SPACE LIFE SCIENCES SYMPOSIUM (A1)
Astrobiology and Exploration (5)

Author: Dr. David P Summers
Carl Sagan/SETI, c/o NASA Ames Research Center, United States, david.p.summers@nasa.gov

Dr. Fathi Karouia
National Aeronautics and Space Administration (NASA), Ames Research Center / UCSF, United States, fathi.karouia@nasa.gov
Ms. Carolina Duart-Garcia
Integrants Program, Spanish ministry of Education and Science, Spain, United States, carolinaduart5@hotmail.com
Mr. Hector Diaz-Maldonado
Integrants Program, Spanish ministry of Education and Science, Spain, United States, hectoruco@hotmail.com
Dr. Orlando Santos
National Aeronautics and Space Administration (NASA), Ames Research Center, United States, Orlando.Santos@nasa.gov
Dr. Johnathan D Trent
National Aeronautics and Space Administration (NASA)/Ames Research Center, United States, jonathan.d.trent@nasa.gov

DETECTION OF METABOLIC ACTIVITY BY125I-IODODEOXYURIDINE INCORPORATION INTO DNA IN COLWELLIA PSYCHRERYTHRAEA OVER A TEMPERATURE RANGE FROM 8C TO -40C

Abstract

A central issue of interest in Astrobiology is; "what are the environmental limits of microbial metabolic activity"? This question is crucial to such issues as where life might be found in the solar system, where life might found in extreme environments on the Earth, and how life may have survived and evolved through difficult periods. For example, the last refuges of life on the surface of Mars may well have been environments where low temperatures restricted organisms to low rates of metabolism and created difficulties in repairing damage caused by background radiation (McKay 1997). Another example is whether microorganisms might exist under the ice of Europa (McKay 2008).

One of the limiting factors in the survival of "dormant" organisms is difficulty in repairing damage to various large molecules such as DNA. In the past, it had been assumed that microbes are not metabolically active and are unable to repair any damage they suffer below the freezing point of water. More recent work has shown this not to be true (Vestal 1988; Friedmann et al. 1993; Schroeter et al. 1994; Rivkina et al. 2000; Christner 2002; Price and Sowers 2004; Junge et al. 2006; Panikov et al. 2006). However, if such activity exists, it likely exists at only low levels. For this reason, we are studying the incorporation of 125I-deoxyuridine (125IdU) into DNA as a measure microbial metabolic activity at low temperatures. Since the iodo group on IdU has a Van der Walls radius similar to that of a methyl group, the compound can act as analog for thymidine, becoming incorporated into DNA during repair and/or synthesis (Cooper et al. 1971).

We present work where the incorporation 125IdU into the DNA of Colwellia psychrerythraea has been studied over a temperature range from 8 C to -40 C. The results are consistent with the view that DNA repair and/or synthesis can occur below 0 C. They also show that this method has the potential to enable

the detection of metabolic activity to lower levels than previously possible.