Proteomic analysis of stress proteins expressed in response to stress in haloarchaea

Dr. Rebecca Thombre1*, Radhika S. Oke1, Sunil Dhar2, Yogesh Shouche2
1Department of Biotechnology, Modern College of Arts, Science and Commerce, Shivajinagar, Pune-05 India.
2Microbial Culture Collection, NCCS, University of Pune, Pune-07, India.
Corresponding author: rebecca.thombre@gmail.com

Introduction

Halophilic archaebacteria, the organisms living in extreme salt conditions have to face several challenges like temperature, chemical and salinity stresses. These stress conditions induce production of certain stress proteins in them which work in association with molecular chaperonins to protect the cells from damage. These proteins expressed in response to chemical stress are mainly from the Universal Proteasomal System (UPS) which helps in accumulation of abnormal proteins and maintains protein homeostasis in stress. Interaction between Chaperones and Proteasomes in stress conditions and to maintain homeostasis (Lim and Zhang, 2013)

Materials and Methods

Ten haloarchaea were isolated from different sources like water, soil and rocks from shores of Western coast of Maharashtra, India.

Identification of the organism using 16S rRNA gene sequencing and its morphological and biochemical studies

Growth of culture in SG medium and Enrichment of the H. argentinensis isolate on SG plate (with 1.5% NaCl)

Peptide Extraction, SDS-PAGE and MALDI-TOF MS analysis of the stress proteins (Mass spectrometry sample preparation handbook)

Results and Discussion

Isolation of haloarchaea: Haloarchaea was isolated and enriched on 1.5% SG medium as described by Digaskar et al., 2015.

Isolation of an aerobic, orange red pigmented, gram negative isolate

Phylogeny was drawn by MEGA 6 Neighbor Joining method. The evolutionary distances are in the units of the number of base substitutions per site. Phylogenetic analysis suggests that the isolated strain RR10 from sea water of Mumbai is H. argentinensis [Genbank Accession No. KP712898]

Effect of perchlorate stress on haloarchaea

Summary of the proteins expressed in H. argentinensis in response to chemical stress

Effect of perchlorate stress on H. argentinensis

Significance of perchlorate stress in Astrobiology

• Extreme environment persists on martian surface characterized due to presence of perchlorate, high salinity, high concentration of minerals like magnesium sulphate and radiation.
• Recent evidences suggest that tolerance to perchlorate, salt and magnesium would be a characteristic requirement for survival in martian soil. In the current investigation, we have studied the effect of perchlorate stress on haloarchaea.
• Results indicate that haloarchaea have the ability to tolerate multiple stress conditions of salinity, perchlorate and MgSO4 concentrations that are a hallmark of Martian environment.
• The possibility of survival of haloarchaea in Martian conditions or the application of haloarchaea as ‘models’ for studying survival response during (Lithopsmium) as well as the possibility of extreme halophilic life on Mars cannot be precluded.

Conclusion

Ten haloarchaea were isolated successfully from Western Coast of Maharashtra, Mumbai and Sindhuagur regions. They were subjected to various biochemical and morphological tests and then identified using 16S rRNA gene sequencing method. Wide range of diversity was seen in the isolated organisms. The organisms were subjected to chemical stress followed by the expression of stress proteins using SDS-PAGE and then its identification using MALDI-TOF MS MS analysis. The identified protein was a beta proteasomal subunit, which is a part of UPS that works in conjugation with UPS and chaperones. 2-DGE may be needed to study proteins expressed in response to stress in more details. The works in conjugation with UPS and chaperones. 2-DGE may be needed to study proteins expressed in response to stress in more details. The study suggests strong cooperative linkage between chaperones and UPS pathways in H. argentinensis. Stress physiology studies can provide useful information about molecular mechanisms of repair and survival of haloarchaea in stress conditions.

References