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RHODIUM SCIENTIFIC ENABLES SPACE BIOMANUFACTURING: DEVELOPING BIOLOGICAL STRAINS AND STANDARD PROCESSES FOR LEO AND BEYOND

Abstract

Rhodium Scientific's Biomanufacturing Program has developed a dedicated process for rapidly onboarding high quality International Space Station (ISS) missions accessible to the commercial, academic and government entities. The Program enables technologies in biomanufacturing that aid in the development of advanced chemical products at the point of need. These enabling technologies greatly reduce the need for stowage, cost of shipping, and risks of supply chain disruptions. For the Low Earth Orbit (LEO) economy, robust biomanufacturing platforms involving cellular activity in extreme environments must be assessed, ruggedized, and field-tested before scalable on-orbit manufacturing can become sustainable.

The overall objective of the Rhodium Biomanufacturing program is to establish reproducible and reliable biomanufacturing platforms suitable for enabling scalable production of targeted products in space and improve production on Earth. Recent ISS missions tested biological stressors placed upon biomanufacturing systems during transit to space, in flight operations, and return to Earth. These stressors include increased radiation and changes in gravitational forces as well as cold chain logistics and biological preservation. Previous work has shown that microgravity provides selection pressures on microbes that result in both genotypic and phenotypic changes. Evidence suggests that microgravity can induce genetic mutations producing adaptive advantages in microbes that can be conserved after the microbes are returned to Earth. In addition, changes observed within the transcriptome as a response to the space environment can provide insight to previously unknown cellular capabilities that may enhance microbial efficiencies leading to targeted strain development for terrestrial applications.] To standardize results from ISS missions and permit inter-mission comparisons, Rhodium developed and implements the Quality, Industry Compatible Space Process^{TM} (QuIC Space Process^{TM}) for all Rhodium missions. The QuIC Space Process^{TM} requires quality assurances and process driven logistics to ensure the reproducibility and reliability required for industry to enter in and operate within the space-based biomanufacturing market.

In the past four years, the Rhodium Biomanufacturing Program has developed and supported six biomanufacturing missions with two more missions planned for the next six months. Specific in-space biomanufacturing capabilities were tested and results from these studies will be presented. These missions tested production capacities from multiple engineered microbial strains at different gravity regimes (microgravity, lunar, Martian and Earth), as well as strain preservation and transport stabilization techniques. Rhodium's efforts are making great strides to expand both space-based and terrestrial biomanufacturing markets by establishing industry-leading science development and mission integration processes.