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BOOK OF ABSTRACTS

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The complexity approach to food irradiation: how to increase the efficiency of processing

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Departments of Chemistry and Physics of Lomonosov Moscow State University with a collaboration of scientists from SINP MSU, FGBNU VILAR and SFSC RAS, conduct research in three main areas.

The impact of ionizing radiation on physical and chemical processes in biological objects: Currently, food irradiation is increasingly used to ensure the microbiological safety of products and increase their shelf life. Physics Department in collaboration with Chemistry Department of Moscow State University and FGBNU VILAR is studying the impact of various types of ionizing radiation with different characteristics on physical, chemical and biological processes in food during storage. The focus of the research is to establish technological modes of irradiation processing for certain categories of food using proven methods of microbiological and biochemical analysis, as well as high accuracy physical methods, such as GC-MS analysis, the method of electron paramagnetic resonance, fluorometric and spectrophotometric methods. It was found that the doses ranging from 250 Gy to 1000 Gy effectively reduce the microbiological component 10 to 100 times without altering organoleptic or chemical properties of meat and fish. A mathematical model was proposed to estimate the shelf life of products taking into account the quantitative and qualitative bacterial content in the source product which is selected for irradiation treatment.

Irradiation treatment of agricultural products to inhibit the growth of phytopathogens: Irradiation technologies are widely used in agriculture not only to inhibit the sprouting of root crops during storage, but also for preplanting seed treatment to suppress various types of fungal, bacterial and viral diseases in crops. Physics Department in collaboration with the Siberian Federal Scientific Center for Agrobiotechnologies of the Russian Academy of Sciences is studying the impact of ionizing radiation on sprouting, biometric properties and yield of zone seeds which are contaminated with region-specific fungal diseases. The research is aimed at the following:

- monitoring the formation of crops, productivity and its fractional composition, microflora, biochemical parameters after irradiation;
- searching for irradiation modes which reduce the growth of pathogens without affecting the yield of root crops and grain crops;
- stimulation of crop growth in order to reduce the negative impact of phytopathogens which can be found in the soil.

It was found that the doses ranging from 30 Gy to 50 Gy effectively reduce the black scurf without altering potato yield. It was shown that the doses ranging from 10 Gy to 30 Gy stimulate crop growth of oilseed crops.

Improving the efficiency of radiation treatment of organic and inorganic objects: Due to the nature of how the absorbed radiation dose is distributed over the depth of the object during processing with accelerated electrons, the inhomogeneity of the irradiation of objects is unavoidable. Under- or over-irradiation of biological objects can have an unfavorable impact on the object's integrity and quality, and may not have the desired microbiological effect. The development of techniques to improve the uniformity of the absorbed dose distribution over the depth of biological objects with a variety of forms and thicknesses is currently a hot topic. Research is being done to improve the homogeneity of the radiation exposure by modifying the beam of accelerated electrons in order to maximize the effectiveness of radiation processing. A universal algorithm has been developed in order to calculate the dose absorbed by a product of any geometry and chemical composition during radiation processing with various types of ionizing radiation, and to assess the uniformity of the distribution of the radiation dose over the product's entire volume for any irradiation scheme.

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