Foreword

International organizations including the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO) have coordinated and worked with others to develop norms and review the safety and efficacy of irradiated foods. International standards set a foundation for commerce and trade agreements. Those for both food irradiation and irradiated food can be found in the general standards and codes of practice of the Codex Alimentarius Commission, and in the International Standards for Phytosanitary Measures of the International Plant Protection Convention. The joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has for many years provided its technical assistance to countries and coordinated research into food irradiation. Therefore it brings me a great deal of pleasure to write this preface.

Dear readers, I commend this topic and this book to you. This publication covers history, legislation, technologies, and economics, and even touches on the social sciences (when considering consumer acceptance). However, it focuses on the important concepts, applications and outcomes of food irradiation technologies. The overwhelming consensus is that irradiated food is safe to eat. The caveat, as with all food processing techniques, is that the quality of the final product depends on the correct application of the process. So please, whilst enjoying reading about food irradiation technologies, pay particular attention to dosimetry, qualification and certification.

Food irradiation involves exposing food to ionizing radiation in a controlled way. As you will see in Chapter 2, the types of radiation allowed in international standards and therefore in legislation are either machine generated electron beams or X-rays, and gamma rays from cobalt-60 or caesium-137 isotopes.

Food Chemistry, Function and Analysis No. 4
Food Irradiation Technologies: Concepts, Applications and Outcomes
Edited by Isabel C. F. R. Ferreira, Amilcar L. Antonio and Sandra Cabo Verde

Published by the Royal Society of Chemistry, www.rsc.org

Chapters 3 and 4 deal with gamma rays, electron beams and X-rays; each has technological pros and cons, but the benefits of exposing food to these ionizing radiations are that it reduces the risk of foodborne disease by destroying pathogenic organisms; it reduces the rate of food spoilage because decay organisms are also destroyed; it does not significantly increase temperature (*e.g.* spices retain their volatile flavours); it avoids the use of fumigants or other chemicals and therefore their residues; food losses can be avoided because irradiation arrests ripening or inhibits sprouting (*e.g.* in garlic, onions, and potatoes); and it is an effective phytosanitary treatment against organisms harmful to plants or plant products.

In the introduction you will see that the concept of using ionizing radiation to maintain food quality is over one hundred years old; it soon followed the discovery of X-rays and radioactivity in the late 1890s. The technology has taken and is taking time to develop. The first commercial use was in 1957, when a spice business in Stuttgart, Germany began to improve the hygienic quality of its products by electron beam irradiation. Commercial scale gamma ray facilities also became available at around this time. For example, the US Army used both gamma ray and electron beam irradiation in the early 1960s in a processing and packaging facility that developed irradiated foods to replace canned or frozen military rations. With regards to X-rays, the first commercial facility started operating in 2000 in Hilo, Hawaii, where it still irradiates fresh fruits and vegetables to meet stringent phytosanitary requirements designed to prevent insect pests being transported to the US mainland.

In commerce, irradiation is mostly used either to prevent food illness (Chapter 10) or as a phytosanitary treatment (Chapter 9). Often, the extension of food's useable lifetime or the maintenance of other food qualities is an added bonus. The FAO has estimated that as much as one third of the annual global food production is currently lost or wasted.[1] The WHO has also estimated that in 2010 there were between 420 to 960 million foodborne illnesses world-wide and some 420 000 deaths.[2] The minimum global cost of invasive insects has been estimated at US$ 70 billion per year.[3] Yet, despite these statistics food irradiation is an under-utilized technology. Most commercial uses relate to high value foods such as dried herbs and spices, exotic fruits and vegetables or ethnic delicacies like frog legs, fermented uncooked pork and fermented chicken feet. However, irradiation is being used increasingly and is gradually finding more favour, especially in the Americas, Asia and Australasia (Chapter 20).

The phytosanitary use of food irradiation has rapidly increased over the past ten years. Insect pests are responding to the opportunities that changing climatic conditions present – some can now thrive in areas where they could not previously. Irradiation to prevent pests from being able to reproduce or develop to maturity is proving to be a viable commercial method to enable trade in fresh produce whilst preventing pests from hitch-hiking to pastures new.

I feel that irradiation is one of a number of food technologies that will become more widely used in future as technologists, chemists, processing professionals and authorities strive to address challenges to food security.† Medium and long-term challenges here include the added pressures of climate change, accelerating population growth, increasing urbanization, and diverse food supply chains with the globalization of food trade. Food irradiation alone is not a panacea – it is not suitable for all foods and cannot resolve all food security and phytosanitary issues. But in future, food irradiation could have an increasingly important role in ensuring food safety and quality, preventing the spread of invasive species and facilitating trade.

Carl Blackburn

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†Food security is the ability for all people, at all times, to have access to sufficient, safe and nutritious food to maintain a healthy and active life.