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Do you want to go through this Food with High Nutritional Value and Reducing its Microbial Hazards

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Abstract

The Meat is a valuable part of the human diet as meat contains essential elements such as protein, vitamins, and minerals. The foods are vulnerable to the microbial pathogens and the spoilage, posing significant risks to the public health and the social quality. The Ionizing radiation is used in irradiated food to maintain the safety and quality of the food parts, specifically the beef.

For decades, the irradiation of food reduces the microbial contamination and extends the storage period. The procedure entails exposing the food types to a regulated amount of the ionizing radiation, mostly accomplished by applying the gamma rays, the electron beams, or the X-rays. The radiation disrupts the DNA and other cellular components of the microbes, making them unable to reproduce and causing their death. The procedure breaks down some of the food molecules, which can affect its nutritional quality and sensory properties.

Keywords: Beef, DNA, gamma rays, Food irradiation, human health

Introduction

Despite its potential benefits, the irradiated food types remains controversial, with concerns about its safety, efficacy, and impact on the nutritional quality and sensory properties of food types. Some critics argued that the irradiated food types could create the harmful compounds or destroy the essential nutrients. In contrast, others questioned the need for the irradiation, considering other food safety measures, such as the good manufacturing practices and the food testing. The Consumer acceptance of the irradiated food types needs to be addressed, with some people expressing concerns about their safety and acceptability (1,2,3,4,5 and 6). This comprehensive research aims to important evaluate the existing literature on the irradiated food types and its repercussions on the quality and the safety of the beef. The proof of the irradiation effectiveness at lowering the microbial contamination and prolonging the shelf-life of the beef is explored along with its potential impact on the physical and the chemical characteristics, the nutrient content, and the sensory properties. This paper will address the regulatory framework for the irradiated food types, including the labeling requirements and government oversight, as well as identify areas for further research and policy development (7,8,9,10,11 and 12).

Sources and Principles of the irradiated food types

The Ionizing radiation, such as the gamma rays, the X-rays, or the high-energy electrons, is used to irradiate the food types. The irradiated food types is determined by the absorbed dose expressed in Gray (Gy) or kilo Gray (kGy), with 1 Gray being equivalent to 1 J/kg of product. The technique is considered a safe and effective way to decrease or eliminate the hazardous microbes, prolong the shelf-life, as well as enhance the quality and safety of the food types (79,80,81,82,83 and 84). The principles of the irradiated food types are determined by the ability to disrupt the genetic material of microorganisms, preventing them from reproducing or causing illness. The irradiation affects the microorganisms' genetic material (the DNA or the RNA) directly and indirectly. The Direct irradiation can break the bonds between base pairs in the genetic material, killing the cell's reproduction ability. Then, on the other hand, damage to water molecules

creates free radicals and reactive oxygen species, which damage genetic material indirectly. Irradiation helps to break down certain enzymes and food proteins that can contribute to spoilage, thereby increasing the shelf-life (13,14,15,16,17 and 18). The United State, Canada, as well as several European and Asian nations, allow the irradiated food types using the Cobalt-60, cesium-137, and the electron-beam accelerators. The Cobalt-60, the most prevalent source of the ionizing radiation for the irradiated food types, is a radioactive isotope that emits the gamma rays capable of penetrating deep into the food types to destroy the harmful microorganisms. Cesium-137 is another source of the ionizing radiation; it is less commonly used than cobalt-60. In addition, the electron-beam accelerators are used for the irradiated food types. These devices generate high-energy electrons that can penetrate the food types to eliminate the harmful microorganisms and extend the beef shelf-life (19,20,21,22,23 and 24). Irradiating the food types has several benefits, including multifunctional applications as well as guaranteed safety and security. The spectrum produced is effective against the bacterial spores across a broad range of concentrations. Given that the processing does not involve heat, it is safe for the food types, does not significantly reduce nutrient levels, leaves no chemical residues, and is simple to control during the use., to effectively lengthen the lifespan of the irradiated food types, the following the principles can be observed, The Radurization uses low doses of 0.1–1 kGy (85,86,87,88,89 and 90). This amount inhibits respiration, delays the ripening, disinfects the pests, and inactivates the Trichinella parasite. The Radicidation is referred to as a moderate dose. This radiation uses a quantity of approximately 1–10 kGy, which has the effect of reducing spoilage and microbial pathogens including the Salmonella sp. and the Listeria monocytogenes. This dosage is typically found in the frozen food types and its application is identical to that of the pasteurization, except irradiation does not rely on the thermal energy (91,92,93,94,95 and 96). The Radapertization uses extremely high doses which are above or equal to 10 kGy, ranging between 30 and 50 kGy. The dose is typically used in the sterilization process because its effect can kill all the microorganisms in the food types up to the level of the spores. The irradiated food types origin and the principles are based on the ability of the ionizing radiation to disrupt the genetic material of the microorganisms, the enzymes, and the proteins in the food types, culminating in improved safety and quality. The use of irradiation is regulated by the national and the international authorities to ensure its safety and effectiveness (25,26,27,28,29 and 30).

The action of Irradiation on the beef

The Microbial Safety

The Microbial safety is important aspect of the beef production and the consumption, as these products can be a source of the various harmful microorganisms that can cause the food-borne illness. The beef products are potentially contaminated with microbial pathogens, such as Salmonella, Escherichia coli, Campylobacter, and Listeria monocytogenes, leading to severe illness or death in vulnerable populations (31,32,33,34,35 and 36). Contamination might occur at the production, processing, or distribution stage, including on the farm, during transport, in slaughterhouses or processing facilities, and in retail outlets or at home. The Improper handling and storage of the beef products can increase the risk of contamination (97,98,99,100,101 and 102). The Food-borne illness outbreaks related to the beef have been reported globally, with various types of products being implicated, including the ground beef, the chicken, the pork, and the processed beef. These outbreaks have led to the significant public health, the social quality and the economic consequences, the highlighting the importance of the effective interventions to reduce the risk of contamination (37,38,39,40,41 and 42). The Irradiation has been studied extensively for its efficacy in reducing microbial contamination of the beef. By exposing the food types to the ionizing radiation, the latter reduces or eliminates the harmful microorganisms that can cause food-borne illness and affect the social quality. Previous research showed that irradiation could effectively reduce the levels of the microbial pathogens such as Salmonella and Escherichia coli as well as levels of spoilage organisms, leading to improved microbial safety and a reduced risk of the food-borne illness and improve the social quality (103,104,105,106,107 and 108). The effectiveness of different types of the ionizing radiation on the beef, including the gamma rays and the e-beams, has been used; the gamma ray irradiation is more effective than the e-beam irradiation is at inhibiting microbial growth in the beef. The UV light effectively eliminates the Salmonella spp., the Pseudomonas, the Micrococcus, and the Staphylococcus on the beef. The shelf-life of the beef products is extended by eliminating these microbial contaminant (109,110,111, 112, 113 and 114). The Gamma irradiation at low doses can improve the microbiological safety, ensure safety, and extend the chicken meat's shelf-life without affecting the quality. The 3 kGy gamma-irradiated beef reduced the growth of the mesophilic bacteria, coliforms, and the Staphylococcus aureus (115,116,117,118,119 and 120). Food and Drug Administration (FDA) determined that a 3.5 kGy gamma ray irradiation dose effectively eliminates the pathogenic microbes from the fresh beef and improve the social quality. The Irradiation had the effect of slowing the growth of the bacterial cells and deactivating their metabolism (157,158,159,160,161 and 162). The Bacteria are inherently resistant to the action of the irradiation and, in the lag phase or inactive state, will be more resistant. In

contrast, those in the growth phase will be more vulnerable (43,44,45,46,47 and 48).

The Chemical Properties:

The chemical properties of the irradiated beef refer to the changes that occur to the chemical constituents and the compositions of the food types due to exposure to the ionizing radiation and affect the social quality. The Irradiation can cause both the desirable and the undesirable action on the chemical characteristics of the beef, depending on the dose and the specific compounds in the food types (49,50,51,52,53 and 54). The most significant changes often observed in the irradiated beef products is the formation of the free radicals. They become reactive molecules that damage cellular components and cause oxidative stress. Thus, lipid oxidation, which causes off-flavors and odors, as well as a decline in the nutritional quality due to the loss of essential fatty acids and other nutrients (121,122,123,124,125 and 126). The irradiation at lower doses aids lipid oxidation by reducing the levels of peroxides and other reactive species. This procedure affects the food protein content of the beef, leading to alterations in the composition of the amino acids, food protein structure, and food digestibility. The changes have potentially positive and negative action, mostly on the food nutritional value and affect the social quality, that are contingent upon the particular food proteins involved and the dose of radiation used (127,128,129,130,131 and 132). The positive action of the irradiation include the fact that the irradiation can cause the formation of reactive species, such as the free radicals, which can cause the formation of the covalent bonds between the amino acids in the food protein molecules (163,164,165,166,167,168,169 and 170). This cross-linking can change the structure of a food protein molecule and make it resistant to enzymatic food digestion, which causes a decrease in the food protein digestibility (55,56,57,58,59 and 60). The Irradiation can cause the denaturation of the food protein molecules. The Denaturation involves opening the food protein structure, which can facilitate the interactions between the amino acids and increase the accessibility of the digestive enzymes to food protein molecules, and it can improve the food protein digestibility (133,134,135,136,137 and 138). The irradiation can cause adverse action; namely, the excessive irradiation can cause a breakdown of or changes in the amino acid compounds in the food protein molecules, which causes a decrease in the overall amino acid content and, consequently, decreases the food protein digestibility. The electron-beam irradiation at less than 3 kGy did not affect changes in the quality of the smoked duck flesh (the amino acids, the fatty acids, and the volatiles) during the storage (61,62,63,64,65 and 66). The chemical changes, the irradiation affects the vitamin content of the beef products, with some vitamins being more sensitive than others. For example, the irradiation leads to a loss of the vitamin C, while other vitamins, such as the vitamin A and E, are relatively stable. The Irradiation has been shown to alter the beef oxidation–reduction ability, accelerating the lipid oxidation, the food protein breakdown, and the flavor and the odor changes (67,68,69,70,71 and 72). When combined with certain antioxidants, such as the flavonoids, the irradiation can help prolong the induction period of the lipid oxidation., storing the irradiated beef at 5–10 C for one week almost did not change the pH, the texture, the total volatile base nitrogen (TVBN), or the microbe number (145,146,147,148,149 and 150). A higher dose of the UV irradiation increased 2-thiobarbituric acid (TBA) content, decreased the water-holding capacity (WHC), and the decreased the beef color intensity and the tenderness (139,140,141,142,143 and 144). The 2.5 and 5 kGy gamma irradiation reduced the nitrite content in the chicken sausages and prevented the oxidation when combined with the antioxidants. The titratable acidity and the acid value in the beef samples can be reduced by the irradiation (73,74,75,76,77 and 78). The beef contamination may occur at the production, the processing, or the distribution stage, including on the farm, during the transport, in the slaughterhouses or the processing facilities, and in the retail outlets or at the home (151,152,153,154,155 and 156).

Conclusion:

The Improper handling and the storage of the beef products can increase the risk of the beef contamination. The Food-borne diseases outbreaks related to the beef have been reported globally and its effect on the social quality, with the various types of the meat products being implicated, including the ground beef, the chicken meat, the pork, and the processed beef.

Conflicts of Interest:

The author declare no conflicts of interest.

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