An orange a day keeps scurvy away

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Astronaut Scott Kelly, Expedition 43, with carrots floating around him in the Node 1 module of the International Space Station. A table covered in other food packets is beside him. Credit: NASA; Terry Virts

Centuries ago, ships often sailed with crews numbering in the hundreds returning with tens. Cause of death: Scurvy - a severe depletion of Vitamin C. Today's explorers cross miles of space with no hope of

finding an island with food and nutrients along the way. All nutritional needs must be met aboard.

"Nutrition is vital to the mission," Scott M. Smith, Ph.D., manager for NASA's Nutritional Biochemistry Lab said. "Without proper nutrition for the astronauts, the mission will fail. It's that simple."

Smith and his colleagues at NASA's Human Research Program are tasked with research to understand the requirements for long-duration spaceflight. In their recent publication, Human Adaptation to Spaceflight: The Role of Nutrition, Smith explains the importance of nutrition to the astronauts and how the spaceflight environment presents even more challenges to eating a healthy diet. For instance, they tend to eat less in space due to being very busy and menu fatigue.

In space, the astronauts' environment also impacts their nutrition needs. Beyond microgravity, higher radiation exposure, higher atmosphere levels of carbon dioxide, temperature and humidity can all have profound effects on health. Nutrition is important to help counteract some of the effects spaceflight have on the body, such as bone and muscle loss, cardiovascular degradation, impairment of immune function, neurovestibular changes and vision changes.

"We need to make sure we understand the body's requirements for nutrients, that the food system has those nutrients, and that they are stable over the duration of a long spaceflight," Smith said. "We can plan for what we know. It's what we don't know that's the challenge."

To help assess the impact spaceflight has on nutrition, astronauts provide blood and urine samples before, during and after their space missions. A biochemical profile is created for each astronaut in the investigation. The ultimate goal is to keep astronauts healthy from a nutrition perspective while they are on the mission.

As mission durations increase and as we prepare for our journey to Mars, it is important to understand how the human body changes with longer exposures to microgravity and higher radiation doses. The Biochemical Profile project examines nutritional markers such as proteins, vitamins, minerals, bone markers, hormones, metabolites, immune function, antioxidants and general chemistry to better understand these changes.

The Twins Study brings another, unique, element to this investigation, because the scientists have a ground-based control for comparison. Mark Kelly will remain on Earth and has agreed to provide his biochemical profile in conjunction with his twin brother, Scott, throughout Scott's one-year mission aboard the International Space Station. The tracking of Scott's overall nutritional status during flight as compared to Mark's here on Earth is of particular interest to these investigators.

This is a continuation of the nutrition study in which several astronauts aboard the Space Station have participated over many years. The biochemical profiles are stored in a database for researchers to extrapolate key factors used to improve efforts to enhance nutrition health on space missions. The database can also be used to test the effectiveness of exercise and diet as countermeasures for the effects of extended weightlessness on the body.

The future of spaceflight includes human space exploration that will go beyond low-Earth orbit, such as a journey to Mars that could last as long as 30 months or more. The human body could experience several physiological effects in this prolonged environment including weight loss, fluid shifts, dehydration, constipation, calcium loss, potassium loss and motion sickness.

"The food system will be of utmost importance for combatting these effects from long-duration missions," Smith said. "But to be helpful,

food must also be palatable, nutritious, and safe even after months in storage. If astronauts do not eat well, they will not receive the necessary nutrients to keep them healthy."

Nutrition is essential for health for people on Earth as well as in space. An improved understanding of the biochemical effects of weightlessness could also help patients on Earth. Studying the response of the astronauts to exercise and dietary countermeasures could help physicians design different treatments or exercises for people with certain health conditions, especially those with limited mobility.

While nutrition investigations are still ongoing, the initial results are promising. Maintaining nutritional health will counteract negative effects of space travel, but in exactly what ways is still being studied. Today's explorers have no hope of finding food on their journey like earlier explorers, but they do have a team of NASA scientists looking for the best ways to use food to keep them healthy throughout their spaceflight missions.

Provided by NASA

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