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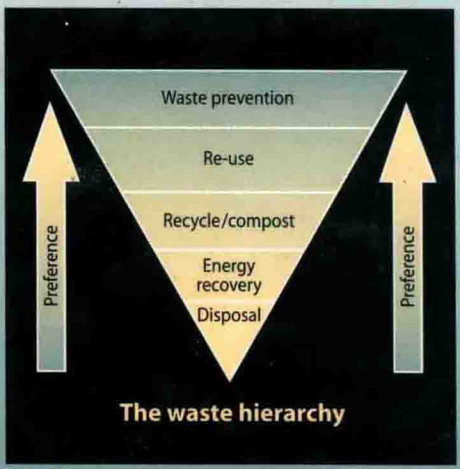

Handbook of waste management and co-product recovery in food processing

Volume 1

Edited by Keith Waldron

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Preface

The global intensification of agriculture and food production has led to the creation of vast quantities of food co-products and wastes, often in centralised locations as food processors seek to achieve economies of scale. Typically, the food industry produces considerable amounts of biodegradable wastes, including large volumes of effluent and residues with a high biological oxygen demand (BOD) and chemical oxygen demand (COD) content. Their uncontrolled spoilage and decomposition lead to the production of methane and other toxic moieties that are environmentally hazardous. In Europe alone, over 220 million tonnes of food-related waste are disposed of annually.

As a consequence of increased environmental awareness, the food industry is facing mounting pressures to reduce food processing and related wastes, for example in the form of legislation such as the EU Council Directive 1999/31/EC on the landfill of waste. Such pressures have contributed to an increase in costs of disposal and a reduction in landfill availability in many member states. Hence, methods to (a) reduce waste production, (b) valorize unused co-products, and (c) improve the management of unavoidable wastes, are becoming increasingly important to the food industry. Coincidentally, there is an increasing body of scientific literature relevant to exploiting food processing co-products. However, much of it is published in journals that do not focus specifically on this topic. This makes it more difficult for food technologists and industrialists to evaluate the 'state-of-the-art', and to exploit knowledge and expertise currently available.

It is in this context that the *Handbook of waste management and co-product recovery in food processing* has been conceived. The current volume

comprises contributions from an array of internationally recognized experts who have reviewed the latest developments in this area, with special reference to optimizing manufacturing processes to decrease waste, understanding how to reduce energy and water loss, and methods that may be used to valorize co-products.

The book provides expert opinion on topics relevant to the minimization of waste, and maximization of co-product recovery in food processing. There are five parts:

Part I Key drivers for waste management and co-product recovery in food processing

This section provides an introduction to the subject, with special reference to the principal drivers. These include legislative pressures (Chapter 1) and the interests of the consumer (Chapter 2).

Part II Optimizing manufacturing to minimize waste in food processing

This section focuses on the minimization of waste, both in terms of biowaste and efficient energy management. Chapter 3 highlights the importance of chain management and good housekeeping practices. Such management is important in reducing instances of irregular waste production that arise from managerial and technical problems. The waste is usually 'one-off' in nature, and hence is difficult to upgrade because of the absence of a regular co-product, thus negating any opportunities for economies of scale. This chapter also emphasizes chain management from an environmental and life-cycle analysis perspective. Chapter 4 explores the potential for minimization of energy use in food processing, highlighting the energy-intensive nature of the industry. For example, a typical energy requirement for the delivery of 1 J in the form of food consumes almost 10 J from natural resources. Chapter 5 completes Part II by evaluating opportunities to minimize water use and wastage. Such activities have the concomitant knock-on effect of reducing the effluent production, thereby reducing the requirement for additional treatment.

Part III Key issues and technologies for food waste separation and co-product recovery

This is a broad section bringing together expert opinion on research and technology associated with stabilization, fractionation, extraction and filtration of waste streams. Chapter 6 focuses on the microbiological stabilization of food processing waste which is fundamental to retaining food-grade quality characteristics and ensuring that maximum value can be obtained from subsequent processing activities. The chapter introduces the importance of HACCP development, not only before and during stabilization but during subsequent exploitation. Chapter 7 extends the concept of stabilization by considering the autolytic and natural deteriora-

tion of waste materials of biological origin once they have been damaged or taken out of their natural environment. Chapter 8 provides a general overview of combination processes that may be used in disassembling co-products – taking into account their structural, chemical and biochemical heterogeneity – whilst Chapter 9 looks at the use of biochemical routes for extraction and waste exploitation. This is followed by an evaluation of modern separation technologies. Chapter 10 explores supercritical CO_2 methods whilst Chapter 11 highlights the emerging and rapidly growing arena of membrane filtration technologies. This part is then completed by Chapter 12 on separation technologies used for food wastewater treatment, with special reference to the recovery of valuable products and water recycling.

Part IV Waste management in particular food industry sectors and recovery of specific co-products

The aim of this section is to provide specific examples of waste management in the main food processing sectors of meat-, fish- and plant-derived co-products. Chapter 13 provides a comprehensive account of waste management and co-product recovery in red and white meat processing, highlighting the difficulties encountered during the past decade due to legislation and food safety concerns. Chapter 14 focuses on dairy processing, an arena that has demonstrated huge improvements in efficiencies during the past 20 years; Chapter 15 gives a general overview of waste management and co-product recovery in fish processing. The remaining chapters in this section relate to the exploitation of plant-based wastes: Chapter 16 reviews the recovery and exploitation of trimmings and pulps from fruit and vegetable processing with emphasis on cell-wall polymer exploitation; Chapter 17 focuses on the extraction and exploitation of intracellular phytochemicals, revealing their potential for use in functional foods and pharmaceuticals. Chapter 18 takes this concept further by extending it into the cosmetics and pharmaceuticals arena. Chapter 19 explores the non-food exploitation of phytochemicals in relation to the production of natural dyes from food processing wastes, and Chapter 20 completes Part 4 by considering the problems of waste and co-product exploitation in the vegetable oil processing industry.

Part V Minimizing disposal: wastewater and solid waste management in the food industry

The final part of the book considers research and development and technologies relevant to the disposal of food processing wastes. Chapter 21 explores the treatment of wastewater generally with emphasis on general macro pollutants, COD, BOD, suspended solids, etc., and introduces anaerobic and aerobic treatments. Chapter 22 evaluates the technologies available for dewatering solid food processing waste streams, including

the use of modern electric field enhancement; Chapter 23 takes the anaerobic concept further by looking at the potential for generating a return on the waste through energy recovery in the form of biohydrogen production.

Keith Waldron

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