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

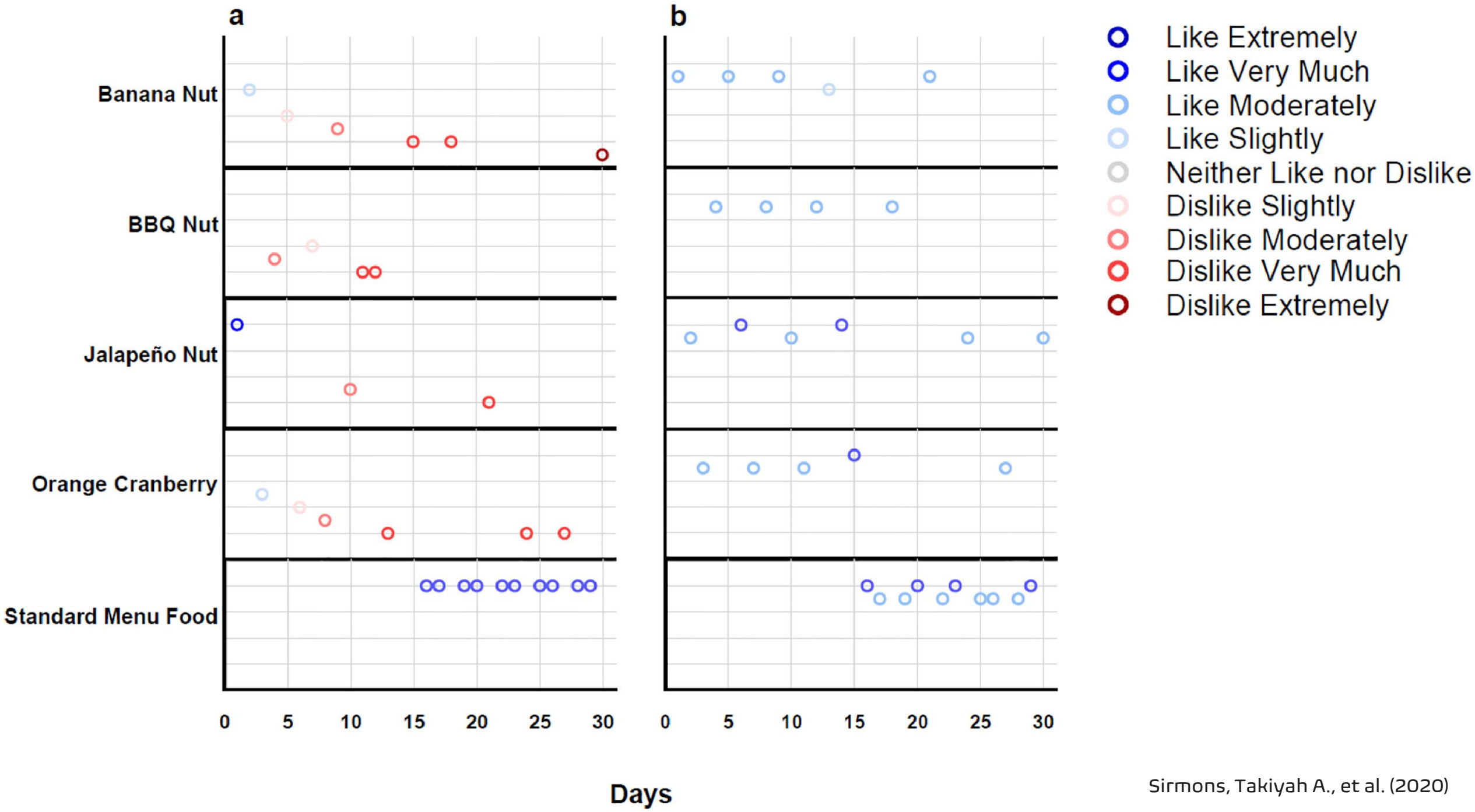
SPACE MARKET ⟷ **EARTH MARKET**

The link between food acceptability and adequate food intake

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

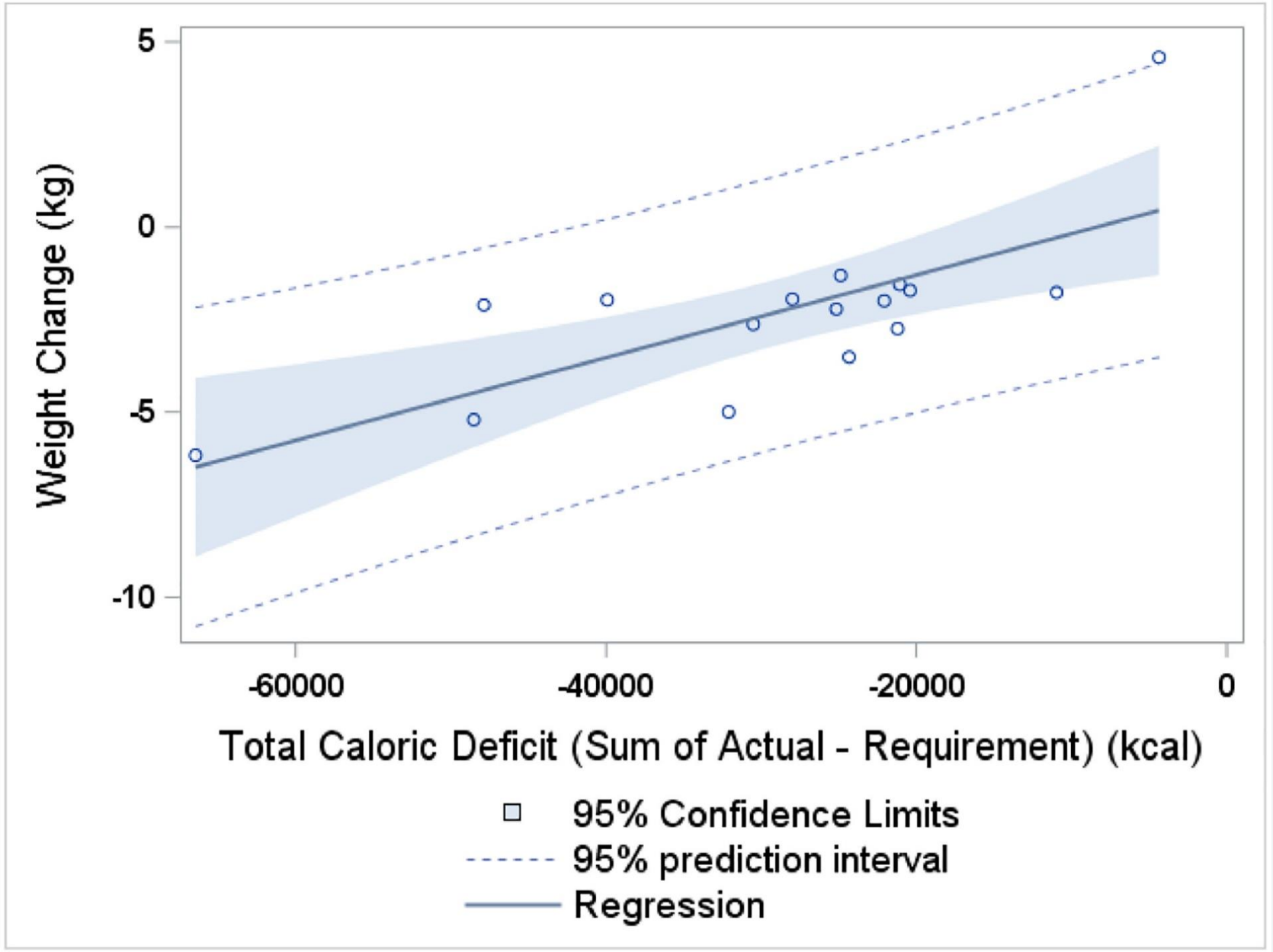
High-calorie nutritional bar being tested as a meal replacement

Sirmons, Takiyah A., et al. "Meal replacement in isolated and confined mission environments: consumption, acceptability, and implications for physical and behavioral health." *Physiology & behavior* 219 (2020): 112829.



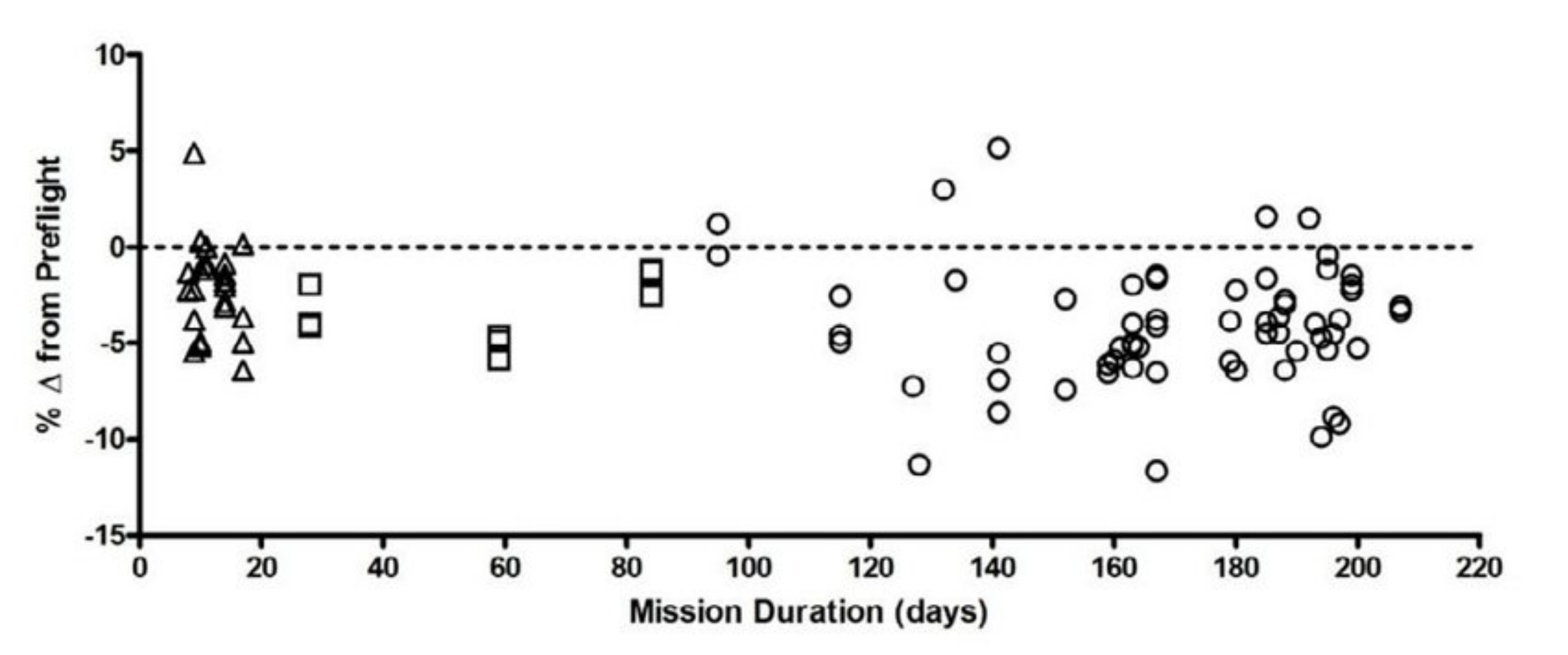
Sirmons, Takiyah A., et al. (2020)

The average daily caloric deficit was higher by 64 calories when MRBs were implemented daily



Sirmons, Takiyah A., et al. "Meal replacement in isolated and confined mission environments: consumption, acceptability, and implications for physical and behavioral health." *Physiology & behavior* 219 (2020): 112829.

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)

Smith, S. M., et al. "Assessment of nutritional intake during space flight and space flight analogs." *Procedia Food Science* 2 (2013): 27-34.

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.

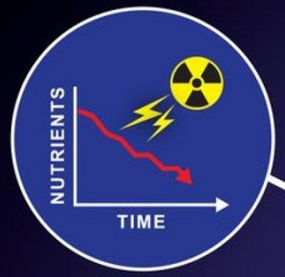
Resource Minimization
All inputs and outputs – mass, volume, crew time, water, power, and waste – must be minimized relative to the food produced.

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

Variety
Menu fatigue is a significant concern.

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

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



Customizability!

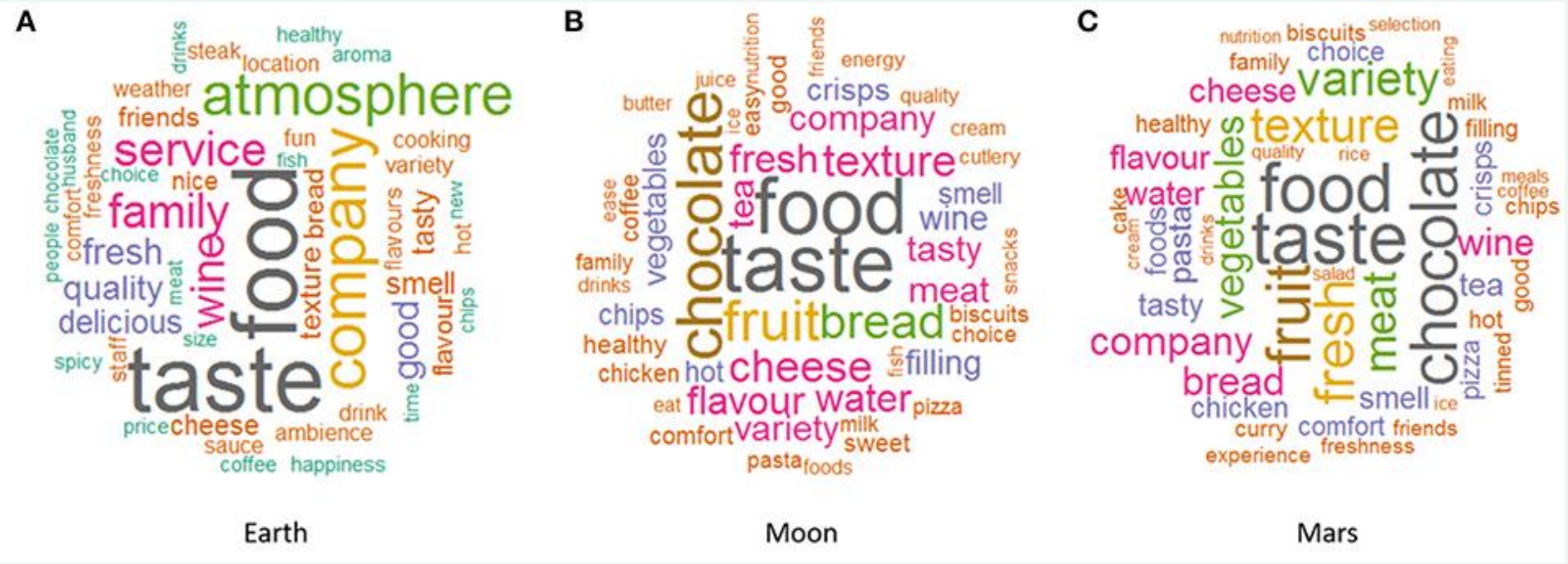
What about future spaceflight passengers?

- 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?

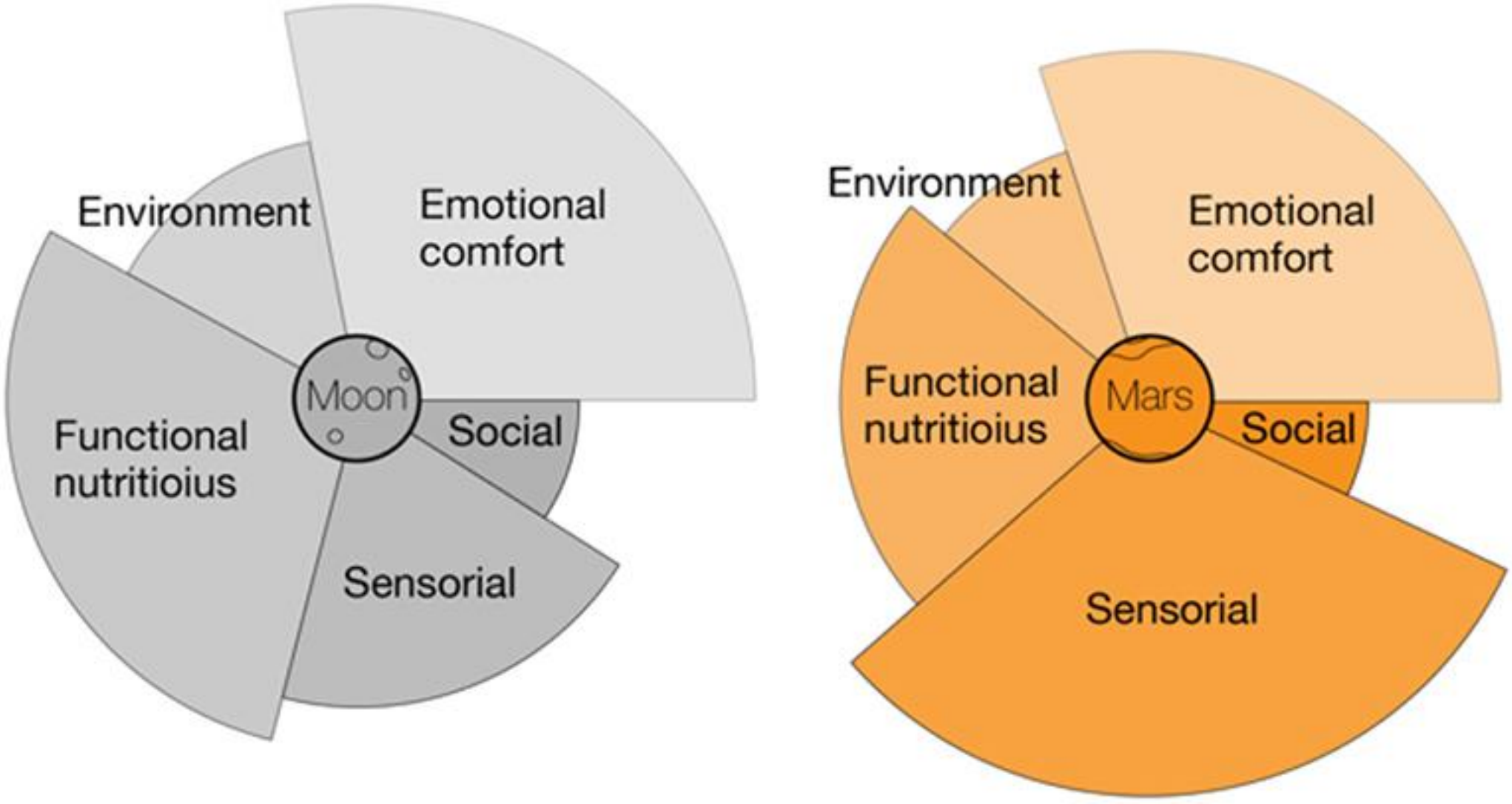
- A study was recently conducted on 215 participants. Most of the participants reported that they did not have much knowledge about space food, though most of them considered themselves “foodies”.

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



Obrist, M. et al. (2019)

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

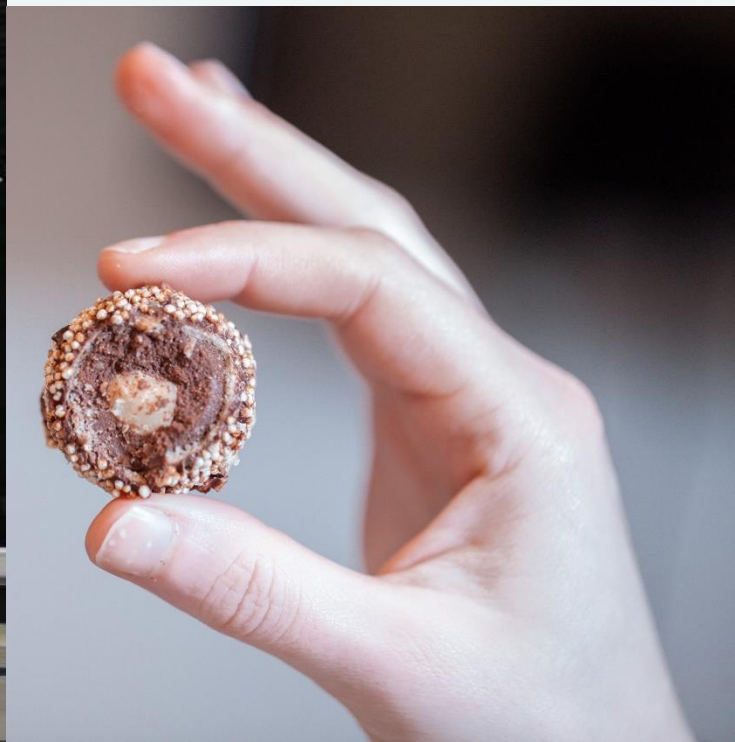
Heightened sensory delivery:
sonic seasoning &
trigeminal stimulation

Low sugar - 4g

No added sodium

Product functionality in microgravity is currently being confirmed

Parabolic flights will advance the TRL of Astreas

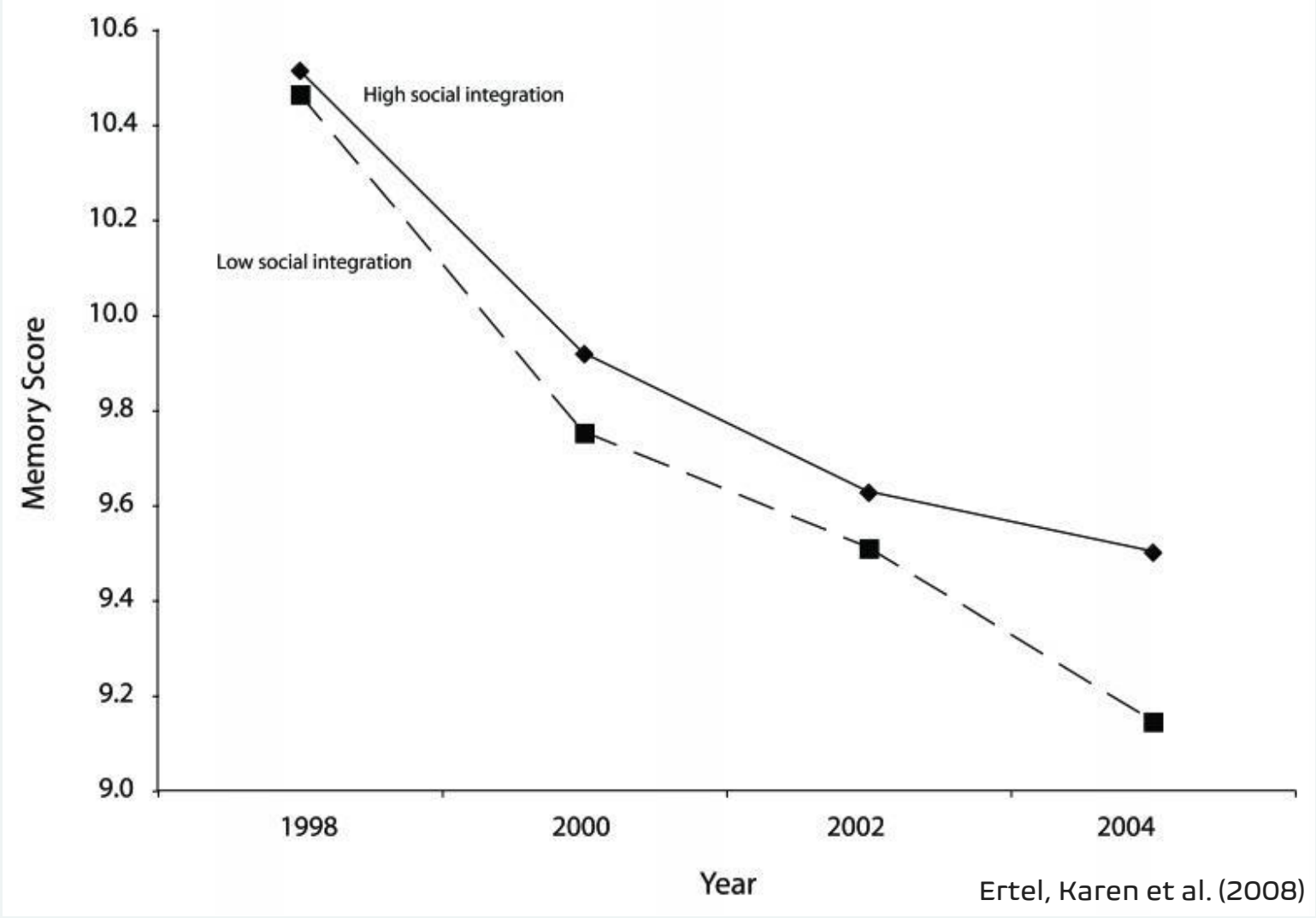


We are using analog environments to test our hypotheses

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

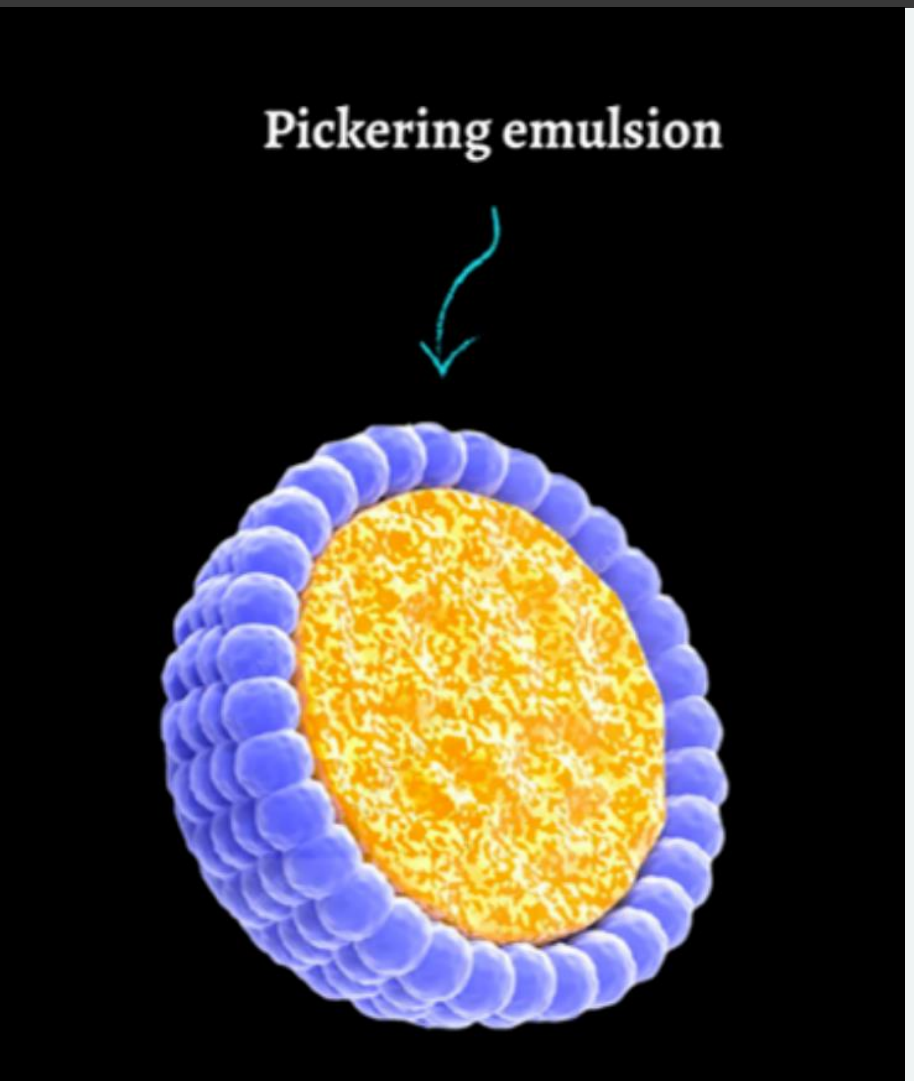
Nootropics as potential interventions for spaceflight-associated anxiety and cognitive decline



Ertel, Karen et al. (2008)

The enemy of shelf life: Maillard reactions, lipid oxidation, and nutrient degradation

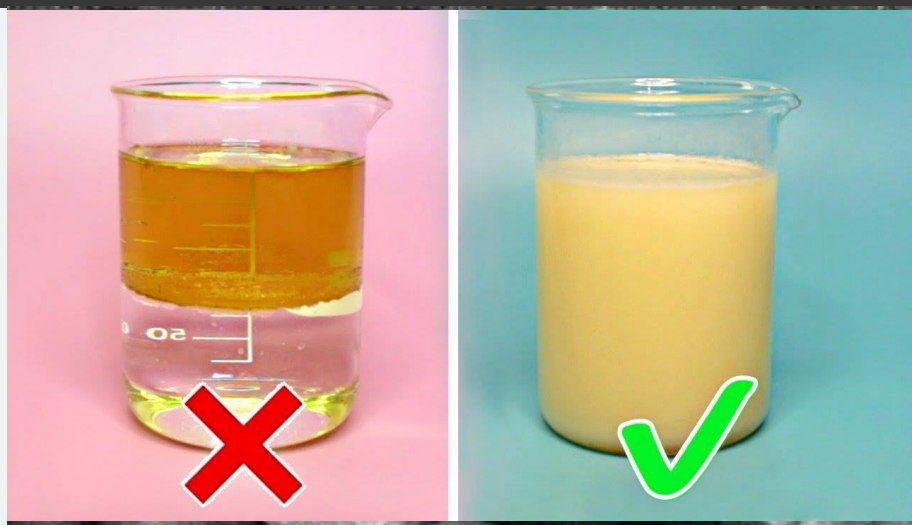
Preserving fats and vitamins



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

	Freeze drying	Spray drying
Length of drying	Days/weeks	Seconds
Capital cost	Very high	Moderate
Operating cost	High	Moderate
Stresses	Freezing, dehydration	Shear, thermal, dehydration
Production	Batch	Continuous
Control of particle characteristics	No	Yes

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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