

Terahertz radiation proteomic response of the thermophilic bacterium *Geobacillus icigianus*

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Motivation and Aim: Fields of terahertz (THz) radiation utilisation is expanding rapidly, including biomedicine, pharmaceuticals, security systems, and communications, requiring the omics studies of radiation effects on biological systems [1]. Studying proteomic level the responses is one of the most effective methods for external impact results detection. The study on the impact of THz radiation on the temperature-sensitive organisms proteome associated with a number of significant technical difficulties, including the optimal temperature range preservation. With increased resistance of high temperatures of extremophilic species, it is easier to isolate THz radiation effect from thermal one. In this work, we studied the proteomic response to terahertz radiation of the thermophilic bacterium *Geobacillus icigianus*. The bacterium persists under the wide temperature fluctuation conditions with an optimum of 60°C, making its enzyme systems stress resistant.

Methods and Algorithms: The experiments were carried out using terahertz free electron laser (FEL) of the Siberian Center for Synchrotron and Terahertz Radiation, designed and employed by the Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences. Cell culture in LB medium, placed in a specially designed cuvette, were irradiated for 15 min with 0.23 W/cm² and 130 µm terahertz radiation. Control sample was incubated using identical cuvette in a thermostat at 60 °C. After, 2D electrophoresis and subsequent mass-spectrometric identification were performed to determine gene expression level alteration and its functional role, based on the results of previously performed whole genome sequencing [2, 3].

Results: It was shown, that protein expression level immediate after irradiation and after 10 min incubation following irradiation, varies. THz radiation rapid response involves metabolic systems of electron transport, regulation of transcription and translation, cell growth and chemotaxis, synthesis of peptidoglycan, riboflavin, cofactors NADH, FAD and pyridoxal phosphate, the Krebs cycle, ATP synthesis, chaperone and protease activity, as well as DNA repair, including methylated. When cells are incubated after the irradiation, the systems of cell anti-stress protection, chemotaxis, and cell growth are partially restored, but respiration and energy metabolism, biosynthesis of riboflavin, cofactors, peptidoglycan, as well as components of the translation system are affected, with the amino acid metabolism system being involved.

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