Human Life support by microbes in space

Leys N., Janssen P., Monsieurs P., Mastroleo F.
1 Belgian Nuclear Research Center SCK•CEN, Mol, Belgium
Natalie.Leys@sckcen.be

To ensure that man can survive and work in space for long durations (e.g. on the moon or on Mars) and to reduce the costs of these expeditions to feasible levels, technological and scientific breakthroughs in life support systems and related recycling technologies are required. A number of recommendations how this could be developed in the future were recently formulated by us, together with a group of European experts, within the THESEUS roadmap.

The large potential of bio-based systems for human life support in space was included. On Earth, life exists thanks to microbes, and we use them every day for producing our food, for our health and well-being, and for maintaining a viable environment. Such water and soil microbes will also have useful applications in space, including the recycling of valuable mineral and organic substrates. In this presentation, we discuss how bacteria can be used in closed life support systems to support human life in space, taking the MELiSSA system as model. Since 1989, the MELiSSA project groups a number of European and Canadian scientists and industrial partners to investigate and demonstrate how microbes can transform organic waste into fertilizers for algae and plant cultures, which in turn will produce oxygen, purify drinking water, and provide fresh food for man in space habitats. In parallel, we are looking, together with a team of geo-microbiology experts, into the potential application of microbes to make planetary regolith suitable for agriculture.

That microbes can survive and proliferate in space habitats is well documented. But for microbes to be successfully used in biotechnological applications in space, their interaction with water, soil, and rock substrates under space conditions has to be studied, particularly because these microbes will be exposed to extended periods of extreme conditions including high radiation, low gravity, low pressure, low and/or high temperatures, and complex chemical compositions. Thus, in this presentation, also the challenges to optimize the desired bacterial activity under space conditions will be discussed. We will give a small overview of what is known, from former flight and ground experiments, on the effects of such space environmental factors on the survival, proliferation, and metabolic activity of water- and soil microbes, or ecologically engineered communities thereof. Our plans for future flight experiments to further investigate this issue will also be explained.

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