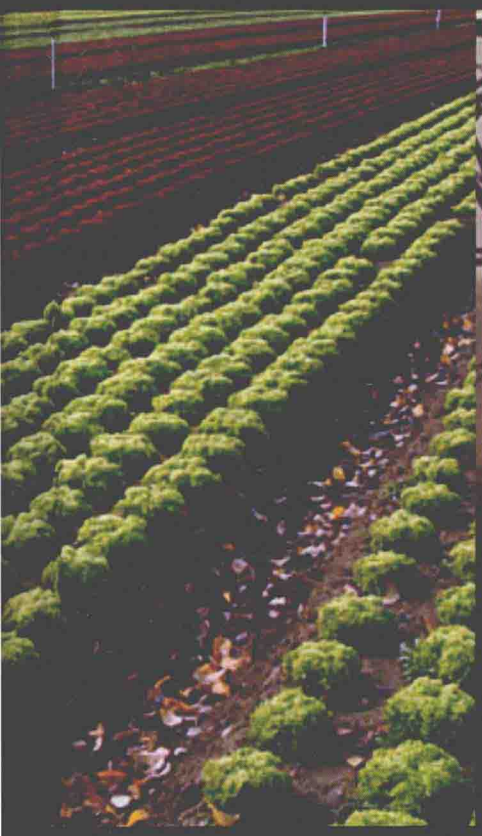
Second Edition

The Produce Contamination Problem

Causes and Solutions



Edited by

Karl R. Matthews, Gerald M. Sapers and Charles P. Gerba

Food Science and Technology, International Series

The Produce Contamination Problem

Causes and Solutions

Second Edition

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The Produce Contamination Problem

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Preface

The premise of the book is that once human pathogen contamination of fresh produce occurs, it is extremely difficult to reduce pathogen levels sufficiently with currently available technologies based on washing with sanitizing agents to assure microbiological safety. Outbreaks since the first edition of this book was published have been attributed to consumption of fresh commodities including but not limited to cantaloupes, mangoes, tomatoes, seed sprouts, and salad greens. Globally extensive research, published in thousands of scientific papers and documents, has focused on the microbiological safety of fresh produce. Disinfection methods whether conventional or based on new innovative technology fail to reduce pathogen loads on produce to levels consistent with product safety.

Produce decontamination methods are surprisingly similar in the level of reductions in pathogens they achieve. Methods that are effective, irradiation and high pressure, are either not accepted by a large segment of consumers or not practical for all types of fresh produce. The intrinsic interaction of microbes with plant tissues, internalization, biofilm formation, and association with inaccessible sites contributes to the insufficient reduction in microbial populations to assure product safety. The key to improving the microbial safety of fresh products is the development of wiser strategies to avoid human pathogen contamination of the products rather than focusing on disinfection technologies with limited efficacy.

Escherichia coli O157:H7 and *Salmonella* continue to be associated with outbreaks of illness linked to the consumption of fresh produce. Recently, a large outbreak in Europe was linked to consumption of fenugreek sprouts contaminated with *Escherichia coli* O104:H4. The serotype was not commonly associated with foodborne illness outbreaks. The pathogen was particularly virulent, causing high morbidity and mortality. In 2013 in the U.S. a large *Cyclospora* outbreak was attributed to an imported salad mix. The outbreak was unusual given the pathogen involved and the size. The specific sources, workers, irrigation water, soil amendments, flooding of fields, of the pathogens remain elusive.

The success of the first edition encouraged us to move forward with a second edition, with contributors who are experts in the area of food safety and produce production, harvesting, packing, and fresh-cut processing, to provide a critical problem-oriented look at produce contamination and its avoidance.

The book is organized into four sections. New chapters have been added and each chapter revised to include the latest information. In the first section, the scope and sources of contamination are covered. Chapters focus on microbial interaction with plant tissue and the limitations of present decontamination methods. Five chapters focus on major sources of contamination – manure, air, water, and wildlife – and examine where and how during crop production, harvesting, packing, or fresh-cut processing these sources might contaminate fresh produce.

In the second section, commodities associated with outbreaks (leafy vegetables, melons, tomatoes, tree fruits and nuts, and berries) are each examined to determine

what intrinsic characteristics or production practices make them especially vulnerable to contamination. A chapter on seed sprouts was added to the second edition; the issues surrounding the microbial safety of this commodity group are underscored by the large outbreak in Europe linked to contaminated seed sprouts.

Chapters in the third section provide international perspective on produce contamination issues, focusing on outbreak trends, marketing and distribution practices, produce imports and exports, governmental agencies and regulations concerned with produce safety, and avoidance of contamination through application of Good Agricultural and Manufacturing Practices and guidance documents.

In the fourth section, technology for reduction of human pathogens in fresh produce is examined. Current technology for produce disinfection by washing and application of sanitizing agents is described. The prospects for technological advances in rapid detection and inactivation of microbial contaminants on produce are examined. The book ends with a chapter summarizing conclusions and recommendations for reduction in the risk of human pathogen contamination of fresh produce.

I am grateful to my coeditors, Dr. Gerald M. Sapers and Dr. Charles P. Gerba, for their many contributions and insight, which made this edition distinctive. Although only our names appear on the cover of the book, many people have made important contributions to it. We acknowledge the subject experts whose insights regarding produce contamination contribute to making each chapter of this book a well-written, comprehensive, and up-to-date examination of their respective topics.

We express our gratitude to all of these people as well as Carrie Bolger and Nancy Maragioglio at Elsevier for the enthusiastic support of this project and their great patience in dealing with our difficulties in meeting major deadlines.

Karl R. Matthews, Editor

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