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CIPROFLOXACIN EFFICACY AGAINST URINARY TRACT PATHOGENS CULTURED UNDER SIMULATED MICRO-, LUNAR, AND MARTIAN GRAVITIES

Abstract

In some studies, it has been observed that the space environment can cause increased bacterial growth and reduced efficacy of some antibiotics, with respect to 1g. While there are data sets at microgravity and 1g, there is a lack of knowledge regarding what may be expected in terms of these two phenomena under lunar (1/6g) and Martian (1/3g) gravitational conditions. In this regard, urinary tract infection (UTI) processes are of special interest given that the urosepsis that may derive from them is the third most likely reason for medical evacuation from the International Space Station, and the consequences they may have on the crew/mission success is severe. Thus, an investigation was performed to characterize the growth dynamics of a uropathogenic clinical isolate strain of *Escherichia coli*, AMG1, under simulated micro-, lunar, and Martian gravities, achieved via a series of in-house developed clinostats. Similarly, an in-house developed code was used to determine the optimal angular speed based on cellular (average cell size/mass), fluid (density/viscosity), and hardware (vessel diameter) parameters, by solving two second order, linear, separable, non-homogeneous, stiff differential equations based on Navier-Stokes. Separately, the efficacy of Ciprofloxacin, a fluoroquinolone and the most commonly prescribed antibiotic against UTI's, was interrogated as a function of gravitational regime. This was quantified by determining the minimum inhibitory concentration (MIC) – the smallest amount of drug necessary to inhibit bacterial growth – at each of these gravitational conditions. To assess the potential role of the sigma factor σs – produced by the *rpoS* gene and which confers *E. coli* with resistance to some antibiotics on Earth – this study included an *rpoS* deletion mutant for growth dynamics and MIC characterization. These strains were cultured in modified Artificial Urine Media (mAUMg-hi Pi) in BioServe Space Technologies' Fluid Processing Apparatus (FPA) spaceflight hardware. This approach, in addition to the spaceflight data of *E. coli* AMG1 and its *rpoS* deletion mutant from a separate study, enabled the comparison of bacterial behavior under actual and simulated reduced gravity conditions. Results showed that as gravitational regime decreased, so did Ciprofloxacin's MIC for *E. coli* AMG1. The understanding of the MIC of Ciprofloxacin on *E.coli* AMG1 between gravitational regimes will be beneficial to the treatment of UTI's during human space exploration.

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