

PUSHCHINO SCIENCE CENTER SAMPLE PAPER ABSTRACTS

One of the program goals is to help students improve their scientific writing skills. Students are required to enroll in the “Writing for Science & Medicine” course, which provides an introduction to science writing. Students are expected to work closely with their science/physician supervisors to focus on their writing produce a journal quality paper at the end of the program.

Below are two abstracts from papers written by William Burke-White and James Park. KEI can provide other samples upon request.

Alternative Translational Initiation of Maize Transcriptional Activator TnpA Yields Two DNA Binding Proteins

by William Burke-White
Supervising Scientist: Oleg Denisenko, Ph.D.

Translation of mRNA in a wheat germ cell free system coding for tnpA, a transcriptional activator of Zea Maize, Suppressor Mutator (Spm) transposon, was studied. Spm a movable genetic element, first characterize by Barbara McClintock, targets several genes. Spm is important in both the evolution of the genome and in eukaryotic gene expression it controls genetic rearrangements, chromosome breaks, inversions, duplications, an subtle alterations in the DNA sequence at the insertion site.

TnpA is a DNA binding protein, which activates Spm transcription by demethylating areas slightly upstream and downstream of the transcription start site. TnpA contains several functional domains: an amino terminal transactivation domain, a central DNA binding domain, and carboxy terminal dimerization domain.

It appeared that increasing the concentration of tnpA mRNA in the in vitro system switches the translation from the synthesis of the 75KDa protein to a 45KDa protein. Using oligonucleotide site specific RNaseH cleavage of the mRNA, the AUG initiator codon for the 45KDa protein has been determined. The synthesis initiates at AUG 769, 732 base pairs downstream from the first AUG codon. This research has also shown that both the 75KDa and the 45KDa proteins posses similar affinities to calf thymus DNA.

These findings led to a model for auto regulation of tnpA synthesis in vivo. In an auto-regulatory loop, an increase in the concentration of tnpA mRNA drives the translational

switch from the synthesis 75KDa proteins to 45KDa proteins. In this model, dimerization not only takes place between two 75KDa monomers, but also between 45KDa and 75KDa monomers, resulting in the formation of nonfunctional (i.e. incapable of transactivation) heterodimers. These nonfunctional heterodimer complexes prohibit excessive Spm activity.

This auto-regulatory model underscores the intricacies of the mechanisms that modulate eukaryotic gene expression. Specifically, the level of TnpA, a transcriptional activator of Spm, is fine tuned as the result of a translational switch. Truly understanding how genes are expressed will further our understanding of carcinogenesis, in addition to other diseases, and the determination and differentiation of cell types which underlie the development of multicellular organisms.

New Clinical Treatment for Burn Patients: Effects of Heat Shock Protein Supernatant (Hsp) on Skin Cell Recovery and Proliferation.

by James Park

Supervising Scientist: Sergey Sukharev, Ph.D.

All organisms produce heatshock proteins (Hsp) when exposed to environmental stress such as hyperthermia, anoxia, exposure to heavy metals or viral infection in order to protect themselves from further damage. Environmental stress such as heat disrupts the process by which nascent polypeptides fold into three-dimensional conformations by overexciting atomic bonds which in turn causes the protein structure to become denatured. Denatured proteins are naturally found in low concentrations in normal cells, however excessive quantities of denatured proteins result in cytotoxicity. If the cell is unable to curb proteolysis and denaturation, death becomes certain for the cell. In order to repair damage caused by stress, the ribosomes manufacture Hsp to act as a "molecular chaperone" whose role is to prevent proteins from becoming denatured, to refold denatured proteins and to assemble new proteins through the binding and release processes.

The level of Hsp 70 involved in the binding and release processes of healthy cells in contrast to genetically defective cells which lack the heat shock gene can be recorded using gel electrophoresis. Based on evidence collected from gel electrophoresis, healthy cells which produce higher levels of Hsp appear to be better able to survive and to recover from stress conditions than genetically defective cells. Consequently, the logical conclusion to follow is that perhaps by raising the level of Hsp, a cell can be better protected, better prepared in removing denatured proteins and thus more apt to recovery and proliferation.

Therefore, it was hypothesized that Hsp might have a direct impact on the rate of cell proliferation. To determine the effectiveness of Hsp, an experiment was designed to compare the rate of cell proliferation between Hsp supernatant-treated stress cells and controlled stressed cells were determined by the use of a micro-fluor reader.

Findings indicate that Hsp supernatant induced cell proliferation at a 35% faster rate than the control. Therefore, the use of Hsp supernatant in conjunction with modern treatment for burns will permit a significant reduction in recovery time. For burn patients, the minimizing of time for cell recovery is crucial because openings in the skin invite bacterial infections which can hinder recovery.