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Radiation Fields, Effects and Risks in Human Space Missions (5)

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REGULATION OF HSP90 GENES ARE DISTURBED BY EXPOSURE TO LOW DOSE IONIZING RADIATION AND SPACEFLIGHT IN ARABIDOPSIS IN ECOTYPE-DEPENDENT MANNER

Abstract

Over the past decades, many studies reported that exposure to space environment could cause diverse changes in plants, including a remarkable increase in the frequency of phenotypic variation. These changes were generally considered as phenotypic responses to genetic modifications induced by cosmic radiation. Whereas several other studies showed that spaceflight exposure does not cause significant increase in gene mutation frequency or heritable changes. So, there is a marked disparity between the incidence of phenotypic variations and genetic changes reported in earlier studies, which should not be neglected. This fact prompts us to speculate about the possibility of non-genetic pathway by which spaceflight provokes phenotypic variations. Hsp90-dependent buffering mechanism seems to be the most probable candidate. Impairment of Hsp90 function could expose previously concealed genetic variations and produce phenotypic changes. Recent studies have shown that expressions of HSP genes are changed in response to spaceflight in plants. But the response of Hsp90 genes to space environment has not been analyzed specially. In this study, we analyzed the mRNA levels of 4 cytosolic Hsp90 genes in two ecotypes of Arabidopsis using Quantitative RT-qPCR after exposing seeds to spaceflight and low dose ionizing radiations . The results showed that a sustaining disturbance in the regulation of Hsp90 genes was induced in Arabidopsis seedlings from seeds exposed to spaceflight and low dose ionizing radiations. The initial changes of Hsp90 expression were responsive to the dose of ionizing radiation within the tested range in a non-linear manner. The responses of different Hsp90 genes varied depending on ecotypes. These results suggest that exposure to low dose of ionizing radiation during spaceflight may play an important role in induction of phenotypic variations by effects on Hsp90-dependent buffering in plants.