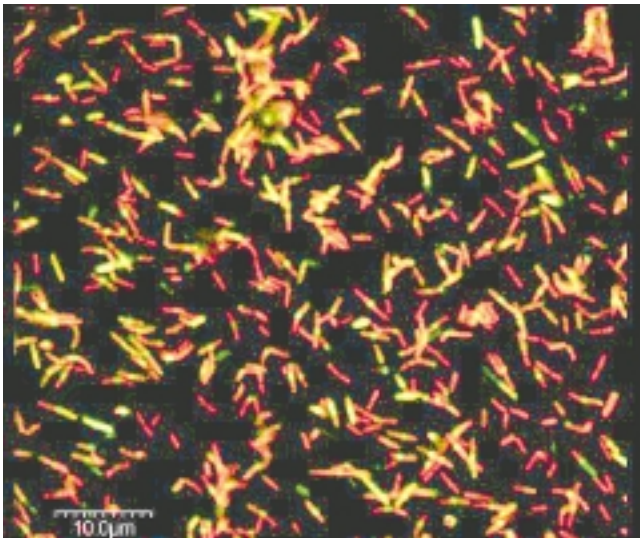
Reaching Alternative

True *Listeria* control requires combining three strategies. By Virginia Lazar.

The American Meat Institute, National Chicken Council, and National Turkey Federation have jointly petitioned the U.S. Food and Drug Administration to establish a regulatory tolerance for *Listeria monocytogenes* in food products, and requested that it be set at 100 colony-forming units per gram in foods that do not support the growth of the pathogen. FDA has said "there is general scientific agreement that low levels of *L. monocytogenes* are not uncommon in the food supply, and such low levels are regularly consumed without apparent harm."

USDA's current regulatory standard of zero-tolerance, however, flies in the face of this opinion, AMI and other organizations as well as many meat and food-safety scientists argue. Moreover, since *L. monocytogenes* is a pathogen that adapts well to several environments—water, air, and cold temperatures, for example—eradicating it from a meat or poultry processing plant is a near impossibility, say processors. At the same time, its deadliness should not be discounted. To date *L. monocytogenes* has been implicated in several deaths and hundreds of sicknesses. Especially worrisome is the fact that some outbreaks of the pathogen have been traced to cooked, ready-to-eat (RTE) meat or poultry products—and some of these had been processed in superior, food-safe plants. Unlike the situation with *E. coli* O157:H7 in ground beef, where thorough cooking before eating kills the pathogen, there is nothing a consumer could be reasonably expected to do to prevent ingesting *L. monocytogenes* cells on contaminated RTE products. Clearly, *L. monocytogenes* is a pathogen presenting a particularly confounding problem for the industry and for researchers.



Confocal image of Listeria monocytogenes *cells. The red are* L. monocytogenes *cells; the green fluorescence is a stain indicating the cell division septum that forms between the dividing cells. Photo courtesy of Andy Benson, Ph.D, University of Nebraska-Lincoln.*

The good news is that *L. monocytogenes* has spurred not just new research and thus some new scientific answers, but also innovation at the processing level.

Meanwhile, researchers, including Dr. Harrshavardhan "Reddi" Thippareddi, assistant professor and extension food safety specialist at the University of Nebraska, continue to do the basic scientific work to unravel *Listeria*'s secrets and thus put the game back in industry's favor. Taking a break from the extensive lab work he is conducting to better understand *L. monocytogenes* and its behavior in foods, Dr. Thippareddi spoke with *Meat Processing* from his office in Lincoln about what his research is telling processors and how processors can better control this pathogen through use of "alternatives" that FSIS suggested for RTE meat and poultry processors.

Meat Processing: *What, specifically, do processors need to know about dealing with* Listeria monocytogenes?

Dr. Thippareddi: *Listeria monocytogenes* is a pathogen of the highest consequence. It has a very high case-fatality rate. If 100 people become ill, 20-30 die. It is second only to another foodborne pathogen *Vibrio* in its lethality.

The major issue with *L. monocytogenes* is that it is a phychrotoph, meaning it can grow at very low temperatures, even under refrigeration. Thus, if you have one to 10 cells right after processing and packaging, it can grow to very high levels by the end of the shelf-life of the product.

The industry associations' request for a 100 CFU permissible level of *Listeria* would be similar to the tolerance levels in Canada and other countries within the European Union, where tolerance levels are based on target populations and specific food products. They have some lower tolerances, even to zero tolerance in the case of the food that is intended for susceptible populations like the elderly, immunocompromised, and pregnant women. For the general public, and in foods that do not support growth of the pathogen, a tolerance limit of 100 CFU is allowed. But in the United States, right from the beginning we had a zero tolerance and USDA is very resolute in its policy, saying we have to protect public health, and zero tolerance is the best way to do that.

Foodborne illness data shows that the incidence of *Listeria monocytogenes* (the data compiles information about four different pathogens, actually) has gone down significantly, and this is a result of USDA's approach and the industry's food safety efforts, especially for *E. coli* O157:H7. The processors have learned to deal more effectively with pathogens because of the pressure from USDA to do so and ensuring food safety is good business.

We have had the zero tolerance policy from the late 1980s, and we really saw a decline in *Listeria*-related recalls until the end of 1999 when it started to creep up. Maybe this happened because we began to scrutinize

Level One

more closely using more sensitive methods.

Q: *How does a processor best approach* Listeria *control?*

A: In general, we have tried to address *Listeria* through sanitation, because it is an environmental pathogen, meaning it establishes itself in the meat processing environment, especially in the ready-to-eat processing environment and equipment. It is not an easy task to prevent entry or eliminate *Listeria* from the ready-to-eat meat processing environment. Our efforts in the area of sanitation were not very successful, and USDA is looking at other strategies in addition to sanitation. These include combining it with use of antimicrobial agents like lactate, citrate, diacetate, or combinations of those to prevent the growth of *Listeria*, or incorporating post-lethality treatments. We know that *Listeria* contamination happens after heat processing of meat products; the contamination is on the surface of the product, so right before or after packaging we can introduce a post-lethality treatment to destroy surface *Listeria*.

Listeria cannot survive the heat processing we apply for processed meat products. When we make bologna, for example, all *Listeria*, *E. coli*, *Salmonella*, if present, will die. The process is designed to kill all of those pathogens. After processing is when recontamination can occur, whether with *Listeria* or with other spoilage microorganisms. Organisms that are not psychrotrophs are not as big a problem as *Listeria*, because they do not grow at refrigerated temperatures as *Listeria* does. Irradiation kills the pathogen, but it is not approved for multi-component products, such as meat products with phosphates.

Q: *What is USDA's current approach to* Listeria *control for ready-to-eat meat and poultry?*

A: The strategy that USDA is applying now is looking at sanitation in combination with antimicrobial agents and post-lethality treatments—a very science-based approach. Most processors in the meat industry are using some kind of antimicrobial agent like lactate, citrate, diacetate, or combinations of these. These at least prevent the growth of *Listeria* populations from very few cells to millions of cells where the illness risk is higher. They are hoping that the antimicrobials will prevent the growth of *Listeria* during the shelf-life of the product.

There are three levels of control possible in a plant: Alternative Level One, Alternative Level Two, and Alternative Level Three.

Q: *Please describe those different levels.*

A: Alternative Level Three is the basic control level when *Listeria monocytogenes* contamination is addressed through sanitation. If I'm a meat processor, I say I'll clean and sanitize using these chemicals in these concentrations addressing food contact surfaces and other non-food contact surfaces like drains, ceilings, equipment, and other similar areas. And eventually, I will verify that I'm very effective at eliminating *Listeria* from the environment.

The next step up, Alternative Level Two, combines sanitation with a post-lethality treatment such as heat, steam, or hot water, or an antimicrobial agent or process such as freezing. Freezing is a very effective treatment, because once we freeze a product, *Listeria* is not going to grow—but it does not die; freezing does not kill bacteria. If I processed meat today and ended up with five cells on the product, then I keep the meat under refrigeration, those five cells will grow to millions of cells; if I freeze it, only those five cells will remain until the consumer eats it. However, a number of products do not freeze well, forcing the industry to address *Listeria* with antimicrobial chemicals that will control the growth of the pathogen.

The best approach is the next step up, Alternative Level One. At this step a processor has good sanitation plus an antimicrobial treatment plus

Alternatives for *Listeria* Control

Antimicrobial Agents include:
Lactate
Diacetate
Combinations of lactates and diacetate
Citrates and combinations of citrates

Post-lethality Treatments include:
Surface heat treatment and cooling
Steam or hot water and cooling
Ultra high pressure
Acidified sodium chloride
Ozone

Antimicrobial Process:
Freezing

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a post-lethality treatment, combining all three strategies. When you look at the risk of foodborne illness, products made under Alternative One have the lowest risk of creating illness because you are trying to eliminate *Listeria* with a post-lethality treatment and you are preventing the outgrowth of it with an antimicrobial agent or process. There is, of course, still a chance that *Listeria monocytogenes* will occur, but the population will be low and is less likely to cause illness. The risk for *Listeria* is much higher with products using just Alternative Three, even with good sanitation.

Q: *What is the likelihood for all processors to reach the level of Alternative One*?

A: That's going to be very tough to do. Right now most of the large processors are in Alternative Level Two. Most of them are using antimicrobial agents, so they have improved their product in terms of preventing *Listeria* growth. Hormel uses an ultra-high-pressure treatment for its prosciutto line to kill *Listeria*. Some large processors use a post-lethality treatment for products that can't be produced with antimicrobial agents, but very few companies have combined antimicrobial treatments and post-lethality treatments to bring them to Alternative Level One. I'm not aware of any companies that have reached this level, but that does not mean there are none.

Reaching this level imposes its own limitations: If you put in a post-lethality treatment like heat, a hot water system, or steam-based system, you must also put in a system to chill the product. *Listeria* is confined to the surface of the product, so the treatments will heat the surface of the product to a temperature high enough to kill *Listeria*, but then you need to chill the product down quickly or there will be undesirable quality effects such as purge and color changes.

H. Thippareddi, Ph.D.

Looking at the footprint of the equipment necessary to heat-treat, and then rapidly chill product surfaces, most meat processors are unable to place that equipment in their existing facilities. That's one of the constraints, and then there is the capital investment that is required. That is a second limitation.

Eventually, we will understand how to control *Listeria*. It is our own best interests to do so. **MP**

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