Brief Insight Halophilic Proteins Adaptation and their Biotechnological Potentials

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Introduction

Life in Extreme Environments

Life has been evolving in almost every niche on our planet. Recently some environments that previously were considered to be too violent to support life (e.g., high salinity, extraordinary pH and temperatures) have been discovered to embrace many forms of life. It is natural, however, to consider many of these so called extreme environments as unsuitable habitats for *Homo sapiens*. Microbial survival in these precluding and discordant habitats, however, needs special adaptation strategies. Organisms that thrive and live optimally in these habitats are referred to as extremophiles and polyextremophiles with one or several extreme factors, respectively (Dartnell, 2011). After the discovery of extremophiles and based on the fact that the environments they live in today are closely similar to that of the early shaped planet Earth around four billion years ago and somehow to extraterrestrial worlds (e.g., Mars and Europa); new research models for study of the origin of life and astrobiology developed (Rinaldi, 2007). Classification of extremophiles is based on extreme conditions in which they live. Table 1 includes some types of extremophiles and their habitats. This book reviews and discusses halophilic microorganisms, their habitats and various strategies used by them for adaptation of their proteins and the relevance of amino acid signatures in the stability and activity of halophilic proteins in high salt concentrations. Also the effect of low-water environments and organic solvents on halophilic proteins will be considered.

Microorganisms and Saline Habitats

Environments with high salt concentration are among most extreme and strongly discordant habitats to support life. The interests in studying proteins, enzymes and intracellular biochemical processes of halophiles have been raised in many laboratories to understand their enigmatic

strategies, by which they are capable to thrive, tolerate and colonized in such extreme habitats. Isolated enzymes and proteins from extremophiles, due to their extraordinary properties to work in such harsh conditions, are considered as useful catalysts for a variety of applications in biotechnology (Champdore, 2007). Divers types of living organisms in different saline environments can be either halotolerants or true halophiles. Halotolerant organisms are those that thrive in low salt habitats but also are able to tolerate partially high salt concentrations, while the halophilic (salt-loving) organisms have a vital need of salt for their optimal growth. Based on salt requirements, halophiles are classified in different groups. Slight halophiles optimally thrive at low salt concentrations (0.2-0.5 M), moderate halophiles prefer moderate salt concentration (0.5-2 M) and extreme halophiles require more than 3 M salt (Table 2) for optimal growth (Joo, 2005).