# Application of computational and biological approaches to detect UV radiation effects on bacterial cells

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Microorganisms are the simple and basic part of the biosphere and their changes may be used as sensors for monitoring of the environmental radioactivity and its toxicity. Microorganisms have evolved mechanisms to maintain cell integrity in the state of extreme environmental stress. Hence, microorganisms can be used as sensors for monitoring of the environmental radiotoxicity.

In order to find an indicator for environmental radiotoxicity the morphological changes and growth response to ionizing UV radiation (IR) of *Escherichia coli* M-17 cells has been studied. Comparison analysis of bacterial cell morphology was carried out utilizing computational approach, using computer programs NOVA and LabView, and biological approach using established methods (determination of specific growth rate and growth lag phase duration, identification of colony forming units (CFU)).

Morphological alternations of *E. coli* cells caused by IR have been detected. The average bacterial cell surface area decreased 16% and 26%, respectively, and bacterial cell perimeter (i.e. 2D projection of bacterial cell perimeter in photo image) - 8% and 12%, respectively, but bacterial cell size decrease was less-significant - 4% and 8%, respectively, after 5 and 10 min of 40 Gy radiation compared to control (non-irradiated) cells. The UV radiation effect on bacterial growth rate has been also studied. The bacterial growth rate has decreased 2 and 4 times, correspondingly, after 5 and 10 min 40 Gy radiation compared to non-irradiated cells. The growth stationary phase of 5 min radiated cells has started after 7 h incubation, while the growth stationary phase of non-irradiated cells started after 5 h incubation. The growth of *E. coli* cells exposed to 40 Gy radiation during 10 min was recovered after 20 h cultivation. CFU of *E. coli* radiated for 5 and 10 min with 40 Gy has decreased by $10^3$ and $10^5$ times correspondingly.

The findings are highly useful in monitoring of UV irradiation and for development of new, rapid analysis method to test bacterial cell morphology and growth alternations.