MEAL REPLACEMENT MASS REDUCTION AND INTEGRATION ACCEPTABILITY STUDY

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Abstract

NASA, in planning for long-duration missions, has an imperative to provide a food system with the necessary nutrition, acceptability, and safety to ensure sustainment of crew health and performance. The Orion Multi-Purpose Crew Vehicle (MPCV) and future exploration missions are mass constrained; therefore the team is challenged to reduce the mass of the food system by 10% while maintaining product safety, nutrition, and acceptability. Commercially available products do not meet the nutritional requirements for a full meal replacement in the spaceflight food system, and it is currently unknown if daily meal replacements will impact crew food intake and psychosocial health over time. The purpose of this study was to develop a variety of nutritionally balanced breakfast replacement bars that meet spaceflight nutritional, microbiological, sensorial, and shelf-life requirements, while enabling a 10% savings in food mass. To date, six nutrient-dense meal replacement bars (approximately 700 calories per bar) have been developed, using traditional methods of compression as well as novel ultrasonic compression technologies developed by Creative Resonance Inc. (Phoenix, AZ). The four highest rated bars were evaluated in the Human Exploration Research Analog (HERA) to assess the frequency with which actual meal replacement options may be implemented. Specifically, overall impact of bars on mood, satiety, digestive discomfort, and satisfaction with food. These factors are currently being analyzed to inform successful implementation strategies where crew maintain adequate food intake. In addition, these bars are currently undergoing shelf-life testing to determine long-term sensory acceptability, nutritional stability, qualitative stability of analytical measurements (i.e. water activity and texture), and microbiological compliance over two years of storage at room temperature and potential temperature abuse conditions to predict long-term acceptability. It is expected that this work will enable a successful meal replacement strategy to be implemented that will maintain crew food consumption and health, while informing exploration missions with appropriate mass savings expectations.