Plant lipid rafts-plasmalemma functional microdomains are sensitive to clinorotation

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Опис

Properties and functions of biological membranes, especially plasmalemma (Pl), may consider as the most sensitive indicators of the influence of gravity or altered gravity on a cell. Currently it has been revealed the presence of functional microdomains with the specific localization and content of lipids and proteins in the plasmalemma of plant cells, that became known as" lipid rafts". It is supposed that rafts enriched on cholesterol and sphingolipids take part in many vitally important cell processes. The investigations of lipid rafts help to explain the biochemical processes which occur in cell membranes in the normal conditions and in responses to stress and can't be explained by using the other models. Despite these ideas, data on the microgravity effects on Pl structure and functions are scarce. We have shown the presence of lipid rafts, which were similar to those in other plant species on the structure and size, and …

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Abstract

Properties and functions of biological membranes, especially plasmalemma (Pl), may consider as the most sensitive indicators of the influence of gravity or altered gravity on a cell. Currently it has been revealed the presence of functional microdomains with the specific localization and content of lipids and proteins in the plasmalemma of plant cells, that became known as "lipid rafts". It is supposed that rafts enriched on cholesterol and sphingolipids take part in many vitally important cell processes. The investigations of lipid rafts help to explain the biochemical processes which occur in cell membranes in the normal conditions and in responses to stress and can't be explained by using the other models. Despite these ideas, data on the microgravity effects on Pl structure and functions are scarce. We have shown the presence of lipid rafts, which were similar to those in other plant species on the structure and size, and also enriched with cholesterol and saturated fatty acids in the Pl isolated from pea seedlings in stationary conditions and under slow horizontal clinorotation using an ultracentrifuge "Optima L-90K" (Beckman Coulter, Germany) and controlled by the electron-microscopic method with a transmission electron microscope JEM 1230 (Jeol, Japan). In simulated microgravity, a significant increase in saturated fatty acids and especially cholesterol in lipid microdomains was revealed that indicated their increased rigidity. The presence of lipid rafts in the Pl of pea seedling root cells and their gravisensitivity were also demonstrated using a fluorescent marker of cholesterol - filipin and a fluorescent lipophilic

probe laurdan with a confocal laser microscope LSM 5 PASCAL (Carl Zeiss, Germany). Unlike control, the joining rafts with each other into complexes around the Pl perimeter was observed, as well as an increased emission of lipid-ordered, denser membrane regions with reduced water content was also registrated under clinorotation. A qualitative analysis of individual phospholipids of lipid rafts, performed by thin-layer chromatography, showed that phosphatidylcholine and phosphatidylethanolamine under clinorotation exceeded those in control samples. To the surprise, sphingomyelin, the main function of which is the transmission of external signals into intracellular space, was not detected, although it is always present in the rafts of animal cells. The prospects of future research of the influence of microgravity on the state of lipid rafts and their role in gravisensitivity of plant cells are discussed.

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