Аннотация по диссертации на английском языке

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Antioxidant properties of plant and microbial preparations and their practical application

The relevance of the topic. According to statistics from the World Health Organization, oxidative stress is responsible for more than 80% of non-communicable diseases, ranging from cardiovascular to cancer and neurodegenerative diseases. It is known that an increase in reactive substances in the environment and in the human body can lead to oxidative stress due to free radicals, which necessitates the study of the mechanisms of these substances and their reaction products on model biological systems and their practical application.

It is known that plant and microbiological preparations have a powerful antioxidant effect, surpassing synthetic analogues in terms of bioavailability and environmental friendliness. Therefore, natural plant substances with antioxidant potential are currently being widely studied, as they inactivate radicals and reduce their toxicity. However, despite the known antioxidant properties of coumarins and flavonoids, their radioprotective potential, especially when combined with nanoparticles and complex extracts using a cellular model, has not been sufficiently studied.

The effects of ionizing radiation on biological objects are the subject of extensive research, which studies both the immediate effects on biological objects at different levels of their organization and the delayed consequences of radiation exposure. All types of ionizing radiation lead to a wide range of biological changes, affecting the biochemical and molecular biological aspects of cell function. Eukaryotic microbial cells are considered representative objects for studying the effects of ionizing radiation and other stressors. Saccharomyces yeast is a well-studied model organism, and in this work, it is

used to study the protective effects of various natural products under the influence of ionizing radiation and other stressors.

The aim of this work is to identify and evaluate the antioxidant and radioprotective activity of plant extracts and individual coumarin compounds under conditions of oxidative stress induced by ionizing radiation using Saccharomyces yeast cells as a test system.

Research objectives:

- Determination of the antioxidant and antiradical activity of herbal extracts and individual reagents under the influence of ionizing radiation and other oxidative stress inducers.
- Evaluation of the radioprotective activity of aqueous solutions of coumarins isolated from extracts of sweet clover, meadowsweet, and wild rosemary.
- Application of Saccharomyces cerevisiae yeast as test systems for identifying and evaluating potential radioprotectors among the obtained extracts.
- Verification of the possibility of adaptation of S. cerevisiae yeast to hydrogen peroxide.
- Evaluation of the effect of visible illumination of irradiated biological material on the damaging and sterilizing effect of ionizing radiation.
- Evaluation of the effect of various chemical reagents on the survival of Saccharomyces yeast before and after irradiation.
- Analysis of cross-reactions of microorganisms to stresses induced by X-ray irradiation and the action of reactive oxygen species.
- Evaluation of the effect of biosynthesized silver and selenium nanoparticles based on plant extracts on the viability of S. cerevisiae before and after X-ray irradiation.

The scientific novelty of the obtained results lies in the following provisions:

- A method for testing plant extracts and coumarin compounds for the detection of antioxidant activity using P. Saccharomyces yeast cells as a test system has been proposed and scientifically substantiated.
- A method has been proposed to increase the radiation resistance of Saccharomyces cerevisiae yeast to the effects of ionizing radiation, for which know-how has been obtained. The method consists in pre-treatment of yeast cells with a biologically active substance rutin (vitamin P) at a certain concentration (0.05 mM in 40% and 70% ethanol solution) before and after irradiation (0 Gy, 400 Gy, 800 Gy, 2000 Gy). Treatment with rutin, which has pronounced antioxidant and membrane-protective properties, significantly reduces radiation-induced oxidative stress and increases the survival rate of the cell population.
- It has been shown that when ionol is administered at concentrations of 0.5 mM and 0.05 mM, the survival rate of S. cerevisiae yeast cells increases by almost three times. Twenty-four hours after irradiation, the addition of ionol to the yeast resulted in a twofold increase in yeast survival compared to the control.
- It has been established that naphthalene also exhibits a radioprotective effect on S. cerevisiae and S. carlsbergensis yeast, especially after the addition of hydrogen peroxide, as evidenced by a decrease in the proportion of dead S. cerevisiae cells. The protective effect of naphthalene may be due to its antioxidant properties in the context of oxidative stress caused by cross-reactions in the response of yeast cells to X-ray radiation.
- It has been established that rutin stabilizes anti-radical activity after irradiation (DFPH inhibition – 67-86%), and the proportion of dead yeast cells is 8-12%, depending on the irradiation dose. Optimal protection is achieved at a rutin concentration of 0.05 mM in a 70% ethanol solution.
- It has been proven that freshly prepared aqueous-alcohol extracts of medicinal plants, such as Ledum palustre, Melilotus officinalis, Murraya koenigii, hibiscus sabdariffa, and Filipendula ulmaria, have an increased antioxidant and

radioprotective effect on yeast cells of Saccharomycetes. The presence of silver nanoparticles obtained through green synthesis has a toxic effect on yeast cells both before and after exposure to X-ray radiation.

- The correlation between the chemical structure of compounds and their ability to protect cells from radiation-induced oxidative stress has been shown.
- For the first time, it has been established that the combined effect of Ledum extract with selenium nanoparticles leads to an increase in antioxidant properties, increasing the number of live yeast cells after irradiation, which indicates the possibility of using this system as a radioprotective agent.

Theoretical and practical significance.

The work addressed current issues related to radiation protection, antioxidant therapy, and the use of natural and chemical compounds to enhance the resistance of biological systems to stress factors:

- mechanisms of radiation damage and cell repair have been proposed to help deepen fundamental knowledge about the interaction of physical, chemical, and biological factors;
- the assessment of the anti-radical activity of substances and plant extracts allows for a better understanding of the mechanisms of neutralization of active oxygen species (AOS) and free radicals. This knowledge can be applied for the prevention and treatment of diseases associated with oxidative stress, such as cancer, cardiovascular, and neurodegenerative diseases;
- It has been experimentally proven that the use of S. cerevisiae and S. carlsbergensis yeast as model organisms allows for the rapid and effective study of the mechanisms of cell damage and repair after radiation exposure, as well as the testing of the effectiveness of new protective substances. • The use of rutin significantly increases the survival rate of yeast cells in a wide range of lethal radiation doses.

- It has been shown that plants such as Ledum palustre, Melilotus officinalis, Murraya paniculata, and Filipendula can become sources of environmentally friendly, affordable, and effective antioxidants and radioprotectors.
- It has been proven that Ledum palustre extract has high antioxidant properties due to its content of biologically active substances, and the formation of selenium nanoparticles significantly enhances antioxidant activity by inhibiting the formation of hydrogen peroxide.

The results of the experiments demonstrate the potential of using selenium nanoparticles to increase the bioavailability and effectiveness of natural radioprotectors, which can be useful for the development of new means of protection against ionizing radiation.

The results of the work can be used to search for and develop new drugs based on plant extracts and chemical compounds that will be able to effectively protect cells from radiation damage and neutralize the effects of ROS. This will contribute to the development of technologies for the use of local natural resources for the food, medical, and pharmaceutical industries of the Republic of Union of Myanmar.

The main points to be defended:

1. The results of studies on the reactivity of various additives (coumarins, naphthalene, ionol, and rutin) and the resulting aqueous-ethanol extracts of medicinal plants in reactions with free radicals (hydroxylethyl carbon-centered radical, DFPG, superoxide anion radical, and others).
2. The antiradical activity of water-ethanol extracts of sweet clover, wild rosemary, and Murraya in relation to the hydroxyethyl carbon-centered radical is associated with the presence of coumarins in their composition, which can be assessed by the change in the concentration of acetaldehyde.
3. The method of testing plant extracts and coumarin compounds for their antioxidant activity using yeast cells of the Saccharomyces species as a test system.

4. Evaluation of the radiation sensitivity of yeast cells Saccharomyces cerevisiae and Saccharomyces carlsbergensis when introducing AFC, ethanol, naphthalene, ionol, rutin, as well as silver and selenium nanoparticles.
5. Evaluation of the viability of yeast cells Saccharomyces when introducing antioxidants of plant origin plant extracts before and after irradiation.