Antifungal resistance patterns of two human yeast strains isolated from the International Space Station (ISS)

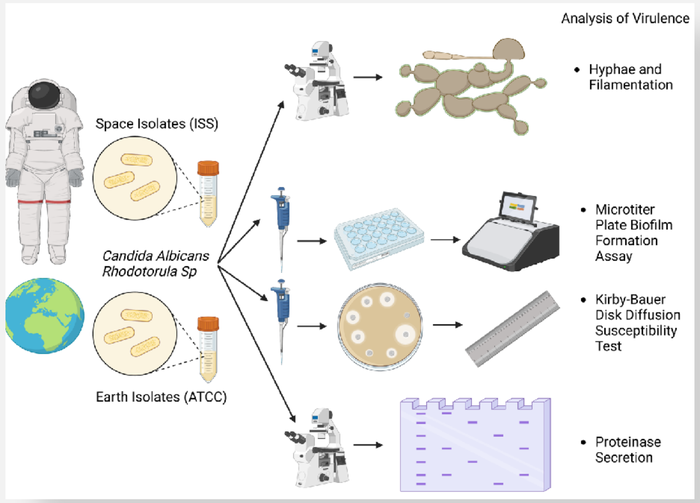
Logan Petty, Riley Dienna, and Alba Chavez, PhD

EMBRY-RIDDLE Aeronautical University

Abstract

This report was designed to compare spaceflight-induced cellular and physiological adaptations of two human yeast commensals, *Candida parapsilosis* and *Rhodotorula sp.* isolated from the International Space Station (ISS). These two yeast strains are common opportunistic pathogens responsible for a variety of superficial infections as well as systemic and more severe infections in immunocompromised individuals. The risk of opportunistic infections can be assessed by testing antifungal susceptibility as a virulence-related phenotype. In this study, antifungal susceptibility was tested using a broth dilution method which included different concentrations of the common antifungals Fluconazole, Amphotericin B, and Caspofungin in strains from the ISS and compared to earth isolates from the American Type Culture Collection (ATCC) library. Preliminary results indicate that, in general, both yeast isolates from the ISS demonstrated increased resistance to all antifungals tested when compared to earth isolates. This study provides insight into deciphering the microbial responses to spaceflight conditions and their potential role in causing antimicrobial-resistant infections.

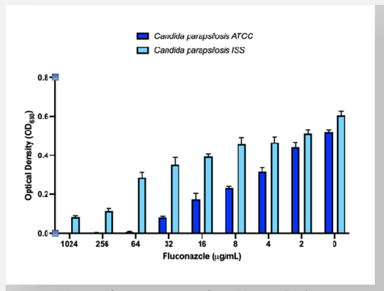
Experimental Methods



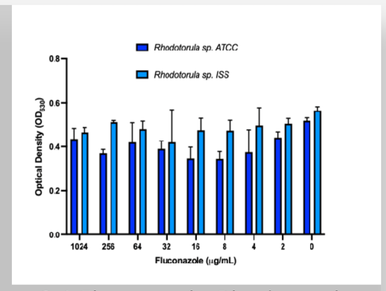
Objectives

- Determine the resistance to common antifungals of *Candida Parapsilosis* and *Rhodotorula sp.* strains isolated from the ISS
- Determine microbial responses to spaceflight conditions
- Monitor hyphae and filamentation of ISS isolates compared to ATCC reference strains
- Determine approximate pathogenicity based on hyphae and filamentation

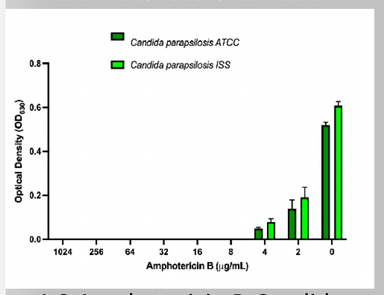
Experimental Results



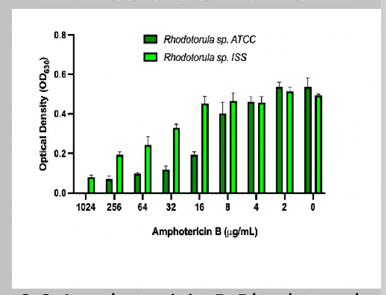
1.1 Fluconazole-Candida



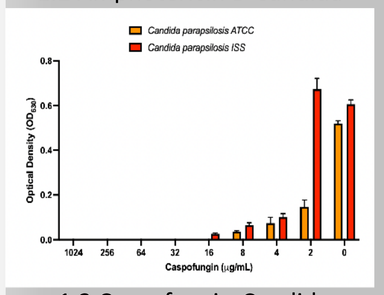
2.1 Fluconazole-Rhodotorula



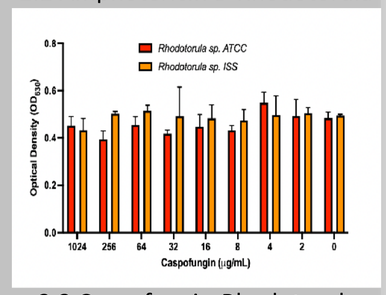
1.2 Amphotericin B-Candida



2.2 Amphotericin B-Rhodotorula



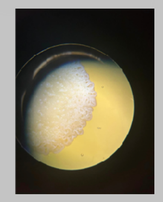
1.3 Caspofungin-Candida



2.3 Caspofungin-Rhodotorula

Discussion

Based on Kirby-Bauer disk diffusion susceptibility test and microtiter plate biofilm formation assay results, ISS isolates of *Candida Parapsilosis* demonstrated increased resistance to Fluconazole at all antifungal concentrations compared to ATCC reference strains. ISS Isolates of *Candida Parapsilosis* also demonstrated increased resistance to Amphotericin B and Caspofungin at lower antifungal concentrations when compared to ATCC reference strains, as indicated by the optical density of colonies. ISS isolates and ATCC reference strains of *Rhodotorula Sp*. demonstrated significant resistance to Caspofungin and Fluconazole across all concentration levels, with no significant statistical difference between earth and ISS isolate resistance. When exposed to Amphotericin B, ISS isolates of *Rhodotorula Sp*. demonstrated increased antifungal resistance over earth isolates at high antifungal concentrations, before levelling off at lower antifungal concentrations where there was no significant statistical difference between ISS and earth isolates. Upon examination, ISS isolates of *Candida Parapsilosis* and *Rhodotorula Sp.* demonstrated increased filamentation compared to the ATCC strain, indicating higher levels of pathogenicity.



3.1 C. Parapsilosis ISS

3.2 C. Parapsilosis ATCC

Future Directions

Based on the results of this study, the logical next step would be to determine the specific mutations in the genome that result in the space isolates being more resistant to antifungals. Determining the exact mutations that make the ISS isolates different from the ATCC isolates could allow for a deeper understanding of the effects of spaceflight on gene expression.