The development of technologies for long-term space missions requires the creation of closed bioregenerative life support systems (BLSS) capable of ensuring food production, air revitalization, and waste recycling. Microalgae and cyanobacteria are the key components of such systems due to their ability to photosynthesise, sequester CO_2, produce oxygen, and assimilate biogenic compounds.

This study aimed to evaluate the feasibility of utilizing the biomass of *Chlorella vulgaris* and *Arthrospira platensis* cultivated on a medium derived from municipal wastewater as a biofertilizer for Marian and lunar regolith simulant. The effectiveness of this approach was evaluated using the growth performance of lettuce (*Lactuca sativa* L.), which was selected as a model plant.

Six regolith simulants were tested, including magnetically modified substrates and those already used in previous cultivation cycles. The parameters evaluated included the productivity of algae cultivation in photobioreactors, the efficiency of pollutant removal, and the fertilizing potential of the resulting biomass.

In most cases, a significant increase in lettuce yield was observed after biomass application, especially at a dosage of up to 10 g/kg dm. The lack of a positive fertilizing effect with one of the Martian regolith simulants (MGS-1) was attributed to its specific chemical composition, in particular the presence of perchlorates and salts, which are known to inhibit plant development. In addition, magnetic separation and reutilisation of the substrate were shown to improve the physicochemical properties of the growth medium and the overall performance of the plants.

These ground-breaking investigations combine biotechnology, environmental engineering, and astrobiology and offer new insights into extraterrestrial agriculture.