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3D PRINTED MICROFLUIDIC MICROPOT PLATFORM FOR GRAIN GROWTH IN MICROGRAVITY CONDITIONS ASSESSMENT.

Abstract

In the near future, mankind wants to start a colonization of Mars and the development of permanent stations in space. The main problem for this kind of missions is food supply. Plants are the best candidates for a constant supply of nutrition's under such conditions. However, we do not know for sure, how the plants will behave in the absence of gravity or microgravity conditions. So far, such studies have been carried out on the ISS and in larger satellites. However, in order to properly verify the growth of plants in the unfavorable conditions of outer space, a tool is needed that will be able to check this phenomenon in greater quantity. CubeSat nanosatellites can be a solution because they are cheap, lightweight, maintenance-free and fully automated. In this paper we present a CubeSat standard micropot platform which enables to assess the growth behavior and potential of plants in their early germination stages in outer space. The most important module of the platform is fully 3D printed microfluidic device, called micropot, with integrated and calibrated force sensors for root and stalk growing force measurements. Micropot is fabricated with InkJet 3D printing and it is fully customizable in terms of grain size to approximately 5 mm in diameter. The life support systems consists of heated microfluidic nutrition containers connected with peristaltic pumps in a closed circuit with the micropot. Detection module is based on the inverted lens microscope with autofocus, LED illumination and camera chip (Sony IMX179). The experiment process is fully automated. It collects the pictures of the seed every 1 hour and provides the nutrition every 12 hours. The micropot module was integrated with two other experiments in CubSat compatible chamber, with atmospheric pressure inside, on LabSat (SatRevolution, Poland) mission and launched on January 13 2022, on Falcon 9, Transporter-3 (SpaceX, USA) rocket. The mission is in progress on low Earth orbit (LEO). The results will answer the question of what is the nature of early grain growth in truly microgravity conditions.