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Luminous bacteria will help to measure radioactivity

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In a new study, scientists asked the following questions, which are important in the field of radiobiology: What are the effects of low-dose gamma radiation on living creatures? What are the differences between gamma, alpha and beta radiation in terms of their effects on living creatures?

Photobacterium phosphoreum, which is suitable for a comprehensive analysis of radiation effects, was used as a test organism. In the course of the experiment, these luminous bacteria were put into an experimental capsule where they were exposed to different radiation capacities and durations at temperatures of +5 °C, +10 °C, and +20 °C.

Compared to alpha and beta radiation, gamma radiation is much more dangerous. Its spread and penetration are quite high, and it is difficult to protect or shelter against it. For instance, a sheet of paper can block alpha radiation, while a lead barrier is required to shield against gamma radiation.

While alpha and beta radiation are the beams of charged particles—the nuclei of helium atoms and electrons respectively—gamma radiation is electromagnetic, characterized by low ionizing power. These distinctive features are believed to influence differing biological effects of both high-dose and low-dose radiation. The current study was concerned with low-dose effects. 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 only be destructive, and is described as a linear correlation in dose-effect coordinates.

Second, the scientists determined that if the radiation is low intensity, the absorbed dose 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, at a temperature of +20 °C, the glow of the luminous bacteria was suppressed, indicating the presence of toxic radiation. According to the scientists, high temperatures increased the speed of metabolic processes, thus making bacteria more sensitive to radiation.

Fourth, in the case of low-dose gamma radiation, the scientists did not find any genetic changes that could have been responsible for the behavior of the bacteria.

According to one of the co-authors, Nadezhda Kudryasheva, says, "These results help to comprehend the nature of low-intensity radiation's biological impact at the cellular level. The cells of luminous bacteria are a suitable object for such kind of research. Practical applications include using luminous bacteria to monitor the levels of toxicity in the environment in the event of chemical pollution. Our research has shown that using luminous bacteria for this purpose is quite promising."

Provided by Siberian Federal University