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AUTOMATED PRODUCTION OF MICROALGAE AS AN EFFICIENT FOOD SOURCE FOR FUTURE MANNED MISSIONS TO MARS.

Abstract

One of the key issues for designing manned missions to Mars is providing food on the red planet. While for shorter missions, bringing sufficient food supplies for the entire duration may be manageable, producing fresh food on Mars is preferable for multiple reasons. First, food in long term storage gradually loses its nutritional value. Second, preparing fresh food, and consuming fresh ingredients is beneficial not only for nutrition but also for the mental health of the crew.

Here we propose a compact, highly efficient food production unit designed for a Martian setting. A photobioreactor producing microalgae is an autonomous unit that requires minimal human intervention, and is able to cover the vitamin and micronutrient requirements for a crew almost completely, in a smaller volume than any plant-based solution. It is designed to run on Martian atmospheric CO2, therefore requiring only power between harvest cycles, and minimal nutrient replenishment after harvests.

The bioreactor is made up of tubular growth chambers with liquid medium containing the microalgae, and is illuminated by power-efficient LEDs. A pump system system compresses, heats, mixes and injects CO2 rich gas to facilitate growth, while a feedback system monitors growth of the algal culture and adjusts operating conditions for optimal production. The system operates with minimal moving parts and simple electronics leading to a low mass and convenient storage and transport.

Harvesting is done simply by filtering the medium solution through a mesh which separates the algae from the medium. The medium can then be reused after the addition of liquid fertilizer, leading to a system more efficient for water use than any known plant cultivating method.

The harvested algae are then washed, dried and are ready for consumption, no processing required. Recommended dosing is 5-50g/day for crew members, it is advised to simply mix it into any meal, adding a lively green colour and significant nutritional value to it.

A proof-of-concept unit to demonstrate the technology is being prepared for the Mars Desert Research Station in Utah for December 2021, where it aims produce enough algae for a crew of 5 to cover their micronutrient requirements for a two week simulated Mars mission, using a bioreactor the size of a standard oil barrel.