Luminous Bacteria Will Help to Measure Radioactivity

Siberian biophysicists have conducted a research concerning a biological effect of low-dose gamma radiation. The results have been published in the Journal of Environmental Radioactivity, one of the leading scientific journals in the world among those dedicated to the issues of environmental radioactivity.

During the research, the scientists were to answer the following questions which are currently considered to be important in the realm of radiobiology:

- What are the peculiarities of low-dose gamma radiation`s effect on living creatures?
- What are the differences between gamma and alpha, beta radiation in terms of their effect on living creatures?

Photobacterium phosphoreum, which is quite suitable for a comprehensive analysis of a radiation effect, was used as a test organism. In the course of the experiment, the luminous bacteria were put into an experimental capsule where they were undergoing the effect of different radiation capacity and duration under the temperatures of +5 °C, +10 °C, +20 °C.

Research concerning gamma radiation is a significant issue, since, compared to alpha- and beta radiation, it is much more dangerous. The level of its spreading and penetrating the objects is quite high, and one cannot simply cover themselves in order to protect from radiation. For example, to prevent from being harmed by alpha radiation a sheet of paper is enough, while gamma radiation can be prevented only by using heavy metals, such as lead.

The differences in effects produced by radiation of alpha-, beta- and gamma-rays are connected with the very nature of those kinds of radiation. While alpha and beta radiation are the beams of charged particles – the nuclei of helium atoms and electrons respectively, gamma radiation is electromagnetic radiation, characterized by low ionizing power. These distinctive features are supposed to influence biological effects in case of both high-dose and low-dose radiation. As low-dose effects are currently being less analyzed, they are the subject of interest for many scientists.

As a result of experiments conducted and all the data compared with the previously known information, the researchers have come to a number of significant conclusions:

- First, if the influence of low-intensity alpha and beta radiation on living creatures can be described applying the model of hormesis (according to which radiation can have both negative and positive influence), low-intensity gamma-radiation under the same circumstances can be only destructive, and is described as a linear correlation in dose-effect coordinates.
- Second, the scientists have found out that if the radiation is low-intense, the dose absorbed is not as important as its duration, which is the most significant factor in terms of toxic effect on organisms.
- Third, the influence of low-dose gamma radiation under the temperatures of +5 °C and +10 °C did not seem to have any harmful radiation effect during the experiment (under 175 hours). However, under the temperature of +20 °C, luminous bacteria intrinsic glow was suppressed, which indicated the presence of toxic radiation. According to the scientists, high temperatures lead to the increase in a speed of a metabolic process, thus making bacteria more sensitive to radiation.
- Fourth, if the danger of radiation impact is usually connected with some changes on genetic level, then

in case of a low-dose gamma radiation the scientists have not found any genetic changes, which could have been responsible for the main functions of bacteria.

According to one of the co-authors of a publication by the Siberian Federal University professor and a scientist of the Institute of Biophysics SB RAS, **Nadezhda Kudryasheva**, the results achieved have both a fundamental role and practical applications, *"These results help to comprehend the nature of low intensity radiation`s biological impact at the cell level. The cells of luminous bacteria are a suitable object for such kind of research. The practical aspect is connected with an opportunity to use luminous bacteria in order to monitor the levels of toxicity in environment in the event of chemical pollution. Our research has shown that usage of luminous bacteria for this purpose is quite prospective."*

Reference

The data gathered in the course of experiments formed the basis for an article entitled "The Effect of Low-dose Gamma Radiation on Marine Luminous Bacteria", published at the beginning of 2017 in the Journal of Environmental Radioactivity. This journal is included in Scopus data base and has a considerable impact factor of 2,38, according to the information of 2016; the journal is one of the leading resources in the realm of radioactivity research. The authors are: Bondar A.A (Institute of Chemical Biology and Fundamental Medicine SB RAS, Novosibirsk), Dementev D.V. (Institute of Biophysics of Krasnoyarsk Scientific Centre SB RAS), Petrova A.S. (Institute of Biophysics of Krasnoyarsk Scientific Centre SB RAS, Krasnoyarsk State Agricultural University), and Kudryasheva N.S. (Siberian Federal University, Institute of Biophysics SB RAS).

19 may 2017