



## HUMAN HEALTH AND PERFORMANCE

Exploring Space | Enhancing Life

# Space Food Systems

## Understanding Food Systems for Humans in Extreme Environments

Our unique space food systems expertise and capabilities complement our nutrition standards knowledge for high-quality food products, as well as technologies, into integrated testing of human-system interfaces, human performance into system concepts, and mission constraints.

### World Renowned Skills and Unique Capabilities

The Johnson Space Center, a world leader in human spaceflight, possesses unique knowledge, skills, and capabilities that can be applied to solving human health and performance challenges here on earth—particularly those related to operating in extreme and harsh environments.

NASA expertise is available in the area of Space Food Systems that maintains the health and optimal performance of crewmembers during spaceflight and upon return to Earth. Evidence strongly supports the role of nutrition in crew performance and cognition. The key to good nutrition is



providing a variety of high-quality food products that are appetizing, nutritious, safe, and convenient. The food system must also take into consideration vehicle constraints (such as mass, volume, waste and power), mission duration, and impacts on crew time. The Space Food Systems Laboratory maintains the tools and techniques required to develop and provision the current Space Food System, and to research new technologies for future food systems.



Johnson Space Center

Space Food Systems Capabilities including expertise, skills, and knowledge are available to support development of advanced food products for space and terrestrial applications: spacecraft for Commercial Crew; evaluation of food concepts, menus, and nutrition pertaining to new space mission endeavors such as an orbiting commercial platform (i.e. Gateway) as well as terrestrial operational challenges such as working and living in extreme environments (i.e. ocean exploration); military use; and optimized human nutritional performance.

### **Advanced Food Technology (AFT)**

Through collaboration, the AFT team conducts research involving new technologies that extend the shelf life of processed foods, including emerging food processing technologies and lightweight packaging materials that can be easily and efficiently disposed of, thereby minimizing mass and volume. AFT also participates in human physiological and psychosocial studies to determine the impact of closed food systems on human health and performance.

### **Spaceflight Food**

Produces, tests, and certifies all food for spaceflight missions and ensures appetizing, nutritious food systems that are safe and easy to prepare on-orbit.

### **Food Analysis**

Performs a variety of food analysis in JSC laboratories including microbiological, moisture, color, texture and sensory.

### **Food Production**

Produces thermally stabilized pouched foods and freeze-dried packaged foods.

### **Food Packaging**

A variety of unique packaging equipment is available, with capabilities including heat sealing, vacuum packaging, and labeling, all within a

clean room environment. Expertise in high barrier flexible packaging materials and headspace testing.

### **Food Stowage**

Knowledge and experience in efficient food packaging and stowing to minimize mass and volume, while protecting food packages from harsh environments.

### **Menu Development**

Creates nutritionally complete menu design for extreme environments, utilizing shelf stable foods.

### **Food Characterization**

Capability to test physical food properties such as texture, color, and viscosity; expertise in accelerated shelf life testing; capability to test water activity including moisture isotherms; and sensory evaluation and analysis.

### **Space Food Systems Capabilities**

The Space Food Systems Laboratory is equipped with a test kitchen, packaging facility, freeze drying facility, thermal processing facility, analytical laboratory, and sensory evaluation center.

Specific capabilities:

- Production of freeze-dried foods
- Production of thermally stabilized food items at a satellite facility at Texas A&M University Research Park, College Station, Texas
- Vacuum packaging and sealing of shelf-stable food products
- Provisioning and stowing of food products to support flight
- Product development of shelf stable foods
- Sensory evaluation to quantify product acceptability and support shelf-life determination
- Design and development of nutritionally appropriate menus for space flight
- Application of various food preservation techniques and packaging design
- Evaluation of the applicability of commercially available technologies to space food systems
- Basic chemical analyses, such as moisture content, texture characterization, color, water activity, pH, and package oxygen content



For the benefit of all