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Research of changes in the chemical properties of food products as a result of exposure to ionizing radiation at different doses

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Today, one of the most important challenges around the world is to ensure the appropriate quality and safety of food products which involves extending the shelf life of foodstuffs without detriment to their nutritional qualities and taste.

Food processing with ionizing radiation is becoming an increasingly efficient and environmentally friendly method to extend the shelf life of food items/ the time of storage. However, irradiation causes/triggers the appearance of free radicals, which, in turn, affect complex organic compounds: proteins, fats, and carbohydrates. Therefore, it is important to study the chemical properties of processed food products.

Our research team is conducting research to assess the effect of ionizing radiation at different doses on the chemical properties of bulk materials and vegetable and meat products.

For example, the electron beam with an energy of 1 MeV in the dose range from 0.25 to 6 kGy influences the organoleptic and chemical characteristics of chilled turkey meat. The concentration of viable microorganisms decreases non-linearly with an increase in the radiation dose. It was found that at range doses of 0.25-2 kGy, there are no changes in the appearance, taste, and smell of the samples. At doses above 3 kGy, the color, consistency, and smell of the product are different compared to those of the unirradiated control samples.

Observations of oxidation as a result of irradiation at doses up to 10 kGy of 25 saturated and unsaturated fatty acids contained in turkey meat have shown that at range doses not exceeding 3-4 kGy, the content of fatty acids remains almost unchanged. At doses of 10 kGy, the content of most acids decreases by 1.6-1.8 times. Method of Gas Chromatography-Mass Spectrometry (GC-MS) has been used to identify volatile substances (alcohols, aldehydes, and ketones) and their concentration in irradiated turkey samples with high accuracy. It was found that the concentration of volatile substances (alcohols, ketones) decreases with an increase in the radiation dose according to an exponential law. Also, acetone was chosen as a marker, since its concentration increases linearly depending on the absorbed dose. The Fingerprint method using spectra, chromatograms, and various data from electrochemical sensors processed by image recognition methods did not reveal statistically significant differences between irradiated and non-irradiated turkey samples.

The study on the effects of ionizing radiation on the concentration of reducing sugars in potato tubers performed to determine the dose required to stop germination of potato tubers during different storage periods, suggests that the concentration of sugars depends on the time of storage of potatoes before irradiation. The earlier the treatment is carried out, the smaller the dose that inhibits germination is, and the smaller the fluctuations in the concentration of reducing sugars is relative to the initial control values during the subsequent storage period.

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