INVESTIGATION OF THE EFFECT OF ULTRAVIOLET RADIATION ON BACTERIAL CELLS AND THEIR BIOSYNTHETIC ACTIVITY

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Introduction. Ultraviolet radiation is the only key component of solar radiation that can have a significant impact on living organisms. It is well known that a certain amount of ultraviolet light can be beneficial for organisms, but too large doses can be harmful. In this context, the study of the effect of ultraviolet radiation on bacteria and their biosenetic effect is an urgent problem in modern science.

The purpose of this work is to study the impact and consequences of ultraviolet radiation on bacterial cells, as well as their biosenetic effect. As part of the study, different doses of ultraviolet radiation and their effect on the growth and development of bacteria, as well as on their biosenetic activity, were studied. The results of this study can help in understanding the impact of ultraviolet radiation on living organisms, as well as in clarifying the possibilities of using bacteria for the biosynthesis of various useful substances.

Materials and methods. Analytical review of the latest foreign research and publications on: the effect of ultraviolet radiation on bacterial cells, as well as their biosenetic effect.

Different strains of bacteria with different biosenetic properties (Escherichia coli, Micrococcus radiodurans), spectral lamps with different wavelengths, dosimeters for measuring the intensity of radiation, and a spectrophotometer for measuring the optical density of bacterial cultures are used in the studied scientific works. [1,2]

Results and discussion. Ultraviolet radiation – is electromagnetic radiation invisible to the human eye, occupying the spectral region between visible and X-ray radiation. Depending on the wavelength, the ultraviolet spectrum is divided into three areas (ranges): UVA, UVB and UVC. The greatest bactericidal effect is characteristic of the UVC range, with a peak at approximately 260–265 nm [3].

According to the results of the study, it was established that the main role of the effect of UV radiation on cells belongs to chemical changes in DNA: pyrimidine compounds, (mainly thymine), during the absorption of quanta of UV radiation, form dimers that prevent the normal doubling (replication) of DNA by cell preparation for division. Damage to biological membranes and disruption of the synthesis of their various components and the cell membrane also play a role in the lethal effect of radiation on cells. [4].

Biological objects differ greatly in their sensitivity to UV radiation. For example, the dose of UV radiation, which leads to the death of 90% of cells, for different strains of Escherichia coli is equal to 10, 100 and 800 erg/mm², and for bacteria Micrococcus radiodurans — 7,000 erg/mm². The sensitivity of cells to UV radiation, to a large extent, also depends on their physiological state and conditions of cultivation before and after irradiation (temperature, composition of the nutrient medium, etc.). Mutations of some genes greatly affect the sensitivity of cells [5].

In addition to DNA and RNA, photochemical processes can occur in proteins, enzymes and other biological molecules. It was found that upon absorption of UV, the

release of amino acids from protein and enzymes become unstable. If the dissociative energy for the disulfide bond is reached, the tertiary structure of amino acids changes, which, in turn, leads to a change (denaturation) of biomolecules. The molecule loses its biological activity and ability to be removed. Since the concentration of protein in bacteria is very high (50% of dry weight), UV absorption affects their role in the synthesis of nucleic acid and chromosomal structure [4,6].

UV radiation can also have an impact on other biological substances that contain unsaturated bonds, such as coenzymes, hormones, and electron carriers, in addition to DNA, proteins, and enzymes. These substances can be deactivated or damaged by exposure to UV radiation. The genetic consequences of ultraviolet irradiation of bacteria are expressed in an increase in the mutation frequency of genes, chromosomes, and plasmids. The frequency of mutation of individual genes under the influence of high doses of UV radiation can increase thousands of times compared to the natural level and reach several percent [6].

Escherichia coli has several defense mechanisms against UV radiation, including the nucleotide excision repair (NER) system and the photolyase system.

The NER system in Escherichia coli is responsible for detecting and repairing UV-induced DNA damage. This system works with the help of different proteins that detect and remove certain types of DNA damage. The photolyase system in Escherichia coli allows bacteria to repair damage caused by ultraviolet radiation, thanks to a unique protein complex that performs photocontrol [1,4]. Micrococcus radiodurans has a very high resistance to ultraviolet radiation due to its unique defense mechanisms. One of the main protective mechanisms is DNA repair [2].

Conclusions. Studies have shown that UV radiation affects cells, particularly their DNA, causing chemical changes. When pyrimidine compounds, mainly thymine, absorb quanta of UV radiation, they form dimers that prevent normal DNA replication as the cell prepares to divide. This can lead to the death of cells or changes in their hereditary properties (mutations). Damage to biological membranes and disruption of the synthesis of their components also have a certain significance in the lethal effect of radiation on cells.

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