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Alternative Proteins

Food Security Considerations

มหาวิทยาลัยเทคโนโลยีราชมงคลพระนคร

ห้องสมุดสาขาโชติเวช



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Dedication

Alaa El-Din dedicates this book to Mona, the first member of the Bekhit family that consumed alternative proteins.

William dedicates this book to his four children and eight grandchildren – their future depends on a safe and sustainable food supply.

Malik dedicates this book to his father (late), mother, wife and three children (Afeef, Hassan and Zahra).

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Preface

Over the last decade, substantial research activities in food science have been dedicated towards prospecting and investigating physiochemical, nutritional and health properties of novel protein sources. This trend was fueled by predictions of increased human population and lack of a parallel increase in traditional animal protein sources (land and marine sources). These predictions should be revised in the light of the recent COVID-19 pandemic and an increase in civil unrest in many hotspots worldwide. One of the main drivers for the rise in novel proteins/novel foods research activities is linked to significant changes in young consumers' attitudes towards red meat consumption and their interest in new alternative protein products. This has led to important changes in the food market. For example, significant market growth has been observed in plant milk imitations (almond, rice, oat and soy varieties) instead of traditional cow, buffalo, sheep and goat milks. Similarly, several plant-based meat analogues and meat-free small goods have been developed and marketed (e.g., Impossible Foods, Quorn, Beyond Meat, and so on). Various novel protein sources have emerged at different levels of commercial uptake (e.g., edible insects, algae, microbial single cell and *in vitro* meat). Many of the new technologies investigating novel proteins are still at the concept stage with issues surrounding upscaling, safety and biosecurity, cost, waste management and consumer issues being major challenges to overcome before these products find their way to our dining tables. Cost and consumer acceptability are probably the most important factors that will influence the purchasing of these new protein products. It is expected that the protein shortage is likely to be more significant in low-income societies and thus affordability will be a key factor for accessibility and purchase of these products. A commonly unaccountable factor in scientific research, but very important for marketability of foods, is the religious status and permissibility of consumption and the cultural acceptability of such food products. This issue appears to be of significant importance to large portions of followers of certain faiths that may have declared restrictions on certain food sources (e.g., certain insects and animals) and in cultures where insects represent emotions of disgust, fear and disease-bearing. This book aims to provide a holistic evaluation of novel proteins by covering processing, nutritional, safety and, where necessary, the consumer and religious aspects of protein type. Chapter 1 introduces the drivers and motivations for novel proteins to examine the humanistic, environmental and epidemiological changes that underline the need for alternative sources to complement, and in some cases, replace traditional protein sources. Several chapters have been dedicated to some of the well-known protein sources, such as plants (Chapter 2), single-cell proteins (Chapter 3), non-traditional meat sources (Chapter 8) and marine wastes (Chapter 10). Other chapters are dedicated to protein sources that have been known and consumed in certain localities and now are being heavily investigated and proposed for international markets, such as algae (Chapter 4), edible insects (Chapter 5) and meat co-products (Chapter 11). Chapter 9 examines the recent updates on *in vitro* meat, a technology that enjoys large publicity worldwide. A special focus has been placed on the religious aspects of this technology. This book also reviews two novel protein sources that have not been considered previously (snails in Chapter 6 and keratin in Chapter 7). Comprehensive accounts of their nutrition and potential utilization have been provided as well as their safety and health aspects. Separate information has been presented on the safety requirements (Chapter 12) and risks associated with novel proteins (Chapter 13).

It was the aim of the editors to provide industry and academia up-to-date views on opportunities and considerations of hindrances that face these novel proteins. While several options are available for the international community to tackle the predicted future protein shortage and address several ethical and sustainability issues, we believe the current situation is as Linus Pauling described: *'The picture is, however, still very far from definite - she suggests various alternatives and does not make any definite predictions.'*

Alaa El-Din A. Bekhit
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About the Editor

Alaa El-Din A. Bekhit, PhD, earned his PhD in Biochemistry from Lincoln University, New Zealand in 2004. His PhD research investigated the role of metmyoglobin reducing activity in the maintenance of fresh meat colour. He obtained his MSc in Food Process Engineering from the University of Reading, UK, in 1994.

Dr. Bekhit is an Associate Professor at the Food Science Department, University of Otago, New Zealand. He also holds an Honorary Distinguished Professor post in the Food Science and Pharmacy College, Xinjiang Agricultural University; and the Chinese Academy of Agricultural Sciences (CAAS); Honorary Associate Professor in College of Food and Agricultural Sciences, King Saud University, Kingdom of Saudi; and Adjunct Associate Professor in Faculty of Agriculture and Life Sciences, Lincoln University, New Zealand. He has been active in studying meat quality and muscle foods for 29 years. He published more than 200 research articles, 50 review articles and >40 book chapters. Aladin led several major research projects that aimed at understanding composition, biochemistry, functionality and potential applications of proteins from oilseed cakes, whey, blood, snails and wool. He also carried out several projects on the quality of muscle foods and the processing of co-products such as animals offal and fish roe.

William W. Riley, PhD, was awarded his PhD in Nutritional Biochemistry from Cornell University, his MSc in Exercise Physiology from the University of Tennessee and his BSc in Physical Education from the University of Massachusetts.

Dr. Riley worked as a National Institutes of Health Postdoctoral Fellow in Biochemistry at the University of Minnesota, in Austin, Minnesota. Since then, he has served as an Assistant Professor in the Department of Food and Nutrition at North Dakota State University, a Senior Clinical Research Associate in the Medical Department, at Ross Laboratories in Columbus, Ohio, and as a Research Associate and Lecturer in the Department of Zoology, University of Manitoba, Winnipeg, Canada. From 1993–95, Dr. Riley held the position of Adjunct Professor in the Department of Food and Nutrition at the University of Manitoba while serving as Vice President, Research and Development with the Canola Council of Canada in Winnipeg.

In 2006, Dr. Riley moved to China and assumed the position of Professor, Food Quality and Safety in the International School at Jinan University. He has also worked within the animal feed and veterinary pharmaceutical industries while living in Guangzhou and Nanjing, having served in various technical consulting roles for Chinese and foreign companies. At present, he is serving as Professorial Lecturer in the Department of Food Science and Nutrition at the University of the Philippines-Diliman, and as Technical Consultant to a number of Asian and North American companies.

Malik A. Hussain, PhD, is a food microbiologist and an active food professional. He holds a PhD degree in food microbiology from the University of Melbourne (Australia) and a master's in food technology from the University of Agriculture Faisalabad (Pakistan) with distinction. He was awarded OECD Fellowship 2014 to work on a collaborative research project at Guelph Food Research Centre, Canada. Over more than 20 years, he has worked on several academic, research, technical and industrial positions in different countries including Australia, Canada, New Zealand and Pakistan.

In academia, he has extensive experience in food science teaching and research supervision at world-renowned universities (i.e., the University of Melbourne, Australia; Queensland University of Technology, Australia; Lincoln University, New Zealand, University of Sydney, Australia). As a food safety expert, he worked at world-leading agencies (i.e., NSW Food Authority, Sydney, Australia; Agriculture and Agri-Food, Canada) in food safety regulation, risk assessment, food

policy and standards development. He was the former associate director at the Centre for Food Research and Innovation (CFRI) of Lincoln University. Dr Hussain completed a variety of industry-led projects on the development of functional foods (probiotics), food safety and microbial proteomics. His research interests are to improve applications of probiotics through understanding the microbial physiology and stress responses. He has published more than 100 scholarly documents in food science area and over 50 conference abstracts. He is the founder and initiator of Asia-Pacific Probiotics workshops in the region. He is an executive director of Asia-Pacific Institute of Food Professional (APIFP). He maintains memberships of several professional associations and sits on scientific committees of many international conferences and symposiums.

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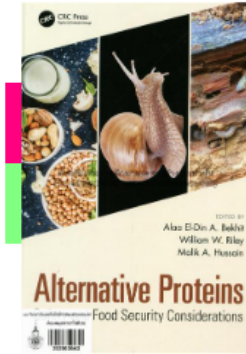
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