The cellular adaptation and survival under stress: pros or cons

Dr. Thangminlal Vaiphei S, PhD

Vaiphei ST. The cellular adaptation and survival under stress: pros or cons. J Microbiol Biotechnol Rep. 2018;2(1):5.

INTRODUCTION

One of the most interesting facts in understanding cellular behavior would comprise of how individual cell or microbial community response to and deal with the surrounding environmental factors. What is more intriguing would be to understand exactly how living cells are able to adapt and survive certain degree of different types of stress. Microbial cells including pathogenic bacteria are known to adapt to various kinds of stressful environments such as nutrient starvation, extreme temperatures, host immune system, low and high pH etc. Several approaches have been employed to address this issues at different levels using a wide range of organisms and other *in vitro* and *in vivo* models for recreating the natural habitats.

BACTERIAL AND MITOCHONDIAL RELATIONSHIP

The close similarity of bacteria and mitochondria suggested that both shared common hereditary triats in the course of evolutionary perspectives. Mitochondria being the powehouse of the cells is the energy producing centres in higher organisms, and involved in multiple cellular functions. The existence of mitochondrial genome itself strongly suggested its importance and inevitability as a cellular component for the cell's survival. The presence of numerous mitochondrial proteins of unknown function also suggested mitochondria's multiple roles apart from what has been known already. The mitochondrial non-coding species such as tRNAs and rRNAs are also known to be linked with human diseases. The non-coding RNAs are very stable and showed great potential as biomarkers for non-invasive and cost-effective assay, as they can be easily biopsied from circulating fluids. Genes coding for short peptides are also present as small open reading frames overlapping or hidden within other genes, such as rRNA. These mitochondrial peptides have been linked to regulatory roles in cellular mechanisms like metabolism, aging, inflammation, apoptosis etc. Comaprative analysis of bacteria and mitochondria by combining genomics and proteomics approaches for exploration and Identification of novel key molecules would impact tremendously in the development of biomarkers and targeted drugs for many diseases.

RADIATION AND STRESS INDUCIBLE GENES

Cellular stress, due to ionization radiation, is another important aspect in understanding the molecular mechanisms of stress induced cells in living cells. Several potential candidate 'radiation response genes' could be identified with the help of DNA microarrays and qPCR analysis from radiation exposed cells *in vivo*. Validation of these genes at the transcriptional and translational level will greatly enhance our understanding towards preparedness during radiological emergency. Assesment of these genes for biodosimetry and biomarkers would be helpful in the development and improvement of diagnostic and therapeutic values. This approach will answer some of the vital questions that still remain elusive such as the role of non-coding RNAs, post-transcriptional regulation of gene expression, the epigenetic factors etc.

NON-CODING RNAS

The non-coding RNAs (ncRNAs) are known to be regulators of gene expression at the transcriptional and post-transcriptional level. These ncRNAs are also involved in other celleular processes such as post-translational modifications of histones, heterochromatin formation, and DNA methylation. The short ncRNAs are <30 nucleotides wheras the long ncRNAs are >200 nucleotides. The short ncRNAs comprise of miRNAs, siRNAs and piRNAs. MicroRNA (miRNA) binds to a complementary mRNA target sequence preventing or blocking its translation. Short interfering RNAs (siRNAs) also leads to post-transcritional silencing of genes by degradation of target mRNA. Piwi-interacting RNAs (piRNAs) interact with the piwi family of proteins that are associated with chromatin regulation and transposon suppression in germ line and somatic cells. Due to their critical roles in gene regulation, ncRNAs have become potential targets for the development of biomarkers in clinical, therapeutic and other diagnostic tools. For example, miRNAs are also involved in the regulation of radiation-induced cellular processes suggesting their potential role in the development of radiation induced biomarkers or biodosimetry tools.

FUTURE PERSPECTIVES

The long term perpectives pertaining to the elucidation of key players in the cellular responses to different types of stress would be underatnding the mechanisms of cellular adaptation. A single-cell level or a unique microbial population interaction and response to environmental stress for adaptation and survival would be a benchmark for the future of clinical and therapeutic applications.

Department of Biotechnology,Central University of Rajasthan, Bandarsindri, Kishangarh, Ajmer, Rajasthan, India

Correspondence: Dr.. Thangminlal Vaiphei S, PhD, Department of Biotechnology, Central University of Rajasthan , Bandarsindri, Kishangarh, Ajmer, Rajasthan, India. Telephone +91 7005885747, e-mail vaiphei@curaj.ac.in

Received: October 25, 2017, Accepted: October 28, 2017, Published: October 28, 2017