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Simulation of potentially habitable environments on the surface of exoplanets

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In this work, we simulate analogous environments to those expected to be found on the surface of Proxima b, considering atmospheric composition and ultraviolet (UV) radiation. We investigated the survival rates of the yeast *Rhodotorula dairenensis* under these conditions.

Proxima b is an exoplanet with 1.17 $M_\oplus$ (Suárez Mascareño, A. et al., 2020) (Mascareño et al. 2020) and is in the habitable zone of an M dwarf. Such stars are interesting for astrobiology studies as they host the majority of terrestrial exoplanets already discovered in habitable zones. However, they are challenging in the biological context due to high levels of stellar activity, presenting frequent and intense flares with high intensity of UV radiation (Suárez Mascareño, A. et al., 2020) (Mascareño et al. 2020). This radiation is very important for biological systems, but excessive exposure can cause oxidative stress in cells and even damage to nucleic acids (Pourzand & Tyrrell, 1999) (Pourzand & Tyrrell 1999). Thus, this work aims to assess the survival rates of life as we know it in these environments.

To achieve this goal, we conducted experiments with the yeast *Rhodotorula dairenensis*. The sample was collected in Serra dos Cristais in Diamantina, Minas Gerais - Brazil (18.21408°S, 43.58771°W/1398 m), in May 2018. We performed three UV irradiation experiments with desiccated yeast. The first experiment was carried out with a tubular lamp that covers only the UVC region (254 nm). The second experiment was carried out with a continuous spectrum lamp that covers the entire UV range. The third experiment was conducted in the Space and Planetary Simulation Chamber (AstroCam) to simulate hypothetical conditions on the surface of Proxima b. In this chamber, we simulate an extreme atmosphere with 100% CO_2 and one that resembles that of primitive Earth (80% CO_2 and 20% N_2), with a pressure of 1000 mbar and with the continuous

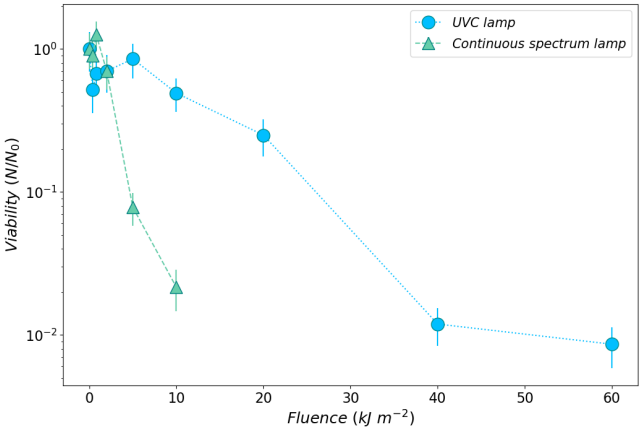

Figure 1. Survival curves for the experiments with *Rhodotorula dairenensis* desiccated. N_0 is the viable count of non-irradiated microorganisms, N is the viable count after irradiation. Experiments performed in triplicate.

spectrum lamp attached to the AstroCam. Our results for this last experiment were inconclusive due to the large error bars, so we will not discuss it here. Non-irradiated samples were used as control in the three experiments. We compared irradiated and control samples to estimate the survival rate of microorganisms.

The results of the experiments are presented in Figure 1. The results showed that irradiation with the continuous spectrum lamp (green line) was much more lethal than the tubular lamp (blue line). The UVA, UVB and UVC ranges cause different damages to cells and dealing with these stresses simultaneously could make their survival more challenging. Furthermore, we observed that there no viable microorganisms for a fluence of 10 kJ m^{-2} to the UV lamp and 60 kJ m^{-2} for the UVC lamp. Using the estimated flux of a typical UVC flare for Proxima b's orbit of 7 W m^{-2}

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(Welsh et al., 2007; Abrevaya et al., 2020) (Welsh et al. 2007; Abrevaya et al. 2020), those values would be reached in about 24m at 2.38h, respectively.

References

Abrevaya, X. C., Leitzinger, M., Oppezzo, O. J., et al. 2020, MNRAS, 494, L69, doi: 10.1093/mnrasl/slaa037

Pourzand, C., & Tyrrell, R. M. 1999, Photochemistry and Photobiology, 70, 380, doi: https://doi.org/10.1111/j.1751-1097.1999.tb08239.x

Suárez Mascareño, A., Faria, J. P., Figueira, P., et al. 2020, A&A, 639, A77, doi: 10.1051/0004-6361/202037745

Welsh, B. Y., Wheatley, J. M., Seibert, M., et al. 2007, ApJS, 173, 673, doi: 10.1086/516640

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