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EFFECTS OF REDUCED GRAVITY INVESTIGATIONS ON ROOT DEVELOPMENTS AND BIOCHEMICAL CHARACTERIZATION: A CASE STUDY OF CUCUMBER FARMING ON THE MOON

Abstract

Long-term real microgravity platforms such as the space-laboratories and autonomous microgravity-laboratories are scarce and expensive to access; and short-term real microgravity platforms (drop-tower, sounding-rocket, parabolic-flight) have short-experimental windows for plants growth and development. The use of simulated-microgravity platforms such as clinostats and Random Positioning-Machines (RPMs) therefore allows long-experimental windows of several hours and days. As exclusive reduced-gravity simulators of the Moon and Mars have not been developed, but two-dimensional clinostats and RPMs are now able to investigate into Moon and Mars research; as habiting them in the nearest future is an agenda of the space-sector – results applicable to Earth's challenges. In this project, as the clinostat is a possible equipment to generate the reduced gravity level of the Moon (0.17 g) by tilting its inclination handle. Placing the rotating axis of a clinostat at an angle simulates a fraction of gravity. The rotation position of the clinostat was tilted to 10^{o} which made it to be set to the Moon's gravity of 0.17 g. Cucumber (Cucumis sativus) seedlings were mounted for six and half hours of observation, the root growth-rate and root-curvature of the seedlings were compared to the control-counterparts (Earth's-gravity sample). The growth-rate and the root-curvature were analyzed using ImageJ software. Afterwards, further biochemical-characterization of proximate composition was done on the root samples to determine if the Moon gravity level samples are favoured. Proximate composition is the macronutrient values in samples of food; these values are the nutritional facts. In proximate analysis, carbohydrate, crude protein, crude fat, crude fiber, ash content (minerals) and moisture content are usually determined. The knowledge obtained from microgravity simulations of crops has been successfully applied and aimed to bio-fortify. A justification for reduced gravity research in the biological sciences is the anticipation that new knowledge will be accumulated by the optimized production of small amounts of reduced gravity-derived bio-macromolecules and biochemicals/phytochemicals, as biological samples give platform for studying the physiological responses to reduced gravity. In the future, field transplant of simulated-lunar samples till fruiting can give access to better biochemical.

Keywords: Simulated-Microgravity, Reduced gravity, Clinostat, Moon, Cucumber, Root growth-rate, Biochemical-characterization.