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Author: Mr. Benjamin Greaves
StarLab Oasis, United States

Ms. Christina-Ariadni Valagkouti
Connectomix, The Netherlands
Ms. Erin Richardson
University of Colorado Boulder, United States
Mr. Connor Kiselchuk
StarLab Oasis, United Arab Emirates
Mr. Mohamed Mbarouk
StarLab Oasis, United Arab Emirates

THE ROLE OF THE LUNAR SURFACE IN DEVELOPING OFF-EARTH FOOD PRODUCTION SYSTEMS

Abstract

Food is an important element in all exploration missions, and space exploration is no exception. So far, astronauts have mainly relied on resupply launches rather than food production systems, and while the option of resupply will be possible and more cost-effective for missions on the lunar surface, relying on resupply missions will be unfeasible for longer duration missions to further destinations, such as Mars' surface. In addition, outside of the possibility of artificial gravity systems using centrifugal forces, the lunar surface is the only location to test systems and biological growth characteristics in partial gravity. Thus, it is of paramount importance to use the lunar surface as a testbed for systems supporting the production of astronaut food items on-site, and ensure the readiness of those systems for longer, further missions. This paper explores the most viable lunar surface food production system that balances both the economics and system test value of lunar surface missions.

Specifically, the authors factor in many rapidly decreasing technology costs of rocket launches and closed environment agriculture systems, as well as exploring case studies and papers on In Situ Resource Utilization (ISRU) to demonstrate the nature of the most cost-effective infrastructure for food production. ISRU, particularly with lunar ice collection and water production will be crucial for lunar food production. Sustainable lunar infrastructure elements will be pivotal to creating a food production system, especially concerning the difficulties associated with surviving the lunar night. This paper will include such technologies in its proposed architecture to ensure challenges imposed by lunar activities are sufficiently addressed. Additionally, plant properties that are paramount for the long-term support of human life and health, such as nutritional value, safety for humans, resilience, hedonics, and other potential products are analysed and compared, in an effort to identify the most suitable candidates. Bringing these two elements of infrastructure and cultivated food sources together on the lunar surface would direct technological advances and would provide crew and ground support with sufficient experience and time to ameliorate consequent situations, increasing the chances of success for Mars missions.