



Impact of different doses of ultrashort pulsed electron beam irradiation on biological properties of lactic acid bacteria isolated from Armenian dairy products

SPEAKER - LUSINE MATEVOSYAN

YEREVAN 2022



Non-Ionizing and Ionizing Radiation



Electron beam (E-beam)



FOOD PATHOGENS













FOOD IRRADIATION

Food is exposed to a carefully measured amount of intense ionizing radiation. This is done in a special processing room or chamber for a specified duration. With food irradiation, radiant energy (electrons, gamma rays, or x-rays) breaks chemical bonds, leaving the food still like-fresh, but with specific benefits, depending on treatment level.



Cobalt 60, Gamma facility

Packaged food products move along the conveyer belt and enter an inner room where they are exposed to the rack containing source pencils. Energy in the form of gamma rays (or photons) pass through the encapsulation and treat the food.



Electronic Beam Facility (E-Beam)

The Electron Beam Linear Accelerator machine generates and accelerates electrons to energies of 5.75 or 10 MeV with beam power of up to 10 kW. Products move in and out of the irradiation area continuously. Product thickness depends on density and electron energy. For example, e-beam energy can penetrate meat a total of 3.5 inches with treatment on the top and bottom of a package.

XrayDose

X-ray Dose is an irradiator to expose food samples which are kept in petri dishes (50 mm in Diameter) or small cups. The dose can be modified with a filter which can be easily removed or replaced. In this system an electron beam accelerator targets electrons on a metal plate. Some energy is absorbed and the rest is converted to X-rays. Like gamma rays, X-rays can penetrate food boxes up to 15 inches thick or more, thus permitting food to be processed in a shipping container.

X-ray irradiator for food samples



Effectiveness of the food irradiation in fruits

- 1. Non-irradiated strawberry after 15 days storage at 4°C
 - 2. Irradiated strawberry after 15 days storage at 4°C

FOOD IRRADIATION

✓ Enhances food safety

PROS (+)

- Extends shelf life of food products
- ✓ Doesn't change texture, nutritional value and freshness of food, unlike heat
- Can't induce any radioactivity in food and doesn't leave any harmful or toxic radioactive residues on foods as in the case with chemical fumigants
- It is a very effective method due to its highly penetrating nature of the radiation energy and can be used on packed food commodities
- ✓ Destroys reproductive capabilities and damages DNA of most pathogens

Can't be applied to all kinds of foods

CONS (-)

- Can't make a bad or spoiled food look good
- Can't destroy already present pesticides and toxins in foods
- Doesn't guarantee total food safety
- Some vitamins (B1, C, E) could be reduced or totally eliminated through irradiation
- Quite expensive (0.5-7 cents per pound)

The main goal of research

The main goal of this research was evaluation of the radioresistance of lactic acid bacteria (LAB) isolated from Armenian dairy products and analysis of the effects of electron beam irradiation on their biological properties. Studied strains have been isolated from different samples of matsoun, cheese and sour cream and have been identified according to morphological, cultural, physiological and biochemical properties, as well as 16S rRNA gene analysis.

Lactobacillus rhamnosus MDC9661 Lactobacillus delbrueckii subsp. bulgaricus (RIN-2003-Ls) L. delbrueckii subsp. lactis MDC9632 L. delbrueckii subsp. bulgaricus MDC9633 Streptococcus thermophilus VKPM B-3809 Enterococcus durans

L. delbrueckii subsp. bulgaricus B7



AREAL (Advanced Research Electron Accelerator Laboratory) laser driven RF gun based 20 MeV electron linear accelerator

Charge (max) – 10-250 pC
Bunch Length – 0.4ps – 10ps
Energy spread – ~1.5 %
RF Pulse Repetition rate – 1-20 Hz









Effects of ultrashort pulsed electron beam irradiation on MDC9661 growth and colony formation

🛑 18 kGy



Effects of 17.5 kGy ultrashort pulsed electron beam irradiation dose on MDC9661 antibacterial activity



Effects of 17.5 kGy ultrashort pulsed electron beam irradiation dose on MDC9661 antibacterial activity



> The limit point of radioresistance of MDC9661 is 17.5 kGy.

Irradiated MDC9661 (17.5 kGy) partly loses its activity compared with intact culture.

Antibacterial activity is saved after irradiation by limit dose even against pathogenic test-organisms, like *Pseudomonas aeruginosa* WT and *Staphylococcus aureus* WDCM-5233. These studies will open the prospective for the creation of new LAB-based effective and safe bio-preparation, which will be used both for production of dairy products and for improvement of irradiated human body immunity.





Acknowledgements

CANDLE Synchrotron Research Institute, Institute of Molecular Biology NAS RA







Dr. Gohar Tsakanova



PhD student, Hakob Davtyan

Yerevan State University



Dr. Inga Bazukyan



BSc, Anahit Rostomyan

