Advancing spaceflight nutrition and psychosocial wellbeing through novel food strategies

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ASTREAS

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Introduction

- Astreas is the first commercial company focused on optimizing food and nutrition for spaceflight
- Our market is functional food for high-performance
- We are a multidisciplinary team of spaceflight engineers, nutrition and health scientists, trained chefs, and former astronauts
The link between food acceptability and adequate food intake


Human Exploration Research Analog (HERA) at the NASA Johnson Space Center

High-calorie nutritional bar being tested as a meal replacement
Sirmons, Takiyah A., et al. (2020)
The average daily caloric deficit was higher by 64 calories when MRBs were implemented daily.

Inadequate dietary intake results in decreased body mass

Body weight loss of astronauts in several space programs (squares, Skylab; triangles, Shuttle, circles, Mir and International Space Station; n=97 total crewmembers)

Space Food System

**Safety**
The food system must be free from microbiological, physical, or chemical risks to astronauts.

**Nutrition**
The food system needs to provide adequate nutrients while avoiding nutrient toxicities.

**Usability**
The food system must account for human factors—it must be user friendly.

**Resource Minimization**
All inputs and outputs—mass, volume, crew time, water, power, and waste—must be minimized relative to the food produced.

**Stability**
The food system needs to provide nutritional requirements and palatability through five years of deep space conditions.

**Palatability**
Astronauts will require enjoyable foods that they will be willing to prepare and consume.

**Variety**
Menu fatigue is a significant concern.

**Reliability**
If part or all of a food system is lost, the result could be catastrophic.

Customizability!
What about future spaceflight passengers?
• An increasing number of spaceflight passengers will be purchasing tickets to space

• When the flight is no longer a “mission” but instead an “experience”...how does the perception of food and eating in space change?

• A study was recently conducted on 215 participants. Most of the participants reported that they did not have much knowledge about space food, though most of them considered themselves “foodies“.
215 people from the U.K. answered a survey about memorable eating experiences on Earth and their expectations about the most important elements they would not want to miss on trips to the Moon and Mars.

Obrist, M. et al. (2019)
Participants’ word association results were further organized into five themes and ranked by importance.
Bottom line: Food taste, texture, flavor, and variety are critical
Our first product is a snack that contrasts the uni-textural nature of current space food.

- No palm oil or coconut oil
- 13 vitamins and 9 minerals
- Low carbs - 8g, complex carbohydrates
- Made with real 63% dark chocolate
- Low sugar - 4g
- No added sodium
- Heightened sensory delivery: sonic seasoning & trigeminal stimulation
Product functionality in microgravity is currently being confirmed

Parabolic flights will advance the TRL of Astreas
We are using analog environments to test our hypotheses

Some nutrients have the potential to regulate anxiety and mood while living and working in isolated and confined environments (ICE).

Astreas contains compounds such as magnesium (dark chocolate), Lion’s Mane mushroom, and Citicoline known as NOOTROPICS.
Nootropics as potential interventions for spaceflight-associated anxiety and cognitive decline

Ertel, Karen et al. (2008)
The enemy of shelf life: Maillard reactions, lipid oxidation, and nutrient degradation
Preserving fats and vitamins

We are improving the preservation of space food (and Earth food) with food science technologies.

Pickering emulsions use solid particles to create a barrier between oil and water.

Modified quinoa starch has been used successfully to encapsulate oil for at least 8 years.

Marefati, Ali, and Marilyn Rayner. (2020)
Pickering emulsions may enable some space food to be made by spray drying – a more affordable drying method

<table>
<thead>
<tr>
<th></th>
<th>Freeze drying</th>
<th>Spray drying</th>
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<tr>
<td>Length of drying</td>
<td>Days/weeks</td>
<td>Seconds</td>
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<td>Capital cost</td>
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<tr>
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<tr>
<td>Control of particle characteristics</td>
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<td>Yes</td>
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Vass, Panna, et al. (2019)
Vision

• To have several products for ISS missions and for direct-to-consumer purchase over the next 5 years

• To leverage our in-house R&D to push the boundaries of safe, nutritious, and palatable food for Earth and for space

• To be innovators in space food processing and cooking over the next 10 years by working closely with suppliers of bioregenerative systems
Questions?
Get in touch!

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