Innovative Food Processing Techniques

Enhancing Safety, Quality, and Shelf Life

Edited by
RAYEES UL ISLAM, ARSHIED MANZOOR,
AND Z. R. AZAZ AHMAD AZAD

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Examining recent developments in the use of thermal and non-thermal food processing methods, this book offers a thorough technical analysis of different processing methods and their possible advantages in improving food safety, quality, and shelf life. It discusses the concepts and methods behind different processing techniques, as well as the effects on food components, sensory qualities, and microbial inactivation. This book also covers how contemporary issues such as sustainability, clean labeling, and food waste mitigation affect these processes. This book will be a valuable tool for industry professionals, providing the necessary resources to make informed decisions on how to effectively implement the latest thermal and non-thermal food processing techniques into their operations.

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Preface

Food processing technology has reached an exciting new frontier, as innovations from both traditional and emerging methods continue to redefine the parameters of quality, safety, and shelf life. This book, *Innovative Food Processing Techniques: Enhancing Safety, Quality, and Shelf Life*, was conceived to address the evolving landscape of food science, with a particular focus on the most recent advancements in novel processing techniques.

The journey to compile this comprehensive technical resource was driven by a desire to bridge gaps between academic theory and industrial application. By critically examining each method's principles, benefits, and real-world implementation, the aim is to empower professionals and learners to make informed decisions that maximize food integrity and consumer trust. The chapters are structured to introduce the fundamentals of conventional thermal processing before moving towards novel technologies that are increasingly shaping the future of food science. This balance allows readers to appreciate both the historical context and the ongoing innovations that continue to redefine food processing.

This book is made for food scientists, researchers, industry professionals, and students who are passionate about advancing processing techniques. It strives to serve not just as an informational guide but as a catalyst for innovation, encouraging readers to adopt and refine technologies that may shape the future of food preservation and safety.

It is hoped that this work inspires curiosity and collaboration, paving the way for safer, higher-quality, and longer-lasting food products worldwide. Grateful acknowledgement is extended to all researchers, collaborators, and mentors who have contributed their expertise and support throughout this endeavour. I would like to express my deepest gratitude to my parents for their unwavering support, to my wife for her encouragement and patience throughout the writing process, and to my son for being a constant source of joy and motivation.

Dr. Rayees Ul Islam

About the Editors

Rayees Ul Islam is an accomplished academic and researcher specializing in Food Processing Technology. He currently serves as an Assistant Professor in the Department of Post-Harvest Engineering and Technology at Aligarh Muslim University, Aligarh, Uttar Pradesh, India. Dr. Islam earned his Ph.D. in Post-Harvest Engineering and Technology from Aligarh Muslim University. He also holds a Master's degree in Food Engineering and a Bachelor's degree in Food Technology, providing him with a strong academic foundation in the discipline. Dr. Islam's academic and research journey spans over a decade, during which he gained extensive experience in both teaching and research. He has served as a Senior Research Fellow in the Livestock Products Technology Department at Lala Lajpat Rai University of Veterinary and Animal Sciences in Hisar, Haryana. Additionally, he has held positions as an Assistant Professor at various institutions, including Gautam Buddha University and Integral University, India. Throughout his career, Dr. Islam has made significant contributions to the field of food science and technology. His research contributions are wide ranging, covering areas such as optimization of food processing techniques, sustainable packaging solutions, utilization of food waste, development of fibre-enriched meat products, food nanotechnology, and application of plant derivatives in meat processing and packaging. His expertise extends to various subjects, including food processing and preservation, food chemistry, dairy products processing, unit operations in food processing, fruit and vegetable processing, meat and poultry processing, and food quality and safety engineering. Dr. Islam has served as a reviewer for esteemed journals such as *Food Hydrocolloids*, *LWT – Food Science and Technology*, *Meat Science*, *Journal of Herbal Medicine*, *Food and Bioproducts Processing*, *Journal of Food Process Engineering*, *International Journal of Food Science & Technology*, and *Journal of Food Processing & Preservation*, contributing to the peer-review process and ensuring the quality and rigour of scientific publications. His involvement as a reviewer demonstrates his commitment to advancing scientific knowledge and promoting excellence in research. Apart from his research endeavours, Dr. Islam has actively participated in conferences and workshops, presenting his work and engaging with fellow researchers. He has supervised several dissertations at the M.Tech. and M.Sc. levels, demonstrating his commitment to nurturing young talents in the field. He is also a Life Member of Association of Food Scientists & Technologists (India). With his vast knowledge and experience, Dr. Rayees Ul Islam continues to contribute to the advancement of the field of Food Processing Technology, striving to improve the quality and safety of food products through his research, teaching, and mentoring activities.

Arshied Manzoor obtained his B.Tech. in Food Technology from the Islamic University of Science and Technology, Jammu and Kashmir, India, and his M.Tech. in Agricultural Process & Food Engineering from Aligarh Muslim University, Uttar Pradesh, a highly ranked central university in India. He further pursued his Ph.D. at Aligarh Muslim University, during which he was granted two prestigious fellowships: the Senior Research Fellowship by the Indian Council of Medical Research (ICMR, New Delhi) and the Maulana Azad National Fellowship (JRF-MANF). Currently, he is a Postdoctoral Fellow at Khalifa University, Abu Dhabi, UAE, and has also served as a Postdoctoral researcher at United Arab Emirates University, UAE and Assistant Professor at Integral University, Lucknow, India. Dr. Manzoor imparts his expertise in various courses, including Meat, Poultry, and Fish Technology, Food and Nutrition, Food Plant Layouts, and Fruits and Vegetable Technology. Furthermore, he has contributed to academia by evaluating the theses of B.Tech. students from Shri Ramswaroop Memorial University. Dr. Manzoor's research focuses on the recovery of natural bioactive components from food waste using novel approaches, fabrication, and characterization of edible films through the valorization of agro-wastes, and preservation and shelf-life improvement of food products (meat/fruit) through the incorporation of bioactive compounds from agro-wastes. His work also involves exploring preservation techniques such as osmotic dehydration

assisted with microwaves for fruits and vegetables. His contributions to the field are evident through numerous research and review articles published in reputable national and international journals alongside two non-provisional and one provisional US patents. Additionally, he has authored several book chapters published by esteemed publishers. Dr. Manzoor has presented several papers at national and international conferences and serves as an editorial board member for the esteemed *International Journal of Food Science* and *Acta Scientific Nutritional Health*. Dr. Manzoor's expertise extends to being an active reviewer for leading journals in the field of Food Science and Technology, including *Food Chemistry*, *Carbohydrate Polymers*, *LWT*, *Meat Science*, *Food Production*, *Processing and Nutrition*, *Food Science and Nutrition*, *Quality Assurance and Safety of Crops & Foods*, and *Acta Scientific Nutritional Health*. Furthermore, he actively participates in national and international conferences, workshops, seminars, and webinars, which have contributed to his commendable expertise in the field. Dr. Arshied Manzoor is a dedicated researcher and educator, recognized for his significant contributions in the field of Food Science and Technology. His work in the recovery of bioactive components, fabrication of edible films, and preservation techniques has garnered attention and respect from the academic community. Through his publications, evaluations, and active participation in conferences, he continues to advance knowledge and inspire fellow researchers in the field.

Z.R. Azaz Ahmad Azad is a highly accomplished and esteemed academic, renowned for his expertise in Food Processing. He is an experienced professional with a career spanning 18 years in the food industry and academia. He is currently a Professor in the Department of Post-Harvest Engineering and Technology at Aligarh Muslim University (AMU), Aligarh, India. Additionally, he has worked as an Assistant Professor in the Department of Food Technology at Jamia Hamdard, Hamdard University in New Delhi, India. He has completed Ph.D. in Food Technology from AMU, Aligarh, in 2002 and holds an M.Tech. degree from the same institution. Dr. Azad has also acquired professional diplomas in Quality Control and ISO:9000, Environmental Science, ISO:22000, and Halal Certification and Accreditation. He has received training in Food Safety & Quality and is a certified Lead Auditor for Food Safety Management System (ISO:22000). Dr. Azad also has industry experience, having worked as a Production Manager at HAIL, Delhi, India, in 2007–2008. During this time, he was involved in export-oriented meat processing and worked in an HACCP and ISO-certified company (ISO 9001:2000, ISO:22000). From 2003 to 2007, he served as an Assistant Production Manager at the International Foodstuffs Co., UAE, where he worked in a processed meat plant that was accredited with HACCP and ISO:9000 by SGS, Dubai. Dr. Azad worked as a Senior Research Fellow and Research Associate at AMU, Aligarh, India, from 1997 to 2003. He has published numerous papers, abstracts, and book chapters in the field of food processing and preservation. Dr. Azad holds several memberships in professional associations, including the Indian Association of Food Technologists, the National Environmental Science Academy, the Nutrition Society of India, the Indian Meat Science Association, and the Indian Society of Agricultural Engineers. Dr. Azad has attended numerous conferences and seminars, and has supervised several M.Tech. dissertations and guided Ph.D. candidates.

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Irradiation of Foods

By Nuzhat Bashir, Mohammad Haris Siddiqui, Owais Yousuf

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ABSTRACT

Food irradiation is a food preservation technique that uses ionising radiation to eradicate harmful microorganisms, such as allergies and moulds, which contribute to food insecurity and malnutrition. This technique involves exposing food to a specific dose of radiation on a conveyor belt for a predetermined time using three types of radiation: X-rays, electrons, and gamma rays. Radiation dosages can be high, low, or medium, depending on the items to be irradiated and the target organism to be destroyed. Applications of radiation technology include inhibiting root and tuber emergence, defoliating grains and pulses, reducing or eliminating foodborne diseases in vegetables and animal products, and delaying fruit maturity. Each application aims to reduce food allergenicity and lengthen shelf life. Despite consumer concerns about the quality and safety of irradiated food, the adoption of this practice is growing owing to increased awareness and perceptions of quality and safety. With food irradiation becoming more widely accepted and commercialised, it has the potential to play a significant role in addressing global food insecurity and foodborne illness issues. Despite advancements in technology over the past decade, food loss remains a significant issue, with gastrointestinal disorders accounting for almost 30% of global mortality rates. Radiation can help guarantee food safety for both healthy and vulnerable consumers, meet quarantine

portation and commercialisation.

Irradiation of Foods

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