Pork Irradiation

Outbreaks of food-borne illness involving meat products have increased consumer awareness of potential food contamination with pathogens such as *Escherichia coli* O157:H7 and *Salmonella*. Although largely preventable, food-borne illness remains a significant problem in the United States. Irradiation has been identified as a highly effective means of enhancing food safety through the reduction or elimination of potential pathogens.

Food irradiation has been intensely researched for over 40 years both in the U.S. and worldwide. It has been scientifically proven to be a safe food processing technology as declared by a joint expert committee of the World Health Organization. Research has demonstrated that irradiated foods are completely safe and wholesome and that their nutritional value remains essentially unaltered. Irradiation has the potential to reduce or eliminate various pathogens in beef, poultry, pork, lamb, fish, and seafood. It has also been successful in eliminating or reducing pathogens in dried vegetables, herbs and spices. In the pork industry, both the U.S. Food and Drug Administration (FDA) and the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) have approved the use of irradiation in 1986 on fresh or previously frozen pork to control the parasite *Trichinella*. Researchers have demonstrated the usefulness of irradiation in controlling bacterial pathogens like *Salmonella*, *Staphylococcus aureus*, enteropathogenic *Escherichia coli*, *Yersinia enterocolitica*, and others, culminating in approval of poultry irradiation in 1990.

Through irradiation, microbial cells can be easily destroyed, leaving them unable to replicate and grow. By destroying spoilage microorganisms, foods will last longer and by destroying pathogens, foods will be safer. The destruction of microorganisms by this technology is logarithmic and thus is highly predictable (stated as a D10 value). For example, if a certain dose of radiation destroys 10 cells of an organism, twice that dose will destroy 100 cells, and three times the dose will destroy 1,000 cells. Table 1 shows D10 values in pork for four bacterial pathogens. This is important information for food processors to use to predict the radiation dose needed to destroy a given number of a particular organism in food. Researchers at Iowa State University (ISU) reported that *Listeria* and *Salmonella* were reduced to undetectable levels with dose levels 1.8-2.0 kilogram (kGy).

Although irradiation holds great promise in the control of foodborne disease, it does not replace proper food handling. In combination with good manufacturing practices, irradiation is one possible method to increase meat safety without compromising pork quality. In a study conducted by meat scientists at Kansas State University (KSU) in Manhattan, Kansas, researchers looked at the effects of three levels of irradiation used in combination with aerobic or vacuum-packaging on the flavor, aroma, color and shelf-life of chilled or frozen boneless pork chops. Using three doses applied by either electron beam or gamma
rays from cobalt-60 (0, 1.5 and 2.5 kGy for chilled pork chops and 0, 2.5 and 3.85 kGy for frozen pork chops), researchers found minimal or no effect on the flavor and texture of chilled or frozen pork chops.6,9

Prior to irradiation, the boneless pork chop samples had aerobic plate counts of < 3.5 log10 CFU/cm², which is well below the spoilage threshold of 7.0 log10 CFU/cm². CFU is an acronym for “colony forming unit,” which is a measurement of the number of bacterial cells that were originally found within a square centimeter on the surface of a food sample. Irradiation resulted in reduction of the total CFU/cm² of chilled pork chops compared to non-irradiated samples, regardless of packaging atmosphere. During the simulated retail display portion of the study, researchers found that aerobic plate counts were highest in non-irradiated samples throughout refrigerated storage. At days 7 and 14, the number of bacteria was higher in irradiated pork chops packaged aerobically compared to those under vacuum. Similarly, the non-irradiated, frozen pork chops had greater aerobic plate counts than irradiated pork chops at 0, 7 and 14 days. It is noteworthy that even at day 14, aerobic plate counts for both chilled and frozen irradiated pork chops were well below the spoilage threshold level of 7.0 log10 CFU/cm².

In another study, researchers from ISU looked at the effects of a 1.0 kGy gamma radiation dose on the growth of bacteria and sensory properties of vacuum-packaged pork loins over a 21 day storage period at 4°C (39.2°F). Researchers concluded that irradiation lowered the number of bacteria with no quality differences found between irradiated and non-irradiated pork after 14 days in storage.7 In another study, researchers irradiated vacuum-packaged pork loins at 3.0 kGy and stored the pork product at 2-4°C (35.6 to 39.2°F). Under these conditions, the shelf-life of the pork loins was extended to 90 days compared to 41 days for non-irradiated pork loins.8

Thus, studies indicate that irradiation can be a positive pathogen intervention step for the pork industry. By using irradiation, the pork industry can potentially extend the shelf-life and improve the safety of its product without compromising the quality of pork.

References

Table 1: D10 values (the amount of irradiation in kilograys required to reduce a bacterial population by 90%) in pork for four bacterial pathogens.9

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>D10 Value</th>
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<tbody>
<tr>
<td>E. coli O157:H7</td>
<td>0.30</td>
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<tr>
<td>Listeria monocytogenes</td>
<td>0.48</td>
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<tr>
<td>Salmonella</td>
<td>0.51</td>
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<tr>
<td>Staphylococcus aureus</td>
<td>0.43</td>
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