Fiscal Year:	FY 2009	**Task Last Updated:**	FY 07/05/2011
PI Name:	Perchonok, Michele Ph.D.		
Project Title:	Thermostabilized Food Study		
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) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Organization Name:	NASA Johnson Space Center		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	Directed Research
Start Date:	08/01/2001	**End Date:**	11/30/2008
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:	Woolford, Barbara	**Contact Phone:**	218-483-3701
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Flight Program:			
Flight Assignment:	NOTE: Moved to Space Human Factors Habitability/Advanced Food Technology in 2006 and extended until November 2008 (jvp 5/2009 info from PI)		
Key Personnel Changes/Previous PI:	0		
COI Name (Institution):	Catauro, Patricia (NASA Johnson Space Center)		
Grant/Contract No.:			
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The National Aeronautics and Space Administration (NASA) is working towards future long duration manned space flights beyond low earth orbit. The duration of these missions may be as long as 2.5 years and will likely include a stay on a lunar or planetary surface. For these long duration missions, a shelf life of 3 to 5 years for the prepackaged transit food system is required. Of the preservation methods currently being used at NASA for the Shuttle and International Space Station food systems, the thermostabilized items will have the longest shelf life. Currently four approved International Space Station thermostabilized packaged foods are undergoing accelerated shelf life testing in the Space Food Systems Laboratory (SFSL) at NASA/Johnson Space Center. The foods, bread pudding, carrot coins, tuna noodle casserole, and apricot cobbler, are being stored in controlled temperature chambers at 40oF, 72oF, and 95oF. Analytical tests to measure color, texture, pH, and water activity will be correlated with the sensory tests to determine the changes occurring in the foods. The sensory tests will measure the difference from control (40oF) as well as overall acceptability. Nutritional analysis will be completed three times during the shelf life test. The objective of this research is to continue the shelf life determination of these four thermostabilized food items. Sensory and analytical data will be collected every four months on the four food items that will be stored at 40oF, 72oF, and 95oF for approximately 3 years. The shelf life test will be terminated after 3 years or whenever the product becomes unacceptable, if before 3 years. In addition to determining the shelf life of these foods, a better understanding of the chemical and physical changes that can occur throughout their shelf life will be learned. Also, as part of this year's tasks, a document describing the accelerated shelf life testing protocol for NASA/JSC will be completed. It will combine the practical portions of a sensory protocol written in FY01 (SFSL Sensory Protocol, 2001) and the analytical tests that have been developed in Fiscal Year 2002. The objective of this project was to continue the accelerated shelf life testing of four thermostabilized food items: apricot cobbler, tuna noodle casserole, bread pudding, and carrot coins. Sensory and analytical data were collected every four months on the four food items stored at 40oF, 72oF, and 95oF. To provide an accelerated shelf life test protocol for thermally processed pouches with a potential 3 - 5 year shelf life.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Extended shelf life foods will be important for third world countries, camping environments, and survival experiences.
Task Progress:	This study is to appraise the suitability of using the existing food items utilized by current NASA programs for long duration space exploration. If the food system is determined to be nutritionally inadequate for a Mars mission, a mitigation strategy or countermeasures will be required. A complete set of nutritional estimates for the ISS menu was compiled using Genesis R&D. The calculated nutrition provides only a close approximation of the true nutrient content of the current space diet, but even the estimates provide some insight into the nutrient delivery by the food system. All food categories provide products with micronutrient significance, even desserts. However, an opportunity exists to add more “power foods”, or foods with nutrient density greater than 5, to the food offerings. The entire nutritional profile was determined analytically for 26 new food items by a selected accredited laboratory at “zero time” after stabilization processing. The empirical data was then compared with the calculated nutrition data. While incongruities in the estimates prevented broad conclusions on vitamin stability, a detailed look at some of the food products confirmed previous study assumptions that the stabilization processing was resulting in degradation of many of the vitamins, including vitamin C, vitamin A, folic acid, and thiamin. Losses after retort processing were as high as 100% for vitamin A and vitamin C. For the fifteen food items tested during FY 2008, repeat analytical testing was conducted on the anniversary of their original stabilization processing. Vitamin A continued to diminish in the package for most products over the one year of storage. Likewise, most folic acid and thiamin levels decreased, and vitamin C levels in all products declined from original levels by 37% to 100%. This degradation is attributed to remnant oxygen in package after nitrogen flushing. The presence of oxygen, even at decreased levels, allowed oxidation reactions to progress which chemically destroyed the vitamins. Given that the estimates highlighted the absence of nutrient dense menu items and that degradation of vitamin profiles was noted after processing and during storage, it is unlikely that vitamin levels will subsist through the necessary three year product life. Countermeasure exploration should begin parallel to this study completion. NASA must identify means for solving critical nutrition problems including, reformulation with more resilient ingredients; fortification and supplementation; and development of processing and preservation methods that have less affect on the nutritional content of the food, e.g., high pressure processing and microwave sterilization. Additionally, the process of nitrogen flushing the retort pouches should be revisited for optimization or replacement.
Bibliography Type:	Description: (Last Updated: 01/30/2012)
Articles in Peer-reviewed Journals	Cooper M, Douglas G, Perchonok M. "Developing the NASA food system for long-duration missions." Journal of Food Science. 2011 Mar;76(2):R40-8. http://dx.doi.org/10.1111/j.1750-3841.2010.01982.x , Mar-2011
Articles in Peer-reviewed Journals	Catauro PM, Perchonok MH. "Assessment of the long-term stability of retort pouch foods to support extended duration spaceflight." J Food Sci. 2012 Jan;77(1):S29-39. Epub 2011 Nov 10. PMID: 22260129 , Jan-2012