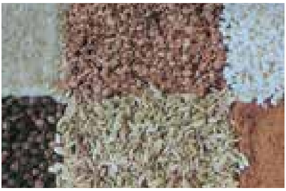
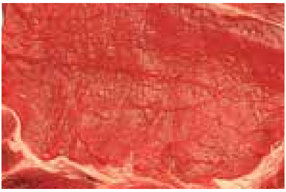
IRRADIATED FOOD









Food Safety
AUTHORITY OF IRELAND



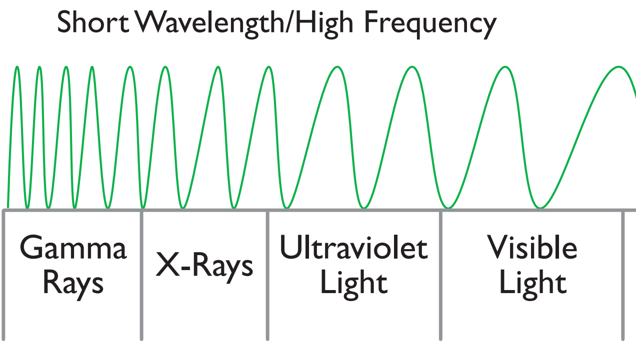
IRRADIATED FOOD

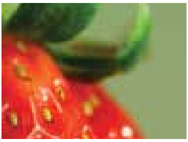
Food Preservation

In the current global economy much of our food is consumed at a time and place far from where it was produced. To protect food and extend its shelf-life during transport and storage, food can be preserved by a variety of processes such as cooking, refrigeration, pasteurisation, salting, marinating, drying, smoking and irradiation. However, some of these processes can also have undesirable effects on the appearance, odour, texture or even flavour of certain foods and therefore, selection of a suitable preservation technique depends on parameters such as desired effect, possible negative impact, cost and even availability.

Food Irradiation

Irradiation is a physical treatment where food is exposed to a defined dose of ionising radiation

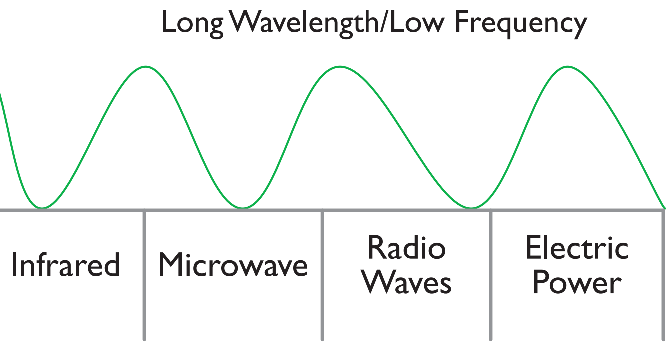


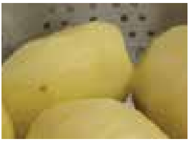


and is used on more than 60 food types in over 40 countries worldwide. Irradiation of food is designed to control insect infestation, reduce the numbers of pathogenic or spoilage microorganisms and delay or eliminate natural biological processes such as ripening, germination or sprouting in fresh food. Like all preservation methods, irradiation should supplement rather than replace good food hygiene, handling and preparation practices.

Ionising and Non-ionising Radiation

Radiation is a form of energy that travels through space (radiant energy) in a wave pattern and can be either naturally occurring, e.g. from the sun or rocks or produced by man-made objects, e.g. microwaves and television sets. The frequency and wavelength of the energy waves produced by different sources distinguishes the various types and functionality of radiation. High frequency radiation (X-rays and Gamma rays) poses the most significant risk to human health.



The energy from high frequency radiation (Gamma rays and X-rays) is at a sufficiently high level to result in the production of charged particles (**ions**) in the material absorbing the radiation, and is thus termed **ionising** radiation. Ionising radiation can be electromagnetic radiation (Gamma rays and X-rays) or particulate radiation (Electron beam). **Non-ionising** radiation, such as that from microwaves, does not produce ions but can create heat under moist conditions and is routinely used for purposes such as cooking and re-heating of foods.

Human Exposure to Ionising Radiation

We are all exposed to low levels of ionising radiation on a daily basis from a variety of natural and man-made sources. Under normal circumstances, almost 90% of the ionising radiation on Earth is due to natural radiation emitted from the sun, rocks, radon gas and even cosmic rays from space. The remaining exposure is due to man-made sources such as nuclear reactors and medical X-rays. Food irradiation facilities that are built, maintained and operated to accepted standards are not considered a significant risk to humans.

Ionising Radiation Sources

Ionising radiation can be produced by three different technologies using different types of rays: Electron beams, X-rays and Gamma rays. Electron beams, a stream of high energy electrons, are generated by electron accelerators and though a cost efficient source of ionising radiation, they are



of limited use since they have poor penetrative power. In contrast, X-rays are a more expensive but highly penetrative form of radiation suitable for bulk operations. Electron beam and X-rays are generated by electrical machines that can be switched on and off and no radioactive substances are involved. By contrast, Gamma rays, which are produced by the radioactive decay of relatively inexpensive radioactive isotopes such as cobalt^{60}, are highly penetrative and thus an attractive option for use in food irradiation. In addition, the energy levels of Electron beams and X-rays are variable, depending on the machine generating them, while the energy levels of Gamma rays from a decaying radioactive isotope are constant.

Food Irradiation Process

Food irradiation is carried out in special containment areas where the food is exposed to a defined dose of radiation in a continuous or batch process. The level of exposure is designed to take into account interdependent parameters such as the type of operation (batch or continuous), the optimum energy requirement to successfully safeguard the food and the source of irradiation (Gamma rays, X-rays or Electron beam). For example, Electron beam irradiation in a continuous process is sufficient to treat most pre-packaged food items, whereas treatment of bulk quantities of food requires a batch system using penetrative X-rays or Gamma rays.



Physical Effects of Ionising Radiation on Food

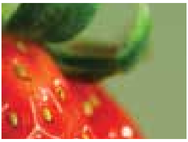
Ionising radiation, even at low doses, may not be suitable for all food as it can result in undesirable odours and flavours in certain foods and even tissue damage in some fruit.

During exposure to ionising radiation, food and water absorb energy, most of which is used in the generation of molecules known as radiolytic products. These short-lived, unstable and reactive molecules chemically react with each other and surrounding molecules causing damage to biological cells, including those of contaminating micro-organisms or insects. Radiolytic products are not unique to irradiated food however, as identical products can be found in food that has been cooked, frozen or pasteurised and even unprocessed food.

Irradiation also disrupts some of the chemical bonds in DNA of food as well as those of contaminating microorganisms or pests. While this disruption is inconsequential to the food, it considerably reduces the chances of survival and proliferation of the contaminating pests or microorganisms.

Nutritional Value of Irradiated Food

The effect of irradiation on the nutritional quality of food is similar to, and in some cases less than that for some other preservation methods. Only minor changes are observed in the level of some vitamins (B_1, C, A and E), while carbohydrates, fats and proteins remain largely unaffected by low or medium

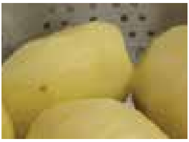
doses. However, nutritional changes in food due to irradiation are dependant on factors such as the temperature, radiation dose, packaging environment and storage. For example, irradiation of frozen food or of food in an oxygen-free environment has been shown to minimise nutrient loss.

Safety of Irradiated Food

Feeding studies carried out with animals or humans have not identified any significant safety concerns related to irradiated food. Regulations governing food irradiation within the European Union ensure that this technology is used to the highest safety standards and only where it provides tangible benefits to the consumer.

The EU Scientific Committee on Food (SCF) issued favourable opinions on irradiation of a range of foods as long as the process was not used to mask a food's unsuitability for consumption or to cover poor handling practices. A joint World Health Organization, Food and Agriculture Organization and the International Atomic Energy Agency study group convened in 1997 concluded that food irradiated to any dose appropriate to achieve the intended technological objective was both safe to consume and nutritionally adequate. However, the EU SCF, in an opinion issued in April 2003, recommended that maximum doses of irradiation should continue to be considered for foods on a case by case basis.

Irradiation does not cause food or packaging material to become radioactive, even when the radiation source itself is radioactive.



Sterilisation or Pasteurisation of Food by Irradiation

Irradiation is sometimes referred to as "cold pasteurisation" since the result achieved is similar to heat-based pasteurisation, but without the heat. The effect of irradiation in food will depend on the dose of radiation, i.e. the amount of energy absorbed per weight of food, and is quantified in rads or grays (1 Gy = 100 rads). Low to medium doses of radiation successfully reduce bacterial contamination but are not sufficient to affect viruses or toxins. However, higher radiation doses can be used to kill all living contaminants creating sterile foods. Such foods are necessary for people with reduced immunity such as patients suffering from AIDS or cancer, but are also used by astronauts and armed forces in certain situations.

Detection of Irradiated Food

Irradiation generally does not significantly alter the physical appearance of a food and therefore laboratory tests have been developed to identify food or food ingredients that have been exposed to ionising radiation. A number of tests have been standardised by the European Committee for Standardisation (https://ec.europa.eu/food/safety/biosafety/irradiation/legislation_en). These tests employ techniques including gas chromatography, mass spectrometry, spectroscopy, luminescence and DNA analysis to identify molecular and spectroscopic properties characteristic of irradiated food.

Labelling of Irradiated Foods

Any irradiated food, or food containing an irradiated ingredient within the EU must carry the word "irradiated" in a prominent position either as part of the main label or next to the ingredient that has been irradiated. It may also (optionally) show the international icon for irradiated food called the "Radura" symbol:

EU Legislation Governing Food Irradiation

Two EU Directives (1999/2/EC and 1999/3/EC) relating to irradiated food were implemented in Ireland in September 2000 by S.I. No. 297 of 2000. The marketing of any product not complying with the Directives is prohibited as of 20th March 2001.

The **Framework Directive** (1999/2/EC) addresses general and technical aspects for carrying out the process, labelling of irradiated foods and conditions for authorising food irradiation. It does not apply to foods inadvertently exposed to ionising radiation from inspection or measuring devices, so long as doses absorbed are below certain limits, nor does it apply to foodstuffs irradiated for patients requiring sterile diets under medical supervision. A Member State may temporarily suspend or restrict marketing of an authorised food in its territory

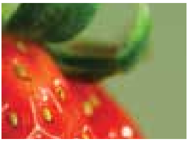


where it has evidence that the food may endanger human health. The Member State shall provide the new evidence to the Commission which will take appropriate measures in consultation of the regulatory committee, the Standing Committee on Plants, Animals, Food and Feed (PAFF Committee).

The Framework Directive specifically requires that irradiation of a specific food item may only be authorised if:

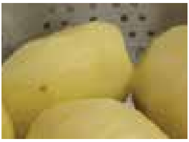
- There is a reasonable technological need
- It presents no health hazard
- It is of benefit to the consumer
- It is not used as a substitute for hygiene and health practices or for good manufacturing or agricultural practice.

The **Implementing Directive** (1999/3/EC) provides a list of foods and food ingredients that are authorised across the EU for irradiation, though currently only dried aromatic herbs, spices and vegetable seasonings at a maximum permitted irradiation dose of 10 kGy are listed. Until the list is completed, Member States may continue to irradiate those foods that had national authorisations prior to implementation of this Directive (see table). Member States may also retain existing restrictions or bans on irradiated foods not on the EU-authorised list.

Food and Food Ingredients that may be Treated with Ionising Radiation Under National Authorisations (2009/C 283/02)

Product	Authorised at the given maximum overall average absorbed radiation dose (kGy)						
	BE	CZ	FR	IT	NL	PL	UK
Deep frozen aromatic herbs	10	10	10				
Potatoes	0.15	0.2		0.15		0.1	0.2
Yams		0.2					0.2
Onions	0.15	0.2	0.075	0.15		0.06	0.2
Garlic	0.15	0.2	0.075	0.15		0.15	0.2
Shallots	0.15	0.2	0.075				0.2
Vegetable, incl. pulses	1	1					1
Pulses		1			1		
Fruit (incl. fungi, tomato, rhubarb)	2	2					2
Strawberries	2	2					
Dried vegetables & fruits	1	1	1		1		
Cereals	1	1					1
Dried fruit		1					
Flakes and germs of cereals for milk products	10	10	10				
Flakes from cereals		1			1		
Rice flour	4	4	4				
Gum arabic	3	3	3		3		

(cont'd)

Product	Authorised at the given maximum overall average absorbed radiation dose (kGy)						
	BE	CZ	FR	IT	NL	PL	UK
Chicken meat		7			7		
Poultry	5	5	5				
Poultry (domestic fowls, geese, ducks, guinea fowls, pigeons, quails, and turkeys)	7	7					7
Mechanically recovered poultry meat	5	5	5				
Offal of poultry	5	5	5				
Frozen frog legs	5	5	5		5		
Dehydrated blood, plasma, coagulates	10	10	10				
Fish and shellfish (incl. eels, crustaceans and molluscs)	3	3					3
Frozen peeled or decapitated shrimps	5	5	5				
Shrimps					3		
Egg white	3	3	3		3		
Casein, caseinates	6	6	6				



Regulation of Irradiated Food In Ireland

Regulation of food irradiation in Ireland is shared by three Government bodies, each with distinct but inter-dependent roles. The Food Safety Authority of Ireland (FSAI) is responsible for the enforcement of legislation governing irradiated food. Policy matters are the remit of the Food Unit of the Department of Health while the Environmental Protection Agency (EPA) ensures that irradiation facilities and processes meet safety and operational standards.

Food Irradiation and Ireland

There are no authorised food irradiation facilities in Ireland and therefore any irradiated foodstuffs or food ingredients on the Irish market are imported. Ireland does not ban or restrict the import of any of the foods irradiated by other Member States.

Food irradiation may be a viable option for enhancing the safety of certain foods and food ingredients. Microorganisms such as *Salmonella*,

Campylobacter, *Listeria* and *Escherichia coli* remain problematic contaminants of meat and poultry despite high standards of production and processing. A more recent study in 2010 detected shiga-toxin producing *E. coli* in 1.1% of beef carcases in Ireland. This highly virulent pathogen is of particular concern due to its prevalence in farm animals and the potential consequences of infection for vulnerable groups such as the very young, old or sick people. Therefore, all risk management options, including food irradiation, should be considered to help avoid the injury or death experienced in other countries due to this pathogen.

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