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Standard Guide for Irradiation of Finfish and Aquatic Invertebrates Used as Food to Control Pathogens and Spoilage Microorganisms[1]

This standard is issued under the fixed designation F1736; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The purpose of this guide is to present information on the use of ionizing radiation for eliminating or reducing the number of pathogenic microorganisms and parasites and for reducing the number of spoilage microorganisms on finfish and aquatic invertebrates. Information on the handling of finfish and aquatic invertebrates before receipt by the irradiation facility and after shipment from the facility is also provided.

This guide is intended to serve as a set of recommendations to be followed when using irradiation technology where approved by an appropriate regulatory control authority. It is not to be construed as setting forth rigid requirements for the use of irradiation. While the use of irradiation involves certain essential requirements to attain the objective of the treatment, some parameters can be varied in optimizing the process.

This guide is based on a guideline published by the International Consultative Group on Food Irradiation (ICGFI) at the initiation of the Joint Food and Agriculture Organization/International Atomic Energy Agency Division of Nuclear Techniques in Food and Agriculture, which serves as the Secretariat to the ICGFI.

1. Scope

1.1 This guide outlines procedures and operations for the irradiation of raw, untreated, fresh (chilled), or frozen finfish and aquatic invertebrates, while ensuring that the irradiated product is safe and wholesome.

1.1.1 Aquatic invertebrates include molluscs, crustacea, echinoderms, etc.

1.1.1.1 Molluscs include bivalve shellfish, such as clams, mussels, and oysters; snails; and cephalopods, such as squid and octopus.

1.1.1.2 Crustacea include shellfish such as shrimp, lobster, crabs, prawns and crayfish.

1.1.1.3 Echinoderms include sea urchins and sea cucumbers.

1.2 This guide covers absorbed doses used to reduce the microbial and parasite populations in aquatic invertebrates and finfish. Such doses typically are below 10 kGy (**1**).[2]

1.3 The use of reduced-oxygen packaging (vacuum or modified atmosphere, and including products packed in oil) with irradiated, raw product is not covered by this guide. The anaerobic environment created by reduced-oxygen packaging provides the potential for outgrowth of, and toxin production from, *Clostridium botulinum* spores.

1.4 This guide does not cover the irradiation of smoked or dried fish to reduce microbial load or to control insect infestation.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

[1] This guide is under the jurisdiction of ASTM Committee E61 on Radiation Processing and is the direct responsibility of Subcommittee E61.05 on Food Irradiation.

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

[3] 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.

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E170 Terminology Relating to Radiation Measurements and Dosimetry
F1416 Guide for Selection of Time-Temperature Indicators
F1640 Guide for Selection and Use of Packaging Materials for Foods to Be Irradiated

2.2 *ISO/ASTM Standards:*[3]

51204 Practice for Dosimetry in Gamma Irradiation Facilities for Food Processing
51261 Guide for the Selection and Application of Dosimetry Systems for Radiation Processing
51431 Practice for Dosimetry in Electron Beam and X-Ray (Bremsstrahlung) Irradiation Facilities for Food Processing
51539 Guide for Use of Radiation-Sensitive Indicators

2.3 *Codex Alimentarius Commission Recommended International Codes and Standards:*[4]

Codex Stan 1 General Standards for the Labelling of Prepackaged Foods
Codex Stan 19 Recommended International Code of Practice for the Operation of Irradiation Facilities for the Treatment of Food
Codex Stan 106 Codex General Standard for Irradiated Foods
CAC/RCP 9 Recommended International Code of Practice for Fresh Fish
CAC/RCP 16 Recommended International Code of Practice for Frozen Fish
CAC/RCP 17 Recommended International Code of Practice for Shrimps and Prawns
CAC/RCP 18 Recommended International Code of Hygienic Practice for Molluscan Shellfish
CAC/RCP 24 Recommended International Code of Practice for Lobsters
CAC/RCP 27 Recommended International Code of Practice for Minced Fish Prepared by Mechanical Separation
CAC/RCP 28 Recommended International Code of Practice for Crabs
CAC/RCP 37 Recommended International Code of Practice for Cephalopods
CAC/RCP 20 Code of Ethics for International Trade in Food
CAC/RCP 42 Sampling Plans for Prepackaged Foods (AQL 6.5)

3. Terminology

3.1 *Definitions:*

3.1.1 Other terms used in this guide may be defined in Terminology E170.

3.1.2 *absorbed dose*—quantity of ionizing radiation energy imparted per unit mass of specified material. The SI unit for absorbed dose is the gray (Gy), where one gray is equivalent to the absorption of 1 joule per kilogram of the specified material (1Gy = 1 J/kg).

3.1.2.1 *Discussion*—A standard definition of absorbed dose appears in Terminology E170.

3.1.3 *dose distribution*—variation in absorbed dose within a process load exposed to ionizing radiation.

3.1.4 *process load*—volume of material with a specified product loading configuration irradiated as a single entity.

3.1.5 *transport system*—conveyor or other mechanical system used to move the product to be irradiated through the irradiator.

4. Significance and Use

4.1 Absorbed doses of or below 1 kGy can inactivate some parasites, such as the broad fish tapeworm (*Dibothrocephalus latus*) (**2**).

4.2 Absorbed doses below 10 kGy can reduce or eliminate vegetative cells of pathogenic sporeforming and non-sporeforming microorganisms, such as *Clostridia* spp., *Vibrio* spp., *Salmonellae*, *Listeria monocytogenes*, or *Staphylococcus aureus*, that may be present in fresh or frozen product.

4.2.1 Absorbed doses below 10 kGy can reduce the numbers of some spores, but are not adequate to reduce the potential health risk from microbial spores or toxins (**3**).

4.3 Absorbed doses below 10 kGy can reduce or eliminate the vegetative cells of sporeforming and non-sporeforming microorganisms, such as *Bacillus* or *Pseudomonas* species, that cause spoilage of fresh product, thus extending refrigerated shelf life in many cases (**4**).

5. Harvest/Raw Material

5.1 Follow relevant Recommended International Codes of Practice (RCP) and Standards of Good Manufacturing Practice of the Codex Alimentarius Commission (CAC) for maintaining the initial quality of the fresh or frozen product during handling from the time of harvest through the time of sale to the consumer (**5**). See CAC/RCP 9, CAC/RCP 16, CAC/RCP 17, CAC/RCP 18, CAC/RCP 24, CAC/RCP 27, CAC/RCP 28, CAC/RCP 37, and CAC/RCP 20.

5.2 In handling, preparing, freezing, storing, and thawing finfish and aquatic invertebrates intended for irradiation, take precautions at all times to minimize microbial contamination and outgrowth. Use standards of hygiene as high as those applied in the processing or preparation of product for the frozen or fresh markets.

5.3 Deliver product to the irradiation facility without delay, such that irradiation occurs as close to the time of harvest as possible. Products approaching the end of their shelf life should not be irradiated in an attempt to extend that shelf life.

NOTE 1—While irradiation can improve finfish and aquatic invertebrates from a public health aspect by reducing the microbial and parasite populations within product, chemical reactions (for example, oxidative degradation) that cause product to spoil also need to be considered when assessing the appropriateness of radiation treatment (**6**).

6. Packaging

6.1 Packaging product prior to irradiation is one means of preventing post-irradiation contamination.

6.2 Use packaging materials suitable to the product considering any planned processing (including irradiation) and consistent with any regulatory requirements (see Guide F1640).

[4] Available from Joint FAO/WHO Food Standards Program, Joint Office, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

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