PERSPECTIVE

Perspectives on the microbiology of chile's salar de atacama chaotropic brines

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ABSTRACT

Only a few number of extremophile or extremotolerant taxa are found in hypersaline settings. High NaCl concentrations are not the only type of hypersaline habitats that can exist naturally or artificially; in these situations, special adaption processes are required to allow for microbial survival and proliferation. Three sizable salars (salt flats) in Argentina, Bolivia, and Chile make up the Lithium Triangle Zone, the region with the world's greatest lithium reserves. There has been a lot of research done on the chemical, geological, climatic, and economic aspects of these salars up to this point. But there is a startling paucity of knowledge on the biology of these particular habitats. Here, we report the discovery of two bacterial strains (isolates LIBR002 and LIBR003) in one of the most lithium-dominated hypersaline artificial environments yet described. Although both isolates belonged to the Bacillus genus, their 16S rRNA gene and fatty acid profiles differed. Our findings also showed that the isolates are lithium-tolerant, can be distinguished phylogenetically from Bacillus linked to habitats with high NaCl concentrations, and belong to a distinct clade from the Lithium Triangle Zone. Both isolates were evaluated for morphological, metabolic, and physiological characteristics in order to discover osmoadaptation mechanisms. Here, we report the discovery of two bacterial strains (isolates LIBR002 and LIBR003) in one of the most lithium-dominated hypersaline artificial environments yet described. Although both isolates belonged to the Bacillus genus, their 16S rRNA gene and fatty acid profiles differed. Our findings also showed that the isolates are lithium-tolerant, can be distinguished phylogenetically from Bacillus linked to habitats with high NaCl concentrations, and belong to a distinct clade from the Lithium Triangle Zone. Both isolates were evaluated for morphological, metabolic, and physiological characteristics in order to discover osmoadaptation mechanisms

Key Words: *Extremotolerant; Lithiumtolerant; Osmoadaptation; Concentratio ns; Bacterial Strains; Hypersaline*

INTRODUCTION

Both biotic and abiotic elements affect how long living things may survive and grow in any environment. Extreme environments, from an anthropocentric perspective, are habitats where one or more abiotic circumstances go beyond what is typically tolerable for most higher species physiologically, such as low or high temperatures, pH extremes, or high concentrations of metals or salts. Microbes often have this ability, and these organisms are classified as extremophile or extremotolerant taxa. Taxa can be categorised as either non-halophilic, halophilic, or extremely halophilic depending on NaCl concentrations, which is the most often used categorization of extremophile. These bacteria are typically found in sediments, salty salterns, seawater, evaporation ponds, and other saline habitats. In particular, bacteria from the Bacillales order are present in nearly all abiotic settings on Earth, including the stratosphere, saline soils, freshwater lakes, and even alkaline lakes. Additionally, brines with varied chemical compositions, such as MgC_{l2}, Na_2CO_3, and NaCl/LiCl, have been used to separate them. Like microbial life has been documented at high salinities of other salts or even different pH as Na_2CO_3, $CaCl_2$, MgC_{l2}, LiClor acid and basic brines, there is a growing recognition that saline environments comprise both natural and manufactured habitats and go beyond those that are dominated by NaCl.

The global concentration of lithium is less than 65 ppm, making it the 27th most prevalent element on Earth. In aquatic ecosystems, brines are a type of lithium that is both solid and liquid in nature. Lithium, an alkaline metal from Group I of the periodic table, is well-known for its extensive applications, which include the production of glass and ceramics as well as the management of psychiatric diseases. It is also employed to estimate the age of stars and the rate at which these celestial bodies consume planets. Up to 85% of the world's soluble lithium stocks are concentrated in the so-called Lithium Triangle Zone, which is comprised of the Salar del Hombre Muerto (Argentina), Salar de Uyuni (Bolivia), and Salar de Atacama (Chile) (Chile). Approximately 70% of the lithium produced worldwide comes from the Salar del Hombre Muerto and Salar de Atacama. The brines in these salares, Salar de Uyuni: 400 mg/L-700 mg/L, Salar del Hombre Muerto: 773 mg/L, and Salar de Atacama: 1,500 mg/L Li,

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contain the greatest average concentration of lithium reported from natural environments while being predominately composed of NaCl. Global demand for lithium has surged as a result of the recent increase in its use as a raw material for batteries for automobiles and technological devices.

Pumping natural brines (0.12% Li), which are subsequently processed to raise lithium concentration in a sequential process of evaporation utilising natural solar radiation, is the first step in the industrial process used to obtain these goods (which is extremely elevated in the region). Finally, to produce lithium products, the concentrated brines (6% Li) are employed as a raw material in chemical processes. These naturally occurring Li reservoirs have received extensive geological, hydrological, meteorological, and economic characterization. Less has been studied about microbial communities, but interest in them has recently increased. Lithium has been categorised as an antibacterial substance at the microbiological level, linked to the activation of autolysis, sporulation in Bacillus species, or growth inhibition in fungi ands makes the reuse of treated wastewater effluent—which may provide and yeast.