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CHLAMYDOMONAS BIOFARM AT THE FOREFRONT OF A SUSTAINABLE LIFE IN SPACE.

Abstract

The ambition to deeply understand the extreme space environment encourages human beings to venture into faraway places. This implicates long-duration missions and exposure to increasingly hostile conditions. In fact, microgravity, radiation of electrically charged particles from the Sun, and cosmic rays make the environment forbidding and highly dangerous for astronauts. Moreover, another crucial and remarkable concern is the supply of food, oxygen and water during long missions. For these reasons, the possibility to grow photosynthetic organisms in space could be a resolute solution as basic elements for oxygen, fresh food production, and air regeneration as well as for psychological support to the crew. Investigation of algae as life support systems during long-term space missions represents a realistic solution, as photosynthetic microorganisms are able to produce oxygen for atmosphere revitalization, as well as food and nutraceuticals for human consumption. Plants and algae can naturally provide metabolites with recognised healthy effects on human. In particular, epidemiological studies highlighted the correlation

between accumulated levels of lutein and zeaxanthin in eye tissues, serum and blood plasma and reduced incidence of oxidative stress. These compounds cannot be synthetized by the human body, whereas they represent important elements in the photosynthetic machinery conducting critical functions during the light harvesting and dissipation of energy excess. In this context, several strains of Chlamydomonas reinhardtii were included in the STS 134 Space mission within the Night Vision project, in order to analyse the effects of extreme conditions present on International Space Station. The main objective of this study was to analyse the physiologic responses of green alga to space environment, particularly focusing on the photochemistry and molecular biology aspects. Expression analyses of genes involved in carotenoids and plastoquinone/tochopherol biosynthesis were realized. The results revealed an accumulation of lutein and zeaxanthin mRNA in comparison with carotenes transcripts, suggesting their potential involvement in the mechanism of algae protection (Giardi, Rea, Lambreva et al., unpublished data). This study represents an important pilot project for successive experimentations aiming to develop C. reinhardtii biofarms able of producing new synthetic peptides with proven antioxidant activity that hinder the negative effects of oxidative stress, constantly afflicting the space navigators. Hence, the transfer of knowledge of these pioneering experiments in further fostering food programs for astronauts could represent an effective starting point to contrast free radicals and, generally, to support or prevent diseases affecting the humans on ground and in space.