Food Supply for Lunar/Martian Living

Name of Technology:
Food Resources and Production

Participating NASA Centers:
KSC (Lead); ARC, JSC

Technological Area:
T6.07 Space Exploration Plant Growth

Vision for the Technology:
Living on the moon and Mars will require a sustainable food supply. The goal is to have high yield crop production, bulk ingredients, bacterial production, algae and fungi production. A successful food supply will consist of a nutritious, safe food system that utilizes minimal resources, such as water, and is available for regular crew usage.

Challenges:
Current missions provide prepackaged and shelf stable food that only requires heat and added water for consumption. ISS is regularly re-supplied, and the current system uses minimal crew time and no cooking. This will be unacceptable for a Mars mission since it requires high mass and volume upfront, however, it requires little resources along the way. The challenge is to have a food system that can reduce resource requirements and maintain reliability. The type of resources includes hardware, software, ingredients, cleaning supplies, testing supplies (microbiological/other), crew time (operable and acceptable with regular use in crew timeline), water, and storage (volume/temp/humidity controls). Other considerations are how the resource will interact with other systems (wastewater, volatiles). (See Reference: STMD-ALSHP-005 in STMD)

If sustainable food systems are not developed, the crew will have insufficient nutrition to carry out their tasks. The results from this gap would be a loss of missions and potentially loss of crew. In addition, if food water content remains above 30% the mass savings benefits of increasing oxygen recovery above 50% can NOT be realized, which is a significant impact (~1,500 kg direct mass or ~21,000 kg launch mass).

NASA Seeks to Meet the Following Specs:
The food system must meet 100% of nutritional value for the crew. Partial benefits can be obtained by providing part of a food system solution. Acceptable foods may include multiple safe and nutritious systems to provide one complete food supply. Partial water content reductions provide partial oxygen loop closure mass savings.

Successful closure of this gap will be determined by demonstrating a safe, acceptable, nutritious food system that:

1) Fits within the resources of the mission profile/reduce resource use,
2) Is operable and functionally acceptable for regular crew use,
3) Is reliable (no risk of food loss/scarcity),
4) Has an average launched water content of <30% (TBD)

Overview of Student Project:
NASA seeks innovative sustainable food supply for crew on missions to Mars and the moon. The food supply must consist of a nutritious, safe food system that utilizes minimal resources, such as water, and is available for regular crew usage.

Innovative Areas Student Projects Can Address:

Food Production and/or Nutrition Technologies/System

1) Crop Production
2) Bacterial Production
3) Algae Production
4) Fungi Production
5) Bulk ingredients

Research Funded by NASA on this Topic:

Proposal Number: 16-1 T6.04-9800
Self-Sustaining Crop Production Unit

Proposal Number: 18-1- T7.02-6802
Hydroponic Rego-rock Produced In-Space for Efficient and Healthy Crop Growth

Proposal Number: 18-1- T7.02-2932
MarsOasis - An Efficient Autonomously Controlled Martian Crop Production System

Proposal Number: 15-1 H3.02-9680
Solar Plant Growth System for Food Production in Space Exploration Missions

References:

T6.07 Space Exploration Plant Growth

6 Life Support and Habitation Systems

X12.05 Advanced Life Support: Food Provisioning and Biomass

STMD Strategic Technology Plan: Advanced Human Life Support and Performance