Fiscal Year:	FY 2019	**Task Last Updated:**	FY 07/25/2019
PI Name:	Schreurs, Ann-Sofie Ph.D.		
Project Title:	Candidate Nutritional Countermeasure to Mitigate Adverse Effects of Spaceflight		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (3) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	ann-sofie.schreurs@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	650-604-6390
Organization Name:	NASA Ames Research Center		
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PI Web Page:			
City:	Moffett Field	**State:**	CA
Zip Code:	94035	**Congressional District:**	18
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2015-16 HERO NNJ15ZSA001N-Crew Health (FLAGSHIP, NSBRI, OMNIBUS). Appendix A-Crew Health, Appendix B-NSBRI, Appendix C-Omnibus
Start Date:	01/01/2017	**End Date:**	12/31/2019
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	2
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
Contact Email:	Peter.norsk@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 12/31/2019 per L. Lewis/ARC (Ed., 7/23/19) NOTE: Period of performance changed to 1/1/2017-1/31/2019 per PI information; previously 10/1/2016-9/30/2018 (Ed., 7/15/19) NOTE: Extended to 9/30/2018 per PI; original end date was 9/30/2017 (Ed., 5/3/18)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Tahimic, Candice Ph.D. (NASA Ames Research Center) Globus, Ruth Ph.D. (NASA Ames Research Center)		
Grant/Contract No.:	Internal Project		

Performance Goal No.:	
Performance Goal Text:	
Task Description:	In recent findings, we showed that dried plum (DP) diet conferred complete protection from the rapid bone loss induced by exposure to radiations, including gamma, protons, and High Z-High Energy (HZE) ions. Based on these very promising results on a new potential countermeasure for space radiation tissue damage, we propose to conduct additional studies and analyses, which are critical for moving the potential countermeasure to a higher countermeasure readiness level (CRL) level. We aim to test the DP diet to prevent bone loss induced by simulated spaceflight. This will be achieved by exposing mice to each factor (weightlessness and radiation) alone and combined. Furthermore, we will establish if DP protects other tissues at risk for astronauts, such as the central nervous system.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Countermeasures that address the combined effects of simulated microgravity and ionizing radiation have not been investigated in bone. Both these factors are inherent to the spaceflight environment and thus, countermeasures must be investigated regarding their protective effect when both are in combination. We sought to evaluate the potentially differing effects of microgravity and ionizing radiation when controlled independently on bone and the two factors in combination. For the purpose of this study, we have used the hindlimb unloading model, in combination with exposure to total body irradiation (132Cs gamma radiation, at 2 Gy dose) as analogs of weightlessness and radiation exposure. The relatively higher dose of radiation (2 Gy) was chosen as a positive control dose to ensure bone loss in rodents to allow for testing DP as a countermeasure for bone loss. We sought to determine if the DP diet prevents simulated-microgravity induced bone loss (HU), as well as if the diet is also effective at preventing simulated spaceflight-induced bone loss (combination of HU+irradiation (IR)). To address these questions, we analyzed both cancellous and cortical bone microarchitecture as well as bone quality. Additionally, we aimed to determine if the DP diet had the capacity to protect osteoprogenitors after exposure to simulated microgravity, an essential part in the healthy maintenance of the skeletal tissue.
Task Progress:	The spaceflight environment poses multiple challenges to homeostasis, including microgravity and ionizing radiation. Together, these factors contribute to cellular stress, and effects include increased generation of reactive oxygen species (ROS), oxidative and DNA damage, cell cycle arrest, and cell senescence. We have shown that a purified diet supplemented with dried plum (DP, 25%) conferred full protection of cancellous structure from the rapid bone loss caused by exposure to ionizing radiation (Schreurs et al., 2016). Based on these promising results for a new countermeasure to prevent space radiation induced-tissue damage, we will conduct additional studies to advance the potential countermeasure to a higher CRL (countermeasure readiness level). We will test the DP diet for its ability to prevent bone loss caused by simulated microgravity as well as exposure to radiation. This will be achieved by exposing mice to each factor (simulated microgravity and radiation) alone and in combination. We hypothesize that spaceflight conditions lead to oxidative damage and bone loss, and that DP, a dietary additive rich in antioxidant and polyphenolic compounds, is an effective countermeasure for multiple tissues, including bone. To achieve these aims, we exposed 16-week-old, C57Bl6/J male mice to different treatments to simulate spaceflight: simulated weightlessness using the well-established Hindlimb-Unloading (HU) system and/or total body irradiation (TBI). Mice were assigned to the following groups: 14 days of normal ambulation (NL) or HU alone, or in combination with total body irradiation, at a dose of 2 Gy 137Cs (0.8G/min). Mice were fed with control diet (CD, AIN93M, Teklad) or AIN93M experimental diet supplemented with DP (25%) 14 days before onset of HU treatment. TBI with 2 Gy 137CS was performed 3 days after onset of HU according to protocols previously shown to cause cancellous bone loss. All groups were sacrificed 14 days after initiating HU. The results analysis are ongoing and will be reported in future reports. Reference Schreurs AS, Shirazi-Fard Y, Shahnazari M, Alwood JS, Truong TA, Tahimic CG, Limoli CL, Turner ND, Halloran B, Globus RK. Dried plum diet protects from bone loss caused by ionizing radiation. Sci Rep. 2016 Feb 11;6:21343.
Bibliography Type:	Description: (Last Updated: 10/09/2024)
Articles in Other Journals or Periodicals	Steczina S, Tahmic GT, Pendleton M, M'Saad O, Lowe M, Alwood JS, Halloran B, Globus RK, Schreurs AS. "Dietary countermeasure prevents simulated spaceflight-induced osteopenia in mice." Nature Communications. Submitted as of July 2019. , Jul-2019