Industrial biotechnology in space exploration: Microorganisms as astronauts' allies.

John Wiley*

Department of Surgery, University of Minnesota Hospital and Clinics, Minneapolis, USACarolina, USA

Introduction

Space exploration has always been a testament to human ingenuity and curiosity. As we venture further into the cosmos, the challenges posed by the harsh conditions of space become increasingly apparent. Among these challenges, sustaining human life in space for extended periods is one of the most critical aspects to overcome. To address this issue, scientists and engineers are turning to industrial biotechnology, harnessing the power of microorganisms as indispensable allies for astronauts. These tiny, versatile organisms play a pivotal role in various aspects of space exploration, from providing life support to producing essential resources. In this article, we will explore how microorganisms are becoming crucial partners in our quest to conquer the final frontier.

Microorganisms as bioreactors: Generating life-sustaining resources

One of the primary concerns in space exploration is the limited availability of essential resources, such as food, water, and oxygen. The cost of launching these supplies from Earth to space is astronomical, both in terms of financial resources and payload capacity. To reduce dependency on Earth and enable sustainable long-term space missions, researchers have developed bioreactors that employ microorganisms to produce these vital resources [1].

One of the most notable examples is the use of microalgae. These tiny photosynthetic organisms can efficiently convert carbon dioxide into oxygen through photosynthesis, a process familiar to us from Earth's ecosystems. By cultivating microalgae aboard spacecraft or space stations, astronauts can breathe fresh oxygen generated by these organisms. Moreover, the bioreactors can also produce edible biomass, such as spirulina, which serves as a nutritious food source for the crew.

Additionally, some microorganisms can be engineered to produce specific compounds or materials that are useful for space missions. For instance, researchers have experimented with using yeast to produce high-value chemicals, such as vitamins or biofuels. By harnessing the metabolic capabilities of these microorganisms, astronauts can create valuable resources while minimizing the reliance on terrestrial supply chains [2].

Waste recycling: Closing the loop in space

Space missions generate a significant amount of waste, including human waste and inedible plant matter. In the confined environment of a spacecraft, waste management becomes a challenge. However, microorganisms offer an elegant solution to this problem: waste recycling. Researchers have developed bioreactors that utilize microorganisms to break down and recycle waste materials. For instance, anaerobic bacteria can be employed to convert organic waste into biogas, a mixture primarily composed of methane and carbon dioxide. This biogas can serve as a renewable energy source, providing power for various systems on the spacecraft [3].

Furthermore, microorganisms can be used in a process known as "bioregenerative life support systems." In such systems, plants and microorganisms work together to create a sustainable, closed-loop ecosystem. Plants absorb carbon dioxide from the air and release oxygen through photosynthesis. Meanwhile, microorganisms in the root zone of the plants help break down and convert organic waste into nutrients that the plants can use. This integrated approach ensures a continuous supply of fresh oxygen and food while efficiently managing waste, making long-term space missions more feasible [4].

Bio-mining: Extracting resources from celestial bodies

As we set our sights on colonizing other planets and celestial bodies, extracting resources from these environments becomes a critical challenge. Microorganisms once again come to the rescue with a process known as bio-mining. Bio-mining involves using microorganisms to extract valuable minerals and metals from rocks and regolith (the layer of loose material covering solid rock on celestial bodies). Certain microorganisms have the ability to dissolve minerals through a process called bioleaching or biomining. These microorganisms excrete chemicals that dissolve the minerals, allowing them to be recovered and used for various purposes, such as construction or manufacturing. By utilizing bio-mining techniques, astronauts can potentially extract resources locally, reducing the need to transport heavy payloads from Earth. This process could revolutionize the feasibility of sustained human presence on other planets and pave the way for future mining activities in space [5].

Biological research and beyond

Microorganisms not only assist astronauts in their daily needs but also play a crucial role in biological research in space. Understanding how microorganisms behave and adapt in the

***Correspondence to**: John Wiley, Department of Surgery, University of Minnesota Hospital and Clinics, Minneapolis, USA, Email id: johnwiley@gmail.com

***Received:** 01-Jun-2023, Manuscript No. AAAIB-23-109065; **Editor assigned:** 03-Jun-2023, PreQC No. AAAIB-23-109065(PQ); **Reviewed:** 17-Jun-2023, QC No. AAAIB-23-109065; **Revised:** 19-Jun-2023, Manuscript No. AAAIB-23-109065(R); **Published:** 26-Jun-2023, DOI:10.35841/aaaib-7.3.152*

***Citation:** Wiley J. Industrial biotechnology in space exploration: Microorganisms as astronauts' allies. J Arch Ind Biot. 2023;7(3):152*

extreme conditions of space can provide valuable insights into fundamental biological processes. Additionally, researchers are exploring the potential of using microorganisms in bioregenerative life support systems for lunar and Martian habitats. Moreover, the genetic engineering of microorganisms for specific functions is an ongoing area of research. Scientists are continuously exploring ways to optimize microorganisms for space applications, tailoring their metabolic pathways to produce specific compounds or adapt to different environments.

Conclusion

Industrial biotechnology has opened up exciting possibilities for space exploration, with microorganisms emerging as valuable allies for astronauts. From generating life-sustaining resources to recycling waste and extracting valuable materials, these tiny organisms prove to be indispensable partners in our journey beyond Earth. As technology and research progress, we can expect to witness even more innovative applications of microorganisms in space exploration, making long-term missions and colonization a reality. By tapping into the vast potential of industrial biotechnology, we are taking significant strides toward humanity's future as a space-faring civilization.

References

1. Aguiar TQ, Silva R, Domingues L. New biotechnological applications for Ashbya gossypii: Challenges and perspectives. Bioengineered. 2017;8(4):309-15.
2. Ahmad M, Hirz M, Pichler H, et al. Protein expression in Pichia pastoris: recent achievements and perspectives for heterologous protein production. Appl Microbiol Biotechnol. 2014;98:5301-17.
3. Alekhova TA, Aleksandrova AA, Novozhilova TY, et al. Monitoring of microbial degraders in manned space stations. Appl Biochem Microbiol. 2005;41:382-9.
4. Appels FV, Dijksterhuis J, Lukasiewicz CE, et al. Hydrophobin gene deletion and environmental growth conditions impact mechanical properties of mycelium by affecting the density of the material. Sci Rep. 2018;8(1):4703.
5. Benoit MR, Li W, Stodieck LS, et al. Microbial antibiotic production aboard the International Space Station .Appl Microbiol Biotechnol. 2006;70:403-11.

Citation: *Wiley J. Industrial biotechnology in space exploration: Microorganisms as astronauts' allies. J Arch Ind Biot. 2023;7(3):152*