Title: Exploring the Interplay of Microgravity and Light on Plant Gene Expression
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In microgravity environments, plants exhibit altered growth patterns due to the absence of gravity. This phenomenon affects both phototropism (response to light) and gravitropism (response to gravity). Additionally, the influence of different wavelengths of light, such as far white light and far-red light, further complicates plant growth patterns. Phototropism in Microgravity refers to the altered growth response of plants to light, where plants may exhibit irregular growth and distribution of tissues due to the lack of gravity's influence. Gravitropism in Microgravity results in significant alterations in plant growth responses to gravity, leading to distorted shapes and reduced structural integrity. The influence of Far White Light and Far-Red Light on plant growth and development persists in microgravity, but altered perception and response to these signals may occur due to the absence of gravity.

This study explores the interplay between microgravity conditions and varying light parameters on plant gene expression, focusing on chloroplast biogenesis and sugar metabolism pathways. We hypothesize that microgravity coupled with light variations will disrupt gene expression patterns, leading to imbalances in chloroplast function and sugar metabolism.

The top five genes most affected by these conditions are: POR, CHLH/GUN5, SIG, PEPC, and Rubisco. Microgravity alters POR kinetics and CHLH/GUN5 expression, while light quality modulates their activities. SIG activity in regulating chloroplast gene expression is influenced by microgravity-induced changes and light variations. PEPC expression and Rubisco function are affected by microgravity and light availability, impacting carbon assimilation pathways.

To investigate these effects, Arabidopsis thaliana and lettuce plants are proposed to be grown in the International Space Station under controlled lighting systems. Gene expression analysis will be conducted using the Genes in Space Toolkit for RNA extraction and quantitative real-time PCR. Statistical analysis could reveal significant alterations in gene expression profiles under different experimental conditions.

Controls included samples grown under normal gravity as positive controls and microgravity without light manipulation as negative controls. Technical replicates and housekeeping genes ensured experimental consistency and reliability.

This study provides insights into the effects of microgravity and light on plant gene expression, contributing to our understanding of plant biology in space. Findings will inform strategies for optimizing space agriculture and enhancing crop resilience, with implications for both space exploration and terrestrial agriculture.