ENZYME KINETICS IN MICROGRAVITY. C.C. Liu and V.J. LiCata, Department of Biological Sciences, Louisiana State University, Baton Rouge, LA 70803 (licata@lsu.edu).

Abstract: The molecular and cellular origins of a variety of physiological effects of microgravity remain unknown. In this study we examined the effects of microgravity on a variety of enzyme kinetic systems and protein-ligand association systems. Experiments were conducted on a series of parabolic flights facilitated by the NASA Reduced Gravity Office at Johnson Space Center.

Six different protein-ligand systems and metabolic enzymes have been examined in microgravity by our group and others: bovine serum albumin, adipocyte lipid binding protein, alkaline phosphatase, acetylcholinesterase, lipoxygenase, and isocitrate lyase. Of these systems, two show definitive changes in microgravity: both acetylcholinesterase and lipoxygenase kinetics are enhanced by 25-30% in the microgravity environment. Surprisingly, the microgravitational effects on these two enzymes are species specific: i.e. homologues of the two enzymes from different species do not universally exhibit microgravitational effects.

These changes are within the range of enzymatic activity changes that can cause physiological disease states, and are within the range of pharmacologically inducible enzymatic activity changes. Thus, beyond potentially explaining some organismal and cellular responses to microgravity, these findings have direct implications for proper pharmacological use in the space environment.

The molecular origins of the effects remain unclear. Microgravity effects did not track with relative reaction rates, i.e. faster enzymes do not preferentially show microgravity effects. Direct measurement of molecular diffusion in microgravity by dynamic light scattering showed no effects of microgravity on diffusion rates of molecules in this size range. The effects seem most experimentally analogous to a brief temperature jump in the micro-environment surrounding the enzymes, possibly due to reduced thermal convection in the immediate vicinity of exothermic reactions. Current investigations into this hypothesis will also be presented.