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Ground testing of the EMCS seed cassette for biocompatibility with the tardigrade, *Hypsibius dujardini*

The European Modular Cultivation System, EMCS, was developed by ESA for plant experiments. We performed ground testing to determine whether ARC EMCS seed cassettes could be adapted for use with tardigrades for future spaceflight experiments. Tardigrades (water bears) are small invertebrates that enter the tun state in response to desiccation or other environmental stresses. Tardigrade tuns have suspended metabolism and have been shown to survive exposure to space vacuum, high pressure, temperature and other stresses. For spaceflight experiments using the EMCS, the organisms ideally must be able to survive desiccation and storage in the cassette at ambient temperature for several weeks prior to the initiation of the experiment by the infusion of water to the cassette during spaceflight. The ability of tardigrades to survive extremes by entering the tun state make them ideal candidates for growth experiments in the EMCS cassettes. The growth substratum in the cassettes is a gridded polyether sulfone (PES) membrane. A blotter beneath the PES membrane contains dried growth medium. The goals of our study were to (1) determine whether tardigrades survive and reproduce on PES membranes, (2) develop a consistent method for dehydration of the tardigrades with high recovery rates upon rehydration, (3) to determine an appropriate food source for the tardigrades that can also be dehydrated/rehydrated and (4) successful mock rehydration experiment in cassettes with appropriate food source. We present results that show successful multigenerational growth of tardigrades on PES membranes with a variety of wet food sources. We have successfully performed a mock rehydration with tardigrades and at least one candidate food, protonema of the moss *Polytrichum*, that supports multigenerational growth and whose spores germinate quickly enough to match tardigrade feeding patterns post rehydration. Our results indicate that experiments on the ISS using the tardigrade, *Hypsibius dujardini* and other similar species could successfully be performed in the flight verified hardware of the EMCS seed cassettes.