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An American National Standard

Standard Guide for Selection and Use of Packaging Materials for Foods to Be Irradiated[1]

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INTRODUCTION

This guide provides information on the selection and use of packaging materials intended to hold food during irradiation with ionizing energy (gamma-rays, X-rays, accelerated electrons). In general, irradiation is used to reduce the incidence of spoilage and pathogenic microorganisms and parasites in foods, control sprouting of tubers and bulbs, and disinfest commodities (see Guides F 1355, F 1356, F 1736, and F 1885). Packaging materials serve to protect the product from recontamination after irradiation and may be used to complement other preservation techniques to extend shelf life of the irradiated food.

1. Scope

1.1 This guide provides a format to assist producers and users of food packaging materials to in selecting materials that have the desirable characteristics for their intended use and comply with applicable standards or government authorizations. It outlines parameters that should be considered when selecting food-contact packaging materials intended for use during irradiation of prepackaged foods and it examines the criteria for fitness for their use.

1.2 This guide identifies known regulations and regulatory frameworks worldwide pertaining to packaging materials for holding foods during irradiation; but it does not address all regulatory issues associated with the selection and use of packaging materials for foods to be irradiated. It is the responsibility of the user of this guide to determine the pertinent regulatory issues in each country where foods are to be irradiated and where irradiated foods are distributed.

1.3 This guide does not address all of the food safety issues associated with the synergistic effects of irradiation and packaging as food preservation techniques on the extension of shelf life or food quality. It is the responsibility of the user of this guide to determine the critical food safety issues and to conduct appropriate product assessment tests to determine the compatibility between the packaging application and irradiation relative to changes in sensory attributes and shelf life.

1.4 This guide does not address the use of irradiation as a processing aid for the production or sterilization of food packaging materials.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents [2]

2.1 *ASTM Standards:*

D 3985 Test Method for Oxygen Gas Transmission Through Plastic Film and Sheeting Using a Coulometric Sensor

E 170 Terminology Relating to Radiation Measurements and Dosimetry

E 460 Practice for Determining Effect of Packaging on Food and Beverage Products During Storage

E 462 Test Method for Odor and Taste Transfer from Packaging Film

F 1355 Guide for Irradiation of Fresh Fruits for Disinfestation as a Quarantine Treatment

F 1356 Guide for the Irradiation of Fresh and Frozen Red Meats and Poultry (to Control Pathogens)

F 1736 Guide for Irradiation of Finfish and Shellfish to Control Pathogens and Spoilage Microorganisms

F 1885 Guide for Irradiation of Dried Spices, Herbs, and

[1] This guide is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.01 on Radiation Processing: Dosimetry and Applications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Vegetable Seasonings to Control Pathogens and Other Microorganisms

3. Terminology

3.1 *Definitions:*

3.1.1 *absorbed dose*—the quantity of energy from ionizing radiation absorbed per unit mass of specified material. The SI unit for absorbed dose is the gray (Gy). One gray is equal to one joule of absorbed energy per kilogram of specified material. Formerly, the unit of absorbed dose was the rad (1 rad = 0.01 Gy).

3.1.1.1 *Discussion*—A standard definition of absorbed dose appears in Terminology E 170.

3.1.2 *absorbed-dose rate*—the absorbed dose in a specified material per incremental time interval; The SI unit for absorbed-dose rate is $Gy \cdot sec^{-1}$.

3.1.2.1 *Discussion*—A standard definition of absorbed doses appears in Terminology E 170.

3.1.3 *anaerobic environment*—an environment having a level of oxygen that will not support the growth of oxygen-requiring microorganisms.

3.1.4 *good manufacturing practice (GMP)*—procedures established and exercised throughout the production, manufacturing, processing, packing, and distribution of foods, encompassing maintenance of sanitation systems, quality control and assurance, qualification of personnel and other relevant activities, to ensure the delivery of a commercially acceptable and safe product.

3.1.4.1 *Discussion*—In the United States, the GMP regulations, which deal primarily with sanitation, are CFR, Title 21, Part 110. **(1)**[3]

3.1.5 *modified-atmosphere packaging (MAP)*—a packaging system for maintaining an environment around the product that is different from the gaseous composition of air. The modified atmosphere can be obtained by application of a vacuum orby gas flushing, and may be maintained by use of gas scavengers.

4. Significance and Use

4.1 The judicious selection of a packaging material is part of Good Manufacturing Practices (GMPs) for the irradiation of prepackaged foods. This guide recognizes the need to evaluate the impact of packaging materials on the safety and quality of foods irradiated to control the proliferation of food borne pathogens, as well as their impact on foods irradiated for other purposes, such as prevention of re-infestation, delay of ripening, or shelf life extension.

4.2 As part of the evaluation, the packaging selection process should consider the effects of irradiation on the chemical and physical properties of the packaging material.

4.3 Packaging is not considered to be a food preservation technique for overcoming any deficiencies attributable to inadequate GMPs during preparation, storage, or treatment of foods to be irradiated. The quality of the irradiated food will depend heavily on its initial quality, control of the irradiation process, storage temperature and handling of the food after irradiation.

[3] The boldface numbers in parenthesis refer to the list of references at the end of this standard.

5. Regulatory Considerations

5.1 Compliance with regulatory requirements within each country where an irradiated food is to be sold should be considered when selecting an appropriate packaging material to hold food during its irradiation. Typically, the requirements for packaging materials for holding foods during irradiation would be that they: *(1)* are approved for contact with the food to be irradiated, *(2)* are resistant to ionizing radiation with respect to their physical properties, and *(3)* are not sources of substances that have toxicological significance as a result of their migration into the food **(2-4)**.

5.2 Canada and the United States have specific regulatory requirements for packaging materials that are permitted to hold food during irradiation. Other countries, in general, do not provide a specific list of packaging materials that are permitted to hold food during irradiation. However, a regulatory framework may exist in these countries which provides for the direct irradiation of foods.

5.3 A review of the regulations of food irradiation has been compiled by the International Consultative Group on Food Irradiation (ICGFI) under the aegis of the Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA), and the World Health Organization (WHO). Regulations specific to the use of packaging materials for food irradiation for some of the participating countries is available in the ICGFI publication "Regulations in the Field of Food Irradiation" published by the IAEA. **(5)** (See Appendix X1.)

6. Fitness for Use

6.1 *Chemical Effects*—The irradiation of packaging materials will lead to the formation of free radicals or ions, formation of unsaturated molecular bonds and scission and cross-linking of polymeric chains. These reactions may modify the physical properties of packaging materials and produce low molecular weight radiolytic products with potential to migrate into food. The extent of the radiation-induced changes is a function of polymer type, additives in the material, the absorbed dose and absorbed-dose rate, and the atmosphere during irradiation. These factors should be taken into account when evaluating the suitability of a packaging material and to ensure that the nature and quantity of any substances that may migrate from the packaging material into the food will not render the food unsafe or otherwise undesirable for consumption.

6.2 *Physical Properties*—Physical properties, such as strength, opacity, color, seal integrity, interlaminar bond strength, brittleness resulting from age or temperature, and gas moisture transmission rates, should be examined for change after processing. In general, the absorbed dose ranges used to irradiate foods for pasteurization or disinfestation **(3,6)** do not adversely affect the functional and protective behavior characteristics of packaging materials.

6.3 *Sensorial Effects*—Foods packaged prior to irradiation may become tainted with volatile compounds from the packaging materials during and following irradiation. The significance of this effect should be determined with appropriate sensory tests. Odor intensity of irradiated packaging material alone is not always an adequate measure of potential tainting of