

# FOOD FUNDAMENTALS

TENTH EDITION



MARGARET McWILLIAMS

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# FOOD FUNDAMENTALS

TENTH EDITION

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**Library of Congress Cataloging-in-Publication Data**

McWilliams, Margaret.

Food fundamentals / Margaret McWilliams.—10th ed.

p. cm.

ISBN-13: 978-0-13-274773-8 (alk. paper)

ISBN-10: 0-13-274773-1 (alk. paper)

1. Food. 2. Cooking. I. Title.

TX354.M28 2013

641.3—dc23

2011048701

10 9 8 7 6 5 4 3 2 1

**PEARSON**

ISBN 10: 0-13-274773-1  
ISBN 13: 978-0-13-274773-8

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# Preface

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The food scene today is dynamic and evolving. Emphasis is not only on eating less to achieve and maintain a healthy weight but also on changes in menu choices. Attention today is focused on eating more fresh fruits and vegetables, substituting olive and other oils for solid fats and reducing total and *trans* fats, choosing more seafood and poultry and less red meat, shifting to whole grains, and reducing sodium and sugar. Increased physical activity and awareness of food safety are the other changes recommended to promote good health. I have written this tenth edition to focus on these priorities.

The nation's focus on weight control makes this a particularly appropriate time to be preparing for a career in the world of food. Considerable attention is being directed toward the safety of our food, its preparation and consumption, and ultimately its effect on health and well-being. Not surprisingly, such a broad field has many specializations and career objectives, but they share the common objective of preparing foods to bring optimum health and pleasure to consumers. Few areas of study afford people such broad opportunities to be of service and benefit to others. Yet another benefit is that the strong academic preparation for careers involving food can be the basis for making personal lifestyle choices that promote healthy and fulfilling lives.

Professionals in any aspect of the food industry need to know the fundamentals of foods and their preparation. Whether your future career will include responsibilities for feeding individuals or large groups of people, research and development of new food products, marketing, or oversight, you will need to use the broad range of information covered in this book. This foundation provides an invaluable perspective for approaching and solving the challenges you will face in your career.

This text provides a broad foundation for studying and working with food. The scientific bases for practices and procedures are integrated with discussions on ingredients as sources of nutrients and as components of products. The effects of preparation techniques are discussed in the context of the science underlying various aspects of preparation: manipulation, ingredients and ratios, effects of heat and cold, storage, preservation, and evaluation. In today's world, this curriculum needs to include foods from cultures around the world. A broader cultural perspective is provided by the feature "Cultural Accents" and by illustrations of exotic foods from distant countries.

Several study aids are included to assist you in your study. A chapter outline and "Key Concepts" introduce each chapter and provide a road map to the subjects that are discussed. Key words defined in the margin and an extensive glossary are aids to expanding your professional vocabulary. The "Science Note" boxes are of particular interest to readers wishing to develop a deeper understanding of the science that underlies what is happening in the laboratory. The "Industry Insight" feature brings some industrial applications into the picture. Numerous illustrations enhance understanding of various topics throughout. "Judging Points" for many products are included to emphasize the importance of product evaluation and the knowledge needed to improve them. Web addresses are included to guide students to accurate, pertinent information on the various topics being studied. The summary at the end of each chapter provides a review of the key topics discussed. Study questions reinforce the learning process.

Chapter 2 (Nutrition and Food) has been revised based on the 2010 *Dietary Guidelines for Americans* and MyPlate. These recommendations regarding changes in food choices and improvements in assuring safety have been incorporated in many of the chapters, particularly Chapter 3 (Food Safety). Emphasis on eating a variety of foods underscores the importance of building a broad base of knowledge about less



familiar ingredients. Many new black and white as well as color photographs have been added to translate unusual food names into reality. Information on healthy food choices and labeling is incorporated in appropriate chapters (e.g., vegetarian diets in Chapter 13 and gluten-free products for people with celiac disease or severe allergies in Chapter 15).

Just in case you are hungry for real food as well as for information about it, you will find my laboratory manual *Illustrated Guide to Food Preparation*, Eleventh edition, to be a useful ingredient in your study and a treasure in your kitchen. You might also enjoy my book *Food Around the World: A Cultural Perspective*, Third edition. These are also Prentice Hall publications.

—Margaret McWilliams  
Redondo Beach, California

# Acknowledgments

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Once again, it is a real privilege to say a heart-felt “thank you” to Pat Chavez. Her sharp eyes and professional expertise helped greatly in eliminating the confounding typos that can so easily pop up in the bound book. She also teamed with me to prepare and photograph some of the new pictures in this edition. Her ideas, culinary skills, and artistic sense are evident in the salad photos.

Special thanks for their very helpful suggestions go to my excellent reviewers. They are Alexandria Miller, Northeastern State University; Sarah Murray, Missouri State University; Marci Smith, Brigham Young University; Jay Sutcliffe, Chadron State College; and Mary Wilson, Eastern Kentucky University.

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# FOOD FUNDAMENTALS

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# Section One

## Foundation for Food Study

CHAPTER 1  
**Food for Today**

CHAPTER 2  
**Nutrition and Food**

CHAPTER 3  
**Food Safety**



Thai shrimp arranged on a petal from a banana blossom are a healthful, tempting dish. Courtesy of Plycon Press.

# 1

## Food for Today

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### INTRODUCTION

Are you eating to live or living to eat? Your answer probably indicates that both of these choices play a role in your life. Of course, it is necessary to eat a diet that supports health, and it also is possible for that food to bring considerable pleasure and added interest to your life. Our global food supply and the ways in which these ingredients are prepared have greatly expanded menu choices. Never before have there been so many opportunities for creating menus and dishes to enhance the joy of the dining table.

Your study of food and the science underlying its preparation will lead to culinary success and set the stage for a lifetime of good eating. It also will broaden your knowledge of ingredients and products to provide a strong foundation for your professional career. Clearly, this is a win–win course of study.

The ultimate goal of food preparation is to create dishes that please diners while providing the nutrients needed for good health. This may sound simple, but success comes from applying scientific principles to the procedures and techniques used in cooking. Ingredients of high quality in the hands of a creative chef are the prelude to dining pleasure (Figure 1.1). Well-prepared food satisfies all the senses and adds pleasure to the day. On the other hand, eating can seem boring or simply a matter of survival if the quality of preparation is poor.

Unfortunately, food can even threaten survival if viable hazardous microorganisms are present. Food must be prepared in a sanitary environment with careful attention paid to personal hygiene habits of workers, cleanliness of work surfaces and utensils to avoid **cross contamination**, and temperature control. Food-borne illnesses (Chapter 3) have been traced to a wide spectrum of sources ranging from produce contaminated in the field to outbreaks due to inadequate heating and/or refrigeration. All food handlers need to be vigilant to maintain food that is safe, whether in a commercial setting or in the home.

### Key Concepts

1. Food professionals coordinate knowledge of food behaviors (e.g., nutritional needs, health issues related to diet) with preparation and evaluation of foods that meet consumer preferences and needs.
2. Food that is prepared well and presented attractively appeals to all the senses and adds significantly to the pleasure of life.
3. People have a wide variety of choices regarding what, where, when, and how much they eat (e.g., food prepared at home, carry-out items, and commercial establishments ranging from fast-food franchises to fine restaurants).
4. Food choices have a significant impact on people's health over a period of time.
5. Subjective (sensory) and objective testing are key components of developing products and evaluating food.
6. Various career paths based on food are available to today's graduates.

#### **cross contamination**

Introduction of microorganisms to a food when it comes in contact with a surface contaminated previously by another food.



**Figure 1.1**

Chefs are often a source of creative menu ideas. Courtesy of Plycon Press.



## FOOD PATTERNS

Food professionals need to be in tune with the way people are choosing to eat, so food in the marketplace and in commercial venues will meet expectations for palatability and safety. Because patterns and preferences change, there is a continuing need for surveying and reviewing the food scene on an ongoing basis. This chapter highlights various aspects that shape and modify what people select to eat, changes that significantly influence food preparation and selection.

Americans have a remarkable number of choices when they eat (Figure 1.2). Their patterns are extremely varied in number of meals and snacks, setting where eaten, and both the types and the quantities of foods. Conformity definitely is not the rule.

Lifestyles and the economy are strong influences on how and what people eat. The hectic pace and demands on time that are placed by jobs and school often limit choices to grabbing food at any opportunity or to carrying it from home. Even airline passengers may need to buy a portable snack to avoid starvation as they race from flight to flight. Income or budget also has an important influence on where and what a person eats. The rapidly rising cost of food is causing many people, particularly those on limited incomes, to be increasingly restricted in the foods they buy.

Health problems or concerns play an important role in food selection for many shoppers. Some people with dietary restrictions due to problems such as diabetes, high blood pressure, or lactose or gluten intolerance are avid label readers as they seek suitable products. Issues such as nutrition and food safety are prominent in the minds of many as they shop for food to promote their health and well-being.

Individual food preferences also determine food choices, and many of these favorite foods reflect family eating patterns. Not surprisingly, a special treat for one person may be a food that is shunned by somebody else (Figure 1.3). People clearly are entitled to their personal tastes. However, students preparing for careers centering on food need to think about it from a very broad perspective, not simply from the limited viewpoint of what, where, and how they personally choose to eat.

### Dining Venues

The recent economic downturn has increased the numbers of people eating meals at home, especially breakfast and dinner. Meals at home provide an

**Figure 1.2**

McDonald's and Starbucks, ubiquitous competing food outlets, vie for consumers and their money on opposite street corners across from a high school.

Courtesy of Plycon Press.



excellent opportunity for family members to coordinate and catch up with the happenings of the day. Conversation there can be easier than in a noisy restaurant where the din frequently makes it impossible to be heard. The advantage of this sociability at home may be offset a bit by the effort and time required to prepare a pleasing, healthful meal unless cooking is a cooperative project.

Dishes from the deli section of the grocery store or a takeout order are time-saving options chosen by some people wishing to eat at home. Some use convenience foods extensively in their meal preparation, particularly during the week. Others prepare their own food, not only for family meals but also for special occasions. The creative opportunity provided by food preparation is viewed as a delightful challenge by some, while others cheerfully buy prepared foods. The results in terms of dining quality vary greatly from household to household.

People frequently eat meals away from home in a wide range of situations, even in the car while driving to work or school. These may have been prepared at home, or they may be purchased from a commercial food operation. Fast-food outlets are popular, particularly among young people and families with young children and limited income. Convenience, low cost, efficiency, and food choices geared toward their clientele are all factors that have contributed to the success of these chains. The competition between various chains is great, but the leaders have been successful in adapting to consumer wishes (e.g., low-carbohydrate menu options) over the years, and their fans continue to come in for both snacks and meals.

Schools, hospitals, and other institutional settings usually have cafeterias or dining rooms where people eat, either through choice or necessity (Figure 1.4). The quality of food served varies considerably from place to place, ranging from acceptable to excellent. The price also ranges from free school lunches for children who qualify under the federal program to \$1500 or more per day in a special hospital unit catering to wealthy clients willing to pay for gourmet meals prepared by a highly trained chef.



**Figure 1.3**  
Breakfasts featuring fried eggs and bacon and lunches highlighting comfort foods tend to draw customers who are focused more on flavor than health. Courtesy of Plycon Press.



**Figure 1.4**  
Lunchtime at the U.S. Naval Academy. Courtesy of Plycon Press.

## CULTURAL ACCENT

### FLAVORS FROM ABROAD

America's immigrants have created a wonderful opportunity for everyone to gain experience and savor the excitement of eating special dishes from other cultures. European dishes have long influenced food choices because of the roots of many families who arrived long before the 20th century. In the Southwest, foods from Mexico have been a part of the scene for centuries. Immigrants in the latter half of the 20th century arrived from countries with very different food patterns that have also expanded dining pleasures for many Americans.

Ethnic restaurants can be found in urban centers throughout the nation. Asian dining opportunities have expanded

beyond the Chinese restaurants that have long been familiar and now include Korean, Japanese, Vietnamese, Indonesian, Cambodian, and Thai restaurants. The adventures do not stop there. Indian, Sri Lankan (Figure 1.5), Middle Eastern, Ethiopian, and Moroccan flavors are offered in other restaurants. Even Tibetan restaurants can be found during the search for food adventures.

These unique dishes and flavors can be savored at home, too. Many stores now carry the exotic spices, herbs, and other ingredients needed to create authentic dishes. Regardless of the venue a diner chooses, foreign flavors can add delightful accents for dining adventures.



**Figure 1.5**

Naan, dal, lamb saag, beef vindaloo, lamb khorma, and raita are favorites on Indian dinner menus. Courtesy of Plycon Press.

Restaurants are the venue selected by many people when dining out rather than a fast-food operation. For special occasions, the choice may be an upscale restaurant that features beautiful food presentations and very attentive service. Families seeking a simple meal and a change of place may choose more economical, less formal restaurants. People seeking food adventures may opt for a restaurant that guarantees an unusual dining experience with foreign or exotic foods.

### Food Choices

People choose the foods in their diets for a variety of reasons. Those that have been familiar since childhood usually continue to be favorites throughout life. These and other choices are influenced by such factors as ethnic heritage, resources (time for preparation and money), personal preferences, and health. If families merge, the variety of foods served may broaden, too.

The ingredients available in grocery stores today provide tempting invitations to try new food experiences. Whether selecting frozen foods, convenience foods, or fresh produce, shoppers have innumerable opportunities to opt for new food adventures as well as old favorites. Items from all around the globe are found in virtually all American supermarkets. The adventurous cook has only to decide what to prepare.

Diners make choices with their forks when they eat. Favorite foods quickly vanish from the table at dinner, but other items may be destined to become leftovers, or even may be thrown away. Unpopular dishes may never appear on the table again because cooks like to make items that will generate praise rather than criticism.

## IMPACT ON HEALTH

Excess weight and obesity are an ever-increasing threat that is creating a national health crisis due to poor food choices and too little exercise. The influence of overweight and obesity on health is well recognized; the risks of heart attacks, strokes, and diabetes increase significantly when people are too heavy. Among the causes cited for this national health risk are the escalating portion sizes, choice of foods high in fat, and frequent snacks high in calories and low in nutrients. Dietary habits throughout life contribute to a person's physical condition, but it still is possible to alleviate some of the problems that have developed over the years. By eating balanced, colorful meals featuring fresh ingredients, in amounts that help to achieve and maintain a healthy weight, people can promote personal well-being. However, responsibility for eating to achieve and maintain a healthful weight rests on each individual.

Although the matter of how much to eat is a personal issue, people preparing food can quietly help by reducing the amount of fat used in cooking, planning menus that

[www.fmi.org](http://www.fmi.org)

—Website for the Food Marketing Institute.

### INDUSTRY INSIGHT

#### FOOD FOR HEALTH

The food industry monitors consumer attitudes, desires, and practices on an ongoing basis, tailoring its research and development efforts to bring new products to market shelves successfully. Today's consumers desire food products that are easy to prepare in a very short time. They place a priority on items that can be prepared in 15 minutes or less and with little effort or cleanup. Food products that can quickly be heated in their own bag are one approach that the food industry has developed to fulfill consumer desires.

In addition to the emphasis on convenience and speed, consumers are becoming increasingly concerned about eating for good health. Vegetables and fruits are viewed as being important in promoting health, and some consumers are seeking foods labeled as "organic." Produce and other foods labeled "organic" must meet the criteria for this designation required in the **National Organic Program**.

Apparently, concern over pesticides has caused some consumers to gradually drop their opposition to **genetically modified organisms** and to support genetic engineering that reduces the need for pesticides during crop production.

Awareness of the potential protection against cancer that some phytochemicals (e.g., various carotenoids) provide has heightened consumer demand for foods containing them. The food industry is incorporating various nutrients and substances with recognized health benefits because of the increased interest in healthful eating.

National concern over the incidence of obesity has added impetus to the interest that consumers have regarding the role of food in promoting health. *Light* and *lean* are important designations that may attract those who are trying to lose weight. High-protein food products are very popular among the many people who are attempting to follow a high-protein, low-carbohydrate regimen to lose weight.

#### **national organic**

**program** Legislation defining the production standards for produce (at least 95 percent of produce must not have been treated with sewage-sludge-based or petroleum-based fertilizers, conventional pesticides, ionizing radiation, or bio-engineering) to be labeled organic.

#### **genetically modified**

**organism (GMO)** Plants (and food) that have been modified by genetic engineering to enhance desired characteristics.

[www.cfsan.fda.gov/~lrd/biotechm.html](http://www.cfsan.fda.gov/~lrd/biotechm.html)

—The FDA's biotechnology website.

[www.cfsan.fda.gov/~lrd/biocon.html](http://www.cfsan.fda.gov/~lrd/biocon.html)

—Bioengineered foods approved by the FDA.



emphasize fruits and vegetables, preparing less food, and serving smaller portions. Creative cooks can find many ways to help reduce the calories in their menus and provide appetizing meals. They are in a position to subtly promote more healthful dietary patterns for their clientele and/or family.

## DETERMINANTS OF PALATABILITY

### Aroma

**aroma** Volatile compounds perceived by the olfactory receptors.

The **aroma** of some foods is evident even before they are seen. Odors wafting from the kitchen hint of the pleasure to come. Bakeries sometimes deliberately vent the aroma from their ovens outside to lure potential customers. Sniffing the air can be a favorite pastime when bread is baking, steaks are being grilled, or a turkey is roasting. Conversely, the aroma of boiling cabbage usually generates far less enthusiasm for the treat being prepared. Clearly, aroma helps to define the palatability of some foods, either positively or negatively.

### Taste

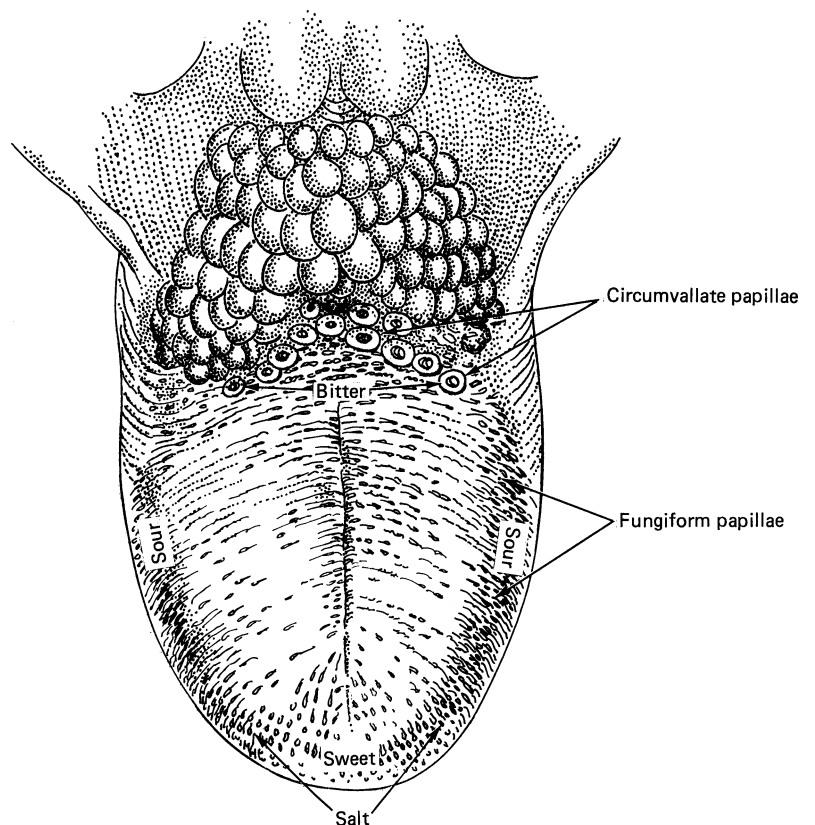
**taste** Sweet, sour, salt, bitter, and umami; basic tastes detected by the taste buds on the tongue.

Remarks about how good a food tastes often are made around the dining table because taste is one reason that food is so enjoyable. However, **taste** is actually quite a limiting term. Four basic tastes—sweet, sour, salt, and bitter—plus **umami**, a savory quality sometimes also classified as a taste, combine to give sensory messages about food in the mouth (Figure 1.6).

**umami** Savory quality that contributes to the taste of some foods.

### Color

The colors of many foods are visually exciting and contribute significantly to palatability. Fruits and vegetables are often colorful, especially when served raw in salads and desserts. If vegetables are cooked, they should be prepared to optimize their colors. Ham and corned beef are meat choices that can add color to a meal; the golden brown skin is an attractive color when roast turkey is carved at the table. Good menu planning incorporates color as a consideration in selecting specific recipes and foods.



**Figure 1.6**  
Diagram of taste receptor sites on the tongue. Courtesy of Plycon Press.

**SCIENCE NOTE****ANATOMY OF FLAVOR**

**Flavor** is perceived as a combination of taste and aroma. This sensory experience involves blending the messages the brain receives from the olfactory receptors in the nose and the taste buds in the mouth. Even before a bite is in the mouth, olfactory receptors detect aromatic compounds in the vapors from the food, especially if it is hot enough to vaporize some of the volatile compounds.

When a bite is being chewed, saliva mixes with the bits of food to help distribute them all over the surface to taste buds on the tongue. These sensors, located in various regions on the upper surface of the tongue, are capable of detecting dissolved substances, such as sugars and salt. Sweet is detected primarily across the tip, salt along the forward edges, sour farther back on the edges, and bitter across the rear.

While food is in the mouth and then being swallowed, the aromatic substances continue to reach the olfactory receptors. The messages of aroma from these receptors mingle with those from the taste buds on the tongue in the **trigeminal cavity** (space including olfactory receptors, taste buds, and the oral cavity) where flavor is perceived.

**flavor** Combination of aroma and taste perceived in the trigeminal cavity.

**trigeminal cavity** Space including olfactory receptors, taste buds, and oral cavity, where flavor is perceived.

[www.ffs.com](http://www.ffs.com)

—Website for Flavor and Fragrance Specialties.

**Texture**

Texture (called **mouthfeel** by food professionals) can add greatly to the pleasure of eating. Crisp bacon, smooth ice cream, a crunchy cracker, and a slippery bite of mango are examples of specific textural characteristics different foods provide. Good menu planning considers texture and utilizes foods that provide interesting contrasts in mouthfeel. Optimal preparation of the foods in the menu results in meals with pleasing textures.

**mouthfeel** The term food professionals use to describe textural properties of a food.

**Overall Appearance/Presentation**

Diners form their initial assessment of food quality based on the overall appearance and presentation of a food or a meal. Although their criteria may not be articulated, all of the factors (aroma, taste, color, and texture) discussed earlier contribute to the perception of food quality. The techniques used in preparing foods determine the final appearance of a food and/or a meal.

The principles of food preparation that are discussed throughout this book provide guidance on achieving food products with an overall appearance that is pleasing and of high quality. Promotion of a pleasing flavor in cabbage and other vegetables that have the potential to alienate diners requires that preparation minimize strong odors and flavors. Retention of bright colors in fruits and vegetables and desirable browning in baked products are essential to achieving optimal quality in these foods. Meats need to be heated to a safe internal temperature, but not so long that texture is negatively affected (e.g., they become dry and tough).

*Presentation* is the term used to describe the way the food is displayed for the diner. A cold bowl of vichyssoise may be more appealing if it is garnished with a sprig of fresh dill or minced chives. Chefs in expensive restaurants often do elaborate presentations that may include painting the plate with a colorful sauce to enhance the entrée or dessert. These suggestions illustrate the importance of a beautiful presentation to enhance the perceived quality of food.

**JUDGING FOOD**

Food quality is determined by ingredients and their preparation, and the final results need to be examined so that possible changes can be identified to create even better products subsequently. Evaluation is an important aspect of study when preparing to be a professional in this field. Foods can be evaluated subjectively and objectively. **Subjective (or sensory) evaluation** is done by people using their senses as instruments to evaluate such qualities of a food as appearance, aroma, flavor, and mouthfeel. **Objective evaluation** is conducted using a variety of machines to measure various physical aspects such as volume and tenderness.

**subjective (or sensory) evaluation** Evaluation using the senses.

**objective evaluation** Evaluation of physical and chemical aspects using equipment for measuring specific aspects of a food.