

Food Irradiation: An Established Food Processing Technology for Food Safety and Security

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ABSTRACT

Food irradiation is a well-established and effective technology for food processing and preservation. The technology aids in reducing food losses and ensuring food safety by elimination of pathogens and parasites causing illness and death. Radiation treatment can be applied to agricultural produce and animal food products to get extended shelf life with improved microbiological safety and quality. Irradiating food can greatly reduce illness from foodborne pathogens thereby preventing morbidity and mortality. Various national and international food and health organisations have endorsed and supported the safety of food and foodstuffs subjected to ionising radiation based on the research and testing data of more than 50 years. A review is presented on the historical developments of food irradiation technology, radiation sources for treatment of food and, the safety and wholesomeness of foods processed by ionising radiation.

Keywords: Food irradiation; Gamma radiation; Wholesomeness; Nutritional adequacy

1. INTRODUCTION

Advanced agro-animal technologies have resulted in increased food production. However, about 25 per cent of agricultural produce is lost worldwide due to damage by insects, microbes and physiological spoilage. Significant losses of food occur due to microbial contamination and pest infestation during post-harvest storage, transportation and marketing. Sprouting is the major cause of losses of vegetable crops like tubers and bulbs. Use of contaminated ingredients and raw materials are also responsible for spoilage and wastage of food¹.

Contamination of food with pathogenic and parasitic organisms is also an important cause of human suffering. One of the leading causes of death worldwide is reported due to the contamination of foods with pathogenic non-spore forming bacteria, parasitic helminths and protozoa^{2,3}. Food safety is a global concern causing hospitalisations, deaths, patient-related costs for treatment and reduced economic productivity⁴.

Significant losses of food due to infestation, microbes, spoilage and the safety concerns regarding foodborne diseases has resulted in increased interest in food preservation technologies. A number of food processing techniques have been explored to control spoilage and ensure safety of the food. Pasteurisation, canning, freezing, refrigeration and chemical preservatives are the common food processing techniques in use. Novel technologies that can keep foods fresher, with higher nutritional value, with minimum food additives and no toxins or allergens are emerging^{4,5}. These non-thermal food

processing techniques include pulse electric field processing, oscillating magnetic fields, high pressure processing, high power ultrasound waves and irradiation⁶.

The technology of food irradiation is increasingly gaining acceptance around the world and can supplement or replace some of the traditional food processing methods. Food irradiation is the application of ionising radiation to food for improving safety and increasing storage and distribution life. The process consists of exposing the food material in bulk or packaged form to specific doses of ionising radiation for achieving certain beneficial effects⁷. The technology has multipurpose role and can be effectively used for treatment of agricultural commodities^{8,9} and animal food such as meat, poultry and seafood^{10,11}. Recent applications include high-dose irradiated specialty food for immunocompromised patients¹².

Interest in radiation technology has been due to persistent losses of food by infestation, spoilage by bacteria and fungi, rising concern about foodborne diseases and strict import standards of quarantine for international trade in food products. Ionising radiation as a means of food preservation and effectiveness of irradiation treatment in controlling the growth of food spoilage and pathogenic microbes is established. Food irradiation technology addresses both food quality and safety by inactivating the parasites, reducing spoilage microbes, eliminating foodborne pathogenic microorganisms, delaying the ripening of fruits, inhibiting sprouting in bulbs and tubers, and controlling the post-harvest losses caused by insect infestation. Scientific data and recommendations from different agencies have established food irradiation as a safe and effective technology for reduction of food losses and foodborne illness.

Food Irradiation Research And Technology

**Ali Demirci, Hao Feng, Kathiravan
Krishnamurthy**



Food Irradiation Research And Technology:

Food Irradiation Research and Technology Christopher H. Sommers,Xuetong Fan,2008-02-28 The benefits of food irradiation to the public health have been described extensively by organizations such as the Centers for Disease Control and Prevention in the U S and the World Health Organization The American Medical Association and the American Dietetic Association have both endorsed the irradiation process Yet the potential health benefits of irradiation are unknown to many consumers and food industry representatives who are wary of irradiated foods due to myth information from consumer advocate groups Food Irradiation Research and Technology presents the latest scientific findings of researchers at the leading edge of food irradiation In this book experts from industry government and academia define the basic principles of irradiation and the public health benefits of irradiation describe advances in irradiation technology detection technology and radiation dosimetry review the regulations pertaining to food irradiation and the toxicological safety data provide food industry representatives and public health officials with effective methodologies to educate consumers and counteract misinformation review recent advances in the irradiation of meat and poultry fruits and vegetables seafood and the use of irradiation as a phytosanitary treatment Food Irradiation Research and Technology appeals to a broad readership industry food scientists involved in the processing of meat and fish fruits and vegetables food microbiologists and radiation processing specialists government and industry representatives involved in the import and export of food commodities and industry local and state officials involved in educational efforts regarding food irradiation Food scientists and technologists share a responsibility to ensure that educational materials provided to the public regarding food safety and processing technologies are based on sound science and fact not on misconceptions Food Irradiation Research and Technology meets that goal

Food Irradiation Research and Technology Xuetong Fan,Christopher H. Sommers,2013 This updated second edition of Food Irradiation Research and Technology reviews the latest developments in irradiation technologies as they are applied to meat seafood fish fruits vegetables and nuts Experts from industry government and academia define the basic principles and public health benefits of irradiation **Food Irradiation** R. A. Molins,2001-05-24 In 1997 the FDA approved the use of low dose ionizing radiation to eliminate pathogens in red meat This food processing technology can improve the safety of food and extend the shelf life of certain foods by eliminating pathogenic bacteria parasites and other microorganisms that cause food borne disease Currently forty two countries practice some form of food irradiation Food Irradiation Principles and Applications provides a comprehensive up to date account of food irradiation principles effects applications and limitations including global regulatory issues and the economics of food irradiation Written by an international panel of scientists this book focuses on science and technology and offers thorough coverage of the current use of food irradiation around the world The contributors in this book present irradiation as a truly critical control point for raw solid foods of animal origin Food Irradiation Principles and Applications discusses such topics as Radiation inactivation of microorganisms Disinfestation of

stored grains pulses dried fruits and nuts Irradiation as a quarantine treatment Irradiation of meat and poultry fish and shellfish fruits and vegetables and tuber and bulb crops Radiation decontamination of spices herbs condiments and other dried food ingredients Process control and dosimetry in food irradiation Food professionals in both academia and industry as well as food safety experts food scientists research scientists and food processing managers will find Food Irradiation Principles and Applications a reliable and valuable reference Food Irradiation Technologies Isabel C F R Ferreira, Amílcar L Antonio, Sandra Cabo Verde, 2017-12-19 Food preservation by irradiation is gaining recognition as a technology that is more environmentally benign than other current processes such as post harvest chemical fumigation it has less impact on thermally sensitive compounds than thermal decontamination technologies such as hot water or steam and the technology is more accessible and cheaper As the technical and economic feasibility as well as the level of consumer acceptance have increased its use has been growing fast 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 Commended in the Foreword by Carl Blackburn Food Irradiation Specialist Joint FAO IAEA Division of Nuclear Techniques in Food and Agriculture this book makes a strong case for the use of this overwhelmingly safe food processing technique This comprehensive book is a useful reference for food technologists analytical chemists and food processing professionals covering all aspects of gamma electron beam and X ray food irradiation its impact on food matrices and microorganisms legislation and market aspects It is the first book to cover control and structural analysis in food irradiation and being written by leading experts in the field addresses the current global best practices It contains updated information about the commercial application of food irradiation technology especially regarding the type of radiation based on food classes and covers dosimetry radiation chemistry food decontamination food quarantine food processing and food sterilization

Review of AEC and Army Food Irradiation Programs United States. Congress. Joint Committee on Atomic Energy. Subcommittee on Research, Development, and Radiation, 1962 Food Irradiation V M Wilkinson, G. W. Gould, 1996-01-15 This reference guide is applicable to the food industry research institutions academia and trade and consumer organisations Contents include Introduction trends in food spoilage and safety food preservation technologies the use of ionising radiation Food irradiation topics from additives to yoghurt List of entries by category including listing by food groups and components control of microbiological hazards and irradiation methods Genetically Modified and Irradiated Food Veslemøy Andersen, 2020-01-09 Genetically Modified and Irradiated Food Controversial Issues Facts versus Perceptions explains the technologies used in these processes so they can be understood by those in general public health scientific organizations politicians and opinion makers policymakers The facts presented include a massive amount of scientific evidence that these technologies are safe and can be beneficial Because the world is facing a future with an increasing number of people new

technologies are needed to ensure enough safe and healthy food thus technologies that have the potential to dramatically increase the availability of safe and healthy food should be welcomed by everybody Includes references to science based research on GMOs Explains the technologies in a clear way that can be understood by the general public Includes a massive amount of scientific evidence that these technologies are safe and can be beneficial Irradiation of Food Commodities Ioannis S. Arvanitoyannis, 2010-06-25 The irradiation of food is a low cost highly effective method of ensuring food safety and extending shelf life Public acceptance of irradiation despite its benefits however has been a significant challenge Irradiation of Food Commodities is the first holistic book that looks not only at the techniques application and legislation of this method but also addresses the concern of public opinion Organized into logical themes and written by experts from industry academia and research this book will meet the needs of those working or considering the use of irradiation in their work Sections focus on legislation irradiation techniques and materials detection and risk assessment application of irradiation on food and consumer opinion Insights into regulations from a variety of countries provides important information on government strategies Extensive coverage of applications from animal food to food for human consumption and disinfestation explores the various potential application opportunities available for consideration Addresses risk assessment key to governmental and more importantly consumer acceptance All topics in one volume for the first time provides complete vision of the technology Electromagnetic Technologies in Food Science Vicente M. Gómez-López, Rajeev Bhat, 2021-11-30 A comprehensive source of in depth information provided on existing and emerging food technologies based on the electromagnetic spectrum Electromagnetic Technologies in Food Science examines various methods employed in food applications that are based on the entire electromagnetic EM spectrum Focusing on recent advances and challenges in food science and technology this is an up to date volume that features vital contributions coming from an international panel of experts who have shared both fundamental and advanced knowledge of information on the dosimetry methods and on potential applications of gamma irradiation electron beams X rays radio and microwaves ultraviolet visible pulsed light and more Organized into four parts the text begins with an accessible overview of the physics of the electromagnetic spectrum followed by discussion on the application of the EM spectrum to non thermal food processing The physics of infrared radiation microwaves and other advanced heating methods are then deliberated in detail supported by case studies and examples that illustrate a range of both current and potential applications of EM based methods The concluding section of the book describes analytical techniques adopted for quality control such as hyperspectral imaging infrared and Raman spectroscopy This authoritative book resource Covers advanced theoretical knowledge and practical applications on the use of EM spectrum as novel methods in food processing technology Discusses the latest progress in developing quality control methods thus enabling the control of continuous fast speed processes Explores future challenges and benefits of employing electromagnetic spectrum in food technology applications Addresses emerging processing technologies related to improving

safety preservation and overall quality of various food commodities Electromagnetic Technologies in Food Science is an essential reading material for undergraduate and graduate students researchers academics and agri food professionals working in the area of food preservation novel food processing techniques and sustainable food production *Handbook of Seafood and Seafood Products Analysis* Leo M.L. Nollet,Fidel Toldra,2009-11-24 Seafood and seafood products represent some of the most important foods in almost all types of societies around the world More intensive production of fish and shellfish to meet high demand has raised some concerns related to the nutritional and sensory qualities of these cultured fish in comparison to their wild catch counterparts In addition t **Status of the Food Irradiation Program** United States. Congress. Joint Committee on Atomic Energy. Subcommittee on Research, Development, and Radiation,1968 **The Department of the Army's Food Irradiation Program** United States. General Accounting Office,1978 **Federal Food Irradiation Development and Control Act of 1985** United States. Congress. House. Committee on Agriculture. Subcommittee on Department Operations, Research, and Foreign Agriculture,1986 *Processing Effects on Safety and Quality of Foods* Enrique Ortega-Rivas,2009-10-08 Covers a Host of Groundbreaking TechniquesThermal processing is known to effectively control microbial populations in food but the procedure also has a downsideit can break down the biochemical composition of foods resulting in a marked loss of sensory and nutritional quality Processing Effects on Safety and Quality of Foods delineates three dec *Food Safety Engineering* Ali Demirci,Hao Feng,Kathiravan Krishnamurthy,2020-05-28 Food Safety Engineering is the first reference work to provide up to date coverage of the advanced technologies and strategies for the engineering of safe foods Researchers laboratory staff and food industry professionals with an interest in food engineering safety will find a singular source containing all of the needed information required to understand this rapidly advancing topic The text lays a solid foundation for solving microbial food safety problems developing advanced thermal and non thermal technologies designing food safety preventive control processes and sustainable operation of the food safety preventive control processes The first section of chapters presents a comprehensive overview of food microbiology from foodborne pathogens to detection methods The next section focuses on preventative practices detailing all of the major manufacturing processes assuring the safety of foods including Good Manufacturing Practices GMP Hazard Analysis and Critical Control Points HACCP Hazard Analysis and Risk Based Preventive Controls HARPC food traceability and recalls Further sections provide insights into plant layout and equipment design and maintenance Modeling and process design are covered in depth Conventional and novel preventive controls for food safety include the current and emerging food processing technologies Further sections focus on such important aspects as aseptic packaging and post packaging technologies With its comprehensive scope of up to date technologies and manufacturing processes this is a useful and first of its kind text for the next generation food safety engineering professionals *Food Irradiation* R. A. Molins,2001-05-24 In 1997 the FDA approved the use of low dose ionizing radiation to eliminate pathogens in red meat This food processing

technology can improve the safety of food and extend the shelf life of certain foods by eliminating pathogenic bacteria parasites and other microorganisms that cause food borne disease Currently forty two countries practice some form of food irradiation Food Irradiation Principles and Applications provides a comprehensive up to date account of food irradiation principles effects applications and limitations including global regulatory issues and the economics of food irradiation Written by an international panel of scientists this book focuses on science and technology and offers thorough coverage of the current use of food irradiation around the world The contributors in this book present irradiation as a truly critical control point for raw solid foods of animal origin Food Irradiation Principles and Applications discusses such topics as Radiation inactivation of microorganisms Disinfestation of stored grains pulses dried fruits and nuts Irradiation as a quarantine treatment Irradiation of meat and poultry fish and shellfish fruits and vegetables and tuber and bulb crops Radiation decontamination of spices herbs condiments and other dried food ingredients Process control and dosimetry in food irradiation Food professionals in both academia and industry as well as food safety experts food scientists research scientists and food processing managers will find Food Irradiation Principles and Applications a reliable and valuable reference

Innovative Food Processing Technologies ,2020-08-18 Food process engineering a branch of both food science and chemical engineering has evolved over the years since its inception and still is a rapidly changing discipline While traditionally the main objective of food process engineering was preservation and stabilization the focus today has shifted to enhance health aspects flavour and taste nutrition sustainable production food security and also to ensure more diversity for the increasing demand of consumers The food industry is becoming increasingly competitive and dynamic and strives to develop high quality freshly prepared food products To achieve this objective food manufacturers are today presented with a growing array of new technologies that have the potential to improve or replace conventional processing technologies to deliver higher quality and better consumer targeted food products which meet many if not all of the demands of the modern consumer These new or innovative technologies are in various stages of development including some still at the R D stage and others that have been commercialised as alternatives to conventional processing technologies Food process engineering comprises a series of unit operations traditionally applied in the food industry One major component of these operations relates to the application of heat directly or indirectly to provide foods free from pathogenic microorganisms but also to enhance or intensify other processes such as extraction separation or modification of components The last three decades have also witnessed the advent and adaptation of several operations processes and techniques aimed at producing high quality foods with minimum alteration of sensory and nutritive properties Some of these innovative technologies have significantly reduced the thermal component in food processing offering alternative nonthermal methods Food Processing Technologies A Comprehensive Review Three Volume Set covers the latest advances in innovative and nonthermal processing such as high pressure pulsed electric fields radiofrequency high intensity pulsed light ultrasound irradiation and

new hurdle technology Each section will have an introductory article covering the basic principles and applications of each technology and in depth articles covering the currently available equipment and or the current state of development food quality and safety application to various sectors food laws and regulations consumer acceptance advancements and future scope It will also contain case studies and examples to illustrate state of the art applications Each section will serve as an excellent reference to food industry professionals involved in the processing of a wide range of food categories e g meat seafood beverage dairy eggs fruits and vegetable products spices herbs among others Status of the Food Irradiation

Program United States. Congress. Joint Committee on Atomic Energy,1968 **Irradiation for Quality Improvement, Microbial Safety and Phytosanitation of Fresh Produce** Rivka Barkai-Golan,Peter A. Follett,2017-05-29 Irradiation for Quality Improvement Microbial Safety and Phytosanitation of Fresh Produce presents the last six and a half decades of scientific information on the topic This book emphasizes proven advantages of ionizing irradiation over the commonly used postharvest treatments for improving postharvest life of fresh fruits and vegetables to enhance their microbial safety This reference is intended for a wide range of scientists researchers and students in the fields of plant diseases and postharvest diseases of fruits and vegetables It is a means for disease control to promote food safety and quality for the food industry and can be used in food safety and agriculture courses Discusses pathogen resistance to common chemical synthetic compounds Presents up to date research and benefits of phytosanitary irradiation Includes comprehensive research for alternative treatments for postharvest disease control Provides the non residual feature of ionizing radiation as a physical means for disease control to produce chemical free foods **Electronic Irradiation of Foods** R. B. Miller,2005-07-06 This book is devoted to an examination of the technologies and practical implementation techniques associated with food irradiation using accelerator sources of ionizing radiation specifically electron beams and x rays Introductory chapters summarize the effects of ionizing radiation on biological organisms and the organic compounds comprising foods and gives an overview of the food irradiation process Subsequent chapters cover the details of the electron beam and x ray energy deposition electron accelerator technologies beam scanning systems material handling systems shielding design and process control considerations Important appendices cover radiation dosimetry induced radioactivity and ozone generation

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