**Inoculation with extreme Biological soil Crusts improves performance and nutritional quality in crop species grown under exoplanetary conditions**

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**ABSTRACT**

**Introduction:** Technological advances have made possible long space travels and even exoplanetary colonies in the future. Nevertheless, the success of these activities depends on our ability to produce edible plants in stressful conditions such as high radiation, extreme temperatures and low oxygen levels. Since beneficial microorganisms, such as fungal endophytes from extreme environments, have helped agriculture cope with those difficulties, endophytic fungi may be a putative tool to ensure plant growth under exoplanetary conditions. Additionally, growing crops in polyculture has been shown to increase productivity and spatial efficiency, which is essential given the likely space restrictions in such conditions.

**Methods:** We evaluated the effect of the inoculation with an ancient microbial metacommunity called “Biological Soil Crusts” from the Atacama Desert on performance (survival, biomass and physiological response) and nutritional quality of three crop species (lettuce, chard and spinach) grown under exoplanetary conditions. In addition, we measured the amount of antioxidants (flavonoids and phenolics) as possible mechanisms to cope with such abiotic conditions. The exoplanetary conditions were; high UV radiation, low temperature, low water availability, and low oxygen levels. These crops were put in growing chambers in monoculture and polyculture (the three species in the same pot) for 60 days.

**Results and Discussion:** Our results show that inoculation with extreme Biological Soil Crusts improved survival, biomass and physiological performance by ca. 30 - 35% in all crop species. The most evident increase was when grown in polyculture. Nutritional quality and the amount of the antioxidant compounds antioxidants increased in all crop species when inoculated with the Biological soil Crusts. Overall, the microbial metacommunity isolated from extreme environments such as the Atacama Desert, the driest desert in the world, could be a key biotechnological tool for future space agriculture, helping plants cope with environmental stress. Additionally, inoculated plants should be grown in polyculture to increase crop turnover and space-use efficiency. Lastly, these results provide useful insights about the role of microbial metacommunities from extreme environments to face the future challenges of space-farming.