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How to reduce risk and prevent quality changes with electronic pasteurization

By Tatiana Koutchma on 6/2/2014

Irradiation has been widely used for spices and other food ingredients for many years. For meat, irradiation is just now emerging into a significant commercial reality. Gamma rays from radioactive nuclides, energetic electrons from particle accelerators, and X-rays emitted by high-energy electrons are suitable kinds of radiant energy because all of these three ionizing energy sources can produce similar effects in any irradiated material.

Though gamma irradiation technology was patented more than 100 years ago and has been thoroughly tested and validated over the past 50 years, there is a lot of misunderstanding and concerns associated with the consumer acceptance, transport, storage, occupational hazards and disposal of cobalt-60 or cesium-137 isotope sources. The advantage of X-rays and electrons beams is that they are generated from machine sources. The term “electronic pasteurization” has been coined for the pasteurization process using electron beams and X-ray technologies with the added benefit that the electronic source stops radiating when switched off. The other terminology that is used to characterize this process is “cold pasteurization” or treated by irradiation.

Irradiation basics

A major advantage of electronic irradiation is that the food can be processed in its final packaging, thereby reducing or eliminating entirely the possibility of recontamination following this treatment. This unique operational capability makes irradiation particularly suitable for cold pasteurization of ready-to-eat foods, such as hot dogs and other deli items that are at risk of contamination with *Listeria monocytogenes* during post-process slicing and packaging operations. Electronic pasteurization can offer to solid and semisolid foods such as meat, poultry, and fish the same benefits that thermal pasteurization has brought to milk and other liquid products.

E-beam irradiation uses electrons accelerated in an electric field to a velocity close to the speed of light generated from machine sources operated at or below an energy level of 10 MeV (mega electronvolts). Since electrons are particulate radiation they do not penetrate the product beyond a few centimeters, depending on product density. The product is exposed to e-beams when it moves on the conveyor. Single or double beams are used to solve issues of packaging thickness.

Similar to gamma radiation, X-rays are less energetic packets of light (photons). X-ray irradiation is used as an alternative to methods that use radioactive materials and generated from machine sources operated at or below an energy level of 5 MeV. X-ray irradiators are scalable and have deep penetration comparable to cobalt-60. The choice of a radiation source for a particular application depends on such practical aspects as thickness and density of the material, dose uniformity ratio (DUR), minimum dose, processing rate, and economics. The portable flat-panel X-ray unit is new development in the technology.

Irradiation and food safety

Irradiation treatment is very effective in killing microbial pathogens such *as Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella* spp. and *Vibrio* spp., among others, that are significant contributors to foodborne illness. In the context of HACCP, electronic pasteurization irradiation is an excellent CCP for *E. coli* O157:H7 and other bacterial pathogens in ground beef and similar products. Its use would reduce the probability of contamination in the finished product by several orders of magnitude, depending on the specifics of any particular application. The requirement of 6 log microbial reduction provides for an adequate safety margin for products such as ground beef and fresh/frozen poultry. However, the applicability of using a 6 log reduction process for pathogens that are usually at low levels in RTE foods is debatable. The possibility of targeting only a 1–2 log reduction of key bacterial pathogens on specific foodstuffs will lead not only to cost reduction but quality and sensory improvements of foods in question.

The large number of scientific evidence showed that the electronic pasteurization does not cause and significant difference in flavour, texture or color of beef, poultry or produce when irradiated at optimal levels. No loss in nutrients, vitamins, proteins, lipids and carbohydrates occurs in food irradiated up to 10 kGy (kilogray). For a comparison, according to the studies by the ARS USDA, the radiation dose of only 3.75 kGy inactivated all of the foodborne pathogens by a minimum of 5 log (99.999 percent), on all of the RTE meat types, which is sufficient to be labeled as pasteurized according to current regulatory requirements**.**

Exploring new packaging options can result in maximizing microbial control and minimize impact on product quality. The larger focus on the development of packaging component can prevent adverse sensory changes during electronic pasteurization combined with incorporating antimicrobial components in packaging materials. Incorporating antimicrobial coatings/antioxidant additions in combination with electronic treatment can provide avenues to potentially extend the product shelf-lives. The development of “intelligent” packaging material or indicators that can visually denote an electronically pasteurized product, or dose range, or detect adverse changes in a product can also find commercial applications.

Conclusion

Electronic pasteurization is a powerful tool to prevent food-borne illnesses. Removal of labeling requirements, use of the term pasteurization and regulatory approvals will lead to the wider acceptance of this technology.

Education and skilled marketing efforts are needed to remedy this lack of awareness of the effectiveness, safety, and functional benefits that electronic pasteurization can bring to foods.