Induced Heat Resistance in *E. Coli*

Escherichia coli O157:H7 bacteria that get only a sublethal dose of heat can become more heat resistant than bacteria that are not so exposed, report Agricultural Research Service scientists in Wyndmoor, Pennsylvania.

The microbiologists at the ARS Eastern Regional Research Center (ERRC) say the finding reiterates the continuing need to adequately cook food to kill *E. coli* O157:H7 and other food-poisoning microorganisms, or pathogens. Cooking remains the primary means to kill these organisms in foods.

"Our increasing understanding of the wide range of factors that can affect pathogens' thermal resistance indicates the need for a standard way to measure that resistance," says Vijay K. Juneja, who conducted the study in ERRC's Food Safety Research Unit.

Juneja and colleagues subjected beef gravy samples containing *E. coli* O157:H7 to 114.8°F for 15 to 30 minutes, heat-shocking the bacteria at a temperature not quite sufficient to kill them. Then they cooked the gravy to a final internal temperature of 140°F.

The results: The pre-heated *E. coli* survived longer (a 1.5-fold increase in heat resistance) than other *E. coli* not subjected to the sublethal heat. The increased thermotolerance lasted for at least 48 hours.

Therefore, says Juneja, food processors should realize that bacteria will not be killed in foods that are heated slowly to the final cooking temperatures normally used. Heat-shocking conditions may occur in minimally processed, refrigerated, cook-in-bag foods such as filled pasta products (ravioli, tortellini, canneloni, etc.), moussaka, lasagna, and chili con carne. The slow heating rate and low heating temperatures used in preparing these foods expose potential pathogens to conditions similar to heat shock—which could make them more heat-resistant.

This induced heat-resistance could also be a concern in meat products kept on warming trays before final heating or reheating, or when equipment failure interrupts the cooking cycle during processing.

Juneja says that traditional research methods to determine if heat kills pathogens are cumbersome because of lengthy sample preparation times and nonuniform heating. He and colleagues used a submerged stainless-steel coil-heating apparatus that allows quick temperature control by a thermostat, eliminating the customary problems.—By **Doris Stanley,** ARS.

Vijay K. Juneja is in the USDA-ARS Food Safety Research Unit, Eastern Regional Research Center, 600 East Mermaid Lane, Wyndmoor, PA 19038; phone (215) 233-6500, fax (215) 233-6406, e-mail vjuneja@arserrc.gov ◆

Model Helps Time Stored Pest Fumigation

Most U.S. warehouses fumigate three or four times a year to control moths and other stored product insect pests. Fumigation—costing about $20,000 each time—is initiated even when only two or three moths are sighted in the warehouse.

"Fumigating when there are so few insects is a costly waste," says Agricultural Research Service entomologist James E. Throne. He works at the U.S. Grain Marketing Production and Research Center in Manhattan, Kansas.

"Better timing can be achieved by having an accurate count of how many insects are present and knowing their stage of development. With this information, warehouse managers can keep costs down and reduce the amount of insecticide used."

Throne and entomologist David W. Hagstrum have developed a computer model for tracking development of the almond moth, a major pest of grain and other stored products throughout the world.

In 1996, using data gathered by Polish entomologist Jan Nawrot, ARS scientists developed a computer model that simulates the life cycle of almond moths on stored peanuts. Shortly after, they modified the model to simulate the moth's life on stored corn and dried citrus pulp. The basic data blocks of the model show how temperature and moisture conditions affect the number of adult moths, how many eggs each adult can lay, and how long it takes for immature moths to complete development.

"Our predictions can help warehouse managers decide when to use alternatives to insecticides. For instance, we know that cooler temperatures can reduce or stop moth reproduction and slow development of immature moths," says Throne. "It may take only a slight temperature drop, say from 75°F to 65°F, to curtail moth activity."

Turning on fans to cool down the warehouse is much less expensive—and more environmentally safe—than fumigating.

Now the researchers are adapting the computer model for predicting Indianmeal moth development in corn and other stored products that can harbor the pest. These moths are responsible for large expenditures by the multibillion-dollar food industry for sanitation and insecticidal treatments.—By **Linda McGraw,** ARS.

James E. Throne and David W. Hagstrum are in the USDA-ARS Biological Research Unit, U.S. Grain Marketing and Production Research Center, 1515 College Ave., Manhattan, KS 66502; phone (785) 776-2796, fax (785) 776-2792, e-mail throne@usgmrl.ksu.edu hagstrum@usgrml.ksu.edu ◆