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D-lactate dehydrogenase: Employing cytotoxic metabolite methylglyoxal for energy production and conferring abiotic stress tolerance

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Methylglyoxal (MG) is a potent cytotoxin, which is produced as a by-product of various metabolic reactions in the cell. In conditions of stress, MG accumulates in cells leading to cell injury and death. To protect the cell from harmful effects of MG, Glyoxalase system is present which comprises of two enzymes, Glyoxalase I and Glyoxalase II. Glyoxalase system converts MG to D- lactate, which on accumulation, is also toxic for cell. Another enzyme D-lactate dehydrogenase converts D-lactate to pyruvate, which goes to TCA cycle for energy production. Thus, MG detoxification involves three enzymes which work together to divert the toxic molecule towards energy production in times of unfavorable conditions. Using a combination of in silico, molecular and biochemical approaches; we functionally characterized a D-lactate dehydrogenase enzyme (OsD-LDH2) from rice for its role in abiotic stress mitigation. The OsD-LDH2 enzyme successfully conferred tolerance against multiple abiotic stresses to bacterial, yeast and plant system. The OsD-LDH2 overexpressing plants maintained a lower level of ROS and other toxic intermediates along with a higher functioning antioxidant system. The presence of D-LDH in transgenic plants led to utilization of toxic methylglyoxal for energy production, ultimately resulting in better growth and yield in stress conditions. Thus, D-LDH is a crucial part of MG detoxification system and an important candidate for engineering abiotic stress tolerance in plants.

Biography

Muskan Jain obtained her Ph.D. in plant molecular biology from South Asian University, New Delhi, India in Feb. 2020. She has published six research articles and two book chapters in her research career so far. She is a germinating molecular biologist, having seven years of research experience in the field of life sciences and biotechnology. During her Ph.D., she has characterized multiple plant proteins and developed keen interest in the field of protein sciences. Following the same, currently, she is working as a research associate in biophysics department in University of Delhi, India.

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