**Preliminary Design Of A Downstream Processing System For Protein Production In Space**

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**Abstract:** Biomanufacturing is a promising technology to convert *in situ* resources into essential products including enzymes, therapeutics, biopolymers and other chemicals required to support deep-space missions that may not be easily supplied or produced by alternative means.In addition to the biomass production operations, vitaldown-stream steps including biomass harvesting/concentration, cell lysis, protein capture and purification are needed to produce an application-ready product. Commercially available terrestrial processes commonly require complex, heavy equipment and highly trained operators, which are not practical in deep space environments. In this work, we aim to identify approaches required to produce an intracellular, His-tagged recombinant enzyme using *E. coli* at 1 L production scales within the constraints of a deep-space mission as a model use-case scenario. Based on extensive literature review and commercially available products, we identified candidate technologies and products that could be integrated for deep space biomanufacturing. Different preliminary designs were then compared in terms of total system impacts on up-mass, processing time, and consumables required. Our analysis indicated that a biomass concentrator would significantly reduce the processing time and consumables required for the overall system without a large increase in the total mass. We also identified viable technologies for other steps such as cell lysis and protein purification. Predictions from our trade study will be validated in the laboratory by testing the most promising products with the results used to optimize the design. This research will help transfer technology that is well developed on Earth to a space-ready format to produce biological products from a wide variety of microorganisms that can support deep-space missions.