

Fiscal Year:	FY 2014	Task Last Updated:	FY 07/30/2013
PI Name:	Barrett, Ann Ph.D.		
Project Title:	Stabilized Foods for Use in Extended Spaceflight: Preservation of Shelf-Life, Nutrient Content and Acceptability		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HHC: Human Health Countermeasures		
Human Research Program Risks:	(1) Food and Nutrition: Risk of Performance Decrement and Crew Illness Due to Inadequate Food and Nutrition		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	GOVERNMENT	Phone:	508-233-4516
Organization Name:	United States Department of the Army		
PI Address 1:	NSDREC, CFD/PORT, RDNS-CFP		
PI Address 2:	U.S. Army Natick Soldier Systems Center		
PI Web Page:			
City:	Natick	State:	MA
Zip Code:	01760-5018	Congressional District:	7
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2011 Crew Health NNJ11ZSA002NA
Start Date:	11/01/2012	End Date:	10/31/2015
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC
Contact Monitor:	Douglas, Grace	Contact Phone:	
Contact Email:	grace.l.douglas@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: Changed from NSBRI to NASA-monitored project, per M. Perchonok/NASA JSC (Ed., 2/25/2013)		
Key Personnel Changes/Previous PI:	N/A		
COI Name (Institution):	Froio, Danielle (United States Department of the Army) Richardson, Michelle (United States Department of the Army)		
Grant/Contract No.:	NNJ13HA911		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The objective of this effort is to develop shelf stable, highly acceptable, food with increased nutrient (vitamins) stability for extended space missions utilizing innovative processing and packaging technologies. There will be two research thrusts. For the first thrust area, we will formulate, test, and optimize the quality and nutrient content of a range of fortified shelf-stable foods. The focus will be on extruded/pressed low-water activity bar-type products. Advances in innovative pre-treatment technologies (encapsulation) for vitamins will be assessed, as well as synergy with matrix chemical character. For the second thrust area, different packaging technologies will be investigated with research focused on the interaction of packaging material with various innovative sterilization processes such as microwave heating, irradiation, and high pressure treatment. The availability of highly nutritious and health-promoting food is a factor that is a significant prerequisite for prolonged space travel. The design of feeding and nutritional strategies for multi-year, non-resupplied flights is an undertaking requiring substantial research and development; it is also an endeavor and that could be founded upon our existing, considerable knowledge and experience base at Natick Soldier RD&E Center.
Rationale for HRP Directed Research:	The proposed study will yield strategies for the development of extremely stable, nutrient-dense foods and the development of packaging materials compatible with new quality-preserving sterilization techniques. While this work is specifically important to the health of astronauts, its significance also extends to the research that is critical to the mission of the Natick Soldier Research Development and Engineering Center: to support and promote the nutritional health of the Warfighter on extended missions with little or no means of resupply.
Research Impact/Earth Benefits:	In the first nine months of this project: 1) Multiple contracts for this project were established or are pending award. These included: a contract to Vision Technologies, Inc. for procurement of vitamins and encapsulation of each vitamin separately in a lipid-based coating or a carbohydrate-base coating; a contract to Covance Co. for multiyear analysis of vitamin contents in stored prototypes; contracts for development and provision of advanced non-foil, high-barrier packaging materials consistent with new sterilization technologies (i.e., to Rollprint Packaging Products, Inc. for pouches that employ an aluminum oxide coating, to Toppan Printing Company for pouches that employ an aluminum oxide coating with an added protective over-coating, and to Kuraray America for pouches that employ a nanocomposite coating); and a contract (vendor identified, with expected award in August 2013) for advanced processing of the selected high aw food prototype by non-conventional methods (i.e., by microwave sterilization, high-pressure sterilization, and irradiation sterilization). Each contract required development of and submission of multiple mandated procurement documents to the Natick Soldier Research Development and Engineering Center Acquisition Directorate, including: thorough market research of each industry; independent government cost estimates; statements of work; selection criteria lists; and contract data requirements lists. Each contract furthermore required mandatory bid solicitation followed by written determination of the compliance of each vendor response with the stated requirements. 2) Vitamin encapsulation completion: The five vitamins were successfully coated, separately, with a carbohydrate-based (gum Arabic/maltodextrin) and with a lipid-based (hydrogenated cottonseed oil) encapsulant. 3) Development of prototype matrices: Two food matrices—one compressed; one dispersed powder—each with high and low lipid contents, were successfully developed. These are: Blueberry Granola Bars, with 25% and 10% lipid contents; and Chocolate-Hazelnut Drink Mixes, with 35% and 5% lipid contents. The compositions were established after preliminary studies in which maximum and minimum lipid levels were determined based on product functionality and organoleptic quality. The products were fortified with 2X the space flight requirement of each vitamin/encapsulant and subjected to 4 weeks at 120oF storage in order to verify maintenance of organoleptic quality at that vitamin loading. Nine-point-hedonic sensory testing (with a score of 1 indicating extremely poor quality and a score of 9 indicating extremely good quality) after storage yielded overall acceptance scores > 6.2 for each product (well within the acceptable range). 4) Vitamin analysis contract establishment: A schedule for anticipated submission of stored samples was forwarded to Covance Co. 5) Production of high storage temperature test samples: eight prototypes (the four versions described in (3), each with lipid-coated and carbohydrate-coated vitamins) for initial vitamin retention assessment were produced at 2X the space flight requirement for each vitamin and placed in 120oF storage for 4 weeks. Samples were pulled on July 16 and sent to Covance Laboratories for vitamin analysis. Results are expected August 2, and will guide formulation of samples to be produced for the 3/(5) year storage study. 6) Establishment of contracts for, and receipt of, non-foil, high-barrier packaging materials (vendors listed in (1)): Pouches from Toppan and Rollprint have been delivered to NSRDEC and visually inspected, and preliminary testing of seal strength has commenced; pouches from Kuraray are expected to be delivered in August 2013. 7) Submission of all contract documents for advanced processing: This contract, for production and sterilization processing of a high water-activity item (Creamy Cajun Chicken), is currently under solicitation, with the likely vendor identified. Award is expected in August, 2013. The contractor will produce the food, fill pouches, and conduct or oversee commercial sterilization trials that will utilize: conventional retorting, Microwave Assisted Thermal Sterilization (MATS), Pressure Assisted Thermal Sterilization (PATs), and irradiation processing. This contract will be awarded for 1 year of processing trials with an option for a second year of refinement-of-parameters processing trials, the exact nature of which will depend on Year 1 results.
Task Progress:	Description: (Last Updated: 08/25/2020)
Bibliography Type: Abstracts for Journals and Proceedings	Barrett A, Perchonok M. "Army–NASA Collaboration on Food Research for the Space Program." Experimental Biology 2013 meeting, Boston, MA, April 20-24, 2013. Invited presentation. Experimental Biology 2013 meeting, Boston, MA, April 20-24, 2013. Invited presentation. , Apr-2013

Abstracts for Journals and Proceedings	Barrett A, Richardson M, Froio D, Anderson D, Racicot K, Ndou T, Pecukonis L. "Stabilized Foods for use in Extended Spaceflight: Preservation of Shelf-Life, Nutrient Content and Acceptability" " Institute of Food Technologists' Annual Meeting, Chicago, IL, July 13-16, 2013. Presentation. Institute of Food Technologists' Annual Meeting, Chicago, IL, July 13-16, 2013. , Jul-2013
Papers from Meeting Proceedings	Barrett A. "Development of Long-Term Shelf Stable Foods for NASA." R&DA's 67th Annual Spring Meeting and Exhibition, Amelia Island, FL, May 20-22, 2013. R&DA's 67th Annual Spring Meeting and Exhibition, Amelia Island, FL, May 20-22, 2013. http://militaryfood.org/newsite/wp-content/uploads/2013/06/01-Food-Tech-Barrett.pdf , May-2013
Papers from Meeting Proceedings	Lane H, Bourland C, Barrett A, Smith S. "The Role of Nutritional Research in the Success of Human Space Flight." Experimental Biology 2013 meeting, Boston, MA, April 20-24, 2013. Experimental Biology Meeting technical symposium. Proceedings paper from techical session "The Role of Nutritional Research in the Success of Human Space Flight." Experimental Biology 2013 meeting, Boston, MA, April 20-24, 2013. , Jun-2013