



Designation: F 1736 – 96

Standard Guide for Irradiation of Finfish and Shellfish to Control Pathogens and Spoilage Microorganisms¹

This standard is issued under the fixed designation F 1736; 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 irradiation of finfish and shellfish to eliminate or reduce, or both, the numbers of certain pathogenic microorganisms and parasites, and to extend the refrigerated shelf-life of seafood by reducing the numbers of certain spoilage microorganisms present. Information on the handling of finfish and shellfish 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, there are some parameters that can be varied in optimizing the process. Hence, this document should be regarded as a guide rather than a rigid code of practice.

This guide has been prepared from a guideline published by the International Consultative Group on Food Irradiation (ICGFI) at the initiation of the Joint Food and Agricultural 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 requirements for the irradiation of raw, untreated, fresh (chilled), or frozen finfish or shellfish.

1.2 This guide covers absorbed doses used to reduce the microbial population in shellfish and finfish. Such doses typically are below 10 kGy.

1.3 The use of vacuum packaging with irradiated, raw seafood is not covered by this guide because of the potential for outgrowth of, and toxin production from, *Clostridium botulinum* spores which can grow in the anaerobic environment created by vacuum packaging.

1.4 This guide does not cover the irradiation of dried fish to control insect infestation.

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

2.1 ASTM Standards:

¹ This guide is under the jurisdiction of ASTM Committee E-10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.06 on Food Irradiation Processing and Packaging.

Current edition approved Oct. 10, 1996. Published December 1996.

E 170 Terminology Relating to Radiation Measurements and Dosimetry²

E 1204 Practice for Dosimetry in Gamma Irradiation Facilities for Food Processing²

E 1261 Guide for the Selection and Application of Dosimetry Systems for Radiation Processing of Food²

E 1431 Practice for Dosimetry in Electron and Bremsstrahlung Irradiation Facilities for Food Processing²

E 1539 Guide for Use of Radiation-Sensitive Indicators²

F 1416 Guide for the Selection of Time-Temperature Indicators³

2.2 Codex Alimentarius Commission Recommended International Codes and Standards:

Codex Stan 1 General Standards for the Labelling of Prepackaged Foods⁴

Codex Stan 19 Recommended International Code of Practice for the Operation of Irradiation Facilities for the Treatment of Food⁴

Codex Stan 106 Codex General Standard for Irradiated Foods⁴

² Annual Book of ASTM Standards, Vol 12.02.

³ Annual Book of ASTM Standards, Vol 15.09.

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.

 F 1736

- CAC/RCP 9 Recommended International Code of Practice for Fresh Fish⁴
CAC/RCP 16 Recommended International Code of Practice for Frozen Fish⁴
CAC/RCP 17 Recommended International Code of Practice for Shrimps and Prawns⁴
CAC/RCP 18 Recommended International Code of Hygienic Practice for Molluscan Shellfish⁴
CAC/RCP 24 Recommended International Code of Practice for Lobsters⁴
CAC/RCP 27 Recommended International Code of Practice for Minced Fish Prepared by Mechanical Separation⁴
CAC/RCP 28 Recommended International Code of Practice for Crabs⁴
CAC/RCP 37 Recommended International Code of Practice for Cephalopods⁴
CAC/RCP 20 Code of Ethics for International Trade in Food⁴
CAC/RCP 42 Sampling Plans for Prepackaged Foods (AQL 6.5)⁴

3. Terminology

3.1 *Definitions*—Other terms used in this guide may be defined in Terminology E 170.

3.1.1 *absorbed dose*—the quantity of energy from ionizing radiation absorbed by a quantity of food. The special name for the unit for absorbed dose is the gray (Gy). The former name for the unit of absorbed dose was rad (1 rad = 0.01 Gy). One gray is equal to one joule of absorbed energy per kilogram of food.

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

3.1.2 *dose distribution*—the variation in absorbed dose within a product unit exposed to ionizing radiation.

3.1.3 *product unit*—one or more containers of product collectively transported through the irradiator as a whole, for example, a box, tote, pallet, or carrier.

3.1.4 *shellfish*—includes molluscan bivalves, cephalopods, and crustacea.

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

4. Significance and Use

4.1 Irradiation at or below 1 kGy inactivates some parasites, such as the broad fish tapeworm (*Diphyllobothrium latum*) (1).⁵

4.2 Irradiation, at absorbed doses below 10 kGy, reduces or eliminates vegetative cells of pathogenic sporeforming and non-sporeforming microorganisms, such as *Clostridia* spp., *Vibrio* spp., *Salmonellae*, *Listeria monocytogenes*, or *Staphylococcus aureus*, present in fresh or frozen seafood, making these products safer for human consumption.

4.2.1 Doses below 10 kGy may reduce the numbers of some spores, but are not adequate to reduce the potential health risk from microbial spores or toxins (2).

4.3 Irradiation, at absorbed doses below 10 kGy, reduces or eliminates the vegetative cells of sporeforming and non-sporeforming microorganisms, such as *Bacillus* or *Pseudomonas* species, that cause spoilage of fresh seafood products, thus extending the refrigerated shelf life of the fresh seafood in many cases (3).

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) in maintaining the initial quality of the fresh or frozen seafood during handling from the time of harvest through the time of sale to the consumer (4). 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 shellfish intended for irradiation, take precautions at all times to minimize microbial contamination and outgrowth. Use standards as high as those applied in the processing or preparation of seafood for the frozen or fresh markets.

5.3 Deliver seafood to the irradiation facility without delay, such that irradiation occurs as close to the time of harvest as possible. Seafood approaching the end of its shelf life should not be irradiated in an attempt to extend that shelf life. Irradiation can improve seafood from a public health aspect, only through its effect by reduction of the microbial population within the product. However, there are mechanisms other than microbial action (for example, oxidative degradation) that cause seafood to spoil that need to be considered (5).

6. Packaging

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

6.1.1 Pack seafood using packaging materials suitable to the product considering any planned processing (including irradiation) and consistent with any regulatory requirements.

6.1.2 The irradiation procedure will be facilitated if the product packages are geometrically well defined and uniform. With certain irradiation facilities, it may be necessary to limit use to particular package shapes and sizes. See Practices E 1204 and E 1431.

6.2 The size, shape, or product loading configuration of a product unit used to hold seafood for irradiation is determined largely by certain design parameters of the irradiation facility. Critical parameters include the characteristics of product transport systems and of the radiation source as they relate to the dose distribution obtained within the product unit. Minimum and maximum dose limits may also affect the size, shape, or product loading configuration of the product unit (see 8.2).

7. Pre-Irradiation Product Handling

7.1 Inspect finfish and shellfish intended for irradiation as soon as it is received at the radiation processing facility to determine that they have been properly handled prior to receipt.

7.1.1 The temperature of fresh seafood, excluding unshucked, live molluscan shellfish, received in the chilled state should be maintained as close to 0°C (32°F) as possible.

⁵ The boldface numbers in parentheses refer to the list of references at the end of this standard.