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Inducing Cryptobiosis State of Tardigrades in Cyanobacteria Synechococcus elongatus for Effective Preservation

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Abstract : Cryptobiosis is a dormant state where all measurable metabolic activities are at a halt, allowing an organism to survive in extreme conditions like low temperature (cryobiosis), extreme drought (anhydrobiosis), etc. This phenomenon is observed especially in tardigrades that can retain this state for decades depending on the abiotic environmental conditions. On returning to favorable conditions, tardigrades re-attain a metabolically active state. In this study, cyanobacteria as a model organism are being chosen to induce cryptobiosis for its effective preservation over a long period of time. Preserving cyanobacteria using this strategy will have multiple space applications because of its ability to produce oxygen. In addition, research has shown the survivability of this organism in space for a certain period of time. Few species of cyanobacterial residents of the soil such as Microcoleus, are able to survive in extreme drought as well. This work specifically focuses on Synechococcus elongatus, an endolith cyanobacteria with multiple benefits. It has the capability to produce 25% oxygen in water bodies. It utilizes carbon dioxide to produce oxygen via photosynthesis and also uses carbon dioxide as an energy source to form glucose via the Calvin cycle. There is a fair possibility of initiating cryptobiosis in such an organism by inducing certain proteins extracted from tardigrades such as Heat Shock Proteins (Hsp27 and Hsp30c) and/or hydrophilic Late Embryogenesis Abundant proteins (LEA). Existing methods like cryopreservation are difficult to execute in space keeping in mind their cost and heavy instrumentation. Also, extensive freezing may cause cellular damage. Therefore, cryptobiosis-induced cyanobacteria for its transportation from Earth to Mars as a part of future terraforming missions on Mars will save resources and increase the effectiveness of preservation. Finally, Cyanobacteria species like Synechococcus elongatus can also produce oxygen and glucose on Mars in favorable conditions and holds the key to terraforming Mars.

Keywords : cryptobiosis, cyanobacteria, glucose, mars, Synechococcus elongatus, tardigrades
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