Food Mass Reduction Trade Study
M.H. Perchonok, A.M. Stoklosa
NASA JSC, 2101 NASA Parkway, Houston, TX 77058

ABSTRACT

Reducing long duration manned space flights beyond low Earth orbit will require the food system to remain safe, acceptable, and nutritious while efficiently balancing appropriate vehicle resources such as mass, volume, power, water, and systems. Often, this presents a challenge since maintaining the quality of the food system can result in higher mass and volume. This study presents an approach towards reducing the overall mass and volume of the food system.

The Orion vehicle is significantly smaller than the Shuttle vehicle and the International Space Station and the mass and volume available for food is limited. Therefore, the food team has been challenged to reduce the mass of the total mass of the packaged food system. The authors have focused on integrating and optimizing the Orion galley equipment as a system to reduce mass. To date, there has not been a significant effort to determine how to reduce the food system.

The objective of this project is to determine how the mass and volume of the packaged food can be reduced while maintaining caloric and hydration requirements.

The following tasks are the key elements in this project:

1. Conduct further analysis of the ISS Standard Menu to determine caloric, protein, carbohydrates, and fat levels.
2. Conduct trade studies to determine how to bring the mass of the food system down.
3. TRADE studies may include removing the water of the total food system and/or increasing the fat content.
4. Determine the preferred method for delivery of the ISS food (e.g., bars, in beverages) and the degree of replacement.
5. Determine whether there are commercially available products that meet the mass and volume criteria.

At the end of this study, an estimate of the mass and volume savings will be provided to the Constellation Program. In addition, if new technologies need to be developed to achieve the desired caloric, protein, carbohydrates, and fat levels, the technologies, timeline, and budget will be identified at the end of the project.

BACKGROUND

AFT System

Food system optimization will require total system resources be minimized. Weight of food item is one factor in a total system approach. Weight optimization opportunities exist by increasing fat and decreasing water content in food items. Meal replacement options would be an efficient manner of delivering nutrition.

RESULTS AND DISCUSSION

ABSTRACT

Current Menu Analysis

Food system optimization will require total system resources be minimized. Weight of food item is one factor in a total system approach. Weight optimization opportunities exist by increasing fat and decreasing water content in food items. Meal replacement options would be an efficient manner of delivering nutrition.

RESULTS AND DISCUSSION

Figure 1: Current Food System

1. Thermosystem - Food items in cans or pouches are heat processed with steam or water-over-pressure to remove excess oxygen and temperature to render the food commercially shelf-stable. 2. Irradiation - Radiation levels, with special FDA permission, control naturally occurring processes such as ripening of raw fruits and vegetables, and is effective for inactivation of spoilage and pathogenic microorganisms. 3. Rehydration - Drying with heat, osmoretic, or freeze drying reduces the water activity of foods, which results in the inability of microorganisms to thrive. 4. Natural form - Commercially available shelf-stable foods with low moisture content, such as almonds and brownies, rely on reduced water activity to prevent microbial activity. 5. Intermediate moisture - Dried foods and food products use increased salt or sugar concentration and reduced moisture to prevent microbial activity. 6. Fresh Food - Fresh fruit and vegetables have a short shelf life and are provided for psychological support rather than as part of meeting dietary requirements. 7. Beverages - Freeze dried beverage mixes (such as coffee or tea) or flavored drink mixes (such as lemonade or orange drinks) are currently being used on International Space Station (ISS) and Shuttle. Drinks are reconstituted with water inside a beverage pouch. Empty beverage pouches are provided for disposal.

Current Menu Analysis

Meal Replacement Options

Meal replacement options are being investigated. Currently available meal replacement bars have either the organoleptic or nutritional properties sought, but not both. Energy gel packets are rich in carbohydrates, but lack protein and fat. Determining the degree of use for these bars is necessary to reduce food system mass while maintaining crew member acceptance.

REFERENCES