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ENABLING A BIOPRODUCTION IN SPACE - PRELIMINARY DESIGN OF A MISSION AND CONSTRUCTION OF A BIOREACTOR CAPABLE OF LONG-TERM OPERATION IN SPACE

Abstract

There is no doubt that wanting to explore the space with humans (human spaceflight) in the long term requires a closer understanding of how these conditions affect everything which is an intrinsic aspect of human life. Life on Earth evolved under conditions of unchanging Earth acceleration, whose direction and return is, after all, constant, which is of particular importance for organisms such as plants, representing gravitropic organisms [1].

Space biosciences are at a stage of development that draws on increasingly accessible forms of launch vehicles into suborbital trajectory and into space, so that it will become increasingly common to explore technologies and phenomena that could potentially allow the production of commercial products with improved, or even hitherto unknown, properties.

The main objective of this work is to propose a mission concept and preliminary design for the AMBER 3.0 scientific payload, of which the mini-bioreactor is a major component. The outcome of this work is a proposal of a technical solution for a mini-bioreactor. The study is also to include a system engineering perspective. Such a solution include the selection of the type of bioreactor, a proposal for the design of the bioreactor chamber, and the feeding system (including computer simulations). The research objective of the payload to be developed on the basis of this work is to test the functioning of the bioreactor and the entire platform in a suborbital mission, with the longer-term aim of preparing for a mission on board the autonomous orbital vehicle or on board the International Space Station. Such a mini-bioreactor would be capable of carrying out bioproduction processes that lead to the creation of enzymes, biopharmaceuticals, or deferring components under space conditions but also can serve as a test system for RD in the biotechnology industry.

[1] M.T. Morita, Directional gravity sensing in gravitropism. Annu. Rev. Plant Biol. 2010, 61, 705–720.