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Mars Missions and Space Synthetic Biology

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NASA and UC Berkeley scientists explain how engineered microbes could hold the ticket to deep space destinations. Learn more...



According to a new analysis by UC Berkeley and NASA bioengineers, astronauts may one day use engineered microbes to bio-manufacture materials they require while away on long-term missions to the moon, asteroids, Mars, and beyond.

The study, published in *Journal of the Royal Society Interface*, highlights the potential for synthetic biology to enable lighter, more adaptive manned space travel by transforming natural resources of extraterrestrial environments into fuel, food, pharmaceuticals, and 3D-printable biopolymers for building materials.

“The notion of not carrying everything with you in space has been around for a while because it’s tremendously expensive to launch things into space,” said Amor Menezes, first author of the study and a postdoctoral researcher in UC Berkeley’s California Institute for Quantitative Biosciences. “For instance, President Obama’s Augustine Commission noted that fuel would be two-thirds of the mass of an Earth-Mars-Earth mission.... So rather than carry all that fuel, we must manufacture what is needed on Mars using the local resources available.”

In their analysis, Menezes’ team used existing NASA data to compare the mass efficiency of biological techniques with traditional abiotic technologies that produce critical items in space. They found that by using biological processes on a 916-day manned mission to Mars, astronauts could save up to 56% of fuel equipment requirements, decrease on-board food mass by 38% during a Mars stay and return, and lower the feedstock mass needed to 3D print a habitat by 85%.

“Because space radiation expires drugs quickly, and shipping emergency medical supplies is time-consuming, you need to be able to manufacture the drugs necessary for medical emergencies almost in real-time,” explained Menezes. “Synthetic biology would be a way to do this with relatively little mass using carbon-dioxide and other resources produced by crews while they are on-board the spaceship for the journey, or even on Mars.”

Now, Menezes plans to focus on experimentally validating future synthetic biology technologies by testing them in simulated space settings. “We still have work to do, but we have some time until a long-duration manned mission occurs, so it’s very possible that this technology will be viable by the time such a mission actually happens,” said Menezes.

Reference

Menezes AA, Cumbers J, Hogan JA, Arkin AP. Towards synthetic biological approaches to resource utilization on space missions. *J R Soc Interface*. 2015 Jan 6;12(102).



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