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Genetic background of enhanced radioresistance in an anhydrobiotic insect: transcriptional response to ionizing radiations and desiccation

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Abstract

© 2016, Springer Japan. It is assumed that resistance to ionizing radiation, as well as cross-resistance to other abiotic stresses, is a side effect of the evolutionary-based adaptation of anhydrobiotic animals to dehydration stress. Larvae of *Polypedilum vanderplanki* can withstand prolonged desiccation as well as high doses of ionizing radiation exposure. For a further understanding of the mechanisms of cross-tolerance to both types of stress exposure, we profiled genome-wide mRNA expression patterns using microarray techniques on the chironomid larvae collected at different stages of desiccation and after exposure to two types of ionizing radiation—70 Gy of high-linear energy transfer (LET) ions (4He) and the same dose of low-LET radiation (gamma rays). In expression profiles, a wide transcriptional response to desiccation stress that much exceeded the amount of up-regulated transcripts to irradiation exposure was observed. An extensive group of coincidentally up-regulated overlapped transcripts in response to desiccation and ionizing radiation was found. Among this, overlapped set of transcripts was indicated anhydrobiosis-related genes: antioxidants, late embryogenesis abundant (LEA) proteins, and heat-shock proteins. The most overexpressed group was that of protein-L-isoaspartate/D-aspartate O-methyltransferase (PIMT), while probes, corresponding to LEA proteins, were the most represented. Performed functional analysis showed strongly enriched gene ontology terms associated with protein methylation. In addition, active processes of DNA repair were detected. We assume that the cross-tolerance of the sleeping chironomid to both desiccation and irradiation exposure comes from a complex mechanism of adaptation to anhydrobiosis.

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Keywords

Anhydrobiosis, Bioinformatics and evolutionary relationship of enzymes, Molecular biology, Radiation tolerance

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