Fiscal Year:	FY 2020	**Task Last Updated:**	FY 07/06/2020
PI Name:	Nielsen, Sheila Ph.D.		
Project Title:	Characterizing the Effects of Spaceflight on the Candida albicans Adaptation Response		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Cell & Molecular Biology (2) Microbiology		
Space Biology Cross-Element Discipline:	(1) Reproductive Biology (2) Immunology		
Space Biology Special Category:	(1) Translational (Countermeasure) Potential		
PI Email:	sheila.nielsen@montana.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	406-994-5177
Organization Name:	Montana State University		
PI Address 1:	Leon Johnson Hall, room 315		
PI Address 2:			
PI Web Page:			
City:	Bozeman	**State:**	MT
Zip Code:	59717	**Congressional District:**	1
Comments:	PI name change to Sheila Nielsen in 2014 (formerly Sheila Nielsen-Preiss)--Ed., 1/12/2015		
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2014 Space Biology Flight NNH14ZTT001N
Start Date:	11/01/2014	**End Date:**	04/30/2022
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:	1	**No. of Bachelor's Degrees:**	3
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA ARC
Contact Monitor:	Griko, Yuri	**Contact Phone:**	650-604-0519
Contact Email:	Yuri.V.Griko@nasa.gov		
Flight Program:	ISS		
Flight Assignment:	NOTE: Extended to 4/30/2022 per F. Hernandez/ARC (Ed., 7/27/21) NOTE: Extended to 4/30/2021 per NSSC information (Ed., 7/22/2020) NOTE: Extended to 4/30/2020 per NSSC information (Ed., 4/21/2020) NOTE: Extended to 3/31/2020 per F. Hernandez/ARC and NSSC information (Ed., 6/11/19) NOTE: Extended to 4/30/2019 per F. Hernandez/ARC (Ed., 11/2/17) NOTE: End date changed to 10/31/2017 per NSSC information (Ed., 11/29/16)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	NNX15AB37G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The common yeast pathogen, Candida albicans, can cause a range of diseases from superficial skin infections to systemic and life threatening infections in immunocompromised individuals. Most members of the population are carriers of this yeast at some point in their lifetime. This point becomes more concerning for astronauts who experience diminished immune responsiveness during spaceflight. In addition, many bacteria have been shown to become more virulent when grown in space. The combination of increased virulence and diminished immunity can jeopardize the health and wellbeing of flight crew. The goal of these studies is to characterize the mechanisms underlying the adaptation responses we have observed in yeast grown in modeled microgravity and in spaceflight. In addition, we will focus on determining whether yeast also become more virulent when grown in space, as our observed cellular alterations might predict. Furthermore, we will define the environmental stressors that exist during spaceflight that influence yeast growth. Our overriding research goals are to characterize the virulence of Candida albicans in the space environment, to understand which aspects of the environment contribute to adaptive changes within the yeast, and to identify targets that might be exploited to control yeast infection in space and on Earth.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	There are low fluid shear environments within the human host so we hope to exploit the low fluid shear environment of microgravity to better understand the yeast adaptation to this physical force and the microenvironment created by it.
Task Progress:	The flight payload associated with these studies is referred to as Micro-14. Due to resource constraints, the Micro-14 payload was divided between two flights with the first half flying on Space X CRS-16 in Dec 2018-Jan 2019 using the BioServe Space Technology Fluid Processing Apparatus/Group Activation Pack (FPA/GAP) hardware and the second half flying on Space X CRS-17 in May-June 2019 with Fluorinated Ethylene Propylene (FEP) bags and 12-well BioCells, also from BioServe. From terrestrial experiments and previous flights, we have seen alterations in Candida albicans that appear to be induced by microgravity/low fluid shear. Specifically, the increases in filamentous cell morphology, resistance to antifungal agents, and altered colony morphology are also consistent with increased virulence. Due to the absence of fluid shear in microgravity, we propose that through metabolic activity yeast are influencing their local environment by depleting the oxygen and elevating the carbon dioxide levels. The Micro-14 FPA/GAP experiment was designed to specifically analyze the effects of an altered gas environment and inform whether cells are adapting to these changes during flight. The experiments were built in FPAs with medium that had been equilibrated with carbon dioxide and/or nitrogen (hypoxia) or oxygen to determine whether the effects of microgravity could be augmented or diminished, respectively. Temperature recorders were included in several GAPs and representative tracings suggest the ground samples were exposed to a lower ambient temperature than were the flight samples. The impacts of this difference were minimal since the cells were in stasis during the storage phase. The post-termination storage temperature was also lower in ground samples, but they didn't freeze so viability was retained. Several outcome measures have been evaluated. Cells were returned viable such that colony structure could be evaluated. Cells in both flight and ground conditions grew comparably, although there was significant variability depending on the gas environment in which they were cultured, with cells growing poorly in hypoxic conditions and the combination of elevated CO2 and hypoxia. Cell viability was determined by colony formation and varied from a low of 5% in mixed gas to a high of 63% in atmospheric conditions. Terrestrial samples retained a greater level of viability throughout the conditions as compared to the flight samples. Variations in colony morphology were not observed. Previous studies evaluating the adaptation responses of C. albicans to microgravity have also demonstrated changes in sensitivity to the antifungal agent, Amphotericin B. Although the cells grown in variable gas conditions could not be tested for antifungal drug sensitivity during flight, due to technical constraints, samples were returned and subjected to post-flight growth in various concentrations of the drug. Cells cultured in microgravity exhibited increased resistance to Amphotericin B, particularly the higher drug concentrations, as compared to the terrestrial controls. This data is consistent with that obtained in previous payloads and ground-based bioreactor studies. The experiment flown on Space X-17 had several components, including an analysis of the interaction between human monocytes and yeast, when one or the other was cultured in space. Importantly, we also had the opportunity to dilute and subculture the yeast allowing an analysis of long term culture for the first time. Unfortunately, there were some sample treatment inconsistencies that prevented us from analyzing these samples to the extent required. A reflight opportunity has been approved and we are currently preparing for the upcoming payload.
Bibliography Type:	Description: (Last Updated: 06/23/2023)