Fiscal Year:	FY 2014	**Task Last Updated:**	FY 09/25/2014
PI Name:	Douglas, Grace Ph.D.		
Project Title:	Delivery of Probiotics in the Space Food System		
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:	(1) **Microhost**:Risk of Adverse Health Effects Due to Host-Microorganism Interactions		
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:**	36
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2012 Crew Health NNJ12ZSA002N
Start Date:	10/01/2013	**End Date:**	09/30/2014
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Castro, Sarah Ph.D. (LZ TECHNOLOGY, INC.) Ott, C. Mark Ph.D. (NASA Johnson Space Center)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			
Task Description:	In response to the Human Research Program Risk of Performance Decrement or Crew Illness Due to an Inadequate Food System this work proposes to determine viability of probiotics in potential flight delivery systems and indicate which is optimal given the restrictions of spaceflight. Probiotic benefits include competitive exclusion of pathogens, mucosal stimulation of immune cells, reduced occurrence and duration of cold and flu-like symptoms, and treatment of antibiotic associated diarrhea. The addition of probiotic bacteria to the astronaut diet may provide a safe and natural countermeasure to improve immune function; however, the expected lack of food refrigeration on space missions and the short shelf life of these bacteria may restrict their use. This work will compare the viability of 1) probiotics provided in a capsule to 2) probiotics mixed with nonfat dry milk (NFDM) powder through eight months of storage at three temperatures and challenge with simulated gastric and small intestinal juice. Viability results will indicate the optimal		

	delivery method for probiotic bacteria in spaceflight.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	The addition of probiotic bacteria to the space food system is expected to confer immunostimulatory benefits on crewmembers, with the potential to counteract the immune dysregulation that has been documented in spaceflight. The optimum delivery system for probiotics has not been determined for spaceflight, where the food system is shelf stable and the lack of refrigeration prevents the use of traditional dairy delivery methods. The work presented here demonstrates the potential of the space food system to deliver viable probiotic bacteria to crewmembers as a countermeasure to crew illness and associated performance decrements. The probiotic Lactobacillus acidophilus was packaged in high barrier flight packaging in nonfat dry milk (NFDM) or in commercial capsule form and viable cells were enumerated over 8 months of storage at 22, 4, and -80ºC. The survival of L. acidophilus rehydrated in NFDM, in a PBS control, and directly from the capsule was also evaluated following stress challenge with simulated gastric and intestinal juices to determine the method that would deliver the most viable cells to the intestine, where they are expected to confer beneficial effects. L. acidophilus was found to be stable to gastric and intestinal juice challenge when delivered in rehydrated NFDM, even after two hours of exposure. In comparison, L. acidophilus was reduced by 1-5 logs when exposed to gastric and intestinal juice directly and when rehydrated in a PBS control. Shelf life data indicate that probiotics will require refrigerated or frozen storage to remain viable at adequate levels over the multi-year storage periods required for spaceflight. This study indicates that the protective effect provided by the dairy matrix, and not merely rehydration prior to consumption, will extend probiotic viability and stress tolerance compared to a capsule during storage conditions expected in spaceflight and in simulated digestion conditions.
Bibliography Type:	Description: (Last Updated: 10/29/2023)