Bio-Algae Regulator for Photobioreactors Used in Suborbital flight and Lunar Life Support Systems
Citizen science research and development

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Abstract

The Bio-Algae Regulator (BAR) is a project that will work alongside ongoing projects on the International Space Station (ISS). Various countries and space organizations conduct a variety of projects on the ISS. This project will connect three different space agencies: The Japanese Aerospace Exploration Agency (JAXA), The German Space Agency (DLR), and The National Aeronautics and Space Administration (NASA). This project combines years of research and improves what we already know to be confirmed by testing and observing experiments onboard the ISS. The project will remain onboard the ISS, while at the same time contributing to new data and incorporating citizen science. The BAR is an experiment that combines a photobioreactor with live Nerite snails, the snails limit the amount of surface algae building up within the photobioreactor. The snails are part of the living system without interfering with the system's primary purpose to provide oxygen. The investigation takes advantage of the Aquatic Habitat (ACH) onboard the ISS, allowing for astronaut observations in space and citizen scientists on earth. They will be working together to improve future photobioreactors that can one day be established on the moon or serve a bigger purpose on the ISS. This project also contributes to a more robust understanding of aquatic snails in microgravity and their effectiveness in regulating surface algae build-up.

Training and Preparation

A smaller mobile photobioreactor prototype may be used here on Earth to begin a baseline study. Allowing a four to a six month study. The Earth study can check for consumption of surface algae within the photobioreactor, snail waste within the enclosed system, surrounding/enclosed oxygen and carbon dioxide levels. The project will also be available for citizen science observations and data input. Citizen scientists will be able to input algae growth and decreased level metrics (fig.1). As well as identifying aquatic snail behavior in suborbital spaceflight. Microgravity/parabolic flight can identify some behaviors that can be evaluated before suborbital spaceflight. The project contains various phases that may be tested on earth and in suborbital spaceflight which advance on to lunar surface testing.

Commercial/Research Flight Availability

Research facilities to display and maintain fixed and mobile photobioreactors are still being considered. Flight availability for project collaboration consideration: International Institute of Astronautical Sciences (IIAS) SpaceX, NASA, Polaris program science and research department, and Zero-G. These organizations are able to contribute to microgravity/parabolic testing/suborbital flight and lead scientific research and development, in this field and more. They are capable of testing this particular payload, in this case a fixed/mobile photobioreactor with a bio-regulator.

Conclusions

The project has run a viability survey with an eight-month success rate, the length of the project. There is more testing to be conducted and more to explore in the multiple stages of the project. The phases conducted on Earth and suborbital spaceflight can advance how we design and develop future lunar life support systems. Giving citizen scientists a chance to analyze and contribute to a possible life support system is crucial. Thinking back to how much citizen science was incorporated in the pre/post-Apollo era there is definitely an enormous advantage in our time now. This also paves the way for others who want to contribute to space exploration but might be limited on spaceflight availability or resources.

Fig.1 Photobioreactor/ Bio-Algae Regulator