Fiscal Year:	FY 2019	**Task Last Updated:**	FY 03/29/2019
PI Name:	Boerma, Marjan Ph.D.		
Project Title:	Gamma-Tocotrienol as a Countermeasure against High-Energy Charged Particle-Induced Carcinogenesis, Cardiovascular Disease, and Central Nervous System Effects		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SR**:Space Radiation		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	72205-7101	**Congressional District:**	2
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	01/31/2019	**End Date:**	01/30/2021
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):	Landes, Reid Ph.D. (University of Arkansas, Little Rock) Weil, Michael Ph.D. (Colorado State University) Pathak, Rupak Ph.D. (University of Arkansas, Little Rock)		
Grant/Contract No.:	80NSSC19K0437		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Recent evidence shows that radiation encountered during deep space travel is associated with increased risks of cancer, cardiovascular disease, and adverse effects in the central nervous system. Administration of a dietary radiation countermeasure before and/or during the mission is an attractive option to reduce the risk of carcinogenesis and degenerative effects in the heart and brain. Gamma-tocotrienol is one of the strongest radiation protectors of all natural compounds tested so far. It is safe, non-toxic and well tolerated, exhibits no interactions with other medications and requires no special storage conditions. It has anti-oxidant and anti-inflammatory properties and protects against endothelial dysfunction. Moreover, studies with tocotrienol administration in human subjects and animal models have shown cancer prevention and protection against brain white matter lesions. In our preliminary studies, gamma-tocotrienol reduced radiation-induced genomic instability, as detected by studying chromosomal aberrations, in human endothelial cells and in bone marrow cells of gamma-ray exposed mice. Moreover, gamma-tocotrienol reduced changes in behavior and cardiac function in a mouse model of exposure to high-energy oxygen ions. Altogether, based on its safety profile, biological properties, and our preliminary results, gamma-tocotrienol has high potential as radiation countermeasure during space travel. Here, we aim to use a mouse model of exposure to modeled galactic cosmic rays to test whether gamma-tocotrienol protects against 1) carcinogenesis, 2) changes in behavior, dendritic morphology, and synaptic plasticity, and 3) changes in cardiac and vascular function and structure. Carcinogenesis will be assessed in genetically modified mice that show a low spontaneous cancer rate but increased tumor incidence in response to low-dose radiation. Degenerative tissue effects will be assessed in wild-type mice. Male and female adult mice will be exposed to mixed charged particle beams or gamma-rays as a reference radiation, in five once-a-day fractions at the NASA Space Radiation Laboratory. Twenty-four hours before each radiation exposure, mice will receive an oral dose of gamma-tocotrienol. Mice will be followed for 18 months after irradiation and inspected daily for tumor formation. Bone marrow cells will be collected to assess the effects of gamma-tocotrienol on genomic instability by cytogenetic analysis. Additional cohorts of mice will be used to assess cognitive and cardiovascular function. At 12 months after irradiation, mice in these subcohorts will be sacrificed to collect blood samples, and brain and heart tissue for histological analysis. These studies will advance the countermeasure readiness level of gamma-tocotrienol against risks of both carcinogenesis and degenerative tissue effects of space radiation.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2019.
Bibliography Type:	Description: (Last Updated: 11/29/2024)