first giving interested parties — governments, consumers, industry and education among them — the chance to comment. The agencies will use a general consensus of the stakeholders to shape the planning process.

After implementation of the three- to five-year plan, the agencies would measure its progress to determine its effects. The report said, "Measurements could be based on a decline in the number of foodborne illnesses and deaths, a decline in the number of outbreaks, more effective prevention and intervention programs, more rapid, coordinated and effective responses to foodborne illness outbreaks, increases in inspection coverage for domestic and imported products, changes in behavior and better detection and quantification methodologies."

Report From the Coordinator

These are benchmark times in the field of food safety. Early this year, President Clinton announced an administration initiative to strengthen the nation's food safety system. The appropriate federal agencies went to work on their task and reported back within 90 days the outline of how to make wise use of the funds that the president is asking Congress to approve in this effort.

Specific plans will be drawn later and the federal agencies will announce the next steps. At that point, the Food Safety Consortium as well as other organizations and institutions will see a clearer picture of the opportunities and roles they can expect to play. We will be keeping an eye on developments and will be involved in the emerging national food safety system.

As explained elsewhere in this newsletter, the agencies designated by the president—the U.S. Department of Agriculture, the Food and Drug Administration, the Centers for Disease Control and Prevention and the Environmental Protection Agency—recommended that a long-term strategic planning effort begin. Public and private stakeholders such as consumers, families, state and local government agencies and industry will participate.

Charles J. Scifres

The long-term process envisioned by the federal agencies will allow interested parties to comment on ways to construct the procedure before it begins operating. Meetings will be convened across the nation at which stakeholders will discuss ways to make the ongoing process work. Participants in the planning process will develop a 3- to 5-year strategic plan that will include an agenda to help set priorities in food safety, improve coordination and efficiency, identify gaps in the current system, strengthen prevention and intervention strategies, and identify measures to show progress.

At public hearings held earlier this year among the federal agencies and the stakeholders, several policy questions emerged as issues that should be discussed in developing a strategic plan. Those issues include matters such as public health questions facing federal food safety agencies, the structure of risk assessment and research agendas, improvements for coordinating food safety regulation, and ways to improve the exchange of information about foodborne disease outbreaks.

As you can see, the process for improving the food safety system has just begun. The picture will become more focused as details are addressed and organizations such as the Food Safety Consortium will have the opportunity to contribute to the development of the master plan. The federal agencies' report to the president said, "Broad participation of stakeholders is central to the success of the discussions." The Consortium stands ready to participate.

FSIS Announces Communications Meetings

Food Safety and Inspection Service Administrator Thomas J. Billy has announced the locations and times for the second round of meetings, from September to December, being held as part of the agency's Plant Communications Initiative. During this second round of meetings, Billy and Dr. Mark Mina, deputy administrator for field operations, will meet with establishment owner/operators to discuss information and communication needs. Billy and Mina also want to hear from plant owners about the usefulness of the generic HACCP models and the Small Plant Demonstration Project in preparing for HACCP implementation.

Seven meetings, including one teleconference, are scheduled. All meetings will be held from 9:30 a.m. to 12:30 p.m. The dates and locations for these meetings are Sept. 18 in Salt Lake City, Utah; Sept. 20 in Burlingame, Calif., and Fullerton, Calif. (an interactive video conference); Oct. 16 in Raleigh, N.C.; Oct. 18 at Tuskegee (Ala.) Institute; Nov. 6 in Springfield, Ill.; Nov. 8 in Milwaukee, and Dec. 6 in Houston. For more information, contact Charles Danner, FSIS Planning Staff, at 202-501-7138.

Education is a Key Component for Poultry Producers

Education of poultry producers is the best way of assuring that safe food products emerge from the live animal production phase, according to Dr. James H. Denton of the Food Safety Consortium. “Poultry production at the breeder farms, hatchery, feed mill and growout has the responsibility for producing very high quality and safe food products,” Denton said.

The poultry industry uses preventive procedures in its attempts to ensure that safe products result from its production processes — Best Manufacturing Practices in raising live poultry and Good Manufacturing Practices in feed milling operations. But education remains the key, Denton said, because in themselves, “even the most effective Best Management Practices and Good Manufacturing Practices programs cannot assure that live animals will be pathogen-free as they move through processing.”

Denton, the Food Safety Consortium’s program director at the University of Arkansas and the director of the university’s Center of Excellence for Poultry Science, said greater efforts in education are also needed to improve food safety in other areas of the chain such as food retailing and food service. The regulations are in place that make it clear what industries must do to safeguard food, leaving education of personnel as the next vital component.

“I believe we should focus our efforts on areas and issues where we can actually improve the situation,” Denton said.

Education is particularly important because as new U.S. Department of Agriculture Food Safety and Inspection Service regulations become effective during the coming three years, poultry producers and processors are more responsible for food safety assurance. They use the science-based Hazard Analysis Critical Control Points (HACCP) systems tailored to their specific operations. The aim is to reduce the occurrence of pathogenic bacteria in poultry. But, Denton cautioned, since the pathogens are already present on the birds, “there is no HACCP program that can assure pathogen reduction in live production.”

The problem is that bacteria normally associated with poultry — *Salmonella* and *E. coli* — are naturally occurring. “They are not the result of any production practices,” Denton said. “There are multiple sources of these bacteria in the environment.”

Rearing large numbers of poultry in confinement actually aids producers in controlling or reducing these types of bacteria, Denton said. But the bacteria remain persistent in the environment and in other animal species.

“The most effective way to look at it is with a preventive philosophy with regard to production,” Denton said. “We need to do everything we can so that we’re in a much stronger position of being able to define the issue and being able to document it scientifically under a good management system.”

Within three years, the new USDA rules will require that all poultry processing plants operate on HACCP-based inspection procedures. That includes a rule that says plants must conduct a hazard analysis to determine the food safety hazards reasonably likely to occur before, during and after their entry of poultry into the plant. The key word here is “before” because for poultry slaughter plants, the phase before entry into the plant is the live production phase, Denton noted.

Microbiological hazards are among the potential trouble spots for which the FSIS requires tests that determine whether a plant is in compliance with food safety requirements. Plant operators collect the information from tests for *E. coli* and the data are used to establish the baseline levels for subsequent testing. Plants found to be in violation of those levels are determined to be out of compliance.

James Denton

The FSIS inspectors collect data on *Salmonella* tests in the plants. There are performance standards governing the level of pathogen reduction expected of the plants. But the information is compared to national baseline studies for *Salmonella* performance standards and that can become a problem for the entire industry, Denton said.

“This is a very poor indicator for making those types of decisions because very little thought was given to seasonal variation or any other factor outside of the fact that it is a national average,” he said.

New Methods Quickly Detect Bacteria in Meat

While food safety researchers continue looking for ways to prevent contamination of meat by pathogenic *E. coli* 0157:H7 bacteria, they also seek ways to detect such bacteria in meat and other sources before outbreaks can occur. Quick detection of the bacteria can make a difference in responding to potentially disastrous situations. Food Safety Consortium scientists at Iowa State University have found ways to detect low contamination levels directly from the meat and have the results within seven hours after overnight incubation of the meat samples.

The *E. coli* 0157:H7 bacteria can cause potentially life-threatening diseases. Foodborne diseases caused by infections from the bacteria have been associated with undercooked beef products. In most cases, the ultimate source of *E. coli* 0157:H7 has been cattle. The bacterium's pathogenicity has been attributed to the production of Shiga-like toxins, or Stx.

To detect Stx types and the *E. coli* 0157:H7 bacterium, the ISU team used a polymerase chain reaction (PCR) procedure. Polymerase is an enzyme that makes it possible to extend strands of DNA. The ISU team's approach avoided a technique that involved DNA extraction because that process uses tedious and laborious steps that can take about three hours per sample.

The plan was to adapt the PCR procedure so that it would detect the pathogens directly from ground pork and beef and bypass the time-consuming process of identifying the bacteria through microbial cultures — seven hours with the PCR procedure instead of 52 hours by microbial culturing. The new procedure also allowed detection of contaminants in smaller concentrations than had been previously possible — levels as low as 1 colony-forming unit per gram of meat.

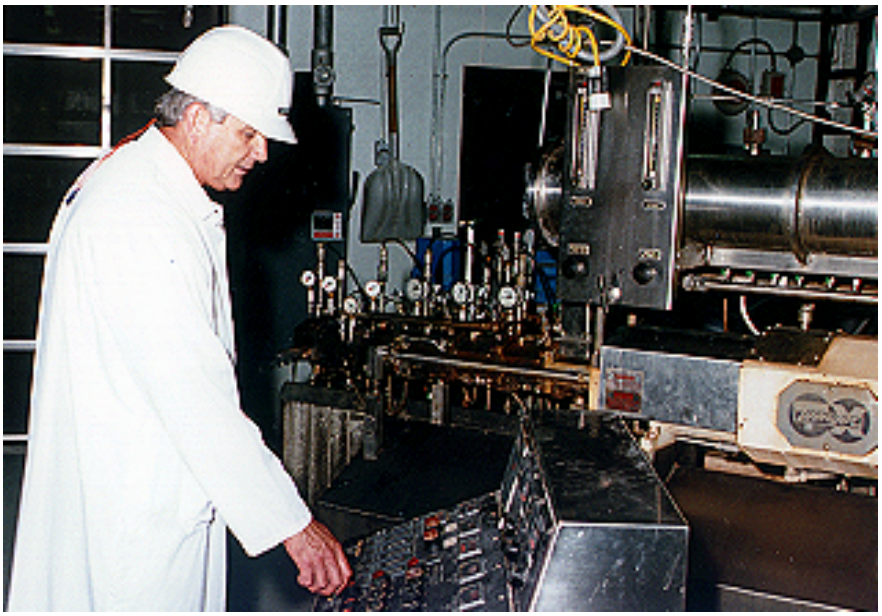
Because the testing procedure requires overnight enrichment of the meat, it isn't possible to obtain same-day results. "Our ultimate goal is to do that without enrichment," said Ilze Matise, an ISU graduate assistant who researched the problem with Dr. Greg Phillips and Dr. Loren Will, both associate professors of microbiology, immunology and preventive medicine, and Mike Shelton, a student in the department. The overnight enrichment process was used to insure that the researchers would detect pathogens within the minimum level for an infectious dose.

Ilze Matise tests meats for presence of *E. coli* bacteria at Iowa State.

"An infectious dose for *E. coli* 0157:H7 is thought to be very low," Matise said. "Some reports say that it is as low as one to 10 colony-forming units per gram of meat." The researchers wouldn't have been able to detect these low levels without using the overnight enrichment process. "Now we are down to limits where we can detect it in less than 1 colony-forming unit per gram."

The process also enabled the researchers to find other strains of Shiga-like toxin-producing bacteria in meat by detecting the presence of the Shiga-like toxin genes. "We felt that it wasn't enough to detect only *E. coli* 0157:H7 in meat," Matise said. "We wanted to know which Shiga-like toxin genes are present because these toxins are considered to play a major role in human disease. Several other bacteria producing the same toxins have been implicated in foodborne diseases. Our method is a tool which detects *E. coli* 0157:H7 serotype and Shiga-like toxin genes in meat at the same time."

Extrusion and Irradiation Keep Snack Sticks Safe



Curtis Kastner operates extrusion cooking apparatus at Kansas State.

Beef-based snack sticks are a convenient food item that are in demand by consumers. Precooked products in vacuum bags are convenient, but industry has been concerned about a potential problem. Pathogenic *Clostridium botulinum* bacteria could grow on the beef if the bag were abused, so Food Safety Consortium researchers at Kansas State University found that irradiation would kill the bacteria and keep the product safe.

"The beef industry is interested in convenient products," explained Curtis Kastner, the Consortium's program director at KSU.

The problem is solved through a two-step process. First, the beef snack stick is formed and cooked through a procedure called extrusion cooking. The raw materials are fed into the extruder and pressure and heat are built up as the raw material passes through the extruder toward a cutting blade at the front. After the heated material escapes the extruder, it is formed and is cut into appropriate lengths.

"Once it comes out of the extruder and we've got it into a vacuum-package product, it's a reasonably shelf-stable product," Kastner said. "If you take a pre-cooked item and put it in a vacuum bag, you've got to make sure that all of the spores, or eggs, of *Clostridium botulinum* are destroyed."

Extrusion cooking had been previously found to kill many spores. But surviving spores that were merely injured might not be detectable and could lead to potential hazards once they are repaired and resume the production of toxins. To find a way to kill all the spores, the KSU team first substituted the bacterium *Clostridium sporogenes* for *Clostridium botulinum. Clostridium sporogenes* is non-pathogenic but its spores are as difficult to kill as its pathogenic cousin.

Claudia Garcia Zepeda, who conducted the KSU experiments, found that extrusion cooking produced a beef snack stick with some surviving spores of *Clostridium sporogenes* in the vacuum bag that would be a problem if they were pathogenic spores and if the bag was temperature-abused.

So Zepeda added low-dose irradiation to the process and found that all the spores that survived the extrusion cooking were killed.

"There are a lot of companies that are interested in looking at irradiation as an in-line kind of processing facility," Kastner said. "You don't have to have a remote location to do all the irradiation. This hasn't been done yet, but we're looking at building small units that could be housed in the processing facility. You could irradiate on line."

Companies producing this sort of vacuum-bagged pre-cooked foods or those freezing ground beef patties to be shipped to fast food outlets could make intensive use of an on-site electron-beam irradiation facility. KSU is planning extensive evaluation of such units. "We're getting the funding together and we've got industry partners that are willing to put money into it," Kastner said. "We've also got university partners."

The beef snack stick products were made partly from ground beef hearts that went through extrusion cooking. Hearts and other lower cost beef by-products provide excellent color and make a good extruded product, Kastner said. The research also showed the feasibility of using extrusion cooking to manufacture products using meat portions that otherwise may not have been used in an optimum manner.

Economists Advise More Study of HACCP Benefits

The nation's meat slaughter and processing plants are in the midst of implementing the Hazard Analysis Critical Control Point (HACCP) system aimed at preventing the presence of pathogenic bacteria in their products. HACCP systems are being phased in following the announcement last year of new rules by the U.S. Department of Agriculture.

As a product of government regulation, HACCP must be evaluated to determine that its costs to industry are less than the resulting benefits to society. Helen Jensen and Laurian Unnevehr, both Food Safety Consortium researchers, contend that the economic benefits of HACCP's preventive procedures have not been adequately explored in economics literature.

The costs of detecting hazards are high while the benefits are uncertain but potentially large, said Jensen, an economics professor at Iowa State University, and Unnevehr, an agricultural and consumer economics associate professor at the University of Illinois. The federal Food Safety and Inspection Service has conducted only a preliminary analysis of HACCP's potential impacts, they noted.

Sanitation standard operating procedures became effective in all plants in January 1997 and FSIS inspectors began reviewing generic testing results for *E. coli* for all slaughtered carcasses. Under HACCP procedures, science-based risk assessment and prevention methods are developed and implemented by individual plants subject to FSIS verification. Each plant must identify points in its processing system in which a chemical, physical or microbiological hazard can occur and establish controls to prevent or reduce those hazards. HACCP will be required of plants with more than 500 employees by January 1998; of plants with 10 to 500 employees by January 1999, and of plants with no more than nine employees or annual sales of less than $2.5 million by January 2000.

Jensen and Unnevehr, writing in the *American Journal of Agricultural Economics*, pointed out there are two ways for government to promote food safety through intervention. One is through direct command-and-control interventions, which include the establishment of performance standards that products must meet, the monitoring of product quality, processing standards that specify certain production procedures, and the mandatory disclosure of information on pathogen reduction processes.

The other approach, the researchers said, is through incentive-based interventions that are designed "to induce either producers or consumers to identify and practice cost-effective methods that achieve food safety." Those methods include the government providing information that enables consumers to evaluate and avoid hazards; subsidizing development of new pathogen tests, or certifying products that meet minimum safety standards.

The new FSIS rules recognize HACCP as a command-and-control intervention with process standards that require meat and poultry processors to adopt antimicrobial treatments. The rules also recognize HACCP as performance standards that require plants to meet pathogen reduction targets.

Many companies began implementing HACCP in their plants before the new government rules required it, but its application was not widespread. "As market incentives did not seem to exist for most firms in meat and poultry slaughter and processing to adopt HACCP, the regulation will impose costs, and these are likely to fall more heavily on smaller firms," Jensen and Unnevehr wrote. An example is found in the high cost of testing directly for the presence of microbial pathogens.

The high costs of testing and guaranteeing a safe product make it expensive for producers to convey reliable information to consumers, the researchers said. "These features of foodborne pathogens support the imposition of a command-and-control performance standard."

Relying on private market incentives-based approaches might not result in sufficient benefits in food safety, Jensen and Unnevehr said, noting that imposition of a minimum performance standard could be justified economically. "Regulators and consumer advocates have argued that the costs of pathogen reduction regulation, while estimated to be substantial (about $2 billion) over 20 years, are small compared to potential benefits (about $6 billion to $24 billion)."

More study is needed to determine whether it would be more efficient to specify overall reduction in the total number of pathogens than to mandate the use of a contamination control technology. The answer to that question depends upon how the contamination control technology would affect product output.

Although HACCP is a process standard, Jensen and Unnevehr asserted that it can be an efficient regulatory tool because it relies on the prevention and identification of measurable critical control points in food processing rather than on testing of finished products.

"Inspection and verification by

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Clinton Nominates Catherine Woteki for Food Safety Official

President Clinton announced in May his nomination of Dr. Catherine Woteki for under secretary for food safety at the U.S. Department of Agriculture.

Woteki has served most recently as the deputy under secretary for research, education, and economics at the USDA. In this capacity, Woteki has been responsible for the management of four agencies: the Agricultural Research Service; the Cooperative State Research, Education, and Extension Service, the Economic Research Service, and the National Agricultural Statistics Service. She has led the Clinton administration's implementation of the 1996 Farm Bill's provisions on research and education.

From 1994 to 1995, Woteki served as the deputy to the associate director for science in the White House Office of Science and Technology Policy. Woteki was the deputy director of the Division of Health and Examination Statistics, National Center for Health Statistics, U.S. Department of Health and Human Services, from 1983 to 1990. From 1980 to 1983, she was the acting associate administrator of the Human Nutrition Information Service and served as leader of the Food and Diet Appraisal Research Group in the Consumer Nutrition Information Service at the USDA.

Woteki received a B.S. degree from Mary Washington College and M.S. and Ph.D. degrees in human nutrition from Virginia Polytechnic Institute and State University.

The under secretary for food safety oversees the Food Safety and Inspection Service, which is the public health agency responsible for ensuring that meat and poultry products are safe, wholesome, and accurately labeled.

Bacteriocins Continued . . .

materials. Such films would be useful, but an outer layer of plastic would still likely be necessary, Johnson said. The edible film would potentially reduce the amount of plastic needed.

"It would be biodegradable. It would be edible," Johnson said of the film. "You've seen biodegradable plastic bags for groceries. They've got starch in them. They go into the landfill and bacteria know how to chew up starch but they don't know how to chew up regular plastic."

Work led by Marlene Janes has been focused on developing procedures for rapidly extracting these bacteriocins from growth media by using rice hull ash, a by-product of rice milling, as an adsorbent and transfer agent. The food science researchers have been collaborating with assistant professors Bob Beitle and Maria Coleman of the UA chemical engineering department. Under a three-year National Science Foundation grant to Beitle and Coleman, 10 undergraduates in chemistry and chemical engineering are pursuing summer research projects in "separation science." One student is working with Jones and Johnson to explore ways to further purify bacteriocins using rice hull ash and other materials.

Economists Advise Continued . . .

regulators can be more efficient when focused on prevention," they said. "Checking critical control points and verifying a HACCP program may provide cheaper and more effective regulatory monitoring than extensive product testing."

Evaluating the costs and benefits of a particular HACCP proposal depends on the performance standard for improving safety and how many fewer pathogens and cases of foodborne illness result. Jensen and Unnevehr acknowledged an analysis of HACCP's effects on the seafood industry that showed the procedures significantly reduced the risk of microbial pathogens related to human health problems. They contended that the USDA HACCP rules would be strengthened by drawing upon scientific literature to link specific pathogen reductions with specific health outcomes.

Policymakers would be better served by an examination of the costs and benefits of different levels of contamination control. So far, the researchers noted, there has not been any linkage between implementation of HACCP with an analysis of marginal cost and benefits.

Although Jensen and Unnevehr advocate a command-and-control approach to prevent foodborne pathogens, they also called for consideration of combining those standards with incentives. "In a food safety context this might mean setting a standard for a minimum level of safety that would capture most of the benefits and then providing incentives for some firms to exceed that standard, for example, by certifying safer products for consumers who have higher risks from foodborne illness."

Papers & Presentations

John Marcy, Arkansas, presented the welcoming address to the North American Food Safety Workshop sponsored by the National Educational Forum for Food Safety Issues on March 10-12 in College Park, Md. He also presented an exhibition at the FSC's booth at the conference.

Mike Johnson, Arkansas, presented an invited research seminar entitled "Rapid Detection of *Listeria monocytogenes* and Enterohemorrhagic *E. coli* " on March 10 to the Clemson University faculty and students in the departments of microbiology and food science. This was part of an exchange seminar program with the Regional Project S-263, "Ensuring Food Safety Through Control of Foodborne Pathogens."

Johnson organized and co-hosted with **Yanbin Li**, Arkansas, a one-day workshop on April 8 for the Food Technology Center of the Electrical Power Institute. **Ramakrishna Nannapaneni**, Arkansas, and **Li** presented research updates on FTC-ERPI funded research projects on "Piezoelectric Detection of *Listeria* with Monoclonal Antibodies" and "Electrical Pasteurization of Poultry Products" to 12 executives from regional electrical companies and cooperatives.

Two research poster papers were presented at the National Annual General Meeting of the American Society for Microbiology May 5 in Miami Beach, Fla., by **Nannapaneni** and coworkers **Johnson, Robert Story** and **A.K. Bhunia**, all of Arkansas. The titles were "Phenotypic Variability in the Expression of the 66 kDa Species-Specific Antigen of *Listeria monocytogenes* Recognized by Monoclonal Antibody EM-7G1" and "Phenotypic Variability in the Expression of *Listeria* Genus Specific Antigen Recognized by Monclonal Antibody EM-6E11."

Four papers were presented by Arkansas researchers June 15-18 at the annual meeting of the Institute of Food Technologists in Orlando, Fla.: **Marlene Janes** et al on "Rice Ash Hull as an Adsorbent and Delivery Agent for Bacteriocins" and "Effects of Food-Grade Additives on Activities of Bacteriocins in a Model Assay System"; **Debra Winters** et al on "Cloning and Sequencing of Genes Associated with Pediocin Production in *Pediococcus acidilactici*"; and **Zeliha Yildirim** et al on "Detection and Characterization of a Bacteriocin Produced by *Lactococcus lactis spp. cremoris* R Isolated from Radish."

Johnson was appointed effective Jan. 1 as the first coordinator of the Technical Committee for the University of Arkansas Center of Food Safety and Quality. The appointment was made by **Charles Scifres**, dean of the UA Dale Bumpers College of Agricultural, Food and Life Sciences and coordinator of the Food Safety Consortium.

An article by **Johnson, Bhunia** and **James H. Goff** of Arkansas, "Complete Inhibition of Low Levels of *Listeria monocytogenes* on Refrigerated Chicken Meat with Pediocin AcH Bound to Heat-Killed *Pediococcus acidilactici* cells" was published in the *Journal of Food Protection*, 59 (11): 1187-1192.

Amy Waldroup, Arkansas, presented a paper on "Antimicrobial Treatment for Raw Poultry" at the Midwest Poultry Federation meeting in April in Minneapolis. Waldroup also published "Development and Evaluation of a Rapid Test Procedure to Detect *Salmonellae* in Feed Ingredients and Finished Feeds" in the *Journal of Rapid Methods and Automation in Microbiology*, 5 (1997) 151-167.

Andronica Handie, Xiang Zhou, Hamid Salari, Phil Breen and **Cesar Compadre**, all of the University of Arkansas for Medical Sciences (UAMS), presented a poster on "Determination of Cetylpyridinium Chloride in Food Products Using High Performance Liquid Chromatography" at the annual MALTO Medicinal Chemistry/Pharmacognosy Meeting May 18-20 in Little Rock. Salari, Breen, Compadre, **E. Kim Fifer** of UAMS, and **Michael Slavik** and **Yanbin Li**, both of Arkansas, presented a poster of "Cetylpyridinium Chloride as a General Agent for Elimination of Pathogens from Food Products."

Breen applied for a patent April 14 as a continuation in part and patent cooperation treaty (foreign filing) for "Improved Method for the Broad Spectrum Prevention and Removal of Microbial Contamination of Food Products by Quaternary Ammonium Compounds."

Harley Moon, Iowa State, delivered an invited presentation on "BSE and Food" at the American Society for Microbiology annual meeting on May 8 in Miami Beach, Fla.

William C. Cray, National Animal Disease Center, **L.A. Thomas, R.A. Schneider** and **Moon**, all of Iowa State, published "Virulence Attributes of *Escherichia coli* Isolated From Dairy Heifer Feces" in *Veterinary Microbiology*, 53:369-374, 1996.

Evelyn Dean-Nystrom, Brad T. Bosworth, and **Cray,** all of National Animal Disease Center, and **Moon** published "Pathogenicity of *Escherichia coli* 0157:H7 in the Intestines of Neonatal Calves" in *Infection and Immunity*, 1997, 65: 1842-1848.

Dean-Nystrom, Bosworth, Moon and **A.D. O'Brien** presented an invited paper on "Bovine Infections with *Escherichia coli* 0157:H7" at the VTEC '97 meeting June 22-26 in Baltimore.

Irene V. Wesley, National Animal Disease Center, attended the Centers for Disease Control working roundtable on *Campylobacter* in January in Atlanta. She also was invited to present lectures on "*Arcobacter*: An Overview" to the World Association of Veterinary Food Hygienists Aug. 24-29 in The Hague, Netherlands, and on "*Arcobacter* and *Helicobacter*: Emerging Foodborne Agents?" at the annual meeting of the American Meat Sciences Association June 29-July 1, in Ames, Iowa.

The following journal articles by **Wesley** with other FSC personnel were accepted for publication: "Specific Detection of *Campylobacter lari* by PCR"

in the *Journal of Microbiological Methods* ; "Detection of *Arcobacter* Species in Gastric Samples From Swine" with **D.J. Larson** in *Veterinary Microbiology*; "Differentiation of *Campylobacter jejuni* and *Campylobacter coli* by Multiplex Polymerize Chain Reaction," with **K.M. Harmon** in *Molecular and Cell Probes*; "Specific Identification of *Campylobacter fetus* by PCR Targeting Variable Regions of the 16S rDNA" with **Harmon** in *Veterinary Microbiology*; "Application of Multiplex Polymerase Chain Reaction for the Rapid Identification of *Campylobacter jejuni* and *Campylobacter coli* Associated With Reproductive Failure" with **Harmon** and **Larson** in *American Journal of Veterinary Research,* and "*Helicobacter* and *Arcobacter*: Emerging Foodborne Agents" in *Trends in Food Science and Technology*.

George W. Beran, Iowa State, coauthored the following 1996 articles with these researchers: "Heat Inactivation of Selected Viruses Following Irradiation" in Vol. 58 of the *Journal of Food Protection* with **E.C. Pirtle** and **Terry Proescholdt**; "Research in the Safety of Pork" in *Swine Research Reports,* ISU Press, 187; "*Salmonella* Infection in Herds of Swine" with **Paula Fedorka-Cray, E. Bush, L.A. Thomas, J.T. Gray, J.B. McKean** and **D.L. Harris** in the *Proceedings* of the Food Safety Consortium, 117-120; "Survival of Selected Viruses in Ground Pork Under Storage Conditions" with **Proescholdt** and **Pirtle** in *Swine Research Reports*, ISU Press, 209; "*Salmonella* Contamination of Swine Carcasses and Pork Products" with **C.L. Knipe, J.J. Saide-Albornoz, E.A. Murano** and **L.M. Santiago** in *Swine Research Reports,* ISU Press, 188-191; "Cost of On-Farm Microbial Testing for *Salmonella*: An Application by Farm Size and Prevalence Level" with **Steve Gorton** and **James Kliebenstein** in *Swine Research Reports*, ISU Press, 196-208; "Risk Assessment for Food Safety: Application to Microbial Foodborne Disease Data Needs" with **Helen Jensen** and **Tanya Roberts** in *Swine Research Reports*, ISU Press, 239; "*Salmonella* Infection in Herds of Swine" with **Fedorka-Cray, Bush, Thomas, Gray, McKean** and **Harris** in *Proceedings* of the Food Safety Consortium, 117-120; "Survival of Selected Viruses in Ground Pork Under Storage Conditions" with **Proescholdt** and **Pirtle** in *Proceedings* of the Food Safety Consortium, 115; "*Salmonella* Contamination of Swine Carcasses and Pork Products" with **Knipe, Saide-Albornoz, Murano** and **Santiago** in *Proceedings* of the Food Safety Consortium, 111-114; "Cost of On-Farm Microbial Testing for *Salmonella*: An Application by Farm Size and Prevalence Level" with **Gorton** and **Kliebenstein** in *Proceedings* of the Food Safety Consortium, 133a to 144a; and "Risk Assessment for Food Safety: Application to Microbial Foodborne Disease Data Needs" with **Jensen** and **Roberts** in *Proceedings* of the Food Safety Consortium, 138.

Dennis G. Olson, Iowa State, reported these articles published during 1996: "Irradiation and Packaging of Fresh Meat and Poultry" with **Joseph Sebranek** in *Journal of Food Protection,* 59:62; "Effects of Postmortem Temperature and Time on the Water-Holding Capacity of Hot-Boned Turkey Breast and Thigh Muscle" with **Dong Ahn** in *Journal of Meat Science*, 43:51; "Survival and Injury of *Listeria monocytogenes, Listeria innocua* and *Listeria ivanoii* in Ground Pork Following Electron Beam Irradiation" in *Journal of Food Protection*, 59:596; "Proteolysis of Specific Muscle Structural Proteins by m-calpain at Low pH and Temperature Is Similar to Degradation in Postmortem Bovine Muscle" in *Journal of Animal Science,* 74:993; "Use of High Hydrostatic Pressure and Irradiation to Eliminate *Clostridium sporogenes* Spores in Chicken Breast" in *Journal of Food Protection,* 59:711; "The Action of High Hydrostatic Pressure on Rapid Thawing of Frozen Meat" in *Journal of Food Science.*

H.M. Stahr, Iowa State, presented invited papers at the Midwest AVAL conference June 9-11 in Fargo, N.D., on "Analysis for Fusaproliferin in Commodities" and "Inter-Laboratory Mycotoxin Samples Analysis 1997." **Stahr** also reported isolation of the new mycotoxin Fusaproliferin acetate from culture *Fusarium Subglutinans.*

Randall Phebus, Kansas State, reported publication of "Comparison of Steam Pasteurization and Other Methods for Reduction of Pathogens on Surfaces of Freshly Slaughtered Beef" with KSU Consortium researchers **Abbey Nutsch** and **Curtis Kastner** in *Journal of Food Protection,* 60 (5): 476-484. **Phebus, Nutsch** and **Kastner** also published "Evaluation of a Steam Pasteurization Process in a Commercial Beef Processing Facility" in *Journal of Food Protection,* 60 (5): 485-492.

Phebus participated in a PBS television interview with David J. Miller for the program "Market to Market," which aired June 13.

Curtis Kastner and **James Marsden**, Kansas State, and **James Dickson**, Iowa State, published "Trimming and Washing of Beef Carcasses as a Method of Improving the Microbiological Quality of Meat" in *Journal of Food Protection,* 59:751.

Kastner, Melvin Hunt and **Donald Kropf**, all of Kansas State, published "Chemical Properties of Ground Beef Patties Exhibiting Normal and Premature Brown Internal Cooked Color" in *Journal of Muscle Foods*, 7:303. **Marsden, Daniel Fung, Phebus, Kastner** and **Marty Vanier**, all of Kansas State, published "The Role of Pathogen Testing in Validating HACCP Critical Control Points" in *Journal of Rapid Methods and Automation in Microbiology,* 4 (4): 247; **Sharon Luchsinger, Kropf, Claudia Garcia Zepeda, Hunt, Marsden** and **Kastner** published "Sensory Analysis and Consumer Acceptance of Irradiated Boneless Pork Chops" in *Journal of Food Science* 61 (6): 1261, and "Color and Oxidative Rancidity of Gamma and Electron Beam-Irradiated Boneless Pork Chops" in *Journal of Food Science* 61 (5): 1000. **Phebus, Nutsch** and **Kastner** published "Steam Pasteurization to Reduce Bacterial Populations on Commercially Slaughtered Beef Carcasses" in *Kansas State University Cattlemen's Day Report,* No. 783.

Food Safety Digest

By Dave Edmark

A meat thermometer — not the internal color of the meat — is the most reliable way to determine if cooked hamburger is really done. The USDA Food Safety and Inspection Service announced the conclusion after research results showed that premature browning of ground beef may be more prevalent than originally thought.

Ground beef must be cooked to 160 degrees Fahrenheit to insure that harmful bacteria such as *E. coli* 0157:H7 have been killed. A brown internal appearance doesn't necessarily mean the patty is done. The only way a consumer can know for sure is to use a meat thermometer that penetrates the thickest part of the hamburger.

Melvin Hunt, a Food Safety Consortium principal investigator at Kansas State University, has done extensive research into the issue and came to the same conclusion. Hunt is pleased that the USDA has adopted the new recommendations and that FSC research helped contribute to the field of knowledge on the subject.

And while premature browning can indicate that a burger might appear to be done when it really isn't, other research has shown that some burgers that have been cooked to 160 degrees still remain pink. The bottom line, according to FSIS Administrator Thomas J. Billy, is that "the color of meat is no longer considered a reliable indicator of ground beef safety. A meat thermometer is the most reliable way to reduce the risk of foodborne illness."

* * *

Billy has also spoken on HACCP recently. Explaining the principles behind the plan, Billy told this to the World Congress on Meat and Poultry Inspection meeting in June in The Netherlands:

"The rule makes it clear that the industry is responsible for producing and marketing products that are safe, unadulterated, and properly packaged and labeled. This is a very important concept, because by placing responsibility for the production of products that meet food safety requirements on the industry, government is better able to use its limited resources more efficiently and effectively. We can focus our resources on inspecting products and facilities to verify that the statutory requirements are being met and for taking appropriate compliance and enforcement actions when the requirements are not being met. This is preferable to the traditional inspection and detection approach, which, without process control, is neither effective nor efficient."

* * *

FSIS recently commended the turkey industry for its use of quality assurance programs to facilitate its compliance with HACCP requirements. Patricia L. White, the FSIS poultry program coordinator in the agency's Animal Production Food Safety Division, discussed the issue at the Midwest Poultry Federation convention in Minneapolis. *Poultry Times* reported that she said the National Turkey Foundation has developed a plan that identifies Best Management Practices for turkey production designed to decrease physical, chemical and microbiological contaminants.

"FSIS feels that there will be competitive advantages in domestic and international markets if producers can demonstrate that all appropriate risk reduction measures are being taken to ensure food safety," White said.

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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