United States Department of Agriculture
Agricultural Research Service

EASTERN REGIONAL RESEARCH CENTER FACT SHEET

Improving Food Safety Through a Better Understanding of Bacterial Responses to Stresses

Program Background

Food and agriculture systems expose pathogenic bacteria to heat, cold, salt, acid, oxidative, and other stresses that provoke bacterial responses designed to cope with the particular stress situation. Bacteria possess mechanisms to adapt to sublethal stresses, rendering them resistant to lethal levels of the same stress and/or resulting in the capacity to withstand other types of stresses. For example, this is important because stress-adapted bacteria may be more difficult to inactivate with techniques commonly used by the food industry. Additionally, stresses used in food systems to control bacterial growth may, in fact, increase the disease-causing potential of pathogens that survive the particular treatment.

Physical treatments or chemical agents used in food processes to inactivate bacteria may leave a fraction of the bacterial population sublethally injured. It is essential that pathogen detection systems have the ability to detect/enumerate injured cells as well as healthy cells since injured/stressed bacteria can potentially recover in the human host and retain their pathogenic traits.

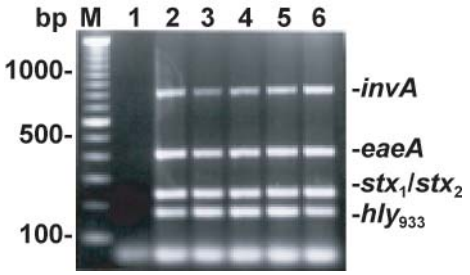
Our research is directed toward enhancing our understanding of bacterial stress responses in food environments and ultimately leading to the development of practical food preservation systems that minimize public health risks.

Research Objectives

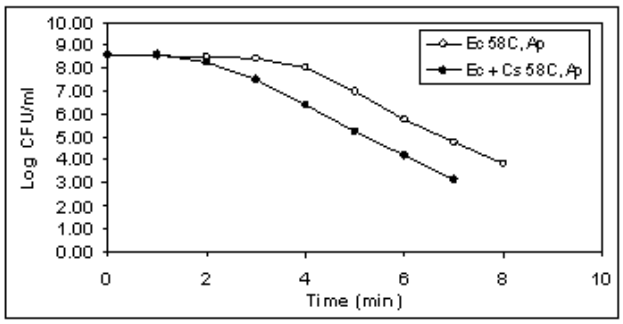
Over the next five year period, the research program on stress responses of bacterial pathogens will focus on the following specific objectives:

- studying the effect of exposure of pathogenic bacteria to different stresses found in food environments on their growth and survival
- examining the effects of stress conditions on the disease-causing potential of pathogenic food-borne bacteria
- examining the role of signaling molecules produced by pathogenic bacteria on regulation of their growth, survival, and disease-causing potential
- developing methods for detection of healthy as well as stressed/injured pathogenic bacteria in foods

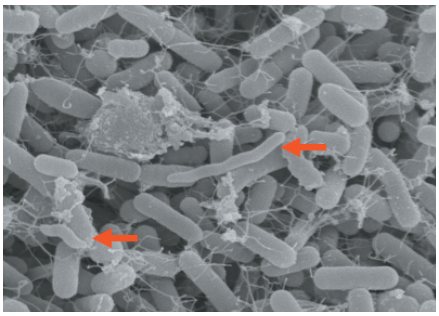
Examples of Research Data



Simultaneous detection of *Escherichia coli* O157:H7 (*eaeA*, stx_1/stx_2, hly_{933}) and *Salmonella* spp. (*invA*) virulence genes by multiplex polymerase chain reaction.



Effect of cold shock (Cs) on heat inactivation of *Escherichia coli* O157:H7 (Ec) in apple cider (Ap).



Bacteria, including *Campylobacter* (arrows), attached to naturally-contaminated pork skin after 24 hours of growth at 42°C.

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Impact

The development of improved detection methods enhances the ability of regulatory agencies and the food industry to detect low levels of harmful bacteria thus increasing the safety of the food supply.

Research on bacterial responses to stresses elucidates the effects of food environments and food processing and storage conditions on the growth and survival of pathogenic bacteria. Our research will lead to the development of strategies to eliminate pathogens in foods.

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