BioNutrients-1, on-demand production of nutrients in space

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Future long-duration missions face significant challenges maintaining crew health. A critical area is supplying adequate nutrition, as certain vitamins and nutrients in supplied foods and supplements demonstrate substantial degradation during extended storage. To address this issue, we are developing and flight-testing a platform technology that demonstrates *in situ* microbial production of targeted nutrients over extended mission durations. This 5-year experiment, known as BioNutrients-1, was started on the International Space Station in May 2019. It involves two components: an on-orbit hydration and production experiment; and the development of space-compatible, key bio-manufacturing microorganisms.

On-orbit testing utilizes a small “production pack” system that encloses sterile edible growth substrate and desiccated *Saccharomyces cerevisiae* strains genetically engineered to produce the nutrients beta-carotene or zeaxanthin. On hydration and mixing of the production pack, the organisms revive and grow until limited by the depletion of growth media, hypothetically leading to consistent amounts of biomass and nutrients. In eventual mission applications, the packet contents would be heat treated to inactivate the microorganisms prior to consumption. For these flight experiments, the packet will not be heat treated, but will instead be frozen for return to Earth for analyses. In addition to the production pack trials, 14 different microorganisms/treatments were also delivered to ISS for long-duration storage. These samples will be intermittently returned to Earth and analyzed to determine survival rates and genomics. For this presentation, initial data from returned samples and ground controls will be discussed.