National Aeronautics and Space Administration

Nature's Fynd is developing technology that could provide sustainable food in space and on Earth

Low-Maintenance Bioreactor Cultivates Fungi for Sustainable Food Source in Space

Challenge

As we continue to expand humanity's potential for habitation away from Earth, NASA seeks innovative and sustainable sources of food that can be easily produced with minimal resources. Water is a precious resource in space, so an ideal food source would require as little water as possible to nurture the food and to clean any materials used for cultivating. One approach to cultivating food with minimal resources is to use bioreactor technology.

A bioreactor is a vessel containing a biologically active population of microbes. For example, when fermenting yeast for baking bread, a baker puts a prepared yeast culture in a bowl and covers it with a towel; the bowl and towel act as parts of a bioreactor in which the yeast will self-sufficiently grow without any interference from the baker. NASA seeks bioreactors and microbial food sources that could be similarly used to sustain humans in space.

Solution

In 2012, under a Yellowstone National Park-permitted research program supported by NASA and the National Science Foundation (NSF), Dr. Mark Kozubal isolated an extremophilic fungal organism—a type of fungus that can thrive in environmentally harsh conditions—from a hot spring in Yellowstone National Park. With this discovery, Dr. Kozubal and Dr. Rich Macur founded a business

Project

Biofilm-biomat reactor to cultivate edible protein source in micro-gravity conditions

Follow-on Success

Hundreds of millions in investor funds related to climate change applications and more

Program

Small Business Technology Transfer

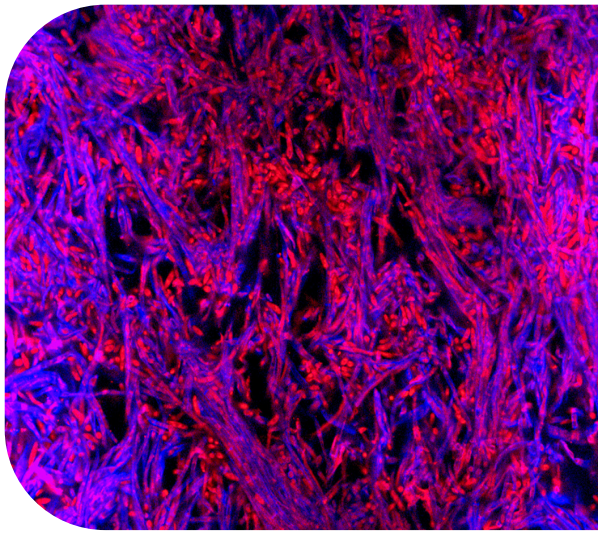
Snapshot

Nature's Fynd, a food company headquartered in Chicago, Illinois, partnered with Montana State University on NASA STTR contracts to further develop a micro-gravity biofilm-biomat reactor, which cultivates a unique fungus to form a dense protein material. The resulting "biomat" could serve as a nutritious food source for life away from Earth. Nature's Fynd has received external investments totaling more than $500 million for developing its technologies, and the company recently launched its meatless and dairy-free foods in specific retailers.

Nature's Fynd
(formerly Sustainable Bioproducts, LLC)
Chicago, Illinois – HQ
Bozeman, Montana (R&D Division)

naturesfynd.com

that later evolved into the Chicago-based company now known as Nature's Fynd. The company received its first Small Business Innovation Research (SBIR) funds from NSF in 2013 to convert inedible plant materials into valuable and sustainable products using the isolated fungus.



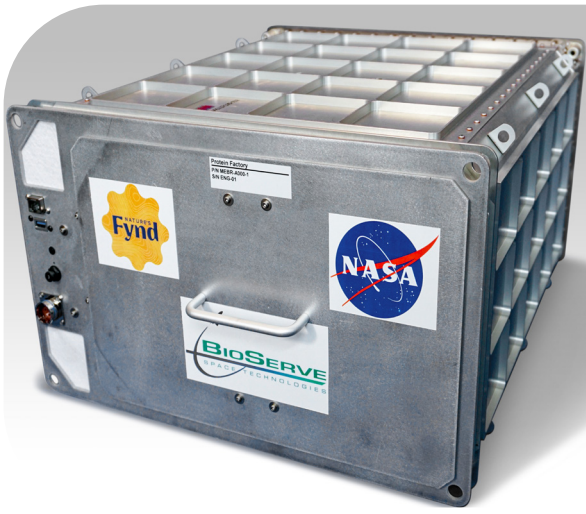
The source of Nature's Fynd's sustainable protein is an extremophilic fungal organism

Following its first SBIR with NSF, Nature's Fynd continued to expand the applications of its proprietary microbial process, receiving SBIR funding from the Department of Agriculture and the Environmental Protection Agency. In 2017, the NASA Small Business Technology Transfer (STTR) program opened a call for microbial biomanufacturing technologies in space. Nature's Fynd proposed to the NASA STTR program in partnership with Montana State University (MSU) in 2017 but was not selected for funding. Based on post-submission feedback on their proposal from the NASA SBIR/STTR program, the team modified and submitted their proposal to the STTR call again in 2018, which led them to receive a Phase I contract to create a proof of concept for a bioreactor that could operate in micro-gravity. This simple yet efficient bioreactor would produce Nature's Fynd's microbial organism as "biomats," filamentous fungi requiring little water and generating little to no waste. These relatively dense, consolidated biomats are rich in nutrients, which could serve as a high-protein food source.

With the STTR program, Nature's Fynd and MSU received Phase I and II contracts to continue development of their biofilm-biomat reactor. The Phase II work will end in January 2022 with a demonstration of a bioreactor that could be incorporated into a midsize locker on the International Space Station (ISS). In 2021, the team, in collaboration with BioServe Space Technologies, was awarded a grant from NASA's **Established Program to Stimulate Competitive Research (EPSCoR)** to test the technology on the ISS, with the purpose of using the protein as an alternative food source for astronauts.

Business Impact

While Nature's Fynd continues to explore the application of its biofilm-biomat reactor in space, a closely related technology developed by Nature's Fynd could impact life on Earth as an alternative high-protein food source. Livestock produce methane as part of their digestive process, and this methane represents more than a quarter of greenhouse emissions from the agriculture economic sector.[1] To help reduce greenhouse gases, there is a need for protein sources that do not emit methane.



Nature's Fynd, in collaboration withBioServe Space Technologies, was awarded a NASA EPSCoR grant to test their technology on the ISS

In the same year as the Phase I STTR, Nature's Fynd raised $33 million in Series A funding from multiple investors, including 1955 Capital and Breakthrough Energy Ventures, an investor-led fund established by Bill Gates to help stop climate change. In February 2020, the Series B raise of $80 million was co-led by Generation Investment Management LLP (a sustainable investment firm co-founded by Al Gore) and Breakthrough Energy Ventures. Most recently, SoftBank served as the lead for the $350 million Series C raise in July 2021.

[1] https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#agriculture

> We continue to apply our skills to a product that's now commercialized. … We'll have established research in this field, opening new doors for funding.
>
> – Dr. Ross Carlson, MSU Professor of Chemical and Biological Engineering

Nature's Fynd has raised more than $500 million in financing as of October 2021. The company has grown beyond government customers; in 2021, Nature's Fynd began serving consumers sustainable meatless patties and dairy-free cream cheese at some supermarkets in Berkeley, California.

Dr. Macur, who is now a senior scientist at Nature's Fynd and leads the NASA STTR project, says a major strategy to the company's expansion was partnering with their business-experienced CEO, Thomas Jonas: "As scientists, [Dr. Kozubal and I] were not strong in the business arena, so our plan was to partner with people who were very strong on the business side. It was important to find key partners to complement our strengths."

In addition to funding from investors, Nature's Fynd's close partnership with MSU also contributed to the technology development. "The university has instrumentation and expertise that we don't have," says Dr. Macur. The partnership benefitted both parties: while Nature's Fynd gains access to resources from the university, Dr. Ross Carlson, Professor of Chemical and Biological Engineering at MSU, notes that the partnership validates his university's research: "We continue to apply our skills to a product that's now commercialized. And this research will give us insight into the catalytic capabilities of these fungi. We'll have established research in this field, opening new doors for funding."

The developments made by Nature's Fynd with the NASA SBIR/STTR program have opened doors to unique and viable options for sustaining life in space, and as the world increases its focus on protecting our people and planet, the company's biomaterials and bioreactors exemplify one potential path for combating climate change on Earth.