Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

POSTER SESSION 2

MGH 241, Easel 158

12:45 PM to 2:15 PM

Subzero Growth, Metabolism, and Protein Expression of the Polar Marine Bacterium *Colwellia psychrerythraea*

Krystal Slattery, Fifth Year, Biology (General), Earth & Space Sciences (Biology)

NASA Space Grant Scholar, Undergraduate Research Conference Travel Awardee

Mentor: Karen Junge, Polar Science Center, Applied Physics Laboratory

Mentor: Karen Cameron

The mechanisms that enable bacteria to be metabolically active at subzero temperatures are of considerable interest to studies of polar microbial ecology, astrobiology, climate and cryopreservation. The true nature of these mechanisms in marine bacteria remains elusive. Previously, protein synthesis within the sea ice bacterium *Colwellia psychrerythraea* str. 34H has been observed down to -20C (and possibly lower) after being flash frozen with liquid nitrogen (Junge et al 2006). Here we report on the results of a long-term study of subzero metabolic activity, growth and protein expression of 34H cells not impeded by possible flash-freezing artifacts. 3H-Leucine- and Thymidine incorporation in addition to shotgun proteomics techniques were applied to 34H cultures incubated for up to 8 weeks at -1, -5, -10, -15, -20, and -196C. Protein synthesis rates were found to be significantly higher without flash-freezing, in particular as temperatures dropped below -5C. Furthermore, maximum protein synthesis and growth rates were observed at -1C and -5C. Evidence for growth cessation with continued protein synthesis at -10C, and possibly below -10C, were also obtained. Triplicate detailed proteomic profiling using tandem mass spectrometry are in progress and will help elucidate specific metabolic pathways that are selectively turned on or upregulated in order to facilitate the observed metabolic activities and growth at subzero temperatures. These combined efforts contribute to solving the critical puzzle concerning the establishment and maintenance of life in saline ice formations as well as provide valuable insight into low temperature cell physiology and adaptations for life in ice with significance to sea-ice ecology and seasonal transitions.

POSTER SESSION 3

MGH 241, Easel 161

2:30 PM to 4:00 PM

Effectiveness of Lactic Acid and Peroxyacetic Acid Treatments on Reducing Generic and Pathogenic *E. coli* on Fresh Apples

Piedad Alcala, Senior, Biomedical Science, Heritage College

McNair Scholar

Mentor: Karen Killinger, School of Food Science, Washington State University

Identifying effective antimicrobial interventions to reduce foodborne pathogen risk are important for the fresh apple packing industry. Apple packing antimicrobial interventions are commonly applied for short application times using spray bars and longer application times in flumes. The objective of this study was to investigate the potential for using lactic acid for spray bar applications and peroxyacetic acid (PAA) for flume applications based on reduction of generic and pathogenic Escherichia coli (E. coli) on fresh apples. For each replication, fresh apples (n=220) were randomly assigned to treatments. Uninoculated controls (5 apples) were examined for background microbial levels (total coliforms, generic *E. coli* and aerobic plate counts) and the remainder were inoculated with pathogenic (E. coli O157:H7) or generic *E. coli*. Lactic acid (1% and 2%) and water treatments were examined at application times of 5, 15 and 30 seconds to mimic spray bar applications. PAA (60 and 80 ppm) and water treatments were examined at application times of 2, 3.5 and 5 minutes to mimic flume applications. Lactic acid (1 and 2%) treatments with short application times do not appear to reduce microbial levels sufficiently for consideration as a spray-bar application for fresh apple packing. PAA treatments of 80 ppm for 2-5 minutes and 60 ppm for 3.5-5 minutes reduced microbial levels sufficiently for consideration as a flume application for fresh apple packing.

POSTER SESSION 4

Balcony, Easel 98

4:15 PM to 5:45 PM

Effect of UV Irradiation Dose on Bacteria in Ice

Marissa Nicole (Marissa) Karpack, Junior, Civil Engineering
NASA Space Grant Scholar
Mentor: Dale Winebrenner, Earth & Space Sciences
Mentor: W. T. Elam, Applied Physics Laboratory
Mentor: Karen Junge, Polar Science Center, Applied Physics Laboratory

UVC is ultraviolet light in the wavelengths 280 – 100nm. UVC's germicidal ability has been employed to prevent forward contamination, or the contamination of a pure planetary body with terrestrial organisms. Scientists have used UVC to sterilize equipment on land and water, but the effective dose of UV needed to prevent contamination when probing a pure ice environment is still unknown. In order to safely explore pure icy environments, data of bacterial response to UVC in ice are needed. To create these data, we first irradiated *Escherichia coli* in water as there is a known decimation curve for this experiment, which serves to standardize our irradiation set up and techniques. After matching the decimation curve of *Escherichia coli* of previous UV sterilization experiments, we will then proceed to irradiate bacteria in ice. In addition to irradiating commonly tested bacteria such as *Escherichia coli* and *Bacillus subtilus*, we will also irradiate samples of glacial isolates that would be more likely contaminants in an icy environment. Each sample of bacteria will be assessed before and after radiation using the Most Probable Number technique, or MPN. The MPN method uses serial dilutions of a sample bacterial culture until no colony forming bacteria are present to determine the concentration of bacteria present in the original sample. From our irradiations, we will create curves of UV dose versus survival of bacteria that will allow future equipment used in the exploration of pure icy environments to employ the correct dosage of UVC light to minimize forward contamination.