FOOD AND NUTRITION AT RISK IN AMERICA: FOOD INSECURITY, BIOTECHNOLOGY, FOOD SAFETY, AND BIOTERRORISM

Sari Edelstein, PhD, RD
Department of Nutrition
Simmons College

Bonnie L. Gerald, PhD, DTR
Department of Nutrition and Food Systems
University of Southern Mississippi

Tamara M. Crutchley Bushell, PhD
Department of Microbiology
University of Alabama at Birmingham

Craig Gundersen, PhD
Human Development and Family Studies Department
Iowa State University

With Preface by: Alison Harmon, PhD, RD, LN
Health and Human Development
Montana State University
DEDICATION

To my husband, Marc, and my children, Staci, Jodi, and Sebastien.
Sari Edelstein

To my husband Mike, my parents Peter and Charlotte Hackes, and my brother Lee Miller.
Bonnie Gerald

To my husband, Christian.
Tamara M. Crutchley Bushell

To my wife, Lisa, and my children, Diego, Faith, and Van.
Craig Gundersen

Thanks to: Mike Brown, Katey Birtcher, Tracey Chapman, and Dawn Browder.
CONTENTS

List of Tables xi
List of Figures xiii
Foreword xv

Chapter 1: Is America at Risk? 1
Sari Edelstein, PhD, RD

Food Safety 2
Biotechnology and Genetically Modified Foods 5
Food Insecurity 6
Agro/Bioterrorism 7

Section One: Food Safety and Biotechnology 13

Chapter 2: Foodborne Illness-Causing Pathogens 15
Bonnie L. Gerald, PhD, DTR

Types of Pathogens: Bacteria 18
Bacterial Infection: Listeria monocytogenes 18
Bacterial Infection: Salmonella spp. 19
Bacterial Infection: Shigella spp. 19
Bacterial Infection: Streptococcus pyogenes 20
Bacterial Infection: Yersinia enterocolitica 20
Bacterial Intoxication: Clostridium botulinum 21
Bacterial Intoxication: Clostridium perfringens 21
Bacterial Intoxication: Bacillus cereus 22
Bacterial Intoxication: Staphylococcus aureus 22
Bacterial Intoxication: Escherichia coli 23
Bacterial Infection: Campylobacter jejuni 23
Bacterial Intoxication: Vibrio vulnificus, Vibrio parahaemolyticus 24

Types of Pathogens: Viruses 25
Viral Gastroenteritis: Norovirus 25
Viral Gastroenteritis: Rotavirus 26
Viral Infections: Hepatitis A Virus (HAV) 26

Types of Pathogens: Parasites 27
Parasitic Roundworms: Trichinella spiralis 27
Chapter 8: The Consequences of Food Insecurity in the United States

Craig Gundersen, PhD

Descriptions of the Differences in Health Outcomes by Food Insecurity Status for Children in the United States

Studies of the Consequences of Food Insecurity in the United States

Dietary Intakes by Food Insecurity Status

Effects of Food Insecurity on Birth Outcomes

Effects of Food Insecurity on Child Health Outcomes

Effects of Food Insecurity on Depression and Anxiety

Food Insecurity and Child Behaviors

Is There a Relationship between Food Insecurity and Childhood Obesity?

Chapter 9: Food Assistance Programs in the United States

Craig Gundersen, PhD

Food Stamp Program

History

Eligibility Criteria

Nonparticipation by Eligible Persons

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

History

Eligibility Criteria

Research on the Benefits of WIC

National School Lunch Program

History

Eligibility Criteria

National School Breakfast Program

History

Eligibility Criteria

The Emergency Food Assistance Program (TEFAP)

History

Eligibility Criteria

Section Three: Food and Bioterrorism

Chapter 10: Intentional and Unintentional Contamination of the Food Supply

Tamara M. Crutchley Bushell, PhD

Key Vulnerabilities in the Food Supply
Contents

Recognition of Foodborne Illnesses Associated with Intentional Contamination 174
Cases of Intentional Contamination Involving Food Items in the United States 175
Intentional Acts of Contamination Perpetrated by Two or More Individuals 176
Intentional Acts of Contamination Perpetrated by One Individual 178
Intentional Acts of Contamination by Unknown Perpetrator(s) 180
Naturally Occurring Foodborne Disease in the United States 181
Reporting of Foodborne Disease Outbreaks (FBDOs) in the United States 181
Foodborne Disease Outbreaks (FBDOs) Caused by Unintentional Contamination 184
Foodborne Disease Outbreaks (FBDOs) in the United States Between 1983 and 2006 184

Chapter 11: Key Issues Associated with Foodborne Disease Outbreaks 211
Tamara M. Crutchley Bushell, PhD

Food Safety Begins on the Farm 214
Significance of Pathogen Carriage in Livestock, Poultry, and Crops 215
Significance of Pathogen Carriage in Crops 217
Antimicrobial Resistance 219
Globalization of the Food Supply 224
Fresh Produce and Globalization 225
Fish/Seafood and Globalization 226
Federal Oversight of Surveillance and Regulatory Control 227
Federal Oversight 228
Regulatory Enforcement Authority 230
Federal Expenditures on Food Safety Activities 231
Surveillance 232
Federal Recall Authority 232

Chapter 12: Principles and Application of the Hazard Analysis and Critical Control Points 243
Tamara M. Crutchley Bushell, PhD

The Seven HACCP Principles 246
Guidelines for the Application of the HACCP System 249
LIST OF TABLES

Table 1.1 Average Annual Hospitalizations and Deaths for Gastrointestinal Illness by Diagnostic Category, National Hospital Discharge Survey, 1992 to 1996
Table 1.2 Summary of Inventory for Federal Food Safety Research
Table 1.3 Percentage of Respondents Identifying Each Pathogen as among the Top Three Causes of Foodborne Illness and Estimated Percentage of Foodborne Illnesses in the United States Actually Caused by Those Pathogens
Table 2.1 Foods Implicated with Foodborne Illness
Table 2.2 Foodborne Illnesses
Table 2.3 Federal Agencies and Web Sites with Food Safety Responsibilities
Table 4.1 Federal Agency Food Safety Responsibilities
Table 5.1 Primary Packaging
Table 5.2 Genetically Modified Food Products: Benefits and Controversies
Table 6.1 Food Insecurity Questions in the Core Food Security Module
Table 6.2 Food Insecurity for American Indians and Non-American Indians
Table 6.3 Food Insecurity for American Indians and Non-American Indians, Households with Incomes Below 185% of the Poverty Line
Table 10.1 Foodborne Illness Outbreaks
LIST OF FIGURES

Figure 1.1 Relative Rates Compared with 1996 to 1998 Baseline Period of Laboratory-Diagnosed Cases of Infection with *Campylobacter*, *Escherichia coli* O157, *Listeria*, *Salmonella*, and *Vibrio*, by Year—Foodborne Diseases Active Surveillance Network, United States, 1996 to 2004

Figure 1.2 Relative Rates Compared with 1996 to 1998 Baseline Period of Laboratory-Diagnosed Cases of Infection with the Five Most Commonly Isolated *Salmonella* Serotypes, by Year—Foodborne Diseases Active Surveillance Network, United States, 1996 to 2004

Figure 1.3 Traditional Plant Breeding and Modern Plant Breeding (Genetic Engineering)

Figure 1.4 Top Three Genetically Engineered Crops in the United States (2003)

Figure 1.5 US Households by Security Status, 2002

Figure 5.1 Farm to Fork

Figure 6.1 Food Insecurity Rates, 2001 to 2005

Figure 6.2 Food Insecurity Rates, Households with Children, 2001 to 2005

Figure 6.3 Food Insecurity Rates, Households without Children, 2001 to 2005

Figure 6.4 Food Insecurity Rates, Incomes <200% of the Poverty Line, 2001 to 2005

Figure 6.5 Food Insecurity Rates, Incomes <200% of the Poverty Line, Households with Children, 2001 to 2005

Figure 6.6 Food Insecurity Rates, Incomes <200% of the Poverty Line, Households without Children, 2001 to 2005

Figure 7.1 Food Insecurity Rates by Income Categories

Figure 7.2 Food Insecurity Rates by Racial Categories

Figure 7.3 Food Insecurity Rates by Hispanic Categories

Figure 7.4 Food Insecurity Rates by Marital Status

Figure 7.5 Food Insecurity Rates by Home Ownership Status

Figure 7.6 Food Insecurity Rates by Metropolitan Status
Figure 7.7 Food Insecurity Rates by Age of Household Head
Figure 7.8 Food Insecurity Rates by Employment Status of Household Head
Figure 7.9 Food Insecurity Rates by Region of Country
Figure 7.10 Food Insecurity Rates by Education Level of Household Head
Figure 7.11 Food Insecurity Rates by Presence of Children
Figure 8.1 Percentage of Children with Asthma by Food Insecurity Status
Figure 8.2 Percentage of Children with ADD by Food Insecurity Status
Figure 8.3 Percentage of Children with a Learning Disability by Food Insecurity Status
Figure 8.4 Percentage of Children with an Ear Infection by Food Insecurity Status
Figure 8.5 Percentage of Children with a Headache by Food Insecurity Status
Figure 8.6 Percentage of Children Missing Five or More Days of School by Food Insecurity Status
Figure 8.7 Percentage of Children Missing 10 or More Days of School by Food Insecurity Status
Figure 8.8 Percentage of Overweight Children by Food Insecurity Status
Figure 8.9 Percentage of At Risk of Overweight or Overweight Children by Food Insecurity Status
Figure 8.10 Percentage of Children in Excellent Health by Food Insecurity Status
Figure 8.11 Percentage of Children in Excellent or Very Good Health by Food Insecurity Status
Figure 8.12 Percentage of Children in Excellent, Very Good, or Good Health by Food Insecurity Status
Figure 12.1 Logic Sequence for the Application of HACCP
Figure 12.2 Example of Decision Tree to Identify CCPs
Food seems simple. It is a necessary part of our lives every single day. When abundant, it is easy to take food for granted, but occasionally we are reminded of its importance and its costs. Questions related to food safety, security, and the implications of new technologies are complex ones. Students of food and nutrition, food science, and public health need to be skilled at considering complex questions. Is our food safe? This is a question that is on the minds of many consumers today. Food safety exists on several levels. Is our food free of pathogens? Is our food free of components that increase our risk for chronic disease? Does our food provide adequate amounts of essential nutrients and contain additional compounds that prevent disease and promote health?

Food dangers arise when food is scarce or when not everyone has safe or socially acceptable ways to access food. We need to strive for food security as families, communities, as a nation, and as a global society. There are different approaches to achieving global food security. Should every small village or community be self-reliant, producing food with limited inputs on a small scale? Or should we specialize and trade for foodstuffs, centralizing and industrializing food production and relying on inexpensive fuel to transport it? These strategies are both employed in the world today, as are many scenarios that fall somewhere in between.

The challenge for those in our food and healthcare systems is in determining where to strike a balance for maximum food safety and food security. When news reports tell of product recalls or foodborne illness outbreaks related to the industrial food system, many consumers start looking for food produced closer to home, by people they know. When midwinter limits the variety of local foods or when convenience is perceived as a necessity, consumers are in turn drawn toward the globally and industrially supplied supermarket.

It is easy to appreciate both the freshness and flavor of local food and the variety and convenience of industrial food. Students and professionals alike will be able to critically evaluate the advantages of
each in view of their costs. The industrial food system, for example, has done much to ensure that we have an abundant and affordable supply of food, thus improving the quality of our lives. Which gains have been worth their costs (i.e., costs for the environment; costs for agricultural communities, culture, and traditions; and costs for our long-term public health)?

Understanding food issues entails understanding trade-offs on both personal and societal levels. When does having immediate food safety compromise our long-term health? Does selecting particular vegetable varieties that are durable for transportation compromise the nutrient density and flavor of the food? What intrinsic qualities of food are lost when they are mass produced? How has the mass production of a few crop varieties in monocultures threatened long-term food security, which is dependent on ecological diversity? How have our agricultural advances made the food system vulnerable to interruption by terrorists? When are sustainability, food safety, and food security at odds?

One of the roles for those charged with responsibilities for our food supply and nutritional status is helping individual clients as well as broader populations understand how to make good food choices. Having choices related to food is a blessing when we understand the power they hold. Our food choices determine, in part, how healthy we will be as individuals. They also can affect our communities and the surrounding landscape. Ultimately our food choices will shape the future food system, its safety, and security. What do we value about food? How do our choices enact those values? Food is not so simple after all. This text will be a tool to help educators train future food and nutrition professionals to critically consider complex questions about food safety, food security, food technology, and the food system as a whole. For those already at work in the field, this book will serve as a valuable reference concerning this most critical issue.

Alison Harmon, PhD, RD, LN
Health and Human Development
Montana State University