

Culinary Medicine

Culinary Medicine

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About This Book

This text is designed to give you a comprehensive introduction to culinary medicine. It contains readings, images, videos, tables, interactive H5P activities, resources, recipes, case studies, glossary terms, and more.

It is provided as an [open educational resource \(OER\)](#). Anyone can freely use, copy, download, print, adapt, and reshare OER.

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Preface

By Melanie Hingle, PhD, MPH, RDN

INTRODUCTION TO CULINARY MEDICINE

Diet quality is the largest single contributor to chronic disease burden as well as the single biggest opportunity for prevention.¹ Morbidity and chronic disability resulting from diet-sensitive diseases and conditions compose almost half of the total health burden in the United States.²

A bipartisan Congressional food policy and health working group endorsed a “food is medicine”³ approach to reducing the burden of diet-sensitive disease in 2018, suggesting “a healthy diet is the best prescription for preventing many chronic diseases.”⁴ Although few would disagree with this idea, individuals often lack the basic skills and practical guidance necessary when using food to reduce chronic disease risk. This open educational resource (OER) is designed to help address this gap.

DEFINING CULINARY MEDICINE

There is no single common definition of culinary medicine. La Puma⁵ defined culinary medicine as an evidence-based medicine that integrates the art of food and cooking with the science of medicine, which allows for the promotion of health and wellbeing

and supports disease management. In this OER, we have adopted and expanded upon this definition, as follows:

Culinary medicine is a subdiscipline of food, agriculture, and human nutrition sciences characterized by the integration of nutrition evidence and culinary techniques that consider real-world budgets, time constraints, and diversity of economic, cultural, and social circumstances, while supporting holistic health and well-being.

It is also important to acknowledge that our ability to achieve holistic health and well-being using food and nutrition is determined by our access to high-quality and affordable food, availability of time and money to procure and prepare healthy food, and the extent to which our social network and health-care resources allow us to have strong alignment between our food preferences, beliefs, and traditions, and our food choices. We address a number of these factors in this book.

WHO SHOULD USE THIS BOOK

The experts we surveyed when creating the themes and content for this OER imagined the following audiences for this resource, all of whom share similar goals and would benefit from our broad approach:

- Undergraduate and graduate students in nutrition, medicine, public health, and other allied health professions who are seeking hands-on, experiential training in culinary medicine
- Nutrition and allied health professionals who work, or aspire to work, at the intersection of nutrition, food, and human health
- Individuals and community organizations who wish to embrace food as a primary way to support lifelong health

HOW TO USE THIS BOOK

In considering which resources to include in this OER, we sought to identify culinary medicine competencies appropriate for nutrition and medical students, many of whom will go on to careers as health professionals. Although widely accepted competencies do not currently exist, proposed competencies common to allied health disciplines are in development.

In the absence of culinary medicine competencies, we surveyed experts in the field from our faculty in nutritional sciences and dietetics, medicine, and public health to identify major components of culinary medicine that were critical for our students to know to implement culinary medicine for their patients and clients, and in their own lives. The expert guidance we received was grouped into the following thematic areas, which is how the chapters of this book are structured:

- **Section I.** The Basics of Preparing, Selecting, and Enjoying Nutritious Food—Chapters 1, 2, and 3
- **Section II.** Food as Medicine: Nutrients, Dietary Supplements, Bioactive Compounds, and Popular Diets—Chapters 4, 5, 6, 7, and 8
- **Section III.** Anatomy of a Food Demonstration—Chapter 9
- **Section IV.** Implementing Culinary Medicine in Your Community—Chapters 10, 11, and 12
- **Appendices.** Additional Resources: Case Studies, Recipes

REFERENCES

1. Neuhouser ML. The importance of healthy dietary patterns in chronic disease prevention. *Nutr Res.* 2019;70:3–6. <https://doi.org/10.1016/j.nutres.2018.06.002>

2. The US Burden of Disease Collaborators. The state of US health, 1990-2016: burden of diseases, injuries, and risk factors among US states. *JAMA*. 2018;319(14):1444-1472. <https://doi.org/10.1001/jama.2018.0158>
3. Bipartisan members of Congress launch Food Is Medicine Working Group to highlight impacts of hunger on health. News release. Jim McGovern: Congressman for the 2nd District of Massachusetts. January 17, 2018. Accessed October 19, 2024. <https://mcgovern.house.gov/news/documentsingle.aspx?DocumentID=397179>
4. Every family deserves access to good nutritious food. Facebook Live video. Jim McGovern: Congressman for the 2nd District of Massachusetts. January 17, 2018. Accessed November 26, 2024. <https://www.facebook.com/watch/?v=1551761298211735>
5. La Puma J. What is culinary medicine and what does it do? *Popul Health Manag*. 2016;19(1):1-3. <https://doi.org/10.1089/pop.2015.0003>

Chapter 1: Understanding Social Influences, Planning Meals, and Shopping Smarter

By Constance Bell, MBA; Stavroula N. Antonopoulos, MS, RDN; Milad Hasankhani; MSc, Aimee Novak, trained chef

INTRODUCTION

Sustaining a healthy eating pattern, one of the goals of culinary medicine, requires ongoing access to nourishing food and strategies to obtain it within an individual's or family's resources (e.g., financial and time). Food can be obtained at many venues within a community and at different costs. Factors important to this accessibility include the **social determinants of health (SDOH)**, food and nutrition security, food access, location, resources, and seasonality. This chapter examines the factors influencing food acquisition, paying attention to maximizing nutrient-dense food while minimizing the associated costs, including waste of finances, time, and food. In addition, we will look at how food management and access are related to food and nutrition security.

This chapter provides information on how to build a plan for locating and purchasing nutritious food that is responsive to individual and cultural preferences and sensitive to time available

and financial resources. An effective plan starts with understanding individual nutrition needs and setting goals, then creating a list of foods that one enjoys based on these goals, needs, and preferences. A well-developed plan can help individuals and families locate and purchase the most nutritious food possible, given the money and time available to spend. The price of food is not necessarily indicative of its nutritional value, and sometimes spending more on a particular food is worthwhile, given the concentration of nutrients the food provides per unit cost.

Eating seasonally and buying locally grown food are helpful because locally grown food is often the most flavorful, the most nutritious, and typically the most economical. It is also helpful to seek out community programs such as **community gardens**, local food markets, and farms where one can purchase shares and receive regular packages of farm-fresh products. Freezing and canning local food in season are good methods to limit waste and preserve nutritional value in the long term.

Federal programs such as the **Supplemental Nutrition Assistance Program (SNAP)** are designed to supplement the grocery budgets of families from households with low incomes so they can afford the nutritious food essential to health and well-being. Many states offer the “Double Up Food Bucks” program that doubles the value of SNAP benefits at participating produce markets, helping people bring home more fresh fruits and vegetables while supporting local farmers. The **Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)** aims to safeguard the health of women, infants, and children up to age 5 years who reside in households with low incomes. WIC provides support to those who are at risk of poor nutrition by providing nutritious foods to supplement diets, education and information on healthy eating, and referrals to health care.

Whether in the clinic or the community, culinary medicine incorporates culturally responsive and budget-conscious resources

for increasing and sustaining an individual's health and nutrition security.

UNDERSTANDING SOCIAL INFLUENCES

Social determinants of health play a significant role in food planning and acquisition. Social determinants of health are defined as the surroundings where populations perform the routine pursuits of life (e.g., birth, day-to-day activities, schooling, employment, exercise, attending church, aging) that affect their well-being, welfare, and overall happiness. Social determinants of health focus on how non-medical factors influence a person's physical condition. Certain populations may find it difficult to purchase nourishing food, especially households with reduced access to affordable and nutritious foods related to geographical location, or individuals with limited resources, or both.¹

A related concept, **food equity**, is the expansive concept wherein all people should have the ability and opportunity to grow and consume healthful, affordable, and culturally significant foods. In an equitable food system, all community members can grow, procure, barter, trade, sell, dispose of, and understand the sources of food in a manner that prioritizes culture, equitable land access, fair and equitable prices and wages, human health, and ecological sustainability. Ecological sustainability is the concept that supports people living with respect for the Earth's environment and their intent to create minimal impact on it. Food equity also requires that food systems be controlled by the wishes of the majority of people and that community stakeholders determine the policies that influence their food system.

Food equity is associated with food access, which goes hand in hand with food and nutrition security. For instance, low food and nutrition security indicates food inequity, which can be influenced by the SDOH, such as the challenge of long distances to a store when one has limited access to or no transportation. With these

factors at play, it is more likely that food and nutrition security may be low, perpetuating food inequity. See [chapter 11](#) for more information about the SDOH, food security, and health equity.

Effective food management and access to nutritious food are important determinants of nourishing and balanced eating patterns. This chapter examines the factors influencing food acquisition (e.g., SDOH, location, resources, seasonality)—with attention to maximizing nutrient-dense food while minimizing the associated costs, including waste of finances, time, and food. In addition, we will look at how food management and access are related to food and nutrition security.

Food security is having reliable access to enough affordable, nutritious food. **Nutrition security** is the means to consistent access, availability, and affordability of foods and beverages that promote well-being and prevent (and, if needed, treat) disease, particularly among racial/ethnic minority populations, historically lower-income populations, and rural and remote populations. Nutrition security builds on and complements efforts to address food security among all people but recognizes that not every person maintains an active, healthy lifestyle. Nutrition security also emphasizes the importance of using equity-sensitive approaches for populations that often are managing the co-existence of food insecurity and nutrition-related chronic diseases or illnesses that are influenced by dietary practices and nutrition. Enabling consumers to use food labels in meal planning to meet caloric and nutrient needs is also an important aspect of nutrition security.²

In the next section, meal planning is discussed, which aims to support the most nutritious, economical, and least wasteful methods of approaching shopping and food procurement. Also, we acknowledge the influences of food security and nutrition security as major factors in determining the level of quantity, quality, and nutritive value of that food.

MEAL PLANNING

Nutrition and healthcare professionals often advise their patients and clients to optimize their eating habits to better manage their health. One way to promote healthier eating patterns is through a structured meal plan. Studies have shown that meal planning can lead to more nutritious food choices as well as improved dietary intake.¹ Meal planning can save time, cut food costs, help manage weight, and reduce the stress of last-minute meal preparation. Meal planning can also aid in preventing unnecessary purchases, impulse buying, and overspending.

A meal planning template can be used to achieve nutritional goals and to reduce food waste.³⁻⁵ The elements of a meal plan include defined goals (e.g., improved health, improved athletic performance, specific dietary needs), caloric and nutritional needs, meal frequency, food choices, portion sizes, and preparation. Plan and create a grocery list based on the meal plan and recipes.³ Try new recipes to incorporate a variety of nutrient-dense foods.

Meal plan templates can vary (see the “Helpful **MyPlate** Tools for Meal Planning” text box), but it is common to see a weekly meal plan that outlines the foods and beverages that will be eaten each day. A meal planning template typically uses a calendar or list structure. The goal is to have an idea and plan for meals and snacks, but flexibility is key. Patients or clients should be



Figure 1.1. Groceries can be expensive, so try meal planning, shopping for items on sale, comparing pricing using units of weight and cost, and considering choosing store or generic brands to save money. “Shopping, Spending, Till Slip” by Steve Buissonne is licensed under a Pixabay License.

encouraged to start small, gradually changing their eating habits over time. Suggest that patients or clients start by planning just a few meals each week and gradually increase that, sourcing additional resources and support as needed.

Helpful MyPlate Tools for Meal Planning

- [Create a Grocery Game Plan—Grocery List \[PDF\]](#)
- [Create a Grocery Game Plan—Weekly Calendar \[PDF\]](#)
- [Create Your Own MyPlate Menu](#)
- [MyPlate Shop Simple app](#)
- [Start Simple with MyPlate app](#)

Note that registered dietitian nutritionists are qualified to create meal plans because they have extensive education and training in nutritional sciences, dietetics, medical history, and dietary practices. Laypersons can create meal plans for general well-being but may not have the robust education for more health- and condition-specific meal plans. Different regions of the United States may set other standards for dietitians, including education, practical experience, and qualifying exams.

Honoring Traditional, Cultural, and Ethnic Foods

NOTE: To better tailor your meal planning tips to your patients or clients, see [chapter 12](#) for information on traditional, cultural, and ethnic food considerations. Learn more about eating patterns from around the world at [Diets Around the World](#).

NUTRITIOUS MEAL PLANNING

In the interactive activities throughout this chapter, select the > to read additional information and try the self-quizzes to test your knowledge:



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<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1083#h5p-1>



Figure 1.2. Creating a weekly meal plan can help you focus on nutrient-dense foods and avoid impulse buys, food waste, and overspending. “A Woman Making a Meal Plan” by Yaroslav Shuraev is licensed under Pexels License.

SHOPPING SMARTER

Now that we are acquainted with the process of meal planning, let's be strategic in the acquisition of nutritious food. Next, we will look at where people typically get food and identifying features of each place.

Where Can I Access Food?

Food may be acquired from a variety of places, including the following:

- **Grocery stores** primarily sell food and beverages along with limited household products.
- **Online shopping** can be retailer-specific or accessed by online platforms and/or applications (apps). Local stores may offer delivery or curbside pickup of food ordered online. Online platforms and apps, such as Amazon Fresh and Instacart, serve as third-party intermediates, fulfilling orders for retailers and delivering purchases directly to customers. Reducing or eliminating the time spent on shopping is part of the appeal of online shopping; however, the tradeoff can be a lack of choice and an inability to self-select quality food.
- **Corner stores** are like grocery or **convenience stores** except they are smaller and may also carry tobacco products, alcoholic beverages, prepared foods, and a limited produce selection.
- **Convenience stores** are convenient to customers, typically in closer proximity, and open longer hours than food stores—even 24 hours. They carry a limited selection of necessities, such as packaged foods and drugstore



Figure 1.3. Fresh produce is often located on the perimeter of a grocery store. Watch for sales. “Grocery, Shopping, Supermarket” by Steve Buissinne is licensed under a Pixabay License.

items.

- **Farmers markets** provide consumers with a seasonal array of agricultural products for direct purchase. Offerings may include fruits, vegetables, milk, cheese, and honey, among other products. Farmers markets eliminate intermediaries between farmers and consumers, thus supplying some of the freshest food items.⁶
- **Food banks** provide donated food items at no cost to those in need. Food items typically consist of canned and packaged goods and, potentially, local produce, eggs, and other items from local farmers or organizations. Food banks can offer access to fresh, nutritious foods for those who might not otherwise have the resources to acquire them.⁷ For further information on food banks, watch this [Food Banks video](#) from Feeding America.
- **Community-supported agriculture (CSA)** is an initiative that enables local buyers to prepay a sum to a farm, which then entitles them to receive recurring packages of the farm's fresh products, including fruits, vegetables, eggs, meat, poultry, and more.^{8,9}
- **Community gardens** are where members of a community collaborate within a designated area to grow and maintain fresh fruits, vegetables, herbs, and flowers. These gardens provide fresh, locally cultivated produce, as well as opportunities for physical activity, healthier eating, community cohesiveness, education, and reduced family food budgets.^{8,9}
- **Mobile markets** bring more affordable, fresh food options to different neighborhoods without having a permanent infrastructure.^{7,10,11}

Additional Resources in Your Community

Some colleges and universities may have student and community support resources such as food pantries. For example, the University of Arizona has a [Student Basic Needs Coalition](#) that sponsors a [Campus Pantry](#) to provide free food for students, faculty, staff, and the university community. Look in your community for similar opportunities.

Find local food by visiting these websites:

- [Local food directory listings](#)
- [Farmers markets](#)
- [Community Supported Agriculture \(CSA\)](#)
- [Community gardens](#)
- [Food pantries/banks](#)

TIPS FOR HEALTHIER SHOPPING

- Focus on purchasing fruits, vegetables (fresh or frozen), whole grains, plant-based proteins (e.g., beans), lean meats (e.g., chicken breast), and low-fat dairy products.^{5,10}
- Select minimally processed foods over those with added sugars, sodium, **saturated fats**, and trans fats. Look for food options with reduced or no added sugar or sodium.^{3,7}

- Read nutrition labels, being mindful of the serving size, **calories** per serving, and nutrition content.^{3,7} See the section Deciphering Food Labels for Nutrition for nutrition label information.
- Shop the perimeter of the store, where fresh produce, meat, and poultry can often be found.
- When shopping online, envision the store's perimeter and choose items typically found there.

Access to Affordable, Nutritious Food

- Learn more about [access to affordable, nutritious food](#)
- When budgets are strained, these resources may be helpful:
 - [Eat Right When Money's Tight](#)
 - [Smart Shopping and Eating Healthy on a Budget](#)
- Many states offer the "Double Up Food Bucks" program that doubles the value of [Supplemental Nutrition Assistance Program \(SNAP\)](#) benefits at participating markets, helping people bring home more nutritious fruits and vegetables while supporting local farmers. Learn more about [Double Up Food Bucks](#).

More Affordable, Nutritious Grocery Shopping Tips



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PRICING TIPS PRICE PER ITEM, PER OUNCE (OZ), OR PER POUND (LB)

- Most stores have a shelf label that displays the price of the item and the cost per unit, as seen in Figure 1.4.
- Items may be priced by the item or by the unit (e.g., 1 muffin), the ounce (oz), or by the pound (lb.). Vegetables, fruits, fresh meats, and bulk items are usually charged by the unit (pounds or ounces). Something premade or already packaged will typically be priced by the package.
- Standardize the price per unit to effectively comparison shop. For example, an item that is \$0.23/oz and another item that is \$3.68/lb. are the same price ($\$0.23 \times 16 \text{ oz} = \3.68 for 16 oz, or 1 lb.).
- In Fig. 1.4, calculate the price per oz ($\$1.99/12 \text{ oz} = \$.25$). To compute price/gal, multiply the price/oz times oz/gal (128 oz/gal) ($\$.25 \times 128 = \31.84 cost/gal).



Fig 1.4. A store shelf label shows unit pricing for a bottle of lime juice (\$1.99 for 8 fl oz, or \$31.84 per gallon). “Unit Price Tag” by Brian Herzog is licensed under CC BY-SA-NC.

TRY EATING SEASONALLY AND LOCALLY

Consuming locally grown food is beneficial because of its freshness and nutritional density. Fruits and vegetables harvested at their peak ripeness and consumed closest to that time retain most of their moisture, nutrients, and freshness. When produce is picked at its peak, it contains higher concentrations of critical nutrients such as potassium, magnesium, phosphorus, and vitamins C and A.^{13,15} When foods are separated from their source of nutrients, they begin to lose moisture and quality, which can lead to microbial spoilage. Learn more about [Health Benefits of Eating Locally](#) and see the section Distance Traveled for more details.

Why Eat Seasonally?

Seasonal produce involves selecting foods that are freshly harvested and available during specific times of the year. Planning your meals based on the season's offerings has numerous advantages, including:



- **Enhanced flavor and freshness:** When harvested at its peak, seasonal food is typically at its ideal texture and taste. In contrast, out-of-season food may have been transported long distances or stored for extended periods, adversely affecting its freshness and taste.
- **Nutritional value:** Fresh seasonal food contains optimal

Figure 1.5. Explore seasonal and local foods, such as those found at farmers markets. "Farmers Market Produce" by Fremont Farmers' Markets is licensed under CC BY.

nutrients because it is customarily harvested closer to consumption. However, frozen and canned produce also have significant nutrients because they are picked at peak ripeness, processed almost immediately, and usually onsite. Because the quality of the vitamins and minerals in fresh fruits and vegetables tends to diminish over time, seasonal produce can be more nutritious than food not in season.

- **Cost savings:** Seasonal food is, in many cases, often less expensive than out-of-season food because it spends less time in transit or storage for long periods. Additionally, the price can be more competitive when farmers or grocery stores have large quantities of fresh food items available. Frozen and canned produce can be the exception to that, because the shelf life of both is longer than that of fresh produce, it still retains nutrients and can be affordable.
- **Environmental benefits:** Eating local and seasonal food helps reduce the carbon footprint of our food system by selecting items grown nearby, thus reducing the need for long-distance transportation. Transporting food over long distances demands a lot of fuel energy and produces greenhouse gas emissions.
- **Supports local agriculture:** Purchasing locally grown food supports small businesses and helps keep agricultural land in use. This, in turn, strengthens local food systems, the local economy, and helps build a sense of community.

Videos With Tips About Fresh Produce

- [Farmers Markets—Fresh, Nutritious, Local](#) (US Department of Agriculture/Nutrition.gov)
- [Community Gardens—10 Steps to Successful Community Gardens](#) (University of Illinois Extension)
- [What Is Community Supported Agriculture \(CSA\)?](#) (OrganicNation)

Here are tips to help you eat seasonally:

- **Know what's in season:** Determine what foods are available in your area and plan your meals accordingly. You can find this information by visiting local farmers markets, checking seasonal produce guides, or talking to local farmers. Also, check your local grocery ads.
- **Shop at farmers markets:** Farmers markets are an excellent place to buy seasonal produce directly from local farmers. You'll find a variety of fresh fruits and vegetables that are in season, and you'll support local agriculture in the process.

- **Join a CSA program:**

A CSA program is a subscription service that curates fresh seasonal produce from local farms. As a CSA member, you will receive a regular supply of fresh, seasonal produce from local farms delivered to your home or made available for pickup at a centralized location.



Fig 1.6. This weekly community-supported agriculture (CSA) box contains lettuce, beets, carrots, broccoli, strawberries, herbs, and more. "CSA Box - Week of April 30 - May 6" by Suzie's Farm is licensed under CC BY-NC-ND.

- **Preserve seasonal**

foods: If you have an abundance of seasonal produce, consider preserving it for later use. You can freeze, can, or dehydrate fruits and vegetables to enjoy when they're out of season. For more information on preserving fruits and vegetables, see [chapter 2](#).

- **Get creative with recipes:** Try new recipes that use seasonal ingredients. Be bold and select one or 2 new produce items to cook with each week. Experiment with different ways of cooking and preparing seasonal produce to discover new flavors and textures.
- **Be flexible:** Be adaptable when eating food in season. Adjust your menu to what is available. If shopping locally for your produce is an option, be ready to swap out an ingredient if the market does not have what you're looking for. Ask the farmers or vendors for suitable substitutes and advice on preparing and cooking the

items. By doing so, you'll be able to enjoy seasonal produce to the fullest while supporting your local community and the environment.

Distance Traveled

The average amount of time it takes for produce to reach its final destination can vary depending on several factors, including the type of produce, the distance it needs to travel, and the transportation method used.¹³ Generally, domestic produce may take anywhere from 1 to 7 days to reach its destination, and international produce can take much longer.¹³ For example, produce from Mexico or South America to the US Midwest may take anywhere from 5 to 14 days, depending on the transportation method used and any customs or inspection procedures required.

Transportation time is just one factor that can affect the quality and freshness of produce.¹³ Other factors—such as storage conditions, handling practices, and the age of the produce at the time of harvest—can also affect the quality and nutritional value of the final product.¹³

By the time produce reaches the table, **nutrient degradation** may occur, which refers to the process by which essential nutrients in food, such as vitamins, minerals, and macronutrients (carbohydrates, proteins, and fats) deteriorate or break down over time, resulting in a reduction of nutritional value. Nutrient degradation can occur due to various factors, including exposure to air, light, heat, moisture, cooking, and enzymatic reactions. As nutrients degrade, their **bioavailability** and effectiveness in providing essential components for the body's functioning may diminish. It is important to store and handle food properly to minimize nutrient degradation and ensure that the nutritional value of the food is preserved for consumption. When nutrient degradation occurs, it is primarily driven by a reduction in water-soluble vitamins, including B vitamins and vitamin C. Once

harvested, produce undergoes higher rates of respiration and moisture loss, further contributing to nutrient degradation.

DECIPHERING FOOD LABELS FOR NUTRITION

When navigating the food choices wherever one shops, there is an objective measure of a product's nutritional value: the food label. Understanding food labels is vital. This section provides insight into these labels to enable the consumer to make informed, nutritionally sound decisions that align with nutrition goals. Whether one is a seasoned shopper or just beginning to be mindful of food choices, this section demystifies food labeling and nutrition facts, empowering health-conscious food selection.

Food Labeling

Understanding Food Labeling and Related Regulations

Food labeling is a crucial aspect of food production and marketing, providing health professionals and consumers with essential information about the food they consume. It is regulated by various authorities worldwide, with the US Food and Drug Administration (FDA) being the primary regulatory body in the United States. Understanding the ingredient list on food labels can be challenging, but it is a vital skill for health-conscious consumers and those advising them.¹⁴



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Ingredients, Additives, and Colors

Food labeling involves providing detailed information about a food product on its packaging. This information typically includes the product's name, ingredients, nutritional information, common allergens, manufacturer details, whether a product is organic or contains a genetically modified organism, and any relevant health claims. The ingredient label is mandated to list all components of the food product, including primary ingredients, fortifying nutrients, flavorings, sweeteners, and additives.

Certain ingredients may appear in various forms or derivations but have similar nutritional effects. For instance, sugars may be listed as corn syrup, agave nectar, or be listed by their chemical terminology (e.g., fructose). Manufacturers may use this nomenclature for marketing purposes. Regulatory standards mandate truthful disclosure of all ingredients.^{14,15}

On food labels, ingredients are listed in descending order by weight. This means that the ingredient that weighs most is listed first, and the ingredient that weighs the least is listed last. If sugar or fat is listed as one of the first few ingredients, it means that the product is high in these items and so less likely to have high nutritional value. Conversely, if whole grains or other nutrient-

dense ingredients are listed first, the product is likely to be a more nutritious choice.¹⁴



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Exemptions from Nutrition Labeling Requirements

Although most food products are required to have nutrition labels, certain businesses and specific types of food are exempt from this requirement. These exemptions are based on various factors, such as the size of the business and the type of food product. Raw fruits, vegetables, fish, and single-ingredient meats are exempt from labeling requirements. Additionally, foods served or sold in bulk or prepared on-site by delis and bakeries are not required to have information labels.

Even if a food product is exempt from nutrition labeling requirements, it is still subject to other food labeling regulations, wherein the product's name and ingredients must still be accurately represented on the label.^{14,15}



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Allergen Information

Allergen information is mandated to be clearly and obviously placed beneath the ingredient label. In the United States, food labels are required to identify the top 9 major allergens: milk, eggs, fish, shellfish, tree nuts, peanuts, wheat, soybeans, and sesame. Potential cross-contact with allergens must also be disclosed. Food allergens can be listed on labels under different names or aliases. It's important to recognize these alternate names to avoid accidental exposure to allergens. Table 1.1 lists some common aliases for various food allergens.^{16,17}

Table 1.1. Food Label Allergens

Allergen	Aliases^{16,17}
Eggs	Albumin, globulin, lecithin, livetin, lysozyme, ovalbumin, ovoglobulin, ovomucin, ovomucoid, ovotransferrin, ovovitellin, Simplese
Fish	Anchovy, bass, catfish, cod, flounder, grouper, haddock, hake, halibut, mahi-mahi, perch, pike, pollock, salmon, sole, snapper, swordfish, tilapia, trout, tuna
Peanuts	Arachis oil, beer nuts, ground nuts, mandelonas, nut meat, nut pieces, peanut butter, peanut flour
Shellfish	Abalone, clams, crab, crawfish, krill, lobster, mussels, oysters, prawns, scallops, shrimp, squid

Soy	Edamame, miso, natto, shoyu, soy albumin, soy concentrate, soy fiber, soy formula, soy grits, soy milk, soy nuts, soy protein, soy sauce, soy sprouts, tamari, tempeh , textured vegetable protein, tofu
Tree nuts	Almonds, Brazil nuts, cashews, chestnuts, filberts/hazelnuts, hickory nuts, macadamia nuts, marzipan/almond paste, nougat, pecans, pine nuts/pignolias, pistachios, walnuts

Wheat	Bran, bread crumbs, bulgur, cereal extract, club wheat, couscous, cracker meal, durum, einkorn, emmer, farina, flour (all-purpose, bread, cake, durum, enriched, graham, high-gluten, high-protein, instant, pastry, self-rising, soft wheat, steel ground, stone ground, whole wheat), gluten, hydrolyzed wheat protein, Kamut, matzoh, matzoh meal (also spelled matzo, matzah, or matza), pasta, seitan , semolina, spelt, sprouted wheat, triticale, vital wheat gluten, wheat (berries, bran, durum, germ, gluten, grass, malt, sprouts, starch), wheat bran hydrolysate, wheat germ oil, wheat grass, wheat protein isolate, whole wheat berries
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Sesame	Benne, benne seed, benniseed, gingelly, gingelly oil, halvah, sesame flour, sesame oil, sesame paste, sesame salt (gomashio), sesame seed, sesamol, <i>Sesamum indicum</i> , simsim, tahini, tehina, til
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The Nutrition Facts Label and Nutritional Density

New Label / What's Different?

Servings: larger, bolder type	Nutrition Facts	— Serving sizes updated	
	8 servings per container Serving size 2/3 cup (55g)		
New: added sugars	Amount per serving	— Calories: larger type	
	Calories 230		
	% Daily Value*		
	Total Fat 8g 10%		
	Saturated Fat 1g 5%		
	Trans Fat 0g		
	Cholesterol 0mg 0%		
	Sodium 160mg 7%		
	Total Carbohydrate 37g 13%		
	Dietary Fiber 4g 14%		
Total Sugars 12g	— Daily Values Updated		
Includes 10g Added Sugars 20%			
Protein 3g			
Vitamin D 2mcg 10%			
Calcium 260mg 20%			
Iron 8mg 45%			
Potassium 240mg 6%			
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.		— Actual amounts declared	
Change in some nutrients required			— New footnote

Fig 1.7. This graphic highlights changes to the Nutrition Facts label, including larger type, updated serving sizes and Daily Values, and the listing of added sugars. "Changes to the Nutrition Facts Label" by the US Food and Drug Administration is in the public domain.

The Nutrition Facts Label

In recent years, the Nutrition Facts label on food packaging has undergone substantial changes to make it more informative and

easier to understand. Some key changes include larger font size for **calories**, serving sizes updated to reflect the amounts people typically consume, and the addition of the term “added sugars” to help consumers distinguish between added sugars and naturally occurring sugars.^{18,19}

Serving Size, Servings Per Container, and Portion Size

In the United States, a serving size is a reference *amount* of food, as defined by the FDA, that helps consumers understand the nutritional content of a certain quantity of food. A serving is a measured portion of food or drink.

The number of servings per package must be based on the serving size of the product. For example, if the serving size of quinoa is 1 cup and a package contains 4 cups, then the number of servings per container is 4.²⁰ In contrast, portion size is the amount of food that a typical consumer would choose to eat for a meal or a snack, which can be larger or smaller than the FDA standard serving sizes.²⁰ For example, if you chose to eat 2 cups of quinoa, your portion size would be 2 cups even though the indicated serving size is 1 cup.²⁰

Understanding these terms can help you make more nutritious food choices. For instance, you might think a small package of quinoa is 1 serving, but if the label says it contains 4 servings, that equals 4 times

the calories, protein, fiber, and other nutrients listed on the label.



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What Is Percent Daily Value and How Is It Calculated?

The term Percent Daily Value (%DV) on food labels is a guide to the nutrients in 1 serving of food. The %DV is based on the recommended daily intake of a nutrient, which is the amount of a nutrient the average person needs each day.²¹ This information can help you determine if a serving of food is high or low in a particular nutrient.²¹

The %DV is calculated based on a 2,000-calorie/day eating pattern for adults and children aged 4 years or older; however, your needs may be more or less depending on your age, sex, weight, and physical activity level.²¹



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Here is how it works:

- **Identify the nutrient:** The nutrient content of the food is determined through laboratory analysis or by using a database of nutrient composition values for foods.²¹
- **Determine the %DV:** The %DV is calculated by dividing the amount of a nutrient in a serving of the food by the recommended daily intake for that nutrient, then multiplying by 100.²²

For example, if a food has 3 g of fiber per serving and the daily recommended intake for fiber is 25 g, the %DV for fiber would be $(3 \div 25) \times 100 = 12\%$. So, one serving of this food provides 12% of the daily recommended intake of fiber.²²

Table 1.2 lists the reference values that are used to calculate the %DV on the Nutrition Facts label.²¹ Note, however, that the recommended intake for a nutrient can vary for each person. Generally, a nutrient amount per serving that is 5% DV or less is deemed low, and a nutrient amount per serving that is 20% DV or more is deemed high.

Table 1.2. The Percent Daily Value Calculation on the Nutrition Facts Label²¹

Nutrient	Current Daily Value	Nutrient	Current Daily Value
Added sugars	50 g	Phosphorus	1,250 mg
Biotin	30 mcg	Potassium	4,700 mg
Calcium	1,300 mg	Protein	50 g
Chloride	2,300 mg	Riboflavin	1.3 mg
Choline	550 mg	Saturated fat	20 g
Cholesterol	300 mg	Selenium	55 mcg
Chromium	35 mcg	Sodium	2,300 mg
Copper	0.9 mg	Thiamin	1.2 mg
Dietary fiber	28 g	Total carbohydrate	275 g
Fat	78 g	Vitamin A	900 mcg RAE

Folate/folic acid	400 mcg DFE	Vitamin B ₆	1.7 mg
Iodine	150 mcg	Vitamin B ₁₂	2.4 mcg
Iron	18 mg	Vitamin C	90 mg
Magnesium	420 mg	Vitamin D	20 mcg
Manganese	2.3 mg	Vitamin E	15 mg α-tocopherol
Molybdenum	45 mcg	Vitamin K	120 mcg
Niacin	16 mg NE	Zinc	11 mg
Pantothenic acid	5 mg		

Abbreviations: DFE = dietary folate equivalents; g = gram; IU = international unit; mcg = microgram; mg = milligram, NE = niacin equivalents; RAE = retinol activity equivalents.

The %DV helps the consumer understand the nutrient content of

a serving of food in the context of a total daily diet.²⁰ Knowing the %DV can help when making dietary choices that can lower the risk of chronic diseases such as heart disease, cancer, or osteoporosis.²⁰

Note, however, that the %DV does not indicate how much of a nutrient is in a serving of food. It indicates the percentage of the recommended daily intake contained in that serving of food.²⁰ If a food has a %DV of 20% for calcium, it does not mean you are getting 20% of your daily calcium from that food. It means you're getting 20% of the recommended daily intake for calcium.²²

Using the Nutrition Facts Label and MyPlate

The FDA's **MyPlate** is a visual guide that helps you create balanced meals based on the 5 food groups.²² The Nutrition Facts label and MyPlate can be used together to make more nutritious food choices that align with your nutritional needs and goals.²²

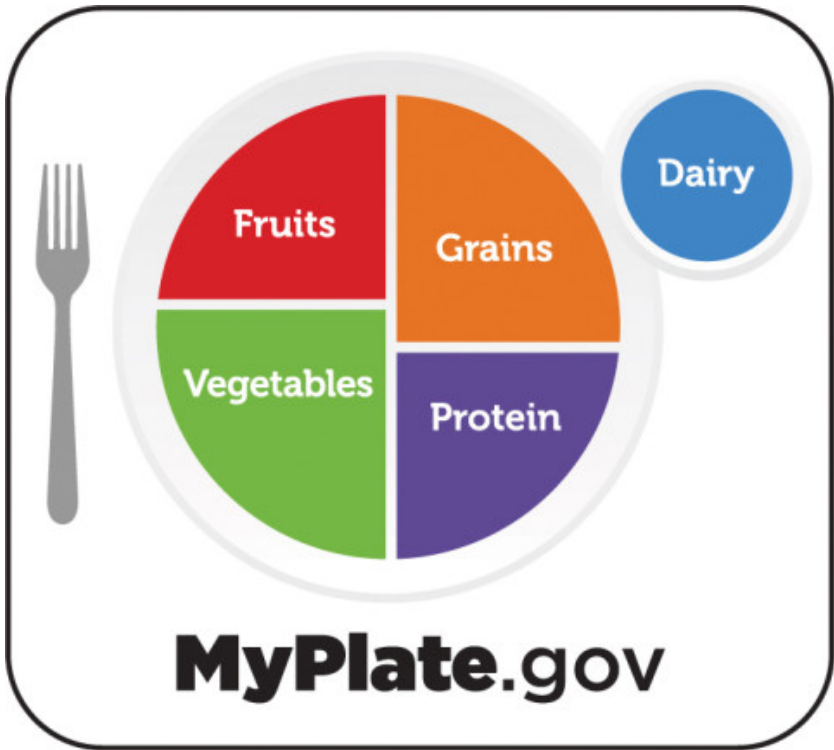


Figure 1.8. MyPlate replaced the Food Guide Pyramid. Make half your plate fruits and vegetables. A quarter of your plate should be whole grains. The amount of protein foods you need depends on your age, sex, height, weight, physical activity, and whether you are pregnant or breastfeeding. "MyPlate.gov" by US Department of Agriculture is in the public domain.



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Key Takeaways

- Make a meal plan and create a grocery list that includes an inventory of what you have to help plan nutritious and cost-effective meals. Use a meal planning template to balance meals, maximize nutritional choices, stay within budget, avoid over- or impulse spending, and minimize food waste.
- Shopping can be at grocery stores, online, corner or convenience stores, farmers markets, food pantries/banks, CSAs, and community gardens.
- Social determinants of health have an influence on food equity, food and nutrition security, as well as food access. Thus, the ways of acquiring food depend on SDOH.
- Shop for items on sale, compare pricing using units of weight and cost, and choose store or generic brands to save money. Consider buying in bulk.
- Explore seasonal and local foods because they can be fresher and more flavorful. Produce harvested nearer to you has optimal nutrient composition, but produce can be sourced domestically and internationally, depending on the

season and availability. Also consider the value of frozen or canned produce, which is often picked at its peak and packaged close to where it is harvested.

- Understand food labeling on the package and its information, including ingredients, nutritional content, and potential allergens. The Nutrition Facts label provides information about the nutritional content of food, including serving sizes, %DV, and other key nutrients. Refer to MyPlate for balanced nutrition guidance.

REFERENCES

1. Lindstrom KN, Tucker JA, McVay M. Nudges and choice architecture to promote healthy food purchases in adults: a systematized review. *Psychol Addict Behav.* 2023;37(1):87–103. doi:10.1037/adb0000892
2. Food and nutrition security. US Department of Agriculture. Accessed October 22, 2024. <https://www.usda.gov/about-usda/general-information/priorities/food-and-nutrition-security>
3. Make a plan. US Department of Agriculture. Accessed October 22, 2024. <https://www.myplate.gov/eat-healthy/healthy-eating-budget/make-plan>
4. More key topics. US Department of Agriculture. Accessed October 22, 2024. <https://www.myplate.gov/eat-healthy/more-key-topics>
5. Gordon B. 3 Strategies for successful meal planning. Academy of Nutrition and Dietetics. July 18, 2019.

- Accessed October 22, 2024. <https://www.eatright.org/food/planning/smart-shopping/3-strategies-for-successful-meal-planning>
6. Farmers markets increase access to fresh, nutritious food. Farmers Market Coalition. Accessed February 22, 2023. <https://farmersmarketcoalition.org/education/increase-access-to-fresh-nutritious-food/>
 7. Madlala SS, Hill J, Kunneke E, Lopes T, Faber M. Adult food choices in association with the local retail food environment and food access in resource-poor communities: a scoping review. *BMC Public Health*. 2023;23(1):1083. doi:10.1186/s12889-023-15996-y
 8. Howarth M, Brettle A, Hardman M, Maden M. What is the evidence for the impact of gardens and gardening on health and well-being: a scoping review and evidence-based logic model to guide healthcare strategy decision making on the use of gardening approaches as a social prescription. *BMJ Open*. 2020;10(7):e036923. doi:10.1136/bmjopen-2020-036923
 9. Nogueira-McRae T, Ryan EP, Jablonski BBR, et al. The role of urban agriculture in a secure, healthy, and sustainable food system. *BioScience*. 2018;68(10):748–759. doi:10.1093/biosci/biy071
 10. Wei Y, Shannon J, Lee JS. Impact of grocery store proximity on store preference among Atlanta SNAP-Ed participants. *J Nutr Educ Behav*. 2022;54(3):263–268. doi:10.1016/j.jneb.2021.01.004
 11. Lucan SC, Maroko A, Sanon O, Frias R, Schechter CB. Urban farmers' markets: accessibility, offerings, and produce variety, quality, and price compared to nearby stores. *Appetite*. 2015;90:23–30. doi:10.1016/j.appet.2015.02.034

12. Drewnowski A. The cost of US foods as related to their nutritive value. *Am J Clin Nutr.* 2010;92(5):1181–1188. doi:10.3945/ajcn.2010.29300
13. Barrett DM. Maximizing the nutritional value of fruits & vegetables: review of literature on nutritional value of produce compares fresh, frozen, and canned products and indicates areas for further research. UC Davis Department of Plant Sciences; 2007;61(4). Accessed October 27, 2024. <https://postharvest.ucdavis.edu/publication/maximizing-nutritional-value-fruits-vegetables>
14. US Department of Health and Human Services (DHHS), US Food and Drug Administration, Center for Food Safety and Applied Nutrition. Guidance for industry: food labeling guide. DHHS; September 23, 2022. Accessed October 22, 2024. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-guide>
15. Gager E. Finding the hidden sugar in the foods you eat. John Hopkins Medicine. August 8, 2021. Accessed October 22, 2024. <https://www.hopkinsmedicine.org/health/wellness-and-prevention/finding-the-hidden-sugar-in-the-foods-you-eat>
16. Allergen control resources. California Department of Public Health, Food and Drug Branch. May 28, 2019. Accessed October 22, 2024. <https://www.cdph.ca.gov/Programs/CEH/DFDCS/Pages/FDBPrograms/FoodSafetyProgram/AllergenControlResources.aspx>
17. The top 8 food allergens and their common aliases. California Department of Public Health, Food and Drug Branch. Accessed December 20, 2024. <https://www.cdph.ca.gov/Programs/CEH/DFDCS/CDPH%20Document%20Library/FDB/FoodSafetyProgram/>

[AllergenControlResources/Allergens.pdf](#)

18. Changes to the Nutrition Facts label. US Food and Drug Administration. April 13, 2023. Accessed October 22, 2024. <https://www.fda.gov/food/food-labeling-nutrition/changes-nutrition-facts-label>
19. Added sugars on the new Nutrition Facts label. US Food and Drug Administration; February 25, 2022. Accessed October 22, 2024. <https://www.fda.gov/food/new-nutrition-facts-label/added-sugars-new-nutrition-facts-label>
20. Guidance for industry: food labeling: serving sizes of foods that can reasonably be consumed at one eating occasion; dual-column labeling; updating, modifying, and establishing certain reference amounts customarily consumed; serving size for breath mints. Docket no. FDA-2004-N-0258. Human Foods Program. US Food and Drug Administration; September 21, 2022. Accessed October 22, 2024. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-serving-sizes-foods-can-reasonably-be-consumed-one-eating-occasion>
21. The lows and highs of percent daily value on the new Nutrition Facts label. US Food and Drug Administration; February 25, 2022. Accessed October 22, 2024. <https://www.fda.gov/food/new-nutrition-facts-label/lows-and-highs-percent-daily-value-new-nutrition-facts-label>
22. Using the Nutrition Facts label and MyPlate to make healthier choices. US Food and Drug Administration; February 25, 2022. Accessed October 22, 2024. <https://www.fda.gov/food/new-nutrition-facts-label/using-nutrition-facts-label-and-myplate-make-healthier-choices>
23. Zimmerman M, Snow B. 2.7: Understanding Dietary

Reference Intakes (DRI). In: *An Introduction to Nutrition*. Medicine Libre Texts; 2016. Accessed October 22, 2024. [https://med.libretexts.org/Bookshelves/Nutrition/An_Introduction_to_Nutrition_\(Zimmerman\)/02%3A_Achieving_a_Healthy_Diet/2.07%3A_Understanding_Dietary_Reference_Intakes_\(DRI\)](https://med.libretexts.org/Bookshelves/Nutrition/An_Introduction_to_Nutrition_(Zimmerman)/02%3A_Achieving_a_Healthy_Diet/2.07%3A_Understanding_Dietary_Reference_Intakes_(DRI))

Chapter 2: In the Kitchen (Storing and Preparing Food; Preventing Food Waste)

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INTRODUCTION

Culinary medicine combines nutrition education and culinary arts to provide the knowledge and skills necessary to sustain a nutritious eating pattern to prevent and treat diet-sensitive disease. Simply instructing people to eat more or less of a food or nutrient is not enough. Sustaining a healthy eating pattern requires ongoing access to nourishing food, including the skills to prepare and store food in a way that maintains its flavor and nutritional value.

Over the years more individuals have increasingly turned to delivery, takeout, and dining out. These trends have been associated with less-nutrient-dense food choices and may be contributing to diminished cooking skills.¹⁻⁶ Cooking at home provides some control over the amount of sugar, sodium, and

saturated fats added to food. Along with effective food storage, these strategies can significantly affect the nutrient density of meals while helping to reduce food waste.¹⁻⁶

This chapter presents strategies for safe and effective food storage and preparation to maximize the health benefits of food and minimize food waste, which are central to sustaining a healthy eating pattern, especially on a limited budget. Prior to reading this chapter, we recommend reviewing the information in [chapter 1](#) on purchasing nutritious foods.



Figure 2.1. Four steps to food safety are cleaning hands with soap and water, using separate cutting boards for meat and produce, cooking meat to recommended temperatures, and chilling cooked leftovers and perishable foods. "4 Steps to Food Safety" from the Centers for Disease Control and Prevention is in the public domain.

GENERAL FOOD SAFETY PRINCIPLES

Food safety is an essential aspect of maintaining good health and

preventing **foodborne** illnesses. The following subsections discuss general food safety principles everyone should be aware of.¹⁻³

Clean

Cleaning and **sanitizing** are essential steps in preventing the spread of harmful bacteria and viruses.⁷ These include regularly cleaning and sanitizing all tools, equipment, and work surfaces used in food preparation. Tools and equipment should be washed with hot, soapy water after each use. Wash hands with soap and water for at least 20 seconds before and after handling food, after using the bathroom, and after touching pets.⁷

In the following set of interactive activities, select the > to read additional information, then take the self-quizzes to test your knowledge:



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Separate

Separate raw meat, poultry, seafood, and eggs from other foods to prevent **cross contamination**. Use separate cutting boards and utensils for each type of food.



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Cook

Cooking food to the proper temperature is essential to kill harmful bacteria and prevent foodborne illness (see Table 2.1). Use a food thermometer to ensure that meat, poultry, seafood, and other foods are cooked to the recommended temperature.⁷



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Table 2.1. Safe Food Handling and Preparation Temperatures⁸

Product	Minimum internal temperature and rest time
Beef, pork, veal and lamb steaks, chops, roasts	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Ground meats	160 °F (71.1 °C)
Ground poultry	165 °F (73.9 °C)
Ham, fresh or smoked (uncooked)	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Fully cooked ham (to reheat)	Reheat cooked hams packaged in USDA-inspected plants to 140 °F (60 °C) and all others to 165 °F (73.9 °C).
All poultry (breasts, whole bird, legs, thighs, wings, ground poultry, giblets, and stuffing)	165 °F (73.9 °C)

Eggs	160 °F (71.1 °C)
Fish and shellfish	145 °F (62.8 °C)
Leftovers	165 °F (73.9 °C)
Casseroles	165 °F (73.9 °C)

Chill

Chill **perishable foods** promptly to prevent the growth of harmful bacteria. Keep the refrigerator temperature at or below 40 °F (4 °C), and the freezer at 0 °F (-18 °C).⁷⁻¹²



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In addition to these general principles, it is also important to be aware of food recalls and to check for any recalls that may affect the safety of the food being consumed. Consumers can check the US Food and Drug Administration's (FDA) [Recalls, Market Withdrawals, & Safety Alerts](#) webpage for a current list.¹³

Finally, it is important to understand the signs and symptoms of foodborne illnesses, such as nausea, vomiting, diarrhea, and fever.

If these symptoms occur after consuming food, it is important to seek medical attention promptly.



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FOOD STORAGE GUIDELINES

To prevent foodborne illnesses and maintain food quality and nutrition, store perishable items such as meat, poultry, seafood, and dairy products in the refrigerator at or below 40 °F (4.4 °C). Keep raw meat separate from other foods to avoid cross-contamination. Store nonperishable items in a cool, dry place away from direct sunlight. Regularly clean and sanitize storage areas to prevent bacteria growth and contamination.

Refrigeration

Temperature control

Proper refrigerator storage slows microbial growth and controls perishable food quality by holding foods at appropriate temperatures.⁹ Perishable foods are those likely to spoil, decay, or become unsafe to consume if not kept refrigerated at 40 °F (4.4 °C) or below, or frozen at 0 °F (-17.8 °C) or below. Examples of foods

that must be kept refrigerated for safety include meat, poultry, fish, dairy products, and all cooked leftovers. Refrigeration can slow bacterial growth.

It is recommended to use a refrigerator thermometer along with the internal thermometer of the refrigerator to measure temperature accurately. A refrigerator thermometer is a small, freestanding gadget that can be used to measure the temperature of both the refrigerator and freezer. It is important to use thermometers that are designed to function in cold temperatures to obtain precise temperature readings. You can purchase these thermometers online or from most hardware stores. They are simple to use.

Adjusting the temperature settings of your refrigerator or freezer is usually a straightforward process because most have temperature controls located inside of them. Consult the manual for specific temperature adjustment instructions and remember that an adjustment period may be necessary for temperatures to stabilize when changing the setting. To minimize temperature fluctuations, you should reduce the number of times you open the refrigerator during warmer weather.⁹

Storage organization

Food Storage Times and Temps

To learn more about food storage, including meats, cheeses, and other

An organized refrigerator is essential to find what you need quickly. To help with organization, adjustable shelves, **crispers**, and meat and cheese drawers are useful storage options. Tempered glass shelves are durable and easy to clean, and some refrigerator models have pullout capabilities for easier access.

For optimal storage of fruits and vegetables, consider using sealed crisper drawers with customizable humidity

settings to ensure maximum freshness. Lastly, an adjustable-temperature meat drawer will help you maximize the storage time for your meats and cheeses.

To keep your food safe from contamination, store all raw meat, poultry, and seafood in sealed containers or wrap them securely in a leak-proof container with a lid to prevent cross-contamination. Labeling and dating food items as you prepare the item for storage will prevent food waste and naturally occurring spoilage bacteria.

perishable and nonperishable items, go to [FoodSafety.gov](https://www.foodsafety.gov)'s [FoodKeeper App](#).

Cleaning and Maintenance

- Maintaining the cleanliness and safety of your refrigerator is important; regularly check for expired or spoiled food items and dispose of them properly. Refer to [FoodSafety.gov's Cold Food Storage Chart guidelines](#) for storing food in the refrigerator. The short time limits for home-refrigerated foods will help keep them from spoiling or becoming dangerous to eat.
- Wipe up spills promptly with hot, soapy water, and dispose of expired perishables weekly.
- Consider keeping an open box of baking soda on a shelf to prevent unpleasant odors.
- When cleaning the refrigerator, it is best to use mild liquid dishwashing detergents and cleaners specifically designed for appliances and to avoid harsh chemicals that could damage the interior.

Check your understanding by completing the following interactive activities:

Reduces food waste:



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Improves food safety:



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Maximizes space:





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Saves money:



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Learn more about food-safe shopping and storage from the FDA:

- [Read in English \[download\]](#)

- [Leer en español](#)

Dry Storage

Storing nonperishable food properly in a pantry will help save money, reduce food waste, and ensure the safety and freshness of food. The pantry is ideal for storing **shelf-stable foods**, such as canned goods, baking ingredients, and spices. Nonperishable products include jerky, country hams, most canned and bottled foods, rice, pasta, flour, sugar, spices, **oils**, and foods processed in packaging solutions that maintain high product quality during shelf life. These products do not require refrigeration until after opening.

Not all canned goods are shelf stable. Some canned foods, such as canned ham and seafood, are unsafe at room temperature. These will be labeled “Keep Refrigerated.”

Here are some tips to help you store your pantry items correctly:

- Check each food item’s expiration or “Best if Used By/ Before” date for storage requirements to maintain quality. Some foods, such as dairy products, meat, and eggs, must be refrigerated at all times, whereas other foods, such as canned goods and dry foods like flour, sugar, and pasta, can be stored in a cool, dry place.



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- Prevent waste by rotating your stock. Store newly purchased items behind older ones and use the oldest items first. This technique helps prevent food spoilage and ensures the consumption of the items before the expiration date.
- Learn more about expiration dates in “[Food Safety Information: Food Product Dating \[PDF\]](#).”



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- Organize your pantry to make meal planning easier and prevent overbuying. Group similar items, such as canned vegetables, fruits, and soups, and baking supplies such as

flour and sugar. Keep frequently used items at eye level or within reach and use clear containers or labels to identify the contents.



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- Use appropriate containers to ensure food safety. To keep dry goods such as cereal and pasta fresh, use airtight containers to prevent moisture and pests from getting inside. It is best to use glass or plastic containers for liquids like oils and vinegar. Avoid using containers that are not food-safe and could potentially cause contamination.



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- Keep your pantry clean and dry, and regularly clean and dust the shelves. Avoid storing food in damp areas and check for signs of pests, such as droppings or chewed packaging, to ensure your pantry stays clean, safe, and free from potential health hazards.



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BUILDING AND ORGANIZING A PANTRY

Keeping a well-stocked pantry and understanding ingredients are the building blocks for creating tasty and nutritious meals. Including versatile ingredients in your pantry can help increase meal options and stretch your food dollars. In addition, purchasing essential pantry items (e.g., fruits, vegetables, and proteins, plus oils, herbs, spices, whole grains, **pulses**, and legumes) provides the foundation for nutrient-dense meals.

Organizing your pantry into “zones” helps you find ingredients easily. Zones could include seasonal ingredients, flavor profiles (sweet, salty, sour, bitter, spicy), global flavors (e.g., Italian, Thai, Indian, Chinese), or cooking categories (e.g., baking, weeknight meals, breakfast, or most-used items).

Essential Pantry Items or Staples

Fruits and Vegetables



Figure 2.3. Eating various colorful vegetables is a great way to consume a wide range of vitamins and minerals, supporting overall health. “Vegetable Basket” by congerdesign is licensed under a Pixabay License.



Figure 2.2. Fresh pears are higher in fiber and vitamin C, whereas canned pears often contain added sugars. To reduce the added sugar content, opt for fruits canned in 100% juice instead of syrup. “Pear, Canned Pear, Organic” by Aline Ponce is licensed under a Pixabay License.

Think seasonally and shop weekly. Locally grown, fresh seasonal vegetables taste better and are generally less expensive than items that might be out of season. Consult a local growing guide to see what fresh produce may be available in your area or use alternative sources such as frozen or canned fruits and vegetables. Select low-sodium canned vegetables and fruit canned in natural fruit juice. Consider buying frozen fruits and vegetables without added salt or sauces to reduce sodium intake.

Proteins



Figure 2.4. Nuts are a great source of nutritious fats, protein, and fiber. They also provide essential minerals such as vitamin E, magnesium, and selenium. "Nuts, Seeds, Almonds" by Usman Yousaf is licensed under a Pixabay License.



Figure 2.5. Tempeh is a versatile plant-based protein. It can be used to replace meat in certain dishes, especially stir fry. "Tempeh, Food, Soybean" by Mochamad Arief is licensed under a Pixabay License.

Protein-rich foods include fresh, canned, or frozen lean meats, poultry, fish, and seafood. If you are looking for meat alternatives, try **pulses**, eggs, nuts (e.g., almonds, walnuts, pecans), seeds (e.g.,

chia seeds, flaxseeds, sunflower seeds), or plant-based proteins such as tofu, **tempeh**, **seitan**, quinoa, and bean pastas (e.g., chickpeas, black beans, red lentils).

Low-cost pantry staples such as beans, legumes, nuts, and seeds are easy to store and versatile for a variety of recipes. Using plant-based proteins can have important health benefits, such as reducing the risk of heart disease, stroke, and type 2 diabetes.

Nutrient-Dense Fats and Oils

Knowing the health benefits of the oils you are cooking with can help determine which oil to use. Consider the oil's flavor characteristics when selecting, because some have a neutral flavor and others have more distinct flavors. Also consider unique cooking properties such as **smoke point**. Examples of nutritious fats include avocado, nuts, seeds, seed oils, olive oil, coconut oil, avocado oil, canola oil, nut oils, and nut butters.

Herbs and Spices

Herbs and spices are often used in cooking as flavoring or seasoning. Herbs are plants with edible leaves, seeds, or flowers. Spices are derived from roots, seeds, bark, buds, and berries. The health benefits of herbs and spices include helping to reduce excess salt and fat while providing flavor and **phytonutrients**, such as **bioactive molecules, tannins, alkaloids, phenolic diterpenes, flavonoids,** and **polyphenols.**¹⁴

Examples of popular cooking herbs include basil, oregano, thyme, mint, cilantro, rosemary, and sage; examples of popular spices include cinnamon, turmeric, ginger, cumin, coriander, garlic, chili powder, and cloves.



Figure 2.6. Herbs can be expensive, so try growing a few in your kitchen near a window. "Herbs, Natural, Pharmaceutical" by Seksak Kerdkanno is licensed under a Pixabay License.

Whole Grains and Pulses



Figure 2.7. Quinoa is a gluten-free seed that is packed with protein, fiber, and other essential nutrients. Roast quinoa in the oven and top salads with it for an added crunch! "Quinoa 3" by nerissa's ring is licensed under CC BY 2.0.

Keeping a variety of grains and pulses in your pantry provides a foundation for nutritious meal options because these foods are rich sources of protein, iron, vitamins (especially folate and other B vitamins), and antioxidants, and an excellent source of fiber and potassium. Examples of whole grains include brown rice, whole-wheat pasta, quinoa, barley, and **millet**.^{15,16} Pulses are the dry, edible seeds of legumes, which include lentils, chickpeas, beans, and dry peas, among others.

The importance of cooking with whole grains as part of a nutritious eating pattern is their nutritional value.¹⁵ Whole grains contain a variety of vitamins, minerals, fiber, protein, antioxidants, and other phytochemicals.¹⁵ Milled or refined grains have less nutritional value than unrefined grains because the nutrients in refined grains typically are stripped during processing.

General cooking methods for whole grains include the absorption, boiling (pasta method), risotto, and pilaf methods. To learn more about cooking whole grains, visit the following links below or refer to Preparing Whole Grains and Pulses within the Principles of Cooking section later in the chapter:

- [Grains](#) (US Department of Agriculture's [USDA] MyPlate)
- [Delicious Whole Grain Recipes](#) (Oldways Whole Grains)

Council)

- [Whole Grain Cooking Tips \[PDF—English\]](#) (Oldways Whole Grains Council)
- [Whole Grain Cooking Tips \[PDF—Spanish\]](#) (Oldways Whole Grains Council)

Pro Tip: Remember, soaking grains overnight accelerates cooking and improves the absorption of liquid and seasonings. If toasting, to ensure the toasting process isn't disrupted, don't rinse the grains. Toast grains using dry heat in an oven or skillet until they are golden brown, stirring occasionally.

Pulses provide a variety of nutrients. They are also an excellent gluten-free protein option. For procedures of preparing pulses, refer to the Cooking Methods section in this chapter.

Read [Pulses Nutrition Facts](#) and watch this [video from USA Pulses](#) to learn more about pulses:



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Snacks and Sweets



Figure 2.9. Dark chocolate can improve heart health. Select varieties with at least 50% cacao for the most health benefits. “Dark, Chocolate, Bar” by StockSnap is licensed under a Pixabay License.



Figure 2.8. Looking for a quick and easy snack? Place about one-quarter cup of popcorn kernels in a brown paper bag, fold the top twice to seal, and microwave on high for 2 to 3 minutes or until the popping slows. "Popcorn, Food, Snack" by Odin Reyna is licensed under a Pixabay License.

There are many advantages to having a variety of nutritious snacks in your pantry. The right snack can provide not only nutrients but also help curb appetite between meals and boost energy throughout the day. Some examples of nutritious snacks include dark chocolate, dried fruits, nuts, and popcorn.

Follow these links for more snack information:

- [Tasty Popcorn Toppings](#) (University of Arizona College of Agriculture and Life Sciences Cooperative Extension: Tucson Village Farm)
- [Hacking Your Snacks](#) (USDA's MyPlate)
- [Culture and Food](#) (USDA's Nutrition.gov)

BASIC PRINCIPLES OF SMELL AND TASTE

Smell (or olfaction) and taste (or gustation) are 2 of the 5 primary senses that play a crucial role in the human experience of the world around us. Understanding taste and smell helps us understand various ingredients' flavors, aromas, and their interactions in the context of food preparation and food preferences.

Taste and smell are the primary senses that play a vital role in experiencing different flavors. By comprehending the science behind taste and smell, we can mix ingredients that complement each other, enhance certain flavors, or create contrasts to achieve the desired taste profile. Furthermore, understanding taste and smell helps when developing new recipes or modifying existing ones by experimenting with different ingredient combinations and adjusting the flavors based on these senses.

Knowing the flavor profiles can also help in finding alternative ingredients or substitutions for certain flavors to prepare safe and enjoyable dishes for everyone. This section delves into the biological mechanisms of smell and taste, which together shape our fundamental experience of food's flavor.¹⁷⁻²⁰



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Flavor encompasses both taste and odor, and the olfactory system plays a vital role in its perception. Odor molecules can reach

the olfactory receptors through the retronasal and orthonasal pathways. In the retronasal pathway, odors are perceived when chewing and swallowing propel **odorants** from the mouth to up behind the palate and into the nose. Although the actual contact and receptor activation occurs at the **olfactory mucosa**, this sensation is perceived as originating from the mouth. The brain processes information from various regions when food in the **oral cavity** interacts with the olfactory mucosa.

The orthonasal pathway, on the other hand, involves odors encountered in the environment and perceived through inhalation of odor-containing air, not originating from the mouth. Certain medical conditions—such as allergies, **sinusitis**, and **COVID-19**—can affect the sense of smell, leading to changes in appetite and food preferences.¹⁸⁻²⁰



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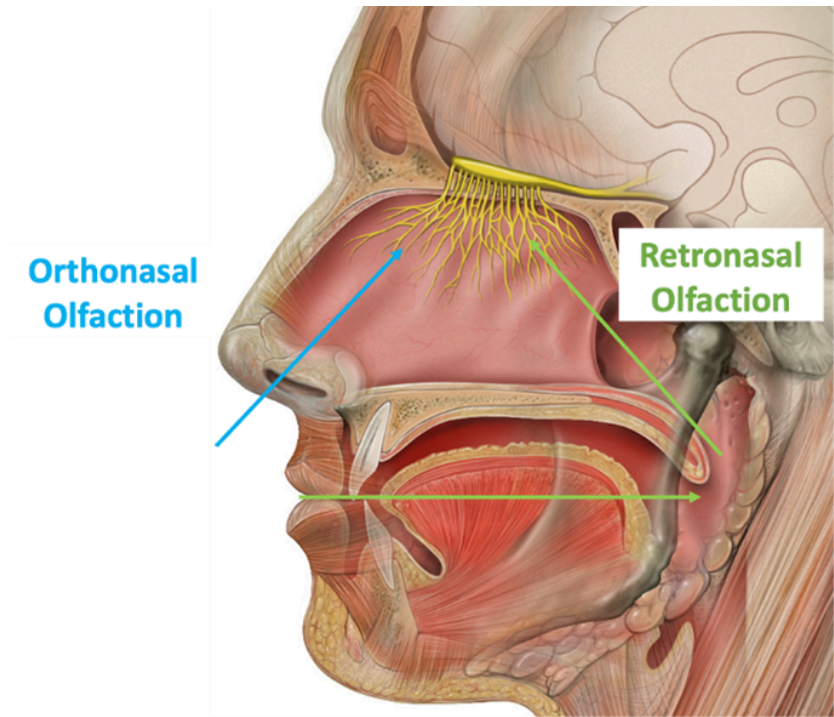


Figure 2.10. Orthonasal olfaction detects odors from the environment via inhalation, whereas retronasal olfaction senses odors from food in the mouth. Both contribute to flavor perception. "Head Olfactory Nerve" by Patrick J. Lynch is licensed under CC-BY 2.5.



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Tastes

Sweet

The perception of sweetness is primarily elicited by the presence of sugars and certain **amino acids** in food. It is thought that the preference for sweet tastes evolved to help identify energy-rich foods, like those with glucose, which provide important fuel for the body.^{19,20}

Consuming too much added sugars can lead to health problems, such as excess body weight, type 2 diabetes, and heart disease. The American Heart Association recommends limiting added sugar intake to no more than 6 teaspoons per day (25.2 g) for women and 9 teaspoons per day (37.8 g) for men.²¹



Figure 2.11. Although donuts do not have significant nutritional benefits, donuts can be part of a balanced, nutritious eating pattern. Pairing a donut with a protein, such as Greek yogurt or nuts, can help balance blood sugar levels. “Passion Fruit Donut” by ecastro is licensed under CC BY 2.0.



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Sour

Sourness or tartness is characteristic of the taste of acids and is induced by the presence of hydrogen ions in food. From an evolutionary standpoint, the ability to perceive sourness is thought to have developed as a means to identify spoiled or rotten foods, which could be detrimental to health.^{21,22} However, it is imperative to note that not all foods with a sour taste are harmful; for example, vinegar, lemon juice, cranberries, yogurt, and buttermilk are safely consumable. Sourness can stimulate digestion and aid nutrient absorption, but consuming too much acid can exacerbate gastroesophageal reflux disease and also can erode tooth enamel over time.²³



Figure 2.12. Add limes to water, salads, or marinades for a refreshing twist. Key limes are smaller and more aromatic than regular limes. They have higher acidity, making them a good option for key lime pie and beverages. “Lime” by Sharon Mollerus is licensed under CC BY 2.0.



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Salty

The salty taste is predominantly caused by the presence of sodium chloride in food, although other mineral salts can also elicit this taste. Sodium is a vital element for maintaining **electrolyte** and fluid balance in the human body. Consequently, the ability to taste saltiness is thought to have evolved to ensure sufficient intake of sodium.^{20,24}

Examples of foods that are typically considered salty include soy sauce, **processed** meats, preserved olives, and french fries. Consuming too much salt can increase the risk of hypertension, stroke, and fluid retention, which can be problematic with heart failure and/or end-stage renal disease.

The American Heart Association recommends limiting sodium intake to no more than 2,300 mg/d (~1 measured **teaspoon**), or 1,500 mg/d for people with high blood pressure, diabetes, or chronic kidney disease.²⁵



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Bitter

Bitterness is a taste sensation that can be attributed to many molecules, many of which are found in plant-based foods. It is widely believed that the human ability to taste bitterness evolved as a defense mechanism to recognize and avoid toxic substances present in certain plants.^{20,26,27} Despite this, not all bitter substances are harmful, and bitterness can be appreciated in moderation or when combined with other tastes, as in coffee, wine, dark chocolate, chicory, endive, and certain leafy greens.



Figure 2.13. Drinking coffee can increase your energy levels. A common misconception is that decaffeinated coffee is caffeine-free; it is not. A truly caffeine-free alternative is chicory coffee. "Coffee Beans" by datenhamster.org is licensed under CC BY-NC-ND 2.0.



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Umami

Umami, often described as a savory or meaty taste, is elicited by foods rich in amino acids, especially glutamic acid and aspartic acid.¹⁸⁻²⁰ Umami is thought to play a role in appetite regulation and the efficient digestion of proteins.^{18-20,28} Foods that are rich in umami include tomatoes, mushrooms, cheeses, and meats.²⁸



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ASSEMBLING TOOLS AND EQUIPMENT

Creating nutrient-dense meals requires the right ingredients and a few essential tools to make the entire process flow smoothly. Use [this checklist](#) to help you identify which essential tools you currently have and which ones you may want to consider adding to your kitchen. It is not necessary to have all the equipment listed here, but it may be helpful to have a few from each category to help make your cooking easier.

Next, test your understanding with this series of interactive

activities. Use the circles or arrows at the bottom to advance through the activities:



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PRINCIPLES OF FOOD PREPARATION

Understanding the Recipe

To achieve culinary success, it is essential to have a solid comprehension of the recipe you are following. Start by carefully reading the instructions, verifying that you have all the required ingredients and tools, and comprehending the proper order, time, and temperature specifications. Familiarity with fundamental cooking techniques, such as chopping and sautéing, also can prove beneficial when executing a recipe. A thorough understanding of a recipe guarantees a more seamless cooking experience and heightens the likelihood of a delicious outcome.

To properly execute a recipe, it is recommended to follow these simple steps:

- Read the entire recipe to understand the methods and techniques to gain a thorough understanding of the cooking processes and equipment required for the recipe.

- Familiarize yourself with the units of measurement used in the recipe and convert them if necessary.
- Reread the recipe, focusing on the step-by-step instructions provided. Pay attention to the order in which ingredients are added and the cooking techniques required at each stage. Begin preparing the items that require the longest cooking time first.
- Determine if the recipe suggests any changes or substitutions for those with dietary restrictions or preferences.
- Plan your prep and cooking schedule based on the recipe.

Pro Tip: Remember to consider healthy cooking methods. Look for keywords such as “grilling,” “roasting,” “steaming,” or “sautéing.” These methods can make your meals delicious and nutritious.

Gathering and Prepping Ingredients

The next step is to gather and prep the ingredients. Begin cooking only after you clearly understand the recipe and have completed your **mise en place**. Follow the instructions step by step and refer to the recipe as needed to ensure you are on track.

Measuring Ingredients

- Measuring weight and volume are *not* equivalent. One

cup does not equal the same weight for all ingredients; those units of measure cannot be used interchangeably.^{28,29}

- Weight measures heaviness (e.g., grams, ounces, or pounds). Volume (height multiplied by width by volume) measures filled space (e.g., fluid ounces, teaspoons, tablespoons, cups, pints, quarts, gallons, liters).^{28,29} To clarify, ounces measure weight, and fluid ounces measure volume (liquids). For example, one-half cup of uncooked rice weighs more than one-half cup of cooked rice.
- Ingredients are weighed using different scales, which are primarily used by commercial operations to optimize precision and reduce waste.^{28,29} For instance, spring-type scales are used to measure dry ingredients, such as grains and beans. A baker's scale is used to measure baking ingredients.²⁸ For home use, a digital scale serves the same purpose. However, some recipes do not require scales, and measuring cups and spoons are suitable for measuring the ingredients.

Measuring Dry Ingredients

- Use flat-topped measuring cups.
- If less than one-quarter or one-eighth cup is to be measured, use flat-topped measuring spoons.
- Level the contents with a knife, with the measuring cup on a flat surface.
- Sifting flour with dry ingredients, such as salt or baking powder, promotes more even distribution.



Figure 2.14. Precise and accurate sugar measurements ensure that recipes turn out consistently every time. "Person Pouring Sugar in a Bowl" by Felicity Tai is licensed under a Pexels License.

Measuring Liquids

Precise liquid measurements can make a difference because recipes can easily turn out too dry or mushy without proper liquid amounts.

- Use a transparent, graduated cup with a pour spout.
- Measure the volume at eye level.



Figure 2.15. With liquids such as oil or water, use a liquid measuring cup with a spout instead of a flat-topped dry measuring cup. “Glass Cup with Measure Scale” by Chris Flaten is licensed under a [Pexels License](#).



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Basic Knife Cuts

To achieve even cooking and consistent texture in your dishes, it is important to have basic knife skills. Whether dicing vegetables for

a stir-fry or julienning carrots for a salad, mastering basic knife cuts will enhance your culinary skills and efficiency, and save you time. The following videos from University of Arizona Yavapai County Cooperative Extension offer a quick and safe guide on preparing your ingredients for cutting and examples of how to perfect some standard cutting techniques:

- [Chiffonnade](#)
- [Dicing](#)
- [Julienne](#)
- [Squaring Off](#)
- [The Claw](#)

PRINCIPLES OF COOKING

Cooking methods can affect the nutrient profile of food positively or negatively. For example, cooking meats or fish until they are well done, charred, or browned could have similar negative effects on nutrient composition.^{28,30} Likewise, cooking red meat at high temperature (see Table 2.3) can promote oxidation of proteins and charring, which has been associated with an increased risk for colon cancer.³¹

Deep-fried foods contain higher levels of fats that may lead to several adverse health conditions. Frying also promotes a chemical composition change in food, as well as lipid oxidation. To reduce fat intake while preserving nutrients and the health benefits of certain foods, select low-fat cooking methods, such as steaming, baking, boiling, grilling, or air frying.

The activities³¹⁻³⁵ below explore the perceptions of flavors as they relate to temperature, thickness, taste, and other factors:



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Learn more about the cooking methods in Tables 2.2 and 2.3.

Table 2.2. Types of Heat Used for Cooking²⁸

Heat transfer type	Description	Examples
Conduction	Heat transferred to food through direct contact with metal (e.g., pan) and flame or electric coil.	Conduction oven, heating pan on stove, melting butter in saucepan
Convection	Heat transferred to food via moving liquid (water or fat) or air currents through and/or around food.	Convection ovens, simmering, steaming, frying
Induction	Heat transferred as particles' waves moving out from their source without direct contact.	Flat-surfaced ranges (electric coil)

Radiation	Electromagnetic wave	Broiling, grilling, microwaving, heat lamps
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Table 2.3. Types of Cooking²⁸

Cooking method	Description	Temperature range	Ideas
<p>Dry heat preparation uses air, fat, radiation, metal, or convection.</p> <p>Video: The Science of Heat Conduction in Aluminum Iron Pans</p>			
<p>Broiling Video: How to Broil</p>	<p>Food cooked under intense heat</p>	<p>500-550 °F (260-288 °C)</p>	<p>Tender steaks, strips, tenderloin, fillets, vegetables</p>
<p>Grilling Video: How To Grill Everything</p>	<p>Food cooked over or above intense heat</p>	<p>500-550 °F (260-290 °C)</p>	<p>Burgers, beef, hot chicken (bone-in), skin, vegetables</p>

<p>Roasting</p> <p>Video: Roasting</p>	<p>Often used for baking meat and poultry</p> <ul style="list-style-type: none"> • Basting used to add flavor and moisture • Sear to brown meat's surface at high temperature before roasting 	<p>325-425 °F (163-218 °C)</p>	<p>Who turk roas roas roas veg</p>
<p>Baking</p> <p>Video: The Physics of Baking</p>	<p>Heating food via hot air within an oven</p>	<p>300-425 °F (149-218 °C)</p> <p>Average temperature: 300 °F (149 °C)</p>	<p>Bre naa cass</p>

<p>Sautéing/ stir frying Video: Sautéing</p>	<p>Uses least amount of oil over moderately high heat</p>	<p>300-350 °F (149-180 °C)</p>	<p>Thin meat cutlets, tender fillings</p>
<p>Pan-frying Video: Pan Frying</p>	<p>Meat or other foods cooked in a moderate to generous amount of fat in very hot frying pan. Food is not completely submerged in fat.</p>	<p>300-350 °F (149-177 °C)</p>	<p>Chicken, chops, vegetable</p>
<p>Deep-fat frying Video: Deep Frying</p>	<p>Complete submersion in liquid fat at high temperature</p>	<p>350-450 °F (177-232 °C)</p>	<p>Chicken (highly), french fries, doughnuts, chips</p>

Moist heat preparation uses water or steam.

Video: The Science Behind Energy Transfer in Liquids

<p>Parboiling Video: How to Parboil Tomatoes Properly</p>	<p>Partially cook food by boiling or used for preparing foods for another final cooking method.</p>	<p>160-212 °F (71-100 °C)</p>	<p>Pota carn toug mea bris sho</p>
<p>Blanching Video: How to Blanch Vegetables</p>	<p>Food is briefly immersed in water. This is done before freezing foods for enzyme inactivation.</p>	<p>160-212 °F (71-100 °C)</p>	<p>Veg (bro bea asp fruit tom seat shri</p>
<p>Pressure cooking Video: The Science Behind Pressure Cookers</p>	<p>Food is cooked faster due to pressure increase (atmospheric pressure) and cooking temperature (boiling point) increases</p>	<p>235-250 °F (113-121 °C)</p>	<p>Tou mea chu sho rice sou</p>

<p>Scalding Video: How to Scald Milk</p>	<p>Term used for milk. Formation of large, stationary bubbles on bottom and sides of pot, bubbles do not break surface. Over medium-high heat.</p>	<p>150-160 °F (66-71 °C)</p>	<p>Dissolving in hot milk and mixing with desired back unpasteurized milk</p>
<p>Poaching Video: Poaching</p>	<p>Relatively motionless bubbles that appear on the bottom of the pan or pot</p>	<p>160-175 °F (71-79 °C)</p>	<p>Egg whites (leaves)</p>
<p>Simmering Video: How to Simmer</p>	<p>Right below boiling point with gently rising bubbles that barely break the surface</p>	<p>>180 °F (>82 °C)</p>	<p>Soup, bean cuts (beef, chicken, pork)</p>

<p>Boiling Video: What Is Boiling? An Introduction</p>	<p>Bubbles rapidly</p>	<p>212 °F (100 °C) at sea level</p>	<p>Pasta sauces tough vegetables beans</p>
<p>Steaming Video: Steaming</p>	<p>Food cooked via direct contact with steam produced</p>	<p>212-250 °F (100-121 °C)</p>	<p>Vegetables (retained taste) textured filled bread cuts</p>


Combination heat

<p>Braising Video: Braising Video: How to Braise Meat Like a Pro</p>	<p>Food simmered in small amount of liquid, using larger cuts of vegetables and meat</p>	<p>250-325 °F (121-163 °C)</p>	<p>Tough meats braises short ribs chicken (thighs) drumsticks</p>
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Stewing	Chopped ingredients simmered in moderate amount of liquid and covered	185-205 °F (85-96 °C)	Tou mea chu sho veg
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Source: Brown AC. *Understanding Food: Principles and Practice*. 6th ed. Cengage Learning; 2015. This table is included for fair use.

Learn more about various cooking methods by watching this [video from NutritionFacts.org](#):

 One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://opentextbooks.library.arizona.edu/culinarymedicine/?p=681#oembed-2>

“The Best Cooking Method” by [Michael Greger, MD, FACLM](#) licensed under [CC-BY-NC 4.0](#)

Microwaving

Microwaving is a combination of moist- and dry-heat methods but

is often categorized as a moist-heat method because it involves water. However, microwaves are a type of radiation (a dry-heat method) that excites (heats) the water molecules within food, which causes the food to warm up. Because microwaves use radiation, it is important to use microwave-safe cookware only or else damage, fires, and physical (nonfood particle) contamination from the container may occur.²⁸

In a microwave, food can be steamed by covering the food with plastic wrap. Sometimes, microwaves are used for thawing, and then the thawed food is cooked immediately afterward.²⁸ For cooking, not all meats (e.g., thicker cuts or whole roasts) can be microwaved, because the waves only go through to approximately 0.5 to 2 inches (0.1-0.5 cm).²⁸ Therefore, it is unsafe and a food safety concern to cook meat in microwaves. See Figure 2.16 for microwave-safe tips and statistics.

BE MICROWAVE SAFE

FOLLOW THESE TIPS TO AVOID SCALDS, BURNS AND FIRES WHEN USING A MICROWAVE

While microwave ovens offer quick, convenient cooking, they also can be dangerous if they aren't used carefully



90 PERCENT of American homes with microwaves

7,100 microwave-related HOME FIRES 2007-2011¹



\$31 MILLION

annual average in PROPERTY DAMAGE from microwave fires²

From 1990-2010 AN AVERAGE OF 21 PEOPLE PER DAY were treated in emergency rooms for microwave-related injuries³

- + Spills were the most common cause of injury⁴
- + The most common injuries were burns to the fingers and hands⁵
- + Kids were more likely than adults to burn their face, head or neck⁶

ERUPTED HOT WATER PHENOMENA

This occurs when **WATER HEATED BEYOND 212 DEGREES** in a clean cup or bowl shows no signs of boiling, but explodes if disturbed. Reduce the risk by:

Use dishes with **SLOPED SIDES**

STIR in sugar or soup mixes before microwaving



Leave a **MICROWAVABLE SPOON** in liquids while heating to break up the surface tension

FIRE AND ICE

TO ELIMINATE HOT SPOTS:

ROTATE the dish one-quarter to one-half midway through cooking



STIR foods before eating

HOT, HOT, HOT!

The steam inside microwaved containers and popcorn bags **CAN EXCEED 180 DEGREES**. Use caution when cooking and handling these items.

Use **VENTED CONTAINERS**

Open containers **AWAY FROM YOUR FACE**



Let containers cool **1-2 MINUTES** before opening

Use **OVEN MITTS** or **POT HOLDERS**



DISHING ON MICROWAVABLE COOKWARE

AREN'T SURE IF YOUR DISHES ARE MICROWAVE-SAFE? FIND OUT IN 4 STEPS:



1 Fill a measuring cup with one cup of water



2 Place it in the microwave along with the dish



3 Microwave one minute on high



4 If the dish feels warm, it isn't microwave-safe

Figure 2.16. Use microwave-safe dishware and follow proper reheating guidelines. Ensure you do not microwave metal, because this can cause a fire. "Microwave Safety infographic" by State Farm is licensed under CC BY 2.0.

Preparing Whole Grains and Pulses

Basic instructions for preparing all types of whole grains²⁸:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

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Basic instructions for preparing all types of pulses:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=681#h5p-49>

Pro Tip: It takes the same amount of time to prepare lentil and split peas as it takes to prepare certain varieties of pasta and rice! For more information on how to cook pulses, see [Get Cooking](#) and [Nutrition Professionals](#) from USA Pulses.

IMPACT OF COOKING ON NUTRIENTS

Water-soluble vitamins (i.e., B vitamins and vitamin C) are more susceptible to nutrient degradation than fat-soluble vitamins (A, D, E, and K) because water loss begins as soon as the produce is picked from its plant source. Temperature management is most important for preventing nutrient loss. During storage, vitamins C losses are accelerated with higher temperatures and longer duration in storage contains and units (see Table 2.4).³⁶⁻³⁹

When cooking with water, water-soluble vitamins degrade and are lost in the water with heat. When cooking with oil, fat-soluble vitamins degrade into the fat.³⁶⁻³⁹ A rule of thumb is to consume the water or oil that the food is cooked in to still receive more of the vitamins that degraded from the food.

Many studies indicate that vitamin C is easily lost during cooking, due to its water solubility and temperature sensitivity. Higher cooking temperatures and longer cooking times particularly increase the loss of vitamin C. Although the nutrient loss varies depending on the vegetable, steaming or microwaving with minimal or no water is ideal to maintain nutrient integrity; and steaming and or stir-frying helps preserve the vitamin profile of vegetables, for this same reason.³⁶⁻³⁹

Table 2.4. Storage Temperature's Impact on Vitamin C Degradation³⁷

Storage temperature for 7 days	Vitamin C loss
Green peas stored at 4 °C (39 °F)	15%
Green beans stored at 4 °C (39 °F)	77%
Broccoli stored at 0 °C (32 °F)	0%
Broccoli stored at 20 °C (68 °F)	56%

Research Study at a Glance

In one study, boiling water rendered almost all samples deficient in vitamin C, and nutrient retention ranged from 0% to 73.86%; vitamin C loss was greatest in boiled chard. According to the retention rate of the samples, which ranged from 57.85% to

88.86%, blanched spinach showing the highest loss. The retention of vitamin C in all vegetables except broccoli was reduced from 0% to 89.24% by steaming. Vitamin C levels were not significantly affected by microwave cooking, and, when steamed or microwaved, spinach, carrots, sweet potatoes, and broccoli had high retention rates (>90%). Increased levels of vitamin C are associated with less water use and shorter cooking times.³⁸

FOOD WASTE

Preventing Edible Food Waste

According to the FDA, food waste in the United States is estimated to range from between 30% and 40% of the food supply. These figures, based on estimates from the USDA Economic Research Service of 31% food loss at the retail and consumer levels, corresponded to approximately 133 billion pounds and \$161 billion worth of food in 2010.⁴⁰

Finding ways to minimize this loss and waste could foster many benefits to society, including reducing food insecurity, saving money, conserving energy, and mitigating climate change by lowering greenhouse gas emissions from rotting food in landfills.⁴⁰

Land, water, labor, energy, and other inputs are used in producing, processing, transporting, preparing, storing, and disposing of discarded food. Top contributors to food waste include spoiled produce and meat, uneaten leftovers, and a misunderstanding of “best by” dates.⁴⁰

One reason for premature food waste is the food and product dating, including the “best if used by/before,” “sell by,” “use by,” and “freeze by” dates, which prompt consumers to throw away food



Figure 2.17. Food sharing apps such as Too Good to Go or Olio are useful for buying discounted foods from businesses or sharing surplus food with neighbors. If receiving food from neighbors, use caution because they may not follow food safety procedures. “Pile of Trash” by Jas Min is licensed under an Unsplash License.

items before their true expiration date (when they are no longer safe to consume).

To avoid discarding food prematurely or before its expiration date, read more from the USDA about [Food Product Dating](#). For a complete guide on food storage and safety to prevent food waste, [Food Keeper](#) was created by the USDA, Cornell University, and the Food Marketing Institute.

Food Keeper

Access the Food Keeper tool on the web or download it on your smartphone:

- [For the web](#)
- [For Android devices](#)
- [For Apple devices](#)

Watch this [video from the University of Arizona Cooperative Extension in Yavapai County](#) on safely storing items that can spoil:



One or more interactive elements has been excluded from this version of the text. You can view them online

here: <https://opentextbooks.library.arizona.edu/culinarymedicine/?p=681#oembed-3>

Product labeling, shopping, ordering, labeling foods at home, and storage also play a role in food waste. If there are flaws in these systems, then food waste is inevitable. Food waste can also be used to create compost or feed animals.⁴⁰⁻⁴² Wholesome food that will

not be sold or consumed before expiration can be donated to **food banks** and pantries, further reducing food waste.⁴²

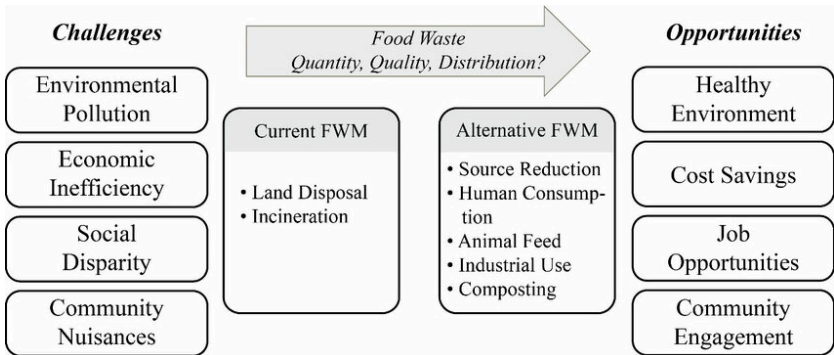


Figure 2.18. This diagram illustrates the complexities of and potential solutions to food waste management (FWM), emphasizing the need for innovative strategies to reduce environmental impact and highlighting the challenges and opportunities to creating more sustainable food systems. by Ning Ai and Junjun Zheng is licensed under CC-BY.



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Preventing Food Packaging Waste

Which items are considered recyclable depends on local regulations. Typically, cardboard, paper, food boxes, beverage

cans, glass bottles, jars (glass and plastic), jugs, and plastic bottles and caps are recyclable. Plastic bags and wraps are also recyclable, but they cannot be recycled in curbside bins.⁴⁴ Learn more about your local recycling options at [Earth911](#) or [Recycle Nation](#). For more information, see [How Do I Recycle Common Recyclables](#) from the US Environmental Protection Agency.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=681#h5p-51>

Key Takeaways

- Practicing the 4 steps—Clean, Separate, Cook, Chill—is crucial for preventing the spread of harmful bacteria and viruses and ensuring food safety. It is also important to stay informed about food recalls and recognize the signs of foodborne illnesses so prompt medical attention can be sought.
- Smell and taste are integral parts of our sensory experience, with the olfactory system playing a crucial role in perceiving flavor through both the retronasal and orthonasal pathways.

- Mastering fundamental cooking methods and using proper knife techniques ensure you can prepare a variety of foods safely and efficiently.

REFERENCES

1. US Department of Agriculture, US Department of Health and Human Services. *Dietary Guidelines for Americans, 2020-2025*. 9th ed. December 2020. Accessed October 26, 2024. <https://www.dietaryguidelines.gov>
2. Mills S, Brown H, Wrieden W, White M, Adams J. Frequency of eating home cooked meals and potential benefits for diet and health: cross-sectional analysis of a population-based cohort study. *Int J Behav Nutr Phys Act*. 2017;14(1):109. doi:10.1186/s12966-017-0567-y
3. McGowan L, Pot GK, Stephen AM, et al. The influence of socio-demographic, psychological and knowledge-related variables alongside perceived cooking and food skills abilities in the prediction of diet quality in adults: a nationally representative cross-sectional study. *Int J Behav Nutr Phys Act*. 2016;13(1):111. doi:10.1186/s12966-016-0440-4
4. Saksena MJ, Okrent A, Anekwe T, et al. America's eating habits: food away from home. Economic Information Bulletin No. (EIB-196). US Department of Agriculture; 2018:26.
5. Smith LP, Ng SW, Popkin BM. Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from 1965–1966 to 2007–2008. *Nutr J*. 2013;12:45. doi:10.1186/

1475-2891-12-45

6. Raber M, Chandra J, Upadhyaya M, et al. An evidence-based conceptual framework of healthy cooking. *Prev Med Rep.* 2016;4:23–28. doi:10.1016/j.pmedr.2016.05.004
7. About four steps to food safety. Centers for Disease Control and Prevention. March 24, 2023. Accessed October 26, 2024. https://www.cdc.gov/food-safety/prevention/?CDC_AAref_Val=https://www.cdc.gov/foodsafety/keep-food-safe.html
8. Safe minimum internal temperature chart. Food Safety and Inspection Service, US Department of Agriculture. May 11, 2020. Accessed October 26, 2024. <https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/safe-temperature-chart>
9. Appliance thermometers. Food Safety and Inspection Service, US Department of Agriculture. August 8, 2013. Accessed October 26, 2024. <http://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/appliance-thermometers>
10. Shelf-stable food safety. Food Safety and Inspection Service, US Department of Agriculture. March 24, 2015. Accessed October 26, 2024. <http://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/shelf-stable-food>
11. Safe food handling. US Food and Drug Administration. November 2, 2022. Accessed October 26, 2024. <https://www.fda.gov/food/buy-store-serve-safe-food/safe-food-handling>
12. Keep food safe! Food safety basics. Food Safety and Inspection Service, US Department of Agriculture. Accessed October 26, 2024. <http://www.fsis.usda.gov>

[food-safety/safe-food-handling-and-preparation/food-safety-basics/steps-keep-food-safe](#)

13. Recalls, market withdrawals, & safety alerts. US Food and Drug Administration. November 2, 2022. Accessed October 26, 2024. <https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts>
14. Jiang TA. Health benefits of culinary herbs and spices. *J AOAC Int.* 2019;102(2):395–411. doi:10.5740/jaoacint.18-0418
15. Grains. US Department of Agriculture. Accessed October 26, 2024. <https://www.myplate.gov/eat-healthy/grains>
16. Oldways Whole Grains Council homepage. Accessed October 26, 2024. <https://wholegrainscouncil.org>
17. Whole Grain Cooking Tips. Oldways Whole Grains Council. Accessed October 26, 2024. https://wholegrainscouncil.org/sites/default/files/atoms/files/WGC-CookingWholeGrains_0.pdf
18. Morrill JS. 6.1: Mouth. In: *Science, Physiology, and Nutrition for the Nonscientist*. Medicine LibreTexts; October 28, 2021. Accessed October 26, 2024. [https://med.libretexts.org/Bookshelves/Nutrition/Science_Physiology_and_Nutrition_for_the_Nonscientist_\(Morrill\)/06%3A_Digestive_Tract/6.01%3A_Mouth](https://med.libretexts.org/Bookshelves/Nutrition/Science_Physiology_and_Nutrition_for_the_Nonscientist_(Morrill)/06%3A_Digestive_Tract/6.01%3A_Mouth)
19. Bartoshuk L, Snyder D. Taste and smell. In: Biswas-Diener R, Diener E. (eds). *Psychology*. Noba textbook series. DEF Publishers. Accessed July 31, 2023. <https://nobaproject.com/modules/taste-and-smell>
20. Breslin PAS. An evolutionary perspective on food and human taste. *Curr Biol.* 2013;23(9):R409–R418. doi:10.1016/j.cub.2013.04.010
21. Johnson RK, Appel LJ, Brands M, et al. Dietary sugars

- intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009;120(11):1011–1020. doi:10.1161/CIRCULATIONAHA.109.192627
22. Ramos Da Conceicao Neta E, Johanningsmeier SD, McFeeters RF. The chemistry and physiology of sour taste—a review. *J Food Sci*. 2007;72(2):R33–38. doi:10.1111/j.1750-3841.2007.00282.x
 23. Taraszewska A. Risk factors for gastroesophageal reflux disease symptoms related to lifestyle and diet. *Rocz Panstw Zakl Hig*. 2021;72(1):21–28. doi:10.32394/rpzh.2021.0145
 24. Taruno A, Gordon MD. Molecular and cellular mechanisms of salt taste. *Annu Rev Physiol*. 2023;85:25–45. doi:10.1146/annurev-physiol-031522-075853
 25. How much sodium should I eat per day? American Heart Association. Accessed October 26, 2024. <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/sodium/how-much-sodium-should-i-eat-per-day>
 26. Wooding SP, Ramirez VA, Behrens M. Bitter taste receptors: genes, evolution and health. *Evol Med Public Health*. 2021;9(1):431–447. doi:10.1093/emph/eoab031
 27. Hartley IE, Liem DG, Keast R. Umami as an ‘alimentary’ taste. A new perspective on taste classification. *Nutrients*. 2019;11(1):182. doi:10.3390/nu11010182
 28. Brown AC. *Understanding Food: Principles and Preparation*. 6th ed. Cengage Learning; 2015.
 29. Molt M. *Food for Fifty*. 14th ed. Pearson; 2017.
 30. Labensky SR, Hause AM, Martel P. *On Cooking: A Textbook of Culinary Fundamentals*. 6th ed. Pearson; 2019.

31. Raber M, Chandra J, Upadhyaya M, et al. An evidence-based conceptual framework of healthy cooking. *Prev Med Rep.* 2016;4:23–28. doi:10.1016/j.pmedr.2016.05.004
32. Delwiche J. The impact of perceptual interactions on perceived flavor. *Food Qual Prefer.* 2004;15(2):137–146. doi:10.1016/S0950-3293(03)00041-7
33. Small DM, Prescott J. Odor/taste integration and the perception of flavor. *Exp Brain Res.* 2005;166(3):345–357. doi:10.1007/s00221-005-2376-9
34. Guichard E. Interactions between flavor compounds and food ingredients and their influence on flavor perception. *Food Rev Intl.* 2002;18(1):49–70. doi:10.1081/FRI-120003417
35. Spence C, Levitan CA, Shankar MU, Zampini M. Does food color influence taste and flavor perception in humans? *Chemosens Percept.* 2010;3(1):68–84. doi:10.1007/s12078-010-9067-z
36. Lee SK, Kader AA. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Bio Tech.* 2000;20(3):207–220. doi:10.1016/S0925-5214(00)00133-2
37. Barrett, DM. Maximizing the nutritional value of fruits and vegetables: review of literature on nutritional value of produce compares fresh, frozen, and canned products and indicates areas for further research. UC Davis Department of Plant Sciences; 2007;61. Accessed October 27, 2024. <https://postharvest.ucdavis.edu/publication/maximizing-nutritional-value-fruits-vegetables>
38. Lee S, Choi Y, Jeong HS, Lee J, Sung J. Effect of different cooking methods on the content of vitamins and true retention in selected vegetables. *Food Sci Biotechnol.* 2017;27(2):333–342. doi:10.1007/s10068-017-0281-1

39. Coe S, Spiro A. Cooking at home to retain nutritional quality and minimize nutrient losses: a focus on vegetables, potatoes and pulses. *Nutr Bulletin*. 2022;47(4):538–562. doi:10.1111/nbu.12584
40. Food loss and waste. US Food and Drug Administration. February 14, 2023. Accessed October 26, 2024. <https://www.fda.gov/food/consumers/food-loss-and-waste>
41. Food product dating. Food Safety and Inspection Service, US Department of Agriculture. October 2, 2019. Accessed October 26, 2024. <http://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/food-product-dating>
42. Harvard T. H. Chan School of Public Health. Food waste. *The Nutrition Source*. April 26, 2017. Accessed December 20, 2024. <https://nutritionsource.hsph.harvard.edu/sustainability/food-waste>
43. Preventing wasted food at home. US Environmental Protection Agency. June 14, 2023. Accessed October 26, 2024. <https://www.epa.gov/recycle/preventing-wasted-food-home>

Chapter 3: Enjoying Food at Home and Beyond—Our Relationship with Food

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INTRODUCTION

Culinary medicine supports individuals in lifelong healthy eating patterns. Effective support must consider the countless ways that individuals interact with food and its meaning in their lives. Food is nourishing beyond the nutrients and energy derived from it. Culinary medicine recognizes and supports the multifaceted relationship people have with food.

Sustaining a healthy eating pattern requires a healthy relationship with food, which honors the social, cultural, and emotional importance of food, along with its nutritional value. Flexibility is key. Empowering people to pursue the various pleasures food brings them can help them sustain health-promoting behaviors more so than restrictive, rigid rules.

To promote lifelong healthy eating patterns, culinary medicine

seeks to help people develop cooking skills, and it promotes feasible behavioral changes compatible with a person's beliefs, preferences, and traditions. From a medical perspective, a fed person is a healthy person, so finding ways to support food choices and patterns that satisfy all aspects of health, including psychosocial health, is key to developing and maintaining a "nourishing" relationship with food.

It is important to remember that weight does not necessarily equate to health, nor does it determine a person's value or worth. For those with limited resources, obtaining an adequate supply of food and adequate energy and nutrients can be difficult. Dietary recommendations by health professionals must be made with an awareness of the potential limitations to regular access to nutritious foods and the cost. Respect and dignity are central to health promotion and efforts to help a person build a healthy relationship with food.



Figure 3.1. Preparing food with loved ones can improve satisfaction. Food can be about more than nutrients; it is also about connection. “Couple Preparing Food” by Kampus Production is used under a Pexels License.

“Food is everywhere. It penetrates everything—our politics, sociology, anthropology. It’s the way we nurture ourselves, our family, our friends. It’s the way we entertain, the way we socialize. It’s the way we connect with others, the way we explain our culture, celebrate our milestones. And there are always so many more delicious things to eat... Food is a unifier.” — Gail Simmons¹

OUR RELATIONSHIP WITH FOOD

Health and its pursuit have many layers and are affected by many factors. Food is a good example of a factor with a complex influence on health. Food provides the nutrients essential for growth and function, but its impact is much more than simple biology. Food holds a story that is unique to an individual, and that is rooted in their environments, families, and culture.

A person’s relationship with food and their body starts early and

can be disrupted if the personal nature of food and the variety of factors that influence it are not understood and honored. Some foods nourish our bodies; others nourish our souls and create connection. All foods serve a purpose, and what is available to eat and what is eaten help establish adequacy—the basis of any healthy relationship with food.

A healthy relationship between food and the body is flexible, nonjudgmental, and nonrestrictive, and considers lived experiences, culture, and the **food environment**.^{2,3} A healthy relationship with food foregoes **dichotomous thinking**, allows for relaxed eating, decreases pressure by limiting rules relative to food, and embraces body diversity.

A healthy relationship with food promotes sustainable food practices, because of flexibility. It is not enough to promote balanced nutrition habits if those practices are not sustainable. Restrictive and rigid food beliefs and rules are not sustainable over time, and they increase the risk of poor health outcomes and the development of disordered eating.^{2,4}

People are experts on their own bodies; they know how they respond to food and what truly provides satisfaction and pleasure. Empowering individuals to pursue pleasure can go hand in hand with empowering individuals and communities to engage in health-promoting behaviors.⁵ This is especially true when we encourage rich, diverse, **culturally appropriate** food options without overly focusing on body size.

Looking at people and communities as experts is vital to building trusting and positive relationships with communities that support their lived experiences. Understanding communities and people's food stories provides practitioners important insight. This awareness and understanding allow providers to engage in more meaningful and sustainable change talk that is more informed than external and general food and nutrition recommendations.^{5,6} This understanding and asset-based thinking can help build a collaborative and respectful process of learning how to incorporate

nourishing foods into people's lives. Helping people work with what is available to them, and talking about food from a positive perspective can remind them that we've always known how to feed ourselves; we just need to listen to inner cues and honor them.

This chapter explores what affects our relationship with food, the food environment, and how to incorporate pleasure from a place of nonjudgment and reviews the importance of coming together as individuals in communities and families to enjoy a meal, at home and elsewhere.

Complex Factors



Figure 3.2. Family dynamics and caregivers' relationships with food can shape individual relationships with food well into the future. "Family Having Dinner Together" by August de Richelieu is used under a Pexels License.

Many intersecting factors influence a person's relationship with food.² These factors include external and internal influences, such as messages about food hierarchy from family, doctors, and

teachers, and other factors, such as genetics, traumatic experiences, and food access.^{2,4} The idea that an individual is in full control of these factors is misguided. This desire to control food can be the source of blame and shame regarding the choices people make regarding food and general care for their body.

The environment and **social norms** that are created around food influence how people relate and interact with food. Social norms are often based on what people believe to be normal, typical, or appropriate. Social norms can function as unspoken rules or guidelines for how people behave and are expected to behave. People generally follow social norms because they want to fit in with the people around them.⁵

Social norm factors that influence food choices include:

- **Diet culture**
- “Good” vs “bad” food messages
- Social media displaying the “right way to eat”
- Societal or family food beliefs/attitudes
- Westernized foods being labeled “healthy” while **cultural foods** are demonized⁵

Diet culture encourages dieting behaviors associated with long-term health consequences, such as muscle loss from repeated weight loss attempts, weakened bones, high blood pressure, and chronic inflammation. Dieting also increases the risk of poor body image and is a strong contributor to eating disorders.²

Diet culture is all around because the drive for weight loss and “health” or “wellness” is adjacent to morality and social status.^{5,6} This affects the relationship with food because it causes a disruption in being able to listen to the body’s needs, and it can cause internal judgment of food choices if they do not align with what is viewed as healthy or nutritious.

When food is not accessible and when life is stressful due to

environmental factors (e.g., unstable housing, unsafe spaces, financial insecurity, **historical trauma, systemic racism**), it's challenging to have a peaceful relationship with food. An example of this would be wanting to eat something because you feel hungry, but the food available is convenience food or only foods that diet culture has deemed "unhealthy," so you skip the meal in fear of weight gain and further stigma, which keeps you in a negative cycle with your relationship with food.^{7,8}

This can be further complicated if a person then eats when they are hungry but outside the rules that diet culture has dictated. The person then may feel guilt and shame for those choices; thanks to **confirmation bias**, this then erodes trust within the body. This phenomenon keeps people in the cycle of not trusting their bodies when it comes to food. They believe a food is bad for them, which creates a power struggle with this food, and when they do eat it, they may end up feeling they have to eat a lot because it is an "off-limits" food. Thus, confirming that this food is not safe or "good."

Interpersonal relationships affect how we view food and bodies. Each individual has lived experiences that shape how they relate to food. Food plays a vital role in many communities and cultures; the importance is meaningful and diverse. Authors Hilary Kinavey and Dana Sturtevant noted in *Reclaiming Body Trust: A Path to Healing and Liberation* that "Eating is not—and should never be—just about survival. For human beings, food is flavored with complex meanings. It tells the story of your ancestors, your culture, and your history. The bottom line: When people mess with your food, they are messing with your life in ways rarely anticipated or understood."⁵

Another area that affects an individual's relationship with food and that often overlaps with relationships and the environment is a person's attitudes and beliefs about food. These beliefs are often learned and may come from others (e.g., doctors, family members, dietitians), the media, or through one's own lived experiences with

food (see the “Measuring Beliefs About Food and Nutrition” text box).^{2,6}

Measuring Beliefs About Food and Nutrition

A variety of food beliefs can be measured by asking questions such as:

- Do you get nervous eating certain foods out of fear they are “bad” for you (e.g., gluten, sugar)?
- Do you label food as good, bad, healthy, or unhealthy?
- Do you label your cultural foods (or others’) as unhealthy?
- Do you have rules about food that feel stressful (e.g., don’t eat after 7 PM, you should avoid carbohydrates, you should avoid beans, sweets are bad)?
- Do you believe willpower and personal choice are important to achieve health?

The questions in the preceding text box relate to some examples of food beliefs. Often, these kinds of beliefs can lead to a more negative relationship with food if not explored or challenged. Challenging these ideas can be helpful. It can also be interesting to consider whether these statements are true—or true for that person. Answers to these kinds of questions provide more to the

person's "story" and can be a very helpful starting point when working with people and supporting them in behavior change.

Ultimately, health is not a moral obligation, and there is no virtue in food choices. Tanya Denise Fields, a food justice activist, once noted, "People don't make good food choices, they have them."⁹ This underpins the complex role that society and the **social determinants of health** play in shaping a person's relationship with food, and thus can deeply affect overall health outcomes.¹⁰

In the following interactive activity, select the > to read additional information:



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Health is also multifaceted and individual. Overall health encompasses many other behaviors and factors, such as sleep, tobacco use, access to quality medical care, access to medical care, alcohol use, genetics, stress, family history, social support (or lack thereof), access to safe spaces, access to transportation, and so much more. These are all determinants of health and make up 30% to 55% of what affects a person's health.¹¹

The lack of access to equitable and unbiased health care can hold individuals back from achieving what is deemed good health for them. Avoidance of health care is not always considered and can be a useful place to start rather than assuming a person "just" needs to

eat better to be healthier. “Food, though a physiological necessity and required for good health and functionality, also contributes to the social, cultural, psychological and emotional well-being of our lives.”⁸

FOOD ENVIRONMENT AND THE PLEASURE FACTOR

Our relationship with food includes our experience with the community we engage with while eating it. Many cultures and communities find belonging and connection through food. Food is associated with emotion in humans, and that is an important part to consider when discussing food and nutrition with individuals.^{5,7}

The idea of experiencing food through community intersects with social support and how that affects overall health. A survey at the University of Arizona in 2021 found that 45.4% of students surveyed ($n = 5,253$) indicated that comparing their food or body on social media had a negative impact on their mental well-being.¹² This illustrates that while community is important, social media can have a harmful impact on body image and food beliefs given the lack of regulation of information about nutrition and health.

There are many ways to eat a meal, and there are often hidden rules about the “correct” way to eat. Examples include that meals



Figure 3.3. Flexibility and enjoyment with food are important. Experiencing joy with food can happen when we try both family food and new foods, such as at a fair or on vacation. A positive environment in general that is free from pressure and judgement improves this joy. “A Family Eating Food Together” by RDNE Stock project is used under a Pexels License.

must be mindful or undistracted, or must be eaten with a fork or a spoon. These are examples of **Westernized beliefs**. Westernization⁶ reached much of the world as part of the process of **colonialism** and continues to be a significant cultural phenomenon, due to globalization of ideas about food and meals that can influence how individuals engage with food. **Ableism** in mealtime behaviors is well known. This can be especially true when learning or supporting those feeding children or **neurodivergent** individuals. If allowed, diet culture and Westernized beliefs can challenge the potential enjoyment of eating a meal.⁶

There is no 1 correct way to eat; it is more about asking how and with whom individuals eat in a way that brings them the most safety and ease. In some cultures, eating with one's hands or having music on is typical, or a child may need the support of a device to nourish themselves. Eating is an opportunity to enjoy, nourish, and experience pleasure, and that may look different for different cultures and individuals. The idea of maintaining pleasure with respect to eating is fascinating. adrienne maree brown once said, "What if it's a measure of our freedom to reclaim pleasure?"¹³

Pleasure is a word that is often viewed as something to feel shame about. Centering pleasure and satisfaction when we consider eating can be rewarding and unlock more attuned forms of eating and movement. Many things can bring someone back to finding pleasure in food.⁵

Cooking Can Influence Our Pleasure Factor

Preparing meals that matter to a person can make a difference. This can mean meals that support connection with one's ancestors, connection with one's community, or just connection with the people one engages with. Food preparation is a very positive sensory experience for some, which can empower them to try new things and play with food.

Asking individuals if they like to cook or what experience they

have with cooking is a doorway to learning if they find importance in this act. These questions can lead to conversations about new recipes to try or other behavior strategies that will increase variety in a person's meal pattern. By reconnecting with food from childhood or an individual's culture, there can be permission for pleasure, especially if diet culture or health messages they've received about their cultural foods have been negative or have a lot of bias. Cooking can also create self-efficacy, which makes behavior change more sustainable and enjoyable.¹⁴

Environment Can Affect Pleasure

Eating outside or alone or with others, learning what environment supports having a relaxed experience with food, and having pleasure with food can be helpful. Learning about the environment and an individual's relationship with pleasure can be discussed more broadly by exploring values.^{3,5,6}

Our values are what we as individuals view as important tenets of our lives. Understanding what is important to us allows us to consider if our beliefs and behaviors align with those values.¹⁵ For example, if a person values connection but eats in isolation, the food behavior is not in alignment with their value and need to support self-care.

ALL THE REASONS WE EAT

Food is universal. Food is needed for our survival, so it is natural that food plays a major role in individuals' lives. Much like a person's relationship with their body, their relationship with food intersects with their body and with how they might express themselves, share experiences, and cope with emotions.

Emotional eating is normal and an important part of the human experience.^{16,17} The only reason emotional eating is often demonized is due to the

fear of and **biases** toward having a higher weight. Body diversity is natural and there are many reasons people eat and support the body they inhabit. It is not uncommon for food restriction to be recommended to decrease emotional eating, but this can cause unintentional harm.

Food restrictions and recommendations to limit foods can harm a person's relationship with food and can also lead to **disordered eating**.^{2,18,19} Disordered eating and diagnosed eating disorders fall along a spectrum. Disordered eating involves the same behaviors as a clinically diagnosed **eating disorder**, but the frequency and severity of the disordered habits differ.

"Normal" eating, as defined by Ellyn Satter,¹⁷ is flexible and free from shame and guilt; thus, when eating becomes inflexible or causes feelings of shame and guilt, this can be a sign of an unhealthy relationship with food. Here are some examples of disordered eating habits:



Figure 3.4. Different cultures and their cultural foods are important to enhance health and increase experiences of pleasure while eating. "Family" by Meruyert Gonullu is used under a Pexels License.

- Avoiding entire food groups, certain macronutrients, or foods with specific textures or colors without a medical reason
- Binge eating (i.e., eating larger-than-typical amounts of food), which often can result from restriction and end with backlash of shame and/or frustration
- Engaging in compensatory behaviors, such as exercising to “make up for” or “earn” food
- Engaging in purging behaviors, such as using laxatives, avoiding insulin doses (i.e., diabulimia, which is specific to people with diabetes), overexercising, or vomiting to control weight
- Exercising compulsively and having increased stress about limiting activity
- Feeling guilt, disgust, or anxiety before or after eating
- Feeling preoccupied by food
- Following strict food rules or rituals
- Intentionally skipping meals (including skipping meals before or after consuming a large meal) or restricting food intake or food or alcohol a person considers unhealthy
- Weighing or taking body measurements often

Even when disordered eating doesn't lead to a clinical eating disorder, it is associated with poorer mental and physical health.^{20,21} Many people do not meet the diagnostic criteria for an eating disorder but struggle with painfully disordered thoughts about behaviors related to food.



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There are also many people who do meet the clinical criteria for an eating disorder but aren't diagnosed, because of various forms of bias and treatment disparities. An example is patients with higher weight who meet all the behavioral criteria for an eating disorder but aren't diagnosed because they aren't "small enough" or don't "look like" they have an eating disorder.^{18,19,21} Disordered eating behaviors aren't always obvious, and many health-care providers don't have the tools needed to identify them. The "Eating Disorder Screening Questions" text box provides some questions that health-care providers can use to screen for disordered eating.

Eating Disorder Screening Questions for Health-Care Professionals

- Would you say that food dominates your life?
- Do you ever feel out of control around

food, like you cannot stop eating until you are uncomfortably full?

- Do you ever eat in secret? Or do you feel guilt or shame about eating?
- Does your weight affect the way you feel about yourself?
- Is the list of foods you like and will eat shorter than a list of foods you won't eat?
- Do you ever make yourself throw up, use laxatives or diuretics, or overexercise to control your weight?
- Do you experience any barriers in accessing food (e.g., scarcity, others intervening in your choices, lack of transportation)?
- Do you ever skip your insulin (diabetes specific) or other medications to control your weight?

Emotions and Food Are Part of the Human Experience

People may use food when they experience emotions, including happiness, sadness, and stress, among others, and food is often an option for self-care. Celebrating with foods can be joyful (e.g., celebrating a holiday or special achievement). Food can also be

a support drawn upon when people are homesick or in need of comfort (e.g., making a traditional meal from your region, culture, or home country while living abroad).

Food may serve as a **coping skill** for some people, or it could be their only accessible coping skill. Regardless, food is very personal, and it is not recommended to insert judgment about how or why a person is eating; rather, it can be an opportunity to engage with people, seek understanding, and maintain curiosity.¹⁶

Activity

Food Memory Reflections

- Consider a memory you have about food.
- What food or dish was made, what was the occasion?
- Where were you and how old were you?
- Who made the dish?
- What did you feel and how do you connect with this memory now, if at all?

Maintaining a Healthy Relationship With Food



Figure 3.5. Relationships with food are as diverse as our human population and experiences. Experiences with food are important for maintaining a flexible approach to nourishing physical and mental health. “A young girl eating her breakfast” by Nicola Barts is used under a Pexels License.

In this chapter, we have presented examples of why our relationship with food is so complex and how that relates to how we each may view our body. We also discussed food as a way to connect with others, express culture, and find pleasure.

There are many reasons a person’s relationship with food might be altered. Diet culture is a barrier, as are systemic and environmental factors that interfere with peaceful relationships with food.²² From a medical perspective, a fed person is a healthy person, so finding ways to support adequacy is key to having and maintaining any food relationship. It is only after adequacy and sustainability are addressed that we can think about nutritional balance. Balance means nothing if it is not sustainable.

Lastly, food and bodies are tied, so often it can be important to remember that weight does not equate to health or determine a person's value or worth. Respect and dignity are at the center of health promotion and relating to food.

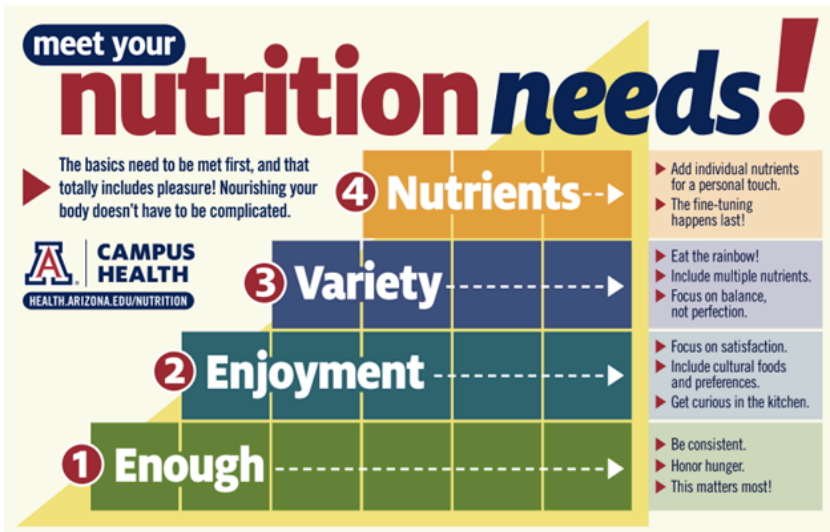


Figure 3.6. This graphic illustrates the importance of meeting basic nutrition needs prior to moving “up” the pyramid to other concepts, such as adding specific macro- or micronutrients. “Nutrition Foundations Pyramid” by University of Arizona Campus Health and Andrew Maghielse is used with permission.

Key Takeaways

- Adequacy and flexibility are at the center of a healthy relationship with food. People need enough food first before they can think about how their relationship with food can improve or heal.

- If food is stressful, it is no longer health promoting. Health is multifaceted and requires many systems working together to be successful.
- Health doesn't "look" a certain way; often, having a peaceful relationship with food can lead to positive health outcomes.
- Food is more than just nutrients. Food is how we connect to our heritage, family, and friends. We can find pleasure in food; there is nothing wrong with wanting to enjoy the experience with food.

SUGGESTED/ADDITIONAL READING LISTS

- *Decolonizing Wellness: A QTBIPOC-Centered Guide to Escape the Diet Trap, Heal Your Self-Image, and Achieve Body Liberation* by Dalia Kinsey, RD, LD (BenBella Books, Inc.; 2022)
- *It's Always Been Ours: Rewriting the Story of Black Women's Bodies* by Jessica Wilson, MS, RD (Hatchett Book Group)
- Resch E. *Intuitive Eating: A Revolutionary Anti-Diet Approach*. 4th ed. by Evelyn Tribole and Elyse Resch (St Martin's Press; 2020)
- *Anti-Diet: Reclaim Your Time, Money, Well-Being, and Happiness Through Intuitive Eating* by Christy Harrison, MPH, RD (Little Brown Spark; 2019)

REFERENCES

1. Gardner L. *Why We Cook: Women on Food, Identity, and Connection*. Workman Publishing; 2021.

2. Tribole E, Resch E. *Intuitive Eating: A Revolutionary Anti-Diet Approach*. 4th ed. St Martin's Press; 2020.
3. Kinsey D. *Decolonizing Wellness: A QTBIPOC-Centered Guide to Escape the Diet Trap, Heal Your Self-Image, and Achieve Body Liberation*. BenBella Books, Inc.; 2022.
4. Patton GC, Selzer R, Coffey C, Carlin JB, Wolfe R. Onset of adolescent eating disorders: population based cohort study over 3 years. *BMJ*. 1999;318(7186):765. doi:10.1136/bmj.318.7186.765
5. Kinavey H, Sturtevant D. *Reclaiming Body Trust: A Path to Healing & Liberation*. TarcherPerigee; 2022.
6. Nemeck K. Cultural awareness of eating patterns in the health care setting. *Clin Liver Dis (Hoboken)*. 2020;16(5):204–207. doi:10.1002/cld.1019
7. Hazzard VM, Loth KA, Hooper L, Becker CB. Food insecurity and eating disorders: a review of emerging evidence. *Curr Psychiatry Rep*. 2020;22(12):74. doi:10.1007/s11920-020-01200-0
8. Kinavey H, Cool C. The broken lens: how anti-fat bias in psychotherapy is harming our clients and what to do about it. *Women Ther*. 2019;42(1–2):116–130. doi:10.1080/02703149.2018.1524070
9. Fields TD. Exploring the intersections of human trafficking, mental health, eating disorders, food justice and weight stigma, presented at: Amplify and Unite Health and Wellness Summit; June 4, 2021.
10. Healthy People 2030. Social determinants of health. US Department of Health and Human Services. Accessed October 27, 2024. [https://health.gov/healthypeople/priority-areas/social-determinants-health#:~:text=Social%20determinants%20of%20health%](https://health.gov/healthypeople/priority-areas/social-determinants-health#:~:text=Social%20determinants%20of%20health%20)

[20\(SDOH,Education%20Access%20and%20Quality.](#)

11. Social determinants of health. World Health Organization. Accessed October 27, 2024. https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1.
12. University of Arizona Campus Health Service. 2022 Health and wellness survey aggregate report for public use – weighted undergraduate report. Accessed November 2, 2023. <https://health.arizona.edu/sites/default/files/2023-03/2022%20aggregate%20undergrads%20final%20PUBLIC.pdf>
13. brown am. *Pleasure Activism: The Politics of Feeling Good*. AK Press; 2019.
14. Lo BK, Loui C, Folta SC, et al. Self-efficacy and cooking confidence are associated with fruit and vegetable intake in a cross-sectional study with rural women. *Eat Behav*. 2019;33:34–39. doi:10.1016/j.eatbeh.2019.02.005
15. Dare to lead list of values. Brené Brown. July 5, 2023. Accessed October 27, 2024. <https://brenebrown.com/resources/dare-to-lead-list-of-values/>
16. Byrne C. I'm a dietitian and it's time to stop pathologizing 'emotional eating.' *SELF*. August 5, 2022. Accessed December 20, 2024. <https://www.self.com/story/emotional-eating-normal>
17. What is normal eating? Ellyn Satter Institute; 2018. Accessed October 27, 2024. <https://www.ellynsatterinstitute.org/wp-content/uploads/2017/11/What-is-normal-eating-Secure.pdf>.
18. Thorne R. Everything you need to know about disordered eating, according to experts. Healthline. September 14, 2022. Accessed November 25, 2024.

<https://www.healthline.com/health/disordered-eating-vs-eating-disorder#risk-factors-and-demographics>

19. Nurkkala M, Keränen AM, Koivumaa-Honkanen H, et al. Disordered eating behavior, health and motives to exercise in young men: cross-sectional population-based MOPO study. *BMC Public Health*. 2016;16:483. doi:10.1186/s12889-016-3162-2
20. Darling KE, Fahrenkamp AJ, Wilson SM, D'Auria AL, Sato AF. Physical and mental health outcomes associated with prior food insecurity among young adults. *J Health Psychol*. 2015;22(5):572–581. doi:10.1177/1359105315609087
21. Babbott KM, Cavadino A, Brenton-Peters J, Consedine NS, Roberts M. Outcomes of intuitive eating interventions: a systematic review and meta-analysis. *Eat Disord*. 2022;31(1):33–63. doi:10.1080/10640266.2022.2030124
22. Harrison, C. *Anti-Diet: Reclaim Your Time, Money, Well-Being, and Happiness Through Intuitive Eating*. Little Brown Spark; 2019.

Chapter 4: Macronutrients

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Student contributor: Edgar Molin

INTRODUCTION

Culinary medicine aims to provide the knowledge and skills that support a nutritious eating plan that provides adequate energy and the nutrients essential for good health and function.

Nutrients are substances that are needed for growth, maintenance, and repair of body tissues. In the body, 3 nutrients provide energy: **carbohydrates**, protein, and fat. These **energy-yielding nutrients** are also referred to as **macronutrients**. The prefix *makro* is Greek for big or large, and because of their size, macronutrients account for most of the nutrients we consume in food.^{1,2}

The body requires many grams of macronutrients per day, in contrast to micronutrients such as vitamins and minerals, which the body requires only in small amounts (milligrams or micrograms) per day.³ Water and fiber are also considered macronutrients. Although water provides no energy, and fiber provides (indirectly) only a small amount of energy, both are critical for optimal function and health. Consuming a variety of foods and beverages ensures adequate intakes of macronutrients. Having an awareness of the different nutrients each food provides can help

culinary medicine practitioners and their clients understand the impact certain foods can have on health.

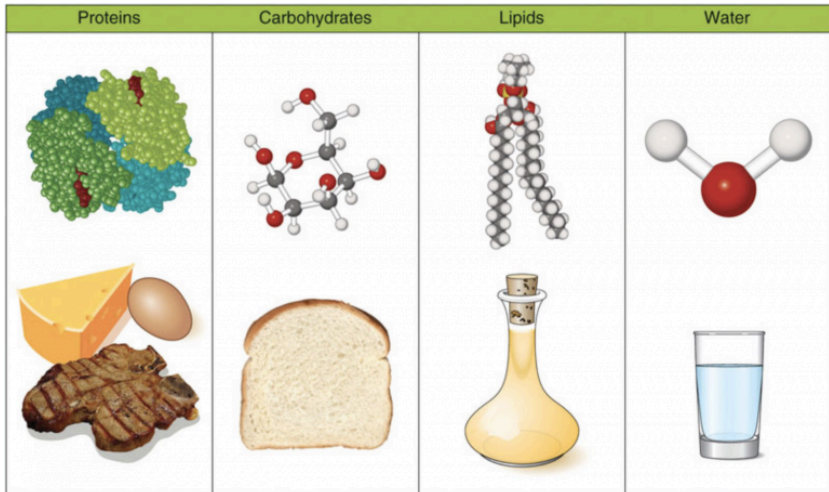


Figure 4.1. This illustration shows the chemical structure of each macronutrient, along with typical food sources of each: cheese, eggs, and meat for proteins; bread for carbohydrates; oil for lipids; and a glass of water for water. “The Macronutrients: Carbohydrates, Lipids, Protein, and Water” from University of Hawai’i at Mānoa Food Science and Human Nutrition Program is licensed CC BY 4.0.

The energy released from carbohydrates, protein, and fat can be measured in **calories**, which are very small units of energy. Energy is expressed in 1,000-calorie metric units known as kilocalories (kcal), but these are commonly referred to as calories. When a food label identifies a slice of bread having 100 calories, this means 100 kcal.³

The amount of energy a food provides depends on the amount of carbohydrates, protein, and fat it contains. One gram of carbohydrate yields 4 kcal; 1 g of protein also yields 4 kcal; and 1 g of fat yields 9 kcal.

CARBOHYDRATES

Carbohydrates are ideal nutrients to meet the body's energy needs. Carbohydrates play a vital role in feeding the brain and nervous system and keeping the digestive system fit. It is important to understand that adequate carbohydrate intake throughout the day is essential to support the body's energy needs. The body requires a minimum dietary intake of 130 g of carbohydrates to provide the brain an adequate amount of **glucose**.³

Role of Carbohydrates in the Body

During digestion, carbohydrates are broken down to glucose. Carbohydrates in the form of glucose provide energy to cells, tissues, and organs to carry out daily activities.⁴ Glucose is the brain and nervous system's preferred source of energy and is essential to fuel its activities. Red blood cells use glucose exclusively.

Glycogen, the storage form of glucose, is used when the body needs glucose but isn't getting it from food. The body obtains glucose and glycogen from consuming foods rich in carbohydrates. Carbohydrates can be used immediately for energy via glucose or converted into glycogen for reserve energy.^{1,3}



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Dietary Sources of Carbohydrates

The carbohydrate family includes **sugars**, **starches**, and **fibers**. Foods rich in carbohydrates include fruits, vegetables, grains, legumes, and milk. Nuts and seeds contain very little carbohydrate, and eggs, cheese, and fresh meat contain virtually no carbohydrates. Table 4.1 gives some examples of the carbohydrate content of foods.

Table 4.1. Examples of Carbohydrate Content in Foods⁴

Food	Carbohydrate (approximate grams per serving)
Grains	
Bagel, 1 whole, 4 inches	66
Bread, wheat (1 slice)	14
Cereal, Cheerios (1 cup)	21
Oatmeal, instant (1 packet)	28
Crackers, club, multigrain (8 crackers)	18
Vegetables	
Potato, russet, baked (medium)	37
Carrots, raw (1 cup)	12
Corn (1 cup)	27

Tomatoes (one-half cup)	15
Fruit	
Apple, raw, with skin (medium)	23
Grapes, red or green, seedless (1 cup)	27
Banana (1 medium)	27
Raisins (1 oz)	22
Legumes	
Beans, black, boiled (one-half cup)	20
Lentils, green, boiled (one-half cup)	20
Dairy	
Milk, 2% fat (1 cup)	12
Yogurt, fruit variety (6 oz)	32

Yogurt, Greek, plain (6 oz)	6
Nuts	
Pecans (1 oz)	4
Almonds (1 oz)	<1
<i>Abbreviations: oz = ounce</i>	

Classification of Carbohydrates

The dietary carbohydrate family includes:

- Monosaccharides: single sugars
- Disaccharides: pairs of monosaccharides
- Polysaccharides: chains of monosaccharides

Carbohydrates are broadly classified into 2 subgroups, based on their chemical composition and structure: simple and complex. Examples of **simple carbohydrates** or

“simple sugars” are monosaccharides and disaccharides. Polysaccharides, which include starches and fibers, are usually



Figure 4.2. One packet of instant oatmeal delivers 28 g of carbohydrates per serving. You can boost oatmeal's nutritional value by adding 2% fat milk, nuts, and fruit, such as bananas. "Oatmeal" by Rachel is licensed CC BY 2.0.

considered **complex carbohydrates**.^{2,3} In culinary medicine, there are different scenarios in which simple and complex carbohydrates are beneficial for the body. Simple carbohydrates provide the body with quick energy and, therefore, may be beneficial for athletes engaging in high-intensity activities for which quick fuel is needed. Simple carbohydrates can also be used to correct low blood sugar in individuals who have hypoglycemia. Additionally, simple carbohydrates can be used in situations where quick nourishment is needed, such as when medical conditions affect the ability of a person to eat adequate amounts of foods. Complex carbohydrates, on the other hand, provide a steady source of energy and an increased amount of fiber. This makes these types of carbohydrates beneficial for digestive health, because many complex carbohydrates are high in fiber. Complex carbohydrates can also be beneficial for blood sugar control, because fiber helps to lower increases in blood sugar levels. This can be particularly helpful for people with diabetes or **insulin** resistance. Carbohydrates high in fiber can also help lower cholesterol and, therefore, reduce the risk of heart disease.³

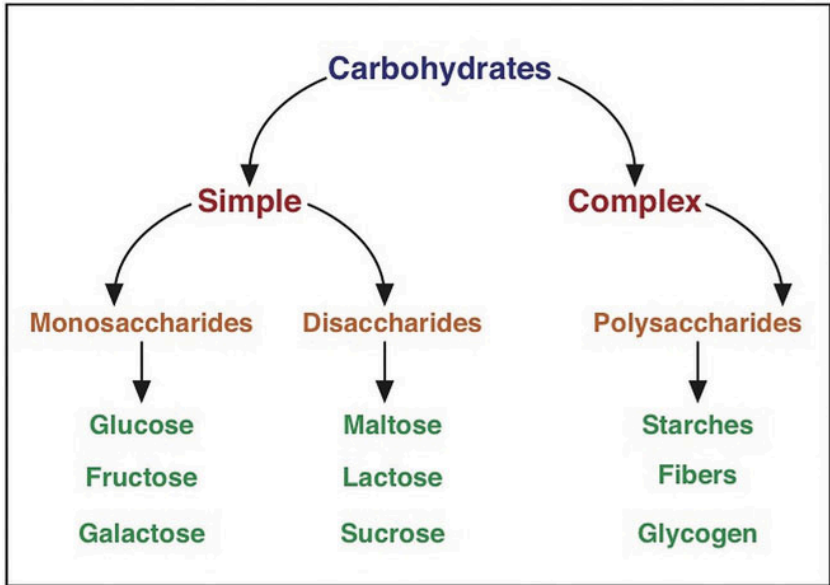


Figure 4.3. Carbohydrates are broken down into 2 subgroups: simple and complex carbohydrates. These subgroups are further categorized into mono-, di-, and polysaccharides. “Carbohydrate Classification Scheme” by University of Hawai’i at Mānoa Food Science and Human Nutrition Program is licensed CC BY 4.0.

Digestion and Absorption of Carbohydrates

Digestion is necessary to break carbohydrates into smaller molecules that the body can more easily absorb and use. Large carbohydrate molecules such as starch require extensive breakdown, whereas smaller carbohydrate molecules such as monosaccharides and disaccharides are easier for the body to break down. Knowing how carbohydrates are digested can help us understand how different types of carbohydrates affect energy, blood sugar, digestive health, satiety, and overall health. Figure 4.4 provides a description of major organs and steps that are involved

in digesting carbohydrates. These include the initial breakdown of starch in the mouth, further digestion in the stomach and small intestine, absorption in the small intestine, and partial digestion in the large intestine.

Carbohydrate digestion begins in the mouth when the salivary enzyme **amylase** starts to chemically breakdown starch to shorter polysaccharides. When carbohydrates reach the stomach, the activity of salivary amylase diminishes as the stomach's acid and protein-digesting enzymes inactivate amylase. The stomach's digestive juices contain no enzymes to break down carbohydrates. Fibers are not digested, but because they linger in the stomach, they delay gastric emptying, thereby increasing feelings of fullness and **satiety**. No further digestion of carbohydrate occurs until the small intestine.³

Most carbohydrate digestion takes place in the small intestine. When carbohydrates reach the small intestine, the pancreas produces pancreatic amylase, which enters the intestine via the pancreatic duct and continues to break down polysaccharides. The enzymes maltase, sucrase, and lactase continue to break down disaccharides into monosaccharides (mostly glucose).³ Within 1 to 4 hours, consumed sugars and starches are digested. Only the indigestible carbohydrates (e.g., fiber) remain in the digestive tract.

Dietary fiber cannot be broken down by digestive enzymes. As dietary fiber lingers in the large intestine, it attracts water, which softens the stool for passage out of the body. Bacteria in the gastrointestinal tract ferment some of the fiber. This process generates water, gas, and short-chain fatty acids.³

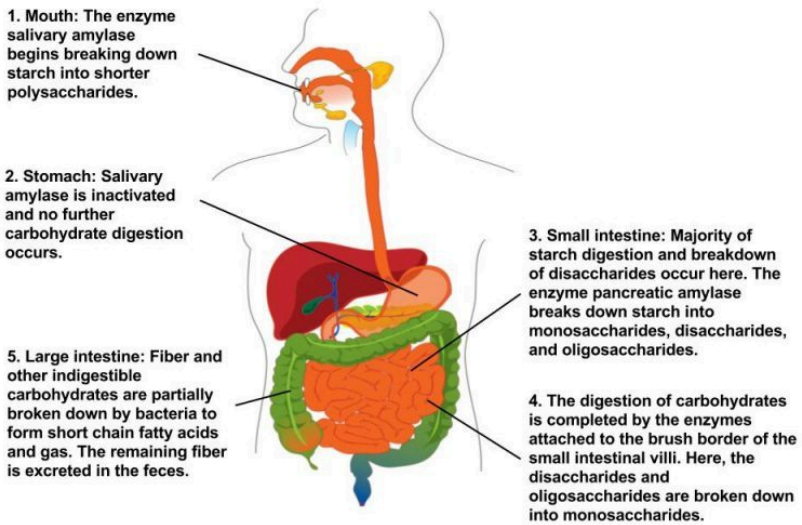


Figure 4.4. This diagram shows how carbohydrate digestion progresses through the mouth, stomach, small intestine, and large intestine, with remaining fiber excreted as waste. "Overview of Carbohydrate Digestion" by Allison Calabrese is licensed CC BY 4.0.

LIPIDS

Lipids are important molecules that serve different roles in the human body. Fat is a type of lipid, but the 2 terms are often used interchangeably. The lipid family includes **triglycerides**, **phospholipids**, and **sterols**, and these lipids are primarily consumed through **fats** and **oils**. It is important to understand the impact fats and lipids have on the body and in cooking, as well as on the flavor and texture of foods.

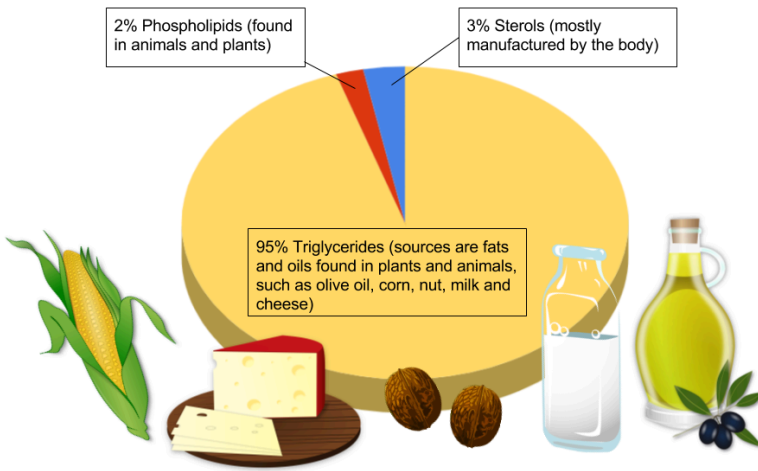


Figure 4.5. Triglycerides make up more than 95% of lipids in the diet. Phospholipids make up only about 2% of dietary lipids. Sterols are the least common type of lipid. "Types of Lipids" by Allison Calabrese is licensed CC BY 4.0.

Role of Lipids in the Body

Lipids provide most of the energy needed to perform the body's work. They are also the chief storage form of the energy we derive from food when we consume more than needed. The storage of fat is an important survival mechanism: stored fat helps keep people alive during times of famine. Compared with carbohydrates, fat is more easily stored because it can pack tightly together without water and can store much more energy in a small space. Fat provides more than twice the energy of carbohydrate or protein, making it the most efficient storage form of energy.¹



An interactive H5P element has been excluded from this version of the text. You can view it online here:

[https://opentextbooks.library.arizona.edu/](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1194#h5p-55)

[culinarymedicine/?p=1194#h5p-55](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1194#h5p-55)

Fat serves many other purposes in the body too. Pads of fat surrounding the vital organs are protective and serve as shock absorbers. Fat plays a critical role in internal climate control by insulating the body and slowing heat loss in cold temperatures. Lipids also serve as raw material for making several products needed by the body, including vitamin D, which is essential for bone health; **bile**, which assists in digestion; and lipid hormones, which regulate tissue functions.¹



Figure 4.6. Avocados contain mostly healthy fats, including monounsaturated and polyunsaturated fats. “Avocado on Board” by Kjøkkenutstyr Net is licensed CC BY-SA 2.0.

Lipids are needed for absorption of some essential nutrients, and some amount of fat in the diet is necessary for their absorption. These nutrients are fat-soluble vitamins: A, D, E, and K; and **essential fatty acids**.¹

Fat carries many sensory qualities that enhance the aroma, texture, and flavor of food. Fat lends crispness to fried foods and

tenderness to foods such as meats and baked goods. Fat also contributes to satiety, which is the satisfaction of feeling full after a meal. Foods that contain fat trigger physiological events that suppress the desire to eat.¹

Classification of Lipids

Triglycerides make up most of the lipid present in the body and in food. Triglycerides are composed of 3 (*tri*) fatty acids that are attached to a molecule of glycerol (hence, triglyceride). Fatty acids can differ from one another in 2 different ways: the chain length and the degree of chemical bond saturation. Triglycerides usually include a mixture of various fatty acids, and the mixture determines whether a fat will be harder or softer at room temperature.¹ Understanding how the structure of lipids affects each type of fat can help us choose fats that are beneficial to our health.

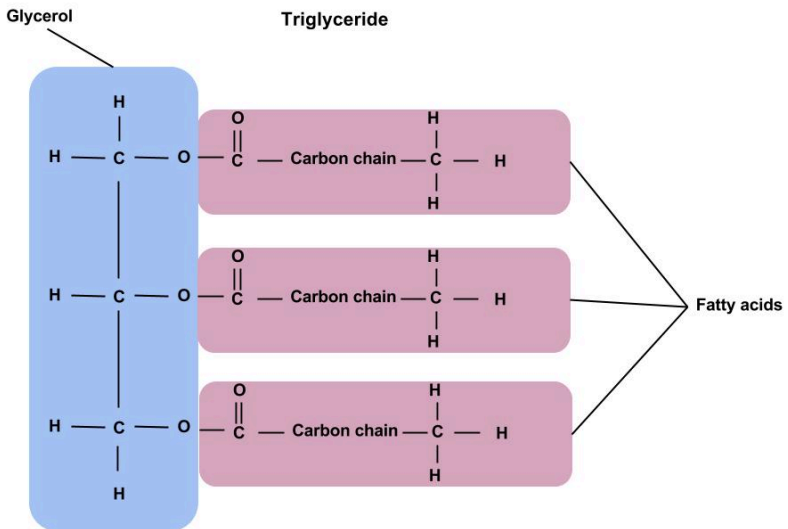


Figure 4.7. Fatty acids and glycerol are the building blocks of triglycerides. Glycerol is a thick, smooth, syrupy compound that is often used in the food industry. "The Structure of a Triglyceride" by Allison Calabrese is licensed CC BY 4.0.

Saturation refers to whether a fatty acid chain contains all the hydrogen atoms its structure allows. If every available carbon bond is holding a hydrogen atom, the chain is a **saturated fatty acid**. If the carbon bond has 1 or more points of unsaturation, or a place where hydrogens are missing, the fatty acid chain is an **unsaturated fatty acid**.

With 1 point of unsaturation, the fatty acid is called a **monounsaturated fatty acid**. With 2 or more points of unsaturation, the fatty acid is called a **polyunsaturated fatty acid**. Often, a single triglyceride contains both saturated and unsaturated fatty acids of varying length, making it a mixed triglyceride.¹

The degree of saturation of the fatty acids affects the temperature at which it melts. Generally, the more unsaturated

fatty acids present in a fat, the more liquid the fat will be at room temperature. The more saturated fatty acids are present, the more solid the fat will be at room temperature.¹

The presence of a double bond in a fatty acid can result in different structures. When the hydrogen atoms are bonded to the same side of the carbon chain, this is called a *cis* fatty acid. Because the hydrogen atoms are on the same side, the fatty acid has a bent structure. Naturally occurring fatty acids usually have a *cis* configuration. In a *trans* configured fatty acid, the hydrogen atoms are attached on opposite sides of the carbon chain. Trans fats are not usually found naturally in foods but are the product of a process called hydrogenation. Hydrogenation adds hydrogen to the double bonds, thus making the fatty acid saturated. This is how vegetable oils are converted into semisolid fats for the use of manufacturing process.² When reading ingredients on a nutrition label, it can be helpful to understand that the term *hydrogenated* means a food contains trans fats. Foods that contain trans fats will include *hydrogenated* or *partially hydrogenated* items in the ingredient list on a food label.

Saturated fatty acid

Stearic acid

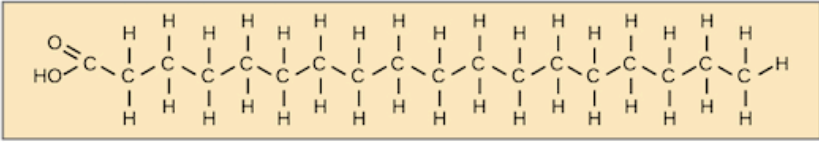
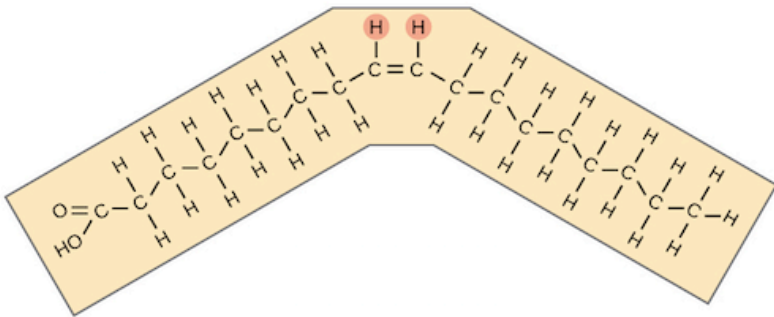
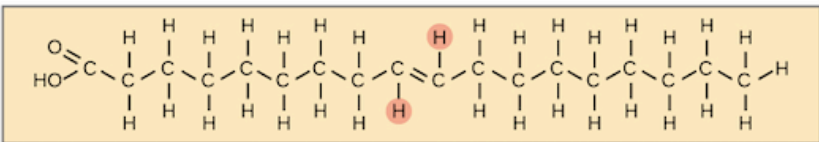
**Unsaturated fatty acids***Cis* oleic acid*Trans* oleic acid

Figure 4.8. Comparison of a saturated fatty acid to both the *cis* and *trans* forms of an unsaturated fatty acid. “Structures of Saturated, Unsaturated, *Cis* and *Trans* Fatty Acids” by Allison Calabrese is licensed under CC BY 4.0.

The last 2 types of lipids, phospholipids and sterols, are present in lower quantities in food and in the body. These types of lipids play important structural and regulatory roles in the body. Phospholipids bind together in a strong double layer that forms the membranes of cells and they generate signals inside cells in response to hormones, such as insulin, to help control bodily conditions. Sterols, such as cholesterol, are also important in the

structure of the cell membrane. Cholesterol also serves as the raw material for making emulsifiers in bile, which is important to fat digestion.

Essential Fatty Acids

The body is capable of synthesizing most of the fatty acids it needs from food, and these fatty acids are known as nonessential fatty acids. However, there are some fatty acids that the body cannot synthesize, and these are called essential fatty acids. Essential fatty acids must be obtained from food.^{1,2}

There are 2 categories of essential fatty acids: **omega-3** and **omega-6**. The 3 and the 6 refer to the position of the first carbon double bond. Omega-6 fatty acids are precursors to important compounds called **eicosanoids**. Eicosanoids act somewhat like hormones by helping to regulate body functions. Omega-3 fatty acids are precursors to **eicosapentaenoic acid (EPA)** and **docosahexaenoic acid (DHA)**, which form their own eicosanoids that often oppose those from omega-6. For example, omega-3 eicosanoid relaxes blood vessels and lowers blood pressure, whereas an omega-6 eicosanoid constricts the vessels and increases blood pressure. A balance between the 2, therefore, promotes normal blood pressure.^{1,2}

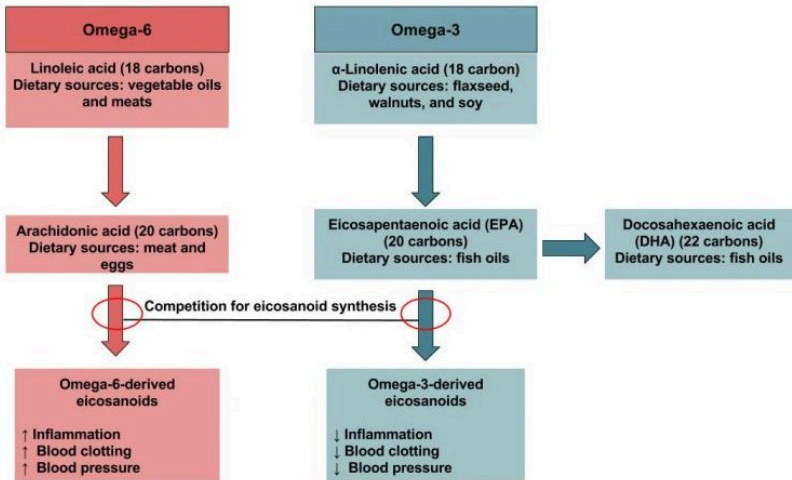


Figure 4.9. Essential fatty acids must be obtained from food. Excellent sources of omega-3 and omega-6 essential fatty acids are fish, flaxseed oil, hemp, walnuts, and leafy vegetables. “Essential Fatty Acids” by Allison Calabrese is licensed CC BY 4.0.

Knowing foods that are a good source of omega-3 and omega-6 fatty acids can enable us to incorporate these foods into daily intake. Omega-3 and omega-6 fatty acids are both a type of unsaturated fat and are found in foods such as fish, flaxseed oil, hemp, walnuts, and leafy vegetables. Table 4.2 shows food sources of omega-6 and omega-3 fatty acids. In the United States and Canada, deficiencies of omega-3 and omega-6 are almost unknown in otherwise healthy adults.^{1,2}

Table 4.2. Food Sources of Omega-6 and Omega-3 Fatty Acids¹

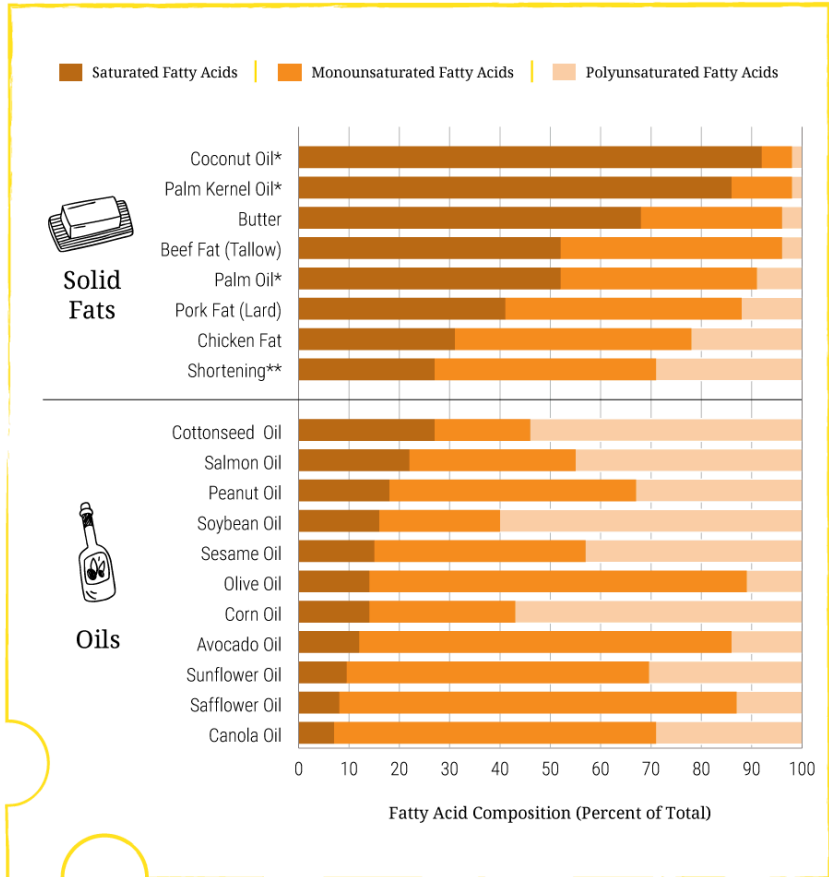
Fatty acid	Food source
Omega-6	Nuts and seeds (e.g., cashews, walnuts, sunflower seeds) Poultry fat Vegetable oils (e.g., corn, safflower, sesame, soybean, sunflower)
Omega-3	Nuts and seeds (e.g., chia seeds, flaxseeds, walnuts, soybeans) Vegetable oils (e.g., canola, flaxseed, soybean, walnut, wheat germ) Fish and seafood

Dietary Sources of Lipids

All foods contain a combination of saturated and unsaturated fats. Some foods contain higher ratios of saturated or unsaturated fats, as shown in Figure 4.10. Animal-based fats generally contain the most saturated fat. However, some oils, such as coconut oil and palm oil, are primarily made of saturated fat. Other vegetable oils and fish oils are rich in polyunsaturated fatty acids. Some vegetable oils are also rich in monounsaturated fatty acids. Figure 4.10 shows how dietary fats contain a mixture of saturated, monounsaturated, and polyunsaturated fatty acids.

Saturated fats are found in animal products (e.g., butter, cheese, meats) and some plant oils (e.g., coconut oil, palm oil).

Increased intake of saturated fats is associated with increased blood levels of cholesterol and blood clotting, which can increase the risk for heart disease. The US Dietary Guidelines suggest aiming for less than 10% of daily energy intake from saturated fats. Whereas trans fats may be implicated in chronic disease such as heart disease, unsaturated fats seem to offer health benefits. For this reason, dietary recommendations suggest replacing sources of saturated fats and trans fats with foods rich in unsaturated fats. Unsaturated fats are found in seafood, nuts, seeds, and vegetable oils.



*Figure 4.10. Dietary fats contain a mixture of saturated, monounsaturated, and polyunsaturated fatty acids. Foods are often categorized by the predominant type of fatty acids they contain, even though foods contain all 3 types. "Fatty Acid Composition" by Dietary Guidelines for Americans is in the public domain. * Coconut, palm kernel, and palm oil are called oils because they come from plants. However, they are solid or semi-solid at room temperature due to their high content of short-chain saturated fatty acids. They are considered solid fats for nutritional purposes.*

*** Shortening may be made from partially hydrogenated vegetable oil, which contains trans fatty acids.*

Digestion and Absorption of Lipids

Lipid digestion begins in the mouth, with some hard fats melting as they reach body temperature. When fat-containing food reaches the stomach, the strong muscle contractions of the stomach propel the partially digested food back and forth. The churning of the stomach grinds the solid pieces into finer particles and disperses fat into smaller droplets. These actions help expose the fat for attack by the gastric enzyme **lipase**.

Most fat digestion takes place in the small intestine.³ When fat enters the small intestine, it triggers the release of bile by the gallbladder. Bile acts as an **emulsifier** that facilitates the mixing of fat molecules in the surrounding watery fluids. Bile is not a digestive enzyme, but it is essential in preparing fat for digestion by the lipase enzymes from the pancreas and small intestine.³

The major fat-digesting enzymes are pancreatic lipase and some intestinal lipases. These enzymes remove each triglyceride's fatty acids. These fatty acids and the remaining fragments of the triglyceride are absorbed by the intestinal cells directly into the bloodstream, where they are packaged and transported to tissues in the body where they are needed.³ Understanding how lipids are digested and used in the body helps us, in turn, to understand the role lipids play in nutrient absorption, energy utilization, and health conditions.

PROTEIN



Figure 4.11. Carbohydrates provide energy for the body. Legumes, such as (from left) chickpeas, lentils, and beans, are a rich source of carbohydrates. “Chickpeas, Lentils, and Marble Beans” by Migle Seikyte is licensed CC BY-SA 2.0.

Protein performs many vital functions in the body. Proteins are made up of **amino acids**, and each protein contains a different combination of amino acids. It is important to understand the key role protein plays in essential functions of the body, balancing the absorption of carbohydrates and promoting satiety. For healthy adults, 0.8 g of protein per kilogram of body weight is recommended.³

Amino Acids

Each amino acid has a distinctive side chain attached to the center carbon of the molecule. This side chain gives each amino acid its identity and chemical nature. There are 20 amino acids, each with a different side chain, and these make up most of the proteins of living tissues. A typical protein is made up of 300 or more amino acids, and the specific sequence of amino acids are unique to each

protein. Depending on the number and sequence of amino acids, the resulting protein will fold into a specific shape. This shape determines the protein's function (e.g., muscle or enzyme).^{1,5}

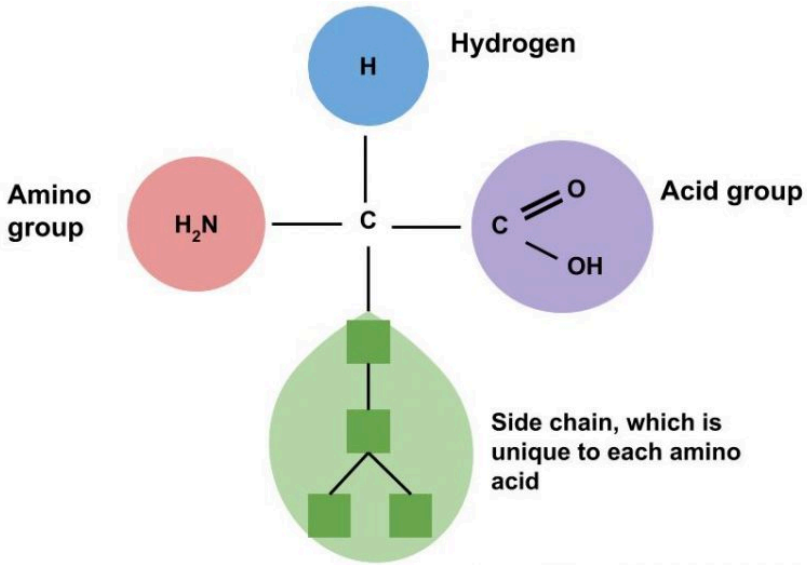


Figure 4.12. Each amino acid consists of a central carbon atom connected to a side chain, a hydrogen, a nitrogen-containing amino group, and a carboxylic acid group—hence the name “amino acid.” “Amino Acid Structure” by Allison Calabrese is licensed CC BY 4.0.

Amino acids are classified as essential or nonessential. The body can produce more than half of the 20 amino acids for itself (given it has all the parts needed), and these are known as **nonessential amino acids**. There are 9 amino acids that the body cannot manufacture, or that it manufactures too slowly to meet its needs. These are known as **essential amino acids** and must be obtained from food.^{1,3,5} Sometimes during infancy, growth, and in diseased states, the body cannot synthesize enough of some of the nonessential amino acids and more of them are required in the diet. These types of amino acids are called **conditionally essential**

amino acids. Essential and nonessential amino acids are summarized in Table 4.3.⁶

Table 4.3. Essential and Nonessential Amino Acids⁶

Essential	Nonessential
Histidine	Alanine
Isoleucine	Arginine*
Leucine	Asparagine
Lysine	Aspartic acid
Methionine	Cysteine*
Phenylalanine	Glutamic acid
Threonine	Glutamine
Tryptophan	Glycine*
Valine	Proline*
	Serine
	Tyrosine*

* This amino acid is *conditionally essential*. It must be obtained in the diet in certain situations when more are needed than the body can synthesize.

Role of Protein in the Body

Amino acids must be continuously available to build the proteins of new tissue. Proteins regulate gene expression; serve as enzymes,

hormones, and antibodies; transport substances throughout the body; maintain fluid and electrolyte balance and acid-base balance; provide structure in tendons, ligaments, and scars; and play a vital role in wound healing and tissue regeneration.^{1,2}

One of the most important functions of protein is as an **enzyme**. Enzymes are proteins that catalyze a specific chemical reaction. Thousands of enzymes are found inside a single cell, and each facilitates a specific chemical reaction.^{1,2}

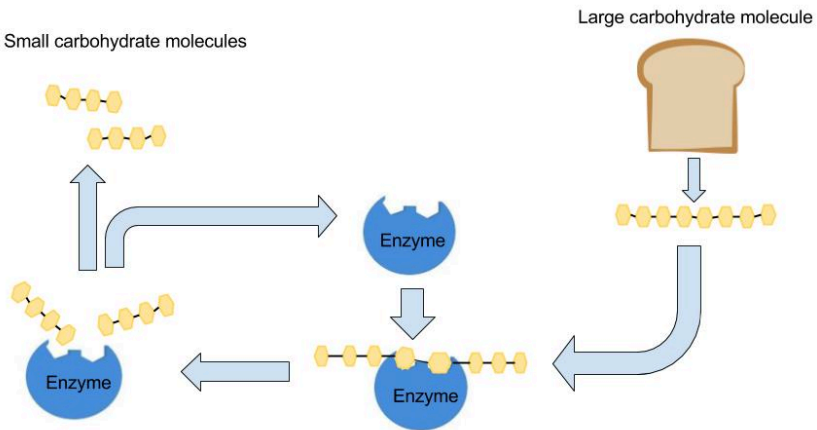


Figure 4.13. All bodily functions, including the breakdown of nutrients in the stomach and small intestine, the transformation of nutrients into molecules a cell can use, and building all macromolecules (including protein itself) involve enzymes. “Enzymes Role in Carbohydrate Digestion” by Allison Calabrese is licensed CC BY 4.0.

The body’s **hormones** are messenger molecules, and many of them comprise amino acids. Many glands in the human body produce hormones. Among these are the endocrine glands, and when the endocrine glands are stimulated, they release a hormone. The hormone is then transported in the blood to its target cell, where it communicates a message to initiate a specific reaction or cellular process. For example, in response to eating a meal, blood glucose levels begin to increase. In response to

increased blood glucose levels, the pancreas releases the hormone insulin. The presence of insulin signals the cells to take up glucose and use it for energy or store it for use later.²

Protein is also essential in maintaining the proper pH balance of the blood. The body has several mechanisms that hold the blood pH within normal range. One of these mechanisms involves circulating **albumin**, a slightly acidic protein that acts as a buffer against abrupt changes in the concentration of positively charged molecules (e.g., proteins, calcium, potassium, magnesium).²

Albumin and another important protein, **hemoglobin**, also play vital roles in molecular transport. Albumin chemically binds to hormones, fatty acids, some vitamins, essential minerals, and drugs, and transports them throughout the circulatory system. Red blood cells, of which hemoglobin is a part, bind oxygen in the lungs and transport oxygen to all tissues in the body.²

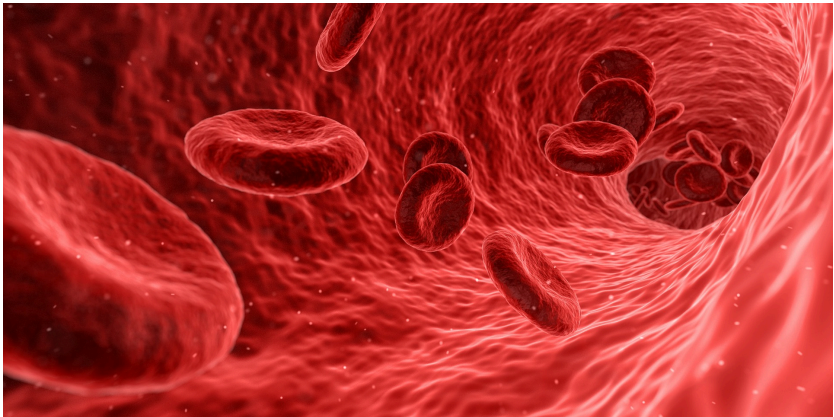


Figure 4.14. Red blood cells, which contain the protein hemoglobin, carry oxygen from the lungs to tissues throughout the body by binding oxygen to the hemoglobin molecule within the red blood cell. "Red Blood Cells" by SciTech Trend is in the public domain.

Dietary Sources of Protein

The protein food group consists of foods made from meat, seafood, poultry, eggs, soy, dry beans, peas, and seeds. Protein sources differ in their additional components. Protein-rich animal-based foods commonly have high amounts of B vitamins, vitamin E, iron, magnesium, and zinc. Some animal-based protein-rich foods have an increased amount of saturated fat and cholesterol.

Plant-based protein-rich foods provide fiber, contain less saturated fat, and are more environmentally sustainable in comparison with animal-based proteins. Plant-based protein-rich foods include beans, peas, lentils, nuts, seeds, soy, and fortified soy beverages.² Table 4.4 lists the protein content in some common foods.

Table 4.4. Protein in Common Foods⁶

Animal source	Grams of protein per standard serving
Egg white	3 g per 1 large white
Whole egg	6 g per 1 large egg
Cheddar cheese	7 g/oz (30 g)
Milk, 1% fat	8 g per 1 cup (8 fl oz)
Yogurt	11 g per 8 oz
Greek yogurt	22 g per 8 oz
Cottage cheese	15 g per ½ cup
Hamburger	30 g per 4 oz
Chicken	35 g per 4 oz
Tuna	40 g per 6 oz can
Plant source	Grams of protein per standard serving
Almonds, dried	6 g per 1 oz
Almond milk	1 g per cup (8 fl oz)
Soy milk	8 g per cup (8 fl oz)
Peanut butter	4 g per 1 tbsp

Hummus	8 g per ½ cup
Refried beans	6 g per ½ cup
Lentil soup	11 g per 10.5 oz
Tofu, extra firm	11 g per 3.5 oz
Enriched wheat bread	1 g per slice (45 g)
Whole-grain bread	5 g per slice (45 g)
Grape Nuts cereal	7 g per ½ cup
<i>Abbreviations: g = gram; oz = ounce; tbsp = tablespoon; fl oz = fluid ounce.</i>	

Protein Quality

There are 2 factors that influence protein quality: the protein's digestibility and its amino acid composition. High-quality proteins provide enough of all the essential amino acids needed to support the body's work. In the United States and other countries where nutritious foods are abundant, most people eat protein in large enough quantities that they receive all the amino acids they need. In countries where food is scarce and people eat only marginal amounts of protein-rich foods, the quality of the protein becomes critical.³



Figure 4.15. In general, plant proteins are of lower quality than animal proteins because they usually don't provide all the essential amino acids in 1 source. "Complete and Incomplete Protein Sources" by Smastronardo is licensed CC BY-SA 4.0.

Protein can be found in both plant- and animal-based foods. In general, plant proteins are of lower quality than animal proteins because they usually don't provide all the essential amino acids in 1 source. For this reason, protein with different but complementary amino acids can be combined to provide all the essential amino acids needed to support health. It is not necessary to balance amino acids at each meal if protein intake is varied and energy intake is sufficient.¹ Table 4.5 lists sources of complementary proteins.

Table 4.5. Complementary Protein Sources⁶

Food	Lacking amino acids	Complementary food	Complementary menu
Legumes	Methionine, tryptophan	Grains, nuts, and seeds	Hummus and whole-wheat
Grains	Lysine, isoleucine, threonine	Legumes	Cornbread and kidney bean
Nuts and seeds	Lysine, isoleucine	Legumes	Stir-fried tofu with cashews

Digestion and Absorption of Protein

Proteins in foods do not directly become proteins in the body. Instead, dietary protein provides amino acids from which the body manufactures its own proteins.

Protein digestion begins in the stomach, where hydrochloric acid uncoils protein strands so digestive enzymes can attack the peptide bonds. **Pepsin**, a gastric enzyme that **hydrolyzes** protein, cleaves proteins into small polypeptides and amino acids. When polypeptides then enter the small intestine, several pancreatic and intestinal **proteases** hydrolyze them further into short peptide chains and amino acids. Then, **peptidase** enzymes split most of the dipeptides and tripeptides into single amino acids. These single amino acids are then absorbed by the intestinal cells, where they can be used for energy or to synthesize needed compounds.³

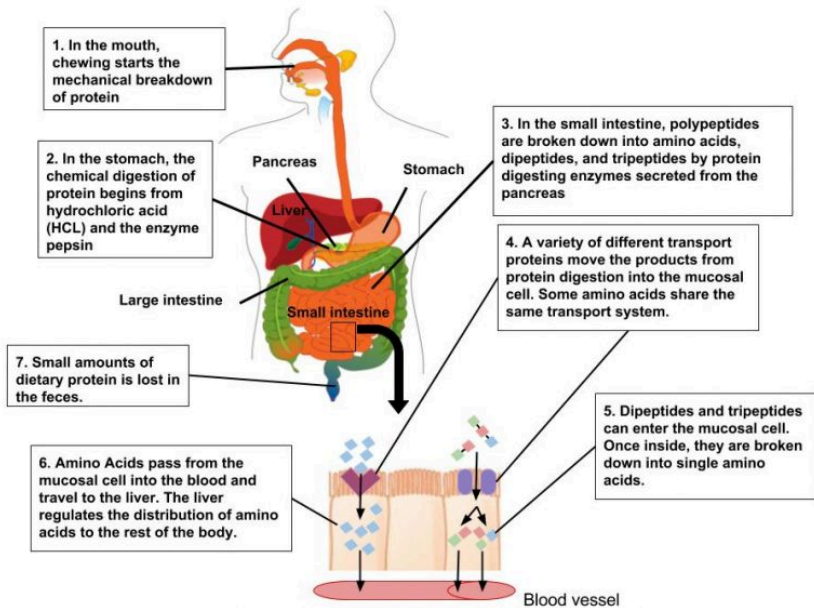


Figure 4.16. This diagram shows the specific path that proteins take down the gastrointestinal tract and into the circulatory system. "Digestion and Absorption of Protein" by Allison Calabrese is licensed CC BY 4.0.

Key Takeaways

- Carbohydrates, protein, and fat are energy-yielding nutrients that provide the body materials needed for growth, maintenance, and repair of body tissues.
- The amount of energy (or calories) a food provides depends on the amount of carbohydrates, protein, and fat it contains.
- Carbohydrate's major function is to provide energy for the body.

- Simple carbohydrates provide the body with a quick energy source, whereas complex carbohydrates provide additional fiber and blood sugar control, and take longer to metabolize.
- Foods rich in carbohydrates include fruits, vegetables, grains, legumes, and milk. Nuts and seeds contain very little carbohydrates, and eggs, cheese, and fresh meat contain virtually no carbohydrates.
- Lipids provide most of the energy needed to perform the body's work and are the primary storage form for the energy from food.
- Saturated and trans fatty acids generally increase the risk for heart disease, whereas unsaturated fatty acids are health promoting.
- Essential fatty acids must be obtained from food and fall into 2 categories: omega-3 and omega-6. Omega-3 and omega-6 fatty acids are beneficial for health, especially heart health.
- Proteins are made up of amino acids, and each protein contains a different combination of amino acids.
- Protein can be found in both plant- and animal-based foods. Balancing amino acids at each meal is unnecessary if protein intake is varied and energy intake is sufficient.

REFERENCES

- 1.Sizer FS, Whitney EN. *Nutrition Concepts and Controversies*. Cengage Learning; 2020.
2. Titchenal A, Hara S, Caacbay NA, et al. *Human Nutrition:*

2020 Edition. University of Hawai'i at Mānoa Food Science and Human Nutrition Program. OER Commons; 2020. Accessed April 2, 2023.

<https://pressbooks.oer.hawaii.edu/humannutrition2/>

3. Rolfes SR, Pinna K, Whitney E. *Understanding Normal and Clinical Nutrition*. Cengage Learning; 2021.
4. Gal NJ, Ford AL, Dahl WJ. Facts about carbohydrate. Publication no. FSHN14-03/FS243. July 18, 2021. Accessed April 22, 2023. <https://edis.ifas.ufl.edu/publication/FS243>
5. What are proteins and what is their function in the body? European Food Information Council. December 16, 2019. Accessed May 15, 2023. <https://www.eufic.org/en/whats-in-food/article/what-are-proteins-and-what-is-their-function-in-the-body>.
6. Callahan A, Leonard H, Powell T. *Nutrition: Science and Everyday Application*. Open Oregon Educational Resources. OER Commons; 2020. Accessed August 18, 2023. <https://openoregon.pressbooks.pub/nutritionscience2e/>

Chapter 5: Micronutrients

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Student contributor: Ame Proietti*

INTRODUCTION

Micronutrients include **vitamins**, **minerals**, and **trace elements** that are required in small amounts for normal growth and development and to support several bodily functions. Micronutrients perform a range of functions, such as supporting the synthesis of enzymes, hormones, and other biological compounds needed for growth and optimal function, including the metabolism of the macronutrients discussed in [chapter 4](#).

Micronutrient **deficiencies** cause visible and dangerous health conditions. They also can contribute to less clinically notable reductions in energy level, mental acuity, and overall functional capacity, as well as an increased risk for other diseases and health conditions. Deficiencies are generally preventable through the consumption of a variety of foods, although certain populations (e.g., pregnant or lactating individuals, elderly adults, young children, individuals with food insecurity) might have difficulty correcting deficiencies with food alone.

Culinary medicine seeks to prevent or address micronutrient deficiencies through nutrition education, including increasing one's knowledge of the nutrients in various foods, food fortification, and

supplementation, and the development of culinary skills that support the preparation of diverse foods.

MICRONUTRIENTS

Micronutrients—including vitamins, minerals, and trace elements—are inorganic compounds essential for health and wellness. The body is unable to synthesize or store many of these micronutrients, so to meet the body's daily needs, these compounds must be obtained from one's diet (through consumption of food and/or dietary supplements) and/or specialized nutrition support (enteral or parenteral nutrition).

Well-planned diets can ensure that healthy individuals consume adequate amounts of micronutrients. Various eating plans, such as the Mediterranean or the Dietary Approaches to Stop Hypertension (DASH) diets, are associated with preventing or managing various health conditions, including cardiovascular disease, hypertension, type 2 diabetes, and certain cancers. Fruits, vegetables, whole grains, nuts, and seeds form the foundation of these eating patterns.

These various foods provide micronutrients that play a key role in health and wellness. The principles of culinary medicine are grounded in the mantra “where health meets foods.” Micronutrient availability and, ultimately, their use by the body are influenced by many factors, including where food is grown and how it is transported, processed, and prepared. But it also is affected by one's medical history and current health status.

Previous chapters have reviewed food preparation and cooking methods that promote the preparation of high-quality whole foods and meals. Furthermore, well-planned diets can ensure that healthy individuals consume adequate amounts of micronutrients. This chapter will review the key functions and recommended intake levels of micronutrients, factors that influence micronutrient availability and that may promote deficiency, food sources, and

biomarkers for assessing status and need for possible supplementation. Also described are the use of popular diets by consumers and their impact on micronutrient provision.

Understanding the relationship between food and micronutrient provision is an essential component that aligns with the application of culinary medicine principles to promote disease prevention and management through the consumption and enjoyment of healthy, tasty food.

Micronutrient Needs

The **Dietary Reference Intakes (DRIs)**—created by the Food and Nutrition Board of the National Academies of Sciences, Engineering, and Medicine and promoted in established guidelines—have set reference micronutrient intake values for all generally healthy Americans.¹ These values are based on age and sex. For women, values vary based on pregnancy and lactation. However, individual needs may be lower or higher than these reference values based on health status; therefore, it is important to assess one's health status before determining interventions.

These standards are used in the design of food labels, for assessing an individual's adequacy of nutrient dietary intake, and for planning diets. Knowing what the daily intake goals are is essential to know whether dietary intake is sufficient and if supplementation is needed to meet nutrient needs to promote optimal health and wellness.

The DRIs provide a set of recommended values used to assess adequacy of nutrient intake.¹⁻³ Included in this set of guidelines are:

- **Adequate Intake (AI)**
- **Estimated Average Requirement (EAR)**
- **Recommended Dietary Allowance (RDA)**

- **Tolerable Upper Intake Level (UL)**

A [digital daily calculator](#) is available to assist health-care professionals in evaluating the adequacy of intake.² This is useful to provide recommendations for achieving optimal micronutrient status.

The RDA values reflect the level of a specific nutrient that 98% of a generally healthy population needs.¹ This is because RDAs are set 2 standard deviations above the EAR values, which establishes a margin of safety for intake.

Food labels can provide valuable information to help consumers determine what micronutrients (and how much of them) are in a product. However, food labels can be confusing because they use the **Daily Value (DV)** or percent DV (%DV) instead of the DRIs.³ Although the DV is similar to the DRIs, the DV is not differentiated by age and sex, like the RDAs. Daily Values have been established by the US Food and Drug Administration (FDA), and before 2016, there was only 1 DV for each of the micronutrients.³

For example, the %DV labels for iron is 18 milligrams (mg). However, the RDA for adult men is 8 mg per day; for women, 18 mg per day reflects the RDA for premenopausal women, and the RDA decreases to 8 mg per day for postmenopausal women. This difference in values

Nutrition Facts	
4 servings per container	
Serving size	1 cup (227g)
Amount per serving	
Calories	280
	% Daily Value*
Total Fat 9g	12%
Saturated Fat 4.5g	23%
Trans Fat 0g	
Cholesterol 35mg	12%
Sodium 850mg	37%
Total Carbohydrate 34g	12%
Dietary Fiber 4g	14%
Total Sugars 6g	
Includes 0g Added Sugars	0%
Protein 15g	
Vitamin D 0mcg	0%
Calcium 320mg	25%
Iron 1.6mg	8%
Potassium 510mg	10%
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

% Daily Value

Figure 5.1. Food label example with percent Daily Values highlighted. "Nutrition Facts Label: Percent Daily Values Explained" is available on the US Food and Drug Administration webpage [The Lows and Highs of Percent Daily Value on the Nutrition Facts Label](#).⁴

can be confusing for consumers when trying to determine which foods will help meet their nutritional needs.

Labels are also only required to reflect the DVs for calcium, vitamin D, potassium, and iron.³ The other micronutrients are not required to be listed, but they can be, at the discretion of the manufacturer.

The DVs reflect the percentage of a nutrient a product will provide as it relates to the “highest” RDA based on age and sex (see Figure 5.1). For example, related to iron, the %DV listed on a food label correlates with the RDA for premenopausal women (18 mg), which is the highest of the various RDAs for age and sex.

VITAMINS

Vitamins can be obtained from a variety of different foods and are classified as either water soluble or fat soluble. Various mechanisms in the small intestine are responsible for the absorption of vitamins. A major difference between the 2 types of vitamins is that **fat-soluble vitamins** are absorbed with fat. The following discussion describes the role each vitamin plays in promoting health and wellness, in addition to reviewing: recommended intake levels, food sources, recommended biomarkers for assessing status, signs of deficiencies, and populations at risk.

Water-Soluble Vitamins

There are 9 **water-soluble vitamins**. They, in addition to other vitamins, play a role in metabolism, primarily as cofactors or coenzymes necessary in the formation and storage of energy (see Table 5.1). Although only needed in small quantities by the body, water-soluble vitamins cannot be synthesized or stored by the body. Thus, they are required daily to meet one’s needs; in some

cases, deficiencies that increase risk for illness and death can develop very quickly.

Table 5.1. Water-Soluble Vitamin Functions⁵⁻¹³

B vitamins

Thiamine (B ₁)	Required in energy transformation, synthesis of pentoses and reduced nicotinamide adenine dinucleotide phosphate (NADPH), and nerve conduction. Plays a major role in carbohydrate metabolism and serves as a magnesium-coordinated coenzyme for oxidative decarboxylation of α -ketoacids (e.g., pyruvate). Deficiencies can arise with alcohol abuse, diuretic use, and malabsorption.
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Riboflavin (B ₂)	Primary function is as a component of the flavin mononucleotide and flavin adenine dinucleotide as an electron transport intermediary for oxidation-reduction reactions. Also has antioxidant properties. Deficiency is rare.
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Niacin (B ₃)	<p>Nicotinamide portion of nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate serves as a hydrogen donor or an electron acceptor for more than 200 enzymes involved in intermediary metabolism of amino acids, carbohydrates, and fatty acids. NADPH is required for activation of folate. Pellagra is the disease caused by niacin deficiency, which is rare in developed nations.</p> <p>Look for the 3 Ds: dermatitis, diarrhea, and dementia. Deficiencies may occur with malnutrition and malabsorption.</p>
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<p>Vitamin B₆ (3 forms: pyridoxine, pyridoxal, and pyridoxamine)</p>	<p>Coenzyme forms participate in more than 100 enzymatic reactions. Facilitates transamination and deamination. Important for cognitive development. Also assists with decreasing homocysteine levels. Pyridoxine is converted to the active coenzyme pyridoxal phosphate and coenzyme pyridoxamine to pyridoxamine phosphate.</p>
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Vitamin B ₁₂	Needed for the conversion of homocysteine to methionine. Elevated homocysteine levels have been linked with increased risk for cardiovascular disease, cerebral vascular accident, dementia, Alzheimer's disease, and osteoporosis. When B ₁₂ is lacking, folate is "trapped" in its inactive form. B ₁₂ is also needed for erythrocyte synthesis. Deficiencies may occur with malabsorption, inadequate intake, and use of certain medications.
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Other vitamins

Folic acid	<p>Primary function is as a coenzyme in the transfer of single-carbon fragments from 1 compound to another for amino acid metabolism and nucleic acid synthesis. There is increased demand for folate during pregnancy, due to increased demand for DNA synthesis for embryonic development.</p> <p>Folate deficiency causes the misincorporation of uracil in place of thymine, leading to DNA fragility and strand breakage that cause neural tube defects (NTDs) during fetal development. Since the FDA mandated folate fortification of cereal and grain products in</p>
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	1998, incidence of NTDs has declined.
Vitamin C	Antioxidant; synthesis of collagen, carnitine, and neurotransmitters; enhances intestinal absorption of nonheme iron, and immune-mediated and antibacterial functions of white blood cells. Deficiency can be caused by inadequate intake and malabsorption.

<p>Pantothenic acid (PA)</p>	<p>As a component of coenzyme A, PA is involved in energy production from fat, carbohydrates, and ketogenic amino acids. Also required for the synthesis of bile salts, cholesterol, steroid hormones, and fatty acids. Deficiency is rare.</p>
<p>Biotin</p>	<p>Necessary for genetic expression of more than 2,000 enzymes; also needed as a cofactor for several carboxylase enzymes required for metabolic pathways, such as gluconeogenesis and fatty acid synthesis. Deficiency is rare because biotin can be synthesized by colonic microflora.</p>

Water-soluble vitamin	RDA/AI: adult men	RDA/AI: adult women	Tolerable Upper Intake Level	Rich food sources
Thiamine	1.2 mg/d	1.1 mg/d	ND	Pork, fortified cereals, enriched breads, sunflower seeds, germ
Riboflavin	1.3 mg/d	1.1 mg/d	ND	Fortified cereals, enriched breads, milk
Niacin	16 mg/d	14 mg/d	35 mg/d	Poultry, beef, fortified cereals, enriched breads

Pyridoxine (vitamin B ₆)	1.3 mg/d	1.3 mg/d	100 mg/d	Fortified enriched foods, garbanzo beans, salmon
Folic acid	400 mcg/d	400 mcg/d	1,000 mcg/d	Spinach fortified foods such as cereals and pasta lentils, legumes asparagus

Vitamin B ₁₂	2.4 mcg/d	2.4 mcg/d	ND	Liver, oysters, fortified cereals, cottage cheese, animal products, fortified vegan
Pantothenic acid	5 mg/d	5 mg/d	ND	Beef liver, fortified enriched foods, shitake mushrooms, sunflower seeds
Biotin	30 mcg/d	30 mcg/d	ND	Egg yolks, nuts, legumes

Vitamin C	90 mg/d Smoke rs: 125 mg/d	75 mg/d Smoke rs: 115 mg/d	2,000 mg/d	Citrus, tomato strawb pepper
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Abbreviations: AI = Adequate Intake; d = day; ND = not detected; RDA = Recommended Daily Allowance.

Given the body's inability to store the water-soluble vitamins, deficiencies can develop quickly for a myriad of reasons. Table 5.3 reflects the populations at risk for deficiencies.

The small intestine is responsible for the digestion and absorption of most micronutrients. Therefore, any conditions that impair these functions or resections of the gastrointestinal tract can lead to the development of deficiencies. Chronic systematic inflammation also adversely affects metabolism of several water-soluble vitamins, including pyridoxine, folate, and vitamin B₁₂.^{9,10} Furthermore, prescribed medications, disordered eating styles, alcohol abuse, and health status can lead to alterations in micronutrient status.

Table 5.3. Water-Soluble Vitamin Clinical Relevance Summary⁵⁻¹³

Vitamin	Signs and symptoms	Conditions that increase risk
Thiamine (B ₁)	Ocular abnormalities, nystagmus, gait ataxia, and mental status changes (Wernicke encephalopathy; wet or dry beriberi)	Bariatric surgery, malabsorptive disorders, protracted vomiting, alcohol abuse, malnutrition with or without hyper-metabolism, diuretics, dialysis

Riboflavin (B ₂)	Angular stomatitis, cheilosis, glossitis, preeclampsia in pregnancy	Malabsorptive disorders, alcohol abuse, malnutrition, pregnancy, vegeta
Niacin (B ₃)	Thickening and rash on sun-exposed skin, dementia, diarrhea, fatigue	Malabsorptive disorders, alcohol abuse, malnutrition

Pyridoxine (B ₆)	Peripheral neuropathy, hyperhomo-cysteinemia, confusion, dermatitis, glossitis, microcytic anemia	Malabsorptive disorders, alcohol abuse, dialysis, eating disorders
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Folic acid (B ₉)	Macrocytic anemia, cheilosis, CVD, dementia, hyperhomo-cysteinemia	Alcohol abuse, malabsorptive disorders, prenatal, pregnancy, dialy
Vitamin B ₁₂	Megaloblastic anemia, depression, glossitis, neuropathy, confusion and cognitive decline, hyperhomo-cysteinemia	Malabsorptive disorders, ileostomy, low gastric HCl outp vegans, vegetarians

Vitamin C	Scurvy, delayed wound healing, petechiae, corkscrew hairs, bleeding gums; splinter hemorrhages under the nails	Malabsorptive disorders, malnutrition, dialysis
Pantothenic acid (B ₅)	Peripheral neuropathy, fatigue	Severely malnourished
Biotin	Thinning hair, hair loss, periorificial skin rash and fatigue	Severely malnourished

Abbreviations: CVD = cardiovascular disease; d = day; DNI = chloride; IM = intramuscular; IV = intravenous; mg = milligram; multivitamin/mineral.

A comprehensive nutrition assessment—including an evaluation of weight history, biochemical data, past and current health status, medications prescribed, and use of dietary supplements, in addition to a diet history—can determine if individuals have or are at risk for developing micronutrient deficiencies.

In addition, a nutrition-focused physical exam should be

completed to observe for signs of any micronutrient deficiencies that may be present. Niacin, riboflavin, pantothenic acid, and biotin deficiencies are rare in the United States, although when they do occur, deficiencies of several other micronutrients also tend to be present. This can be seen with certain medications, malabsorption, and alcohol abuse.

Therapeutic doses of the water-soluble vitamins are often used for treating certain medical conditions. For example, riboflavin in high doses has been used to treat migraines, and therapeutic doses of niacin are often used to treat dyslipidemia by increasing high-density lipoprotein cholesterol and reducing triglycerides and low-density lipoprotein cholesterol levels (Table 5.3).^{6,7}

Fat-Soluble Vitamins

The fat-soluble vitamins include vitamins A, D, E, and K. Each vitamin has unique characteristics that contribute to overall health and wellness. Fat-soluble vitamins have complex absorption because fat must be present in the gastrointestinal tract at the same time as the vitamin for absorption. The fat-soluble vitamins are necessary for immune function, bone health, vision, and blood clotting (see Table 5.4). In contrast to water-soluble vitamins, fat-soluble vitamins can be stored by the body, so deficiencies can take months to become noticeable.

Table 5.4. Summary of the Fat-Soluble Vitamins Form and Function¹⁴⁻¹⁷

Vitamin	Function(s)
Vitamin A: subgroup of retinols; 90% of vitamin A is absorbed; 8% in carotinoids; need fat for absorption of all fat-soluble vitamins	Vision, antioxidant, wound healing

<p>Vitamin D (active form: calcitriol/D₃)</p>	<p>Primary role is to maintain serum calcium and phosphorus levels needed to support bone mineralization, neuromuscular functions, calcium absorption, and other cellular functions.</p> <p>Pleiotropic effects*: May reduce risk for cardiovascular disease, promote glucose control and optimal neuromuscular function, reduce the risk for some cancers, reduce the risk for falls, and promote optimal immune function</p>
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<p>Vitamin E: comprises 8 naturally occurring compounds: 4 tocopherols and 4 tocotrienols. α-Tocopherol is the most active form; functions as an antioxidant; γ-tocopherol is the most abundant dietary form</p>	<p>Neuroprotective; may reduce the risk for certain cancers due to antioxidant benefits; may reduce serum cholesterol levels</p>
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Vitamin K	Involved in the clotting cascade and promotes bone health; synthesized by microbes in the small bowel and colon; vitamin K negates the effects of warfarin (patient education often needed regarding this)
*A pleiotropic effect, in this context, refers to when a nutrient deficiency can affect multiple body systems.	

Table 5.5 lists the daily recommendations for intake for adults based on sex and upper tolerable limits. Rich food sources in addition to recommended biomarkers for assessing micronutrient status are also shown.¹⁴⁻¹⁷

Table 5.5. Fat-Soluble Vitamin Recommendations¹⁴⁻¹⁷

Fat-soluble vitamin	RDA/ AI: adult men	RDA/ AI: adult women	Tolerable Upper Intake Level	Rich food sources	Re bi as
Vitamin A	900 mcg/d	700 mcg/d	3,000 IU/d	Orange and yellow vegetables and fruits, fish, liver, dairy, eggs	Se se re pr
Vitamin D	15 mcg/d	19-70 years old: 15 mcg/d >70 years old: 20 mcg/d	100 mcg/d	Orange and yellow vegetables and fruits, fish, liver, dairy, eggs	Se 25 D

Vitamin E	15 mg/d	15 mg/d	1,000 mg/d	Seeds, nuts, vegetable oils , green leafy vegetables	Se α-
Vitamin K	120 mcg/d	90 mcg/d	ND	Dark leafy greens, broccoli	Se ph pr

Abbreviations: AI = Adequate Intake; d = day; IU = international unit; mcg = microgram; mg = milligram; ND = not determined; RDA = recommended daily allowance.

Table 5.6 lists common signs and symptoms that may reflect fat-soluble vitamin deficiencies. Other non-nutritional factors can play a role; therefore, it is important for the health-care professional to consider all factors that may be involved and rule out the possibilities, based on clinical status. Table 5.6 also indicates populations at risk and repletion doses to consider when a deficiency has been identified.

Table 5.6. Summary of Clinical Relevance for Fat-Soluble Vitamins¹⁴⁻¹⁷

Vitamin	Signs and symptoms	Conditions that increase risk	Repletion dose
Vitamin A	Night blindness, Bitot spots, poor wound healing, follicular hyperkeratosis	Malabsorptive disorders, poor intake, pregnancy, use of corticosteroids	3,000-15,000 RAE for 10 days
Vitamin D	Osteomalacia, hypocalcemia, tetany	Malabsorptive disorders, poor intake, liver or renal dysfunction/ dialysis, poor sun exposure, obese	50,000 IU/wk for 8 weeks → 1,000 IU/d

Vitamin E	Vision changes, ataxia, hemolytic anemia; deficiency rare	Malabsorptive/ GI disorders, intestinal resection, reduced biliary function	200-2,000 mg/d
Vitamin K	Bruising, prolonged bleeding, ↓ bone density	Malabsorptive disorders	Not available but typically 2.5-10 mg twice weekly to daily

Abbreviations: d = day; DNI = drug-nutrient interaction; GI = gastrointestinal; INR = international normalized ratio; IU = unit; mg = milligram; NAFLD = nonalcoholic fatty liver disease activity equivalent; wk = week.

MINERALS

Similar to vitamins, minerals are classified as elements that are required daily from the diet for health and wellness. Minerals are often organized into 3 categories:

- macrominerals (i.e., calcium, chloride, magnesium, phosphorus, potassium, and sodium)
- trace minerals (i.e., copper, chromium, fluoride, iodine, iron, manganese, molybdenum, selenium, and zinc)
- ultra-trace minerals (i.e., arsenic, boron, nickel, silicon, and vanadium)

In contrast to vitamins, the bioavailability of minerals is often poor, which increases the potential for deficiencies.¹⁸ Oxalates, phytates, saponins, and tannins—compounds found in plant-based foods—can interfere with the absorption of calcium, iron, magnesium, and zinc, thereby increasing the potential for deficiencies to develop.

Moreover, excess intake of a particular mineral at 1 time may result in decreased absorption. For example, absorption of calcium is best when consumed in doses of less than 500 mg.¹⁹ When daily doses are needed in greater amounts, the doses should be divided and consumed throughout the day. Table 5.7 reflects the functions as well as other notable details for a selection of minerals.

Table 5.7. Summary of Select Minerals and Function¹⁹⁻³⁰

Mineral	Functions	Notes
Calcium	<p>Bone and teeth structure; cardiac, neurological, and muscle functions; activation of blood-clotting factors. Higher intakes are associated with lower risk for colon cancer but greater risk for prostate cancer.</p>	<p>The most abundant mineral in the body. The medication exemestane is classified as an aromatase inhibitor (e.g., letrozole, anastrozole, Aromasin [a type of hormone therapy] prescribed for breast cancer in women with a history of estrogen-positive breast cancer and corticosteroids can increase bone density. Ensure adequate calcium and vitamin D intake.</p>

Iron	<p>Iron is an essential component of hundreds of enzymes and proteins that are necessary for critical functions, such as the production of hemoglobin and myoglobin, which transport oxygen; energy production; and DNA synthesis. Iron is also an active site for many reduction-oxidation enzymes involved in metabolism. Necessary for growth, neurological development, and synthesis of some hormones.</p>	<p>Absorption: Absorption mechanisms differ for heme iron and nonheme iron. Heme iron is absorbed intact (the enterocyte in a red blood cell) and the globin fraction removed, then hydrolyzed to ferrous iron by the intestinal cell. In the stomach, nonheme iron is released from food, usually in the ferric form, and converted to ferrous iron via the action of gastric acid. The ferrous iron then binds to receptors</p>
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		primarily in the duodenum and jejunum for absorption.
Magnesium	Essential in the activation of more than 300 enzymatic reactions; required for maintenance of the sodium-potassium-ATPase pump; structural component of bone, neuromuscular transmission, cardiovascular excitability, vasomotor tone, and muscle contraction.	Intake has generally been reported inadequate for adults in the United States.

Potassium	Most abundant intracellular cation; needed for sodium-potassium pump and cardiac, muscle, and neurological functions	
Sodium	Sodium-potassium pump, fluid/ electrolyte balance, and blood pressure	Excess intake increases urinary excretion of calcium

Zinc	Needed in more than 200 enzymatic reactions; cellular proliferation and differentiation; wound healing; insulin synthesis; glucose control; immune function. Can decrease by 50% of the normal level during the acute phase response* due to zinc sequestration. Consider checking C-reactive protein levels to assess level of inflammation.	
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Copper	Serves as a cofactor for various enzymatic pathways (commonly referred to as “cuproenzymes”) for energy production, iron metabolism, neurotransmission, and connective tissue synthesis	
Iodine	Critical component of thyroid hormones and necessary for overall growth and development	

Manganese	Serves as a cofactor for many enzymatic pathways involved in antioxidant defenses, metabolism, bone and cartilage formation, and wound healing	Although manganese deficiencies are extremely rare in humans, neurotoxicity is possible. It can arise in the form of disorders associated with manganese-overload disorders and overconsumption of manganese through inhalation, drinking water, and total parenteral nutrition. Individuals with chronic liver dysfunction are at a high risk for manganese toxicity.
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Selenium	A major constituent for more than 24 selenoproteins that play an essential role in DNA synthesis, thyroid hormone metabolism, reproduction, and antioxidant functions	
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Ultra-Trace Minerals

The ultra-trace minerals, although needed in very small amounts by the body, play a critical role in maintaining health and wellness. Table 5.8 reflects the daily recommendations for intake, upper tolerable limit, and biomarkers that can be used to assess the status of several ultra-trace elements. Information regarding rich dietary sources is also included.

Chromium, molybdenum, and fluoride are additional trace elements needed for various physiological functions for health. The functions of chromium are not well understood, but chromium plays a role in insulin sensitivity and glucose control. As such, chromium supplementation has been promoted for glucose regulation despite clinical research results being inconclusive.

Molybdenum functions as a cofactor for sulfite oxidase, xanthine oxidase, and aldehyde oxidase. Deficiencies in molybdenum have not been reported in healthy adults but may be present in individuals with very rare metabolic disorders.

Even though fluoride helps prevent tooth decay, it is not considered an essential mineral, because it is not required for

growth and survival. However, **dental caries** are a nutritional concern because poor oral health can cause malnutrition related to difficulty chewing. Furthermore, dental caries can ultimately lead to edentulism (partial or total loss of permanent teeth), which can also lead to inadequate nutrient intake and malnutrition because individuals may be unable to consume a variety of foods.³⁰

Table 5.8. Summary of Daily Reference Values, Food Sources, and Biomarkers for Some Minerals¹⁹⁻³⁰

Mineral	RDA/AI: men	RDA/ AI: women	Tolerable Upper Intake Level	Rich food sources
Calcium	18-70 y.o.: 1,000 mg/d >70 y.o.: 1,200 mg/d	18-51 y.o.: 1,000 mg/d >51 y.o.: 1,200 mg/d	18-50 y.o.: 2,500 mg/d >51 y.o.: 2,000 mg/d	Dairy foods, kale, broccoli, bok choi , fortified foods such as orange juice and cereal
Iron	>19 y.o.: 8 mg/d	19-50 y.o.: 18 mg/d >51 y.o.: 8 mg/d	45 mg/d	Beef, fortified foods, oysters, white beans

Magnesium	19-30 y.o.: 400 mg/d >31 y.o.: 420 mg/d	19-30 y.o.: 310 mg/d >31 y.o.: 320 mg/d	350 mg/d*	Pumpkin seeds, chia seeds, almonds soy milk, beans
Potassium	3,400 mg/d (AI)	2,600 mg/d (AI)	ND	Bananas potatoes dairy products tomatoes oranges orange juice
Sodium	1,500-2,300 mg/d (AI)	1,500 mg/ d-2,300 mg/d (AI)	<2,300 mg/d	Water, processed foods

Zinc	11 mg/d	8 mg/d	40 mg/d	Seafood, meats, greens, whole grains
Trace minerals				
Copper	900 mcg/d	900 mcg/d	2 mg/d	Shellfish nuts, seeds
Iodine	150 mcg/d	150 mcg/d	1,100 mcg/d	Iodized salt, seaweed, seafood, eggs, fortified, enriched foods

Manganese	2.3 mg/d	1.8 mg/d	200-600 mg/d depending on body weight	Nuts, seafood, tea, whole grains
Selenium	70 mcg/d	55 mcg/d	400 mcg/d	Brazil nuts, seafood, organ meats

Abbreviations: AI = adequate intake; d = day; mcg = microgram; MCHC = mean corpuscular hemoglobin concentration; MCV = mean corpuscular volume; mg = milligram; ND = not determined; y.o. = years

**Denotes that the Tolerable Upper Intake Level (UL) is higher than the Recommended Daily Allowance (RDA) for men because the recommendations based on using magnesium supplements are based on intake from food, beverages, and supplements.*

Table 5.9 lists common signs and symptoms that may reflect

mineral deficiencies. Because non-nutritional factors can also promote these findings, the health-care professional must discern between nutritional and non-nutritional factors that play a role. Table 5.9 also lists conditions that increase risk for depletion and repletion doses to consider when a deficiency has been identified.

Table 5.9. Mineral Clinical Relevance Summary¹⁹⁻³⁰

Mineral	Signs and symptoms	Conditions that increase risk	Repl dose
Calcium	Hypocalcemia can result due to low vitamin D status, CKD, Mg deficiency, rickets and osteoporosis, hypotension, tetany, muscle cramps, seizures	Lactose intolerant/milk allergy, female athletes, postmenopausal, dialysis, vegan diets, malabsorptive disorders	1 g of chloro calci gluco
Iron	Microcytic anemia, pica, pallor, fatigue, cheilosis, glossitis, koilonychia, poor pregnancy outcomes	Low gastric acid, malabsorptive disorders, kidney dysfunction, poor intake	150- elem iron; with C

Magnesium	Tetany, Chvostek and Trousseau signs, arrhythmias	Critical illness, malabsorptive disorders, EtOH abuse, AKD/CKD	Labo valu = 2-4 sulfa <1 Mg s
Potassium	Weakness, lethargy, muscle necrosis, arrhythmias	Poor intake, AKD/CKD, malabsorptive disorders, hypermetabolic/refeeding syndrome, diabetes insipidus	Oral mEq IV: mEq depe seve level

Sodium	Headache, nausea, vomiting, muscle cramps, disorientation	Elderly (deficiency), starvation, PN populations	Base clinic
Zinc	Poor wound healing, rash, alopecia, impaired night vision, alterations in taste and smell	Poor intake, alcohol abuse, wound healing/wound drainage, malabsorptive disorders, liver disease and macular degeneration	Wound healing mg E days dege 80 m
Copper	Anemia unresponsive to iron supplementation	Neonates fed cow's milk, malnourished, malabsorptive syndromes, individuals taking high doses of zinc for 6-10 weeks	2-4 m

Iodine	Goiter, hypothyroidism	Pregnant women who don't consume dairy products; vegans; individuals not using iodized salt	150- mcg
Manganese	Evidence is limited, but deficiency maybe linked to poor growth in children, skin rashes, hair depigmentation, poor bone health	No known populations are at risk	Insu- data defic very

Selenium	Keshan disease (cardiomyopathy), Kashin-Beck disease, male infertility, muscular weakness	Malnourished, dialysis, bariatric surgery, GI disorders, and individuals with diet-associated conditions such as PKU	>90
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Abbreviations: AKD = acute kidney disease; BID = twice a day; CKD = chronic kidney disease; d = day; DNI = drug-nutrient interaction; g = gram; GI = gastrointestinal; h = hour; ICU = intensive care unit; K = potassium; mcg = microgram; mEq = milliequivalent; Mg = magnesium; OC = oral contraceptive; PKU = phenylketonuria; PN = parenteral nutrition; PPI = proton-pump inhibitor.

MICRONUTRIENT DEFICIENCIES

Reportedly affecting more than 2 billion people worldwide, the deficiency of micronutrients has been described as the “hidden hunger”³¹ and can be caused by a multitude of factors. However, because most Americans do not follow the Dietary Guidelines recommendations, poor dietary habits are likely 1 of the primary contributors to inadequate intake.

Worldwide, deficiencies of vitamin A, iron, zinc, folate, and iodine reportedly are the most common.³² Data from the National Health and Nutrition Examination Survey (NHANES) 2005-2016 *What We*

Eat in America survey data noted that in addition to inadequate vitamin A intake (45%), insufficient intakes of vitamins C (46%), D (95%), and E (84%) were also common in the US population when only food intake was evaluated. Inadequate zinc intake was also reported in 15% of the surveyed study participants.³² Although inadequate intake was also described for other micronutrients such as vitamin B₆ (11%), folate (12%), and iron (5%), insufficiencies of these micronutrients are less common.³²

Dietary supplements have led to a reduction in nutrient inadequacy. When the use of dietary supplements was evaluated in addition to food intake, inadequacies were reduced as follows: vitamin A from 45% to 35%; vitamin C, 46% to 33%; vitamin D, 95% to 65%; vitamin E, 84% to 60%; and zinc, 15% to 11%.³²

Check your understanding with the following case study activity:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1012#h5p-77>

In addition to the aforementioned variety of factors that can affect micronutrient need and availability, many other factors, such as food choices, food preparation, food plantings and harvesting, and climate change, also have an impact.

FOOD CHOICES

“No one size fits all” when it comes to what consumers eat, because

there are many reasons why people choose to eat what they do (see [chapter 3](#) for a more in-depth discussion). Popular diets such as low-carbohydrate (low carb), high-protein, or the ketogenic (“keto”) diet (high fat and low carb) are often the focus of “healthy eating.” Moreover, dietary restrictions such as reduced sodium, potassium, or phosphorus may be prescribed based on one’s health status.

Conversely, the national and global dietary recommendations for health and wellness promote a plant-based, whole-foods approach that reflects an intake of a variety of foods that provide not only macronutrients but also important micronutrients and **phytonutrients**. Examples include the DASH and the Mediterranean diet. Both are evidence-based approaches to preventing and managing diet-related medical conditions.^{33,34}

These “diets” share similar characteristics in their fundamental principles. Both promote the intake of a variety of fruits, vegetables, unprocessed whole grains, legumes, nuts, seeds, and healthy **fats**, which provide an array of valuable micronutrients including antioxidants along with phytonutrients. Together, these have a synergistic effect that reduces blood glucose, serum lipid, and inflammatory biomarker levels, thereby promoting disease prevention and management.³⁵ Animal proteins, processed foods, and alcohol are recommended to be consumed less often.

These recommendations contrast with what the average American is reportedly consuming. Most don’t meet the guidelines for fruit and vegetable consumption: only 1 in 10 Americans consumes the recommended servings per day.³² Additionally, most Americans don’t meet the guidelines of 2 to 3 servings per day for dairy intake, although intake of calcium-fortified dairy alternatives can help people meet the RDA for calcium.

IMPACT OF POPULAR DIETS ON MICRONUTRIENT INTAKE

In recent years, multiple different eating patterns with distinct

attributes have been popularized and followed by American adults. Each dietary pattern may affect micronutrient status. Therefore, understanding the relationship between these diets and micronutrient intake is essential to ensure optimal nutritional and health status. The following discussion reviews selected popular diets, their attributes, and their potential impact on micronutrient excess or deficiency.³⁶ For more information, refer to [chapter 8](#), which reviews popular diets in more detail. Table 5.10 provides a summary of popular diets and their impact on micronutrient status.

Vegetarian-Style Diets

- **Lacto-ovo-vegetarian:**
 - **Attributes:** Excludes meat, poultry, and fish but may include dairy (lacto-vegetarian) and egg (ovo-vegetarian) products.
 - **Impact on micronutrient status:** Lacto-ovo-vegetarians may be at risk for deficiencies in vitamin B₁₂, iron, zinc, and **omega-3 fatty acids**.
 - **Supplementation:** Vitamin B₁₂ supplementation is often recommended for vegetarians to meet their needs.

- **Vegan diet:**
 - **Attributes:** Excludes all animal products, including meat, fish, eggs, dairy, and honey. Products that may involve animal products or wildlife, such as certain beers or figs, may be excluded too.
 - **Impact on micronutrient status:** Vegans commonly face potential deficiencies in vitamin B₁₂, iron, calcium, iodine, zinc, and omega-3 fatty

acids.

- **Supplementation:** Vitamin B₁₂, iron, and omega-3 fatty acid supplementation are often advised for vegans. Calcium and iodine sources should also be carefully considered.

Pescatarian Diet

- **Attributes:** Excludes meat and poultry but includes fish and other seafood.
- **Impact on micronutrient status:** Pescatarians generally have a lower risk of deficiencies compared with vegetarians because they consume seafood. Seafood provides essential nutrients such as omega-3 fatty acids, vitamin B₁₂, and iron.
- **Supplementation:** Depending on individual dietary choices, supplementation may still be necessary, particularly for vitamin D and omega-3 fatty acids.

Paleolithic Diet (Paleo)

- **Attributes:** Emphasizes whole foods, lean meats, fish, fruits, vegetables, nuts, and seeds while excluding refined grains, legumes, dairy, and processed foods.
- **Impact on micronutrient status:** The paleo diet may result in inadequate intakes of calcium, vitamin D, vitamin E, and some B vitamins.
- **Supplementation:** Depending on individual dietary choices and sun exposure for vitamin D

synthesis, supplementation may be needed for certain nutrients.

Low-Carbohydrate Diets

- **Ketogenic diet (keto)**
 - **Attributes:** High fat, very low carbohydrate, and moderate protein intake; emphasizes intake of nuts and seeds, red meat, poultry, fish and seafood, eggs, full-fat dairy, and oils.
 - **Impact on micronutrient status:** The keto diet may lead to deficiencies in fiber, vitamin C, vitamin D, vitamin E, vitamin K, calcium, magnesium, potassium, and some B vitamins due to the limited variety of food choices.
 - **Supplementation:** Supplementation with vitamins and minerals, particularly those mentioned, may be necessary to avoid potential deficiencies.
- **Low-carbohydrate/high-protein diet**
 - **Attributes:** Restricts carbohydrate intake while emphasizing high protein consumption.
 - **Impact on micronutrient status:** Low-carb/high-protein diets may lead to deficiencies in vitamins C, D, and E; folate; calcium; magnesium; and potassium, due to limited intake of fruits, vegetables, and whole grains.
 - **Supplementation:** Consideration should be given to supplementation, especially for vitamins and minerals commonly found in plant-based foods.

Check your understanding with the following activity:



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Table 5.10. Summary of Popular Diets Defining Features and Impact on Micronutrient Status³⁶

Vegetarian-style diet	Defining feature	Impact on micronutrient status	P s n
Lacto-ovo-vegetarian	Plant-based foods, excluding meat and fish	Potential deficiency in vitamin B ₁₂ , iron, zinc, and omega-3 fatty acids	V
Pescatarian	Includes fish, excludes meat and dairy products	Reduced risk of deficiencies compared with vegetarian	V
Vegan	Excludes all animal products	Potential deficiencies in vitamin B ₁₂ , iron, calcium, and omega-3s	V ca o

Ketogenic	High fat, very low carbohydrate intake	Possible deficiency in vitamins C, D, E; calcium; and magnesium	B vi ca m
Paleo	Emulates ancestral diets	Potential deficiency in calcium, vitamin D, fiber	V ca
Low-carb/ high-protein	Low carbohydrate, high protein intake	Potential deficiency in B vitamins and vitamin C	B vi

FOOD PRODUCTION AND HARVESTING: HOW IT AFFECTS MICRONUTRIENT AVAILABILITY

The essence of food production depends on the quality of the soil food is grown in as plants extract nutrients from the soil. This makes up the nutrient composition of the plant.

The nutrients obtained from eating chicken, beef, and pork also contribute to a nutrient-dense diet based on the nutrient availability and micronutrient density in these animals' feeds. Nutrients are returned to the soil through organic matter (plant or

livestock biomatter), in addition to the use of inorganic fertilizers. These avenues are essential to maintain or replenish the fertility of the soil. However, the refurbishing of these nutrients rarely fully replaces all that are lost; thus, over time, harvesting results in continued soil nutrient loss. Furthermore, soil nutrient content is variable from region to region throughout the world. Although increased global food production and distribution have reduced some nutritional deficiencies, micronutrient deficiencies related to iron, calcium, zinc, and vitamin A still occur. Lower soil levels of zinc, copper, and manganese have been associated with increased child mortality.³⁷ And micronutrient deficiencies arising from consumption of nutrient-poor foods also can adversely affect childhood and adolescent growth.³⁸

Reportedly, soil degradation affects most of the global food production regions.³⁷ To meet the global need for food in 2050, it is estimated that food production will need to increase by 70% to 100% of today's production.³⁹ To promote and maintain optimal food production that will produce high nutritional quality food to meet the nutritional needs of the world's population, including provision of essential micronutrients, soil management is crucial in agriculture. Farming practices that focus solely on increasing yield often lead to lower micronutrient content of the crop.

Global trade of food has led to an increased allocation in the variety of foods available across the world. Although this has led to an increased availability of foods, the availability of nutrient-rich foods may not be equitable. For example, refined wheat products may be fortified with micronutrients lost in processing in some countries, but not all. Fortification typically depends on the economic state of the country. Higher-income countries are more likely to fortify products that have been stripped of their micronutrients.

Increasing global trade of food increases the exposure of the world's population to foods grown in nutrient-poor soils. Food is highly perishable and prone to damage from pests and nutrient

degradation during post-farm production handling, transportation, storage, and packaging. These aggregated factors lead to the consumption of nutrient-poor foods, which can lead to malnutrition and diet-related health consequences.

Farming Practices

Farming practices also play a critical role in the micronutrient content of plants and livestock. Nutrient density is dropping in harvested crops due to over-tilling, use of nitrogen fertilizers, focusing on increased yield, using synthetic pesticides, and other factors. However, implementing regenerative farming practices (replenishing soil organic matter and health), also known as “conservative agriculture,” can result in higher levels of micronutrients and phytonutrients.⁴⁰

Instituting regenerative farming practices improves soil health and plant micronutrient content at farms where traditional practices previously were used. In addition, regenerative farming practices also led to an increase in omega-3 fatty acid levels in meat when compared with meat from grass-fed animals, using conventional farming.⁴⁰

Climate Change

Climate change also can have a significant impact on soil nutrient density. Crops grown in regions with higher carbon dioxide (CO₂) levels reportedly have 3% to 17% less iron, zinc, and protein.⁴¹ Lower protein content in wheat, potatoes, barley, and rice are projected to decline 6% to 14% if atmospheric CO₂ levels continue to increase.⁴² Reduced amounts of several B vitamins, iron, and zinc have been found in different varieties of rice, due to higher levels of CO₂ as well.

MICRONUTRIENT DIETARY EXCESSES

Despite popular belief that more is better, excessive intake of several micronutrients may be associated with adverse health outcomes. Food choices such as overconsumption of prepared and fast foods increase sodium intake. Excess fluoride intake during critical periods of tooth formation can be detrimental. Furthermore, increased intake of potassium and phosphorus by patients with chronic kidney disease can increase their risk for morbidity and death. Lastly, dietary supplements are commonly used and contribute, in addition to diet, to the overall intake of micronutrients—something most consumers don't consider.

The FDA reports adults in the United States consume 3,400 mg of sodium daily, which exceeds the recommendations set forth by the Dietary Guidelines of $\leq 2,300$ mg/d.⁴³ Furthermore, the American Heart Association recommends $\leq 1,500$ mg/d for adults with hypertension. It is concerning, then, that reportedly 40% of US adults, including almost 60% of non-Hispanic Black people, have hypertension related to excessive sodium intake.⁴⁴ Moreover, hypertension may increase the risk for heart disease and stroke, primary causes of death. Processed, packaged, and ready-prepared foods contribute the majority of dietary sodium intake.⁴³ Numerous low-sodium options are available, and their use should be encouraged to reduce intake, in addition to following the DASH or Mediterranean dietary patterns to promote risk reduction.⁴⁵

Beginning in the mid-1940s, a large proportion of the water in the United States has been supplemented with fluoride, based on observations that dental caries were significantly lower in populations drinking water with higher fluoride concentrations. Today, approximately 60% of the US population consumes water from community sources that is fortified with fluoride as a public health measure to reduce the prevalence of dental caries.⁴⁶ Note that bottled water, increasingly consumed by adults, is generally a relatively poor source of fluoride. Although fluoridation of water

sources has reduced the prevalence of dental caries in the United States, excess intake of fluoride can lead to **dental fluorosis**, which occurs when the tooth is developing during the first 8 years of life. Excess fluoride after this time will not have any adverse effects on the teeth.⁴⁶

Using NHANES data from 2011 to 2014, Cowan et al.⁴⁷ found that surveyed participants ≥ 19 years of age who used dietary supplements exceeded the recommended intake levels for iron, folic acid, vitamin D, and calcium, regardless of their living situations and health status. This, in turn, could lead to adverse outcomes. See [chapter 6](#) for a detailed discussion on dietary supplements.

Several medical conditions, including hemochromatosis and chronic kidney disease, may require restricting micronutrient intake to avoid the adverse effects of overconsumption. For example, in hemochromatosis, iron intake is restricted to prevent excess iron storage in the liver, heart, and pancreas. Excess storage can eventually cause liver, cardiac, and pancreatic failure. Individuals with chronic kidney disease are often counseled to limit their intake of potassium and phosphorus to avoid adverse effects of hyperkalemia and hyperphosphatemia that occur due to compromised renal excretion. Excess intake of vitamin E and calcium also have been linked to an increased risk for prostate cancer in men, with recommendations focused on not exceeding the recommended daily intake levels.⁴⁸

SUMMARY

Although micronutrients are required in small amounts by the body, they are vital for promoting and maintaining health and wellness. Many factors can alter an individual's micronutrient requirements and status. Dietary choices, health status, availability of and access to healthy foods, and food production methods from

farming to processing influence the micronutrient content in the foods we eat and, ultimately, micronutrient status.

By completing a comprehensive nutrition assessment that includes an evaluation of weight history and body composition, available laboratory data, past and present medical status, and dietary habits, individuals with or at risk for developing micronutrient deficiencies can be identified. A nutrition-focused physical exam provides additional data on whether any signs of deficiencies are present.

Subsequently, appropriate counseling can then help prevent deficiencies or maintain or improve micronutrient status. Evaluating current status and risk for deficiency can help prevent or manage medical conditions or diseases associated with various micronutrients.

Consuming plant-based diets such as the DASH or Mediterranean-style diet can provide a rich foundation for micronutrient intakes. These diets also reduce the diet-related diseases of heart disease, stroke, type 2 diabetes, and hypertension. Overall, understanding the factors affecting micronutrient intake can lead to improved, evidenced-based nutrition counseling and intervention.

PRACTICE CASE

Andrea is a 23-year-old woman who changed her eating habits 6 months ago because she wanted to become a vegan and heard that the vegan diet was healthier. She's made an appointment with you because she feels tired and weak often. She also tells you she's having trouble concentrating, is dizzy at times, and she can feel some tingling in her feet.

You notice her skin looks pale and her tongue is smooth and red.

Diet History

- Breakfast: ½ cup of oatmeal with honey, almonds, and apples. 8 oz of black coffee
- Morning snack: ½ cup of edamame
- Lunch: 1 cup of kale and quinoa salad, lemon vinaigrette dressing; 8 oz of fruit smoothie
- Afternoon snack: handful of pita chips with hummus
- Dinner: lentil soup, small garden salad (mixed greens, olives, vegan feta cheese, and tomatoes), and 2 slices of sourdough bread
- Dessert: fruit sorbet

Patient history: gastrointestinal reflux disease

Medication: proton-pump inhibitor

Laboratory values:

- MCV: 105 femtoliters (fL; normal range: 80-100 fL)
- Hemoglobin: 12.8 g/dL (normal range: 14-18 g/dL)

Using the information about Andrea in the preceding practice case, test your understanding by answering the questions in the following activities:



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Key Takeaways

- Micronutrients include a variety of vitamins and minerals that are needed in small amounts but are essential for health and wellness.
- Several factors can influence micronutrient intake, including appetite, source of nutrition, health status, type of food consumed, and method of food preparation.
- Dietary patterns, following trendy diets, and use of dietary supplements can lead to excessive or insufficient micronutrient intake.
- Commonly used medications can increase the risk for micronutrient deficiencies. Education is often needed to help patients minimize that risk.
- Micronutrient deficiencies can be detected by completing a nutrition-focused physical exam and the use of biomarkers.

REFERENCES

1. National Institutes of Health Office of Dietary Supplements. Nutrient recommendations and databases. Accessed May 12, 2023. <https://ods.od.nih.gov/HealthInformation/nutrientrecommendations.aspx>
2. DRI calculator for healthcare professionals. National Agriculture Library, US Department of Agriculture. Accessed May 12, 2023. <https://www.nal.usda.gov/human-nutrition-and-food-safety/dri-calculator>
3. How to understand and use the Nutrition Facts label. US Food and Drug Administration. Accessed May 12, 2023. <https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label#:~:text=The%20Daily%20Values%20are%20reference,or%20low%20in%20a%20nutrient.>
4. The lows and highs of percent daily value on the new Nutrition Facts label. US Food and Drug Administration. Accessed June 26, 2023. <https://www.fda.gov/food/new-nutrition-facts-label/lows-and-highs-percent-daily-value-new-nutrition-facts-label>
5. Drake VJ. Thiamin. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated October 2021. Accessed May 13, 2023. <https://lpi.oregonstate.edu/mic/vitamins/thiamin>
6. Drake VJ. Riboflavin. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated July 2022. Accessed May 13, 2023. <https://lpi.oregonstate.edu/mic/vitamins/riboflavin>
7. Delage B. Niacin. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated August 10, 2018. Accessed June 21, 2023.

<https://lpi.oregonstate.edu/mic/vitamins/niacin>.

8. Johnson LE. Vitamin B₆ deficiency and dependency. Merck Manual professional version. November 2022. Accessed June 21, 2023. <https://www.merckmanuals.com/professional/nutritional-disorders/vitamin-deficiency,-dependency,-and-toxicity/vitamin-b6-deficiency-and-dependency>
9. Drake VJ. Vitamin B₁₂. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated June 4, 2015. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-B12>
10. Drake VJ. Folate. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated December 2014. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/folate>
11. Delage B. Vitamin C. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated December 2018. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-C>
12. Drake VJ. Pantothenic acid. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated July 2015. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/pantothenic-acid>
13. Drake VJ. Biotin. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated March 2023. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/biotin>
14. Drake VJ. Vitamin A. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated February 25, 2021. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-A>

15. Delage B. Vitamin D. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated February 11, 2021. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-D>
16. Delage B. Vitamin E. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated October 2015. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-E>
17. Drake VJ. Vitamin K. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated July 2022. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-K>
18. Bielik V, Kolisek M. Bioaccessibility and bioavailability of minerals in relation to a healthy gut microbiome. *Int J Mol Sci.* 2021;22(13):6803. doi:10.3390/ijms22136803
19. Delage B. Calcium. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated September 2017. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/minerals/calcium>
20. Delage B. Iron. Linus Pauling Micronutrient Information Center. Updated May 2016. Accessed June 22, 2023. <https://lpi.oregonstate.edu/mic/minerals/iron>
21. Delage B. Magnesium. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated February 2019. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/magnesium>
22. Delage B. Potassium. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated April 2019. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/potassium>
23. Delage B. Sodium (chloride). Oregon State University

- Linus Pauling Institute, Micronutrient Information Center. Updated April 11, 2019. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/sodium>
24. Delage B. Zinc. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated May 2019. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/zinc>
 25. Collins JF. Copper. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated January 2014. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/copper>
 26. Drake VJ. Iodine. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated January 2014. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/iodine>
 27. Drake VJ. Manganese. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated May 2021. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/manganese>
 28. Drake VJ. Selenium. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated June 2015. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/selenium>
 29. Drake VJ. Molybdenum. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated May 2021. Accessed June 23, 2023. <https://lpi.oregonstate.edu/mic/minerals/molybdenum>
 30. Drake VJ. Fluoride. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated December 2021. Accessed June 25, 2023. <https://lpi.oregonstate.edu/mic/minerals/fluoride>

31. Lowe NM. The global challenge of hidden hunger: perspectives from the field. *Proc Nutr Soc.* 2021;80(3):283-289. doi: [10.1017/S0029665121000902](https://doi.org/10.1017/S0029665121000902)
32. Reider CA, Chung RY, Devarshi PP, Grant RW, Mitmesser SH. Inadequacy of immune health nutrients: intakes in US adults, the 2005-2016 NHANES. *Nutrients.* 2020;12(6):1735. doi:[10.3390/nu12061735](https://doi.org/10.3390/nu12061735)
33. Wang JS, Liu WJ, Lee CL. Associations of adherence to the DASH diet and the Mediterranean diet with all cause mortality in subjects with various glucose regulation states. *Front Nutr.* 2022;9:828792. doi:[10.3389/fnut.2022.828792](https://doi.org/10.3389/fnut.2022.828792)
34. Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med.* 2001; 344:3-10. doi:[10.1056/NEJM200101043440101](https://doi.org/10.1056/NEJM200101043440101)
35. Koelman L, Rodrigues CE, Aleksandrova K. Effects of dietary patterns on biomarkers of inflammation and immune responses: a systematic review and meta-analysis of randomized controlled trials. *Adv Nutr.* 2022;13(1):101-115. doi:[10.1093/advances/nmab086](https://doi.org/10.1093/advances/nmab086)
36. Tahreem A, Rakha A, Rabail R, et al. Fad diets: facts and fiction. *Front Nutr.* 2022;9:960922. doi:[10.3389/fnut.2022.960922](https://doi.org/10.3389/fnut.2022.960922)
37. Silver WL, Perez T, Mayer A, Jones AR. The role of soil in the contribution of food and feed. *Philos Trans R Soc Lond B Biol Sci.* 2021;376(1834):20200181. doi:[10.1098/rstb.2020.0181](https://doi.org/10.1098/rstb.2020.0181)
38. Berkhout ED, Malan M, Kram T. Better soils for healthier lives? An econometric assessment of the link between soil nutrients and malnutrition in Sub-Saharan Africa. *PLoS*

- One*. 2019;14,2-3. doi:10.1371/journal.pone.0210642
39. Global Panel. Healthy diets for all: a key to meeting the SDGs. Policy Brief No. 10. Global Panel on Agriculture and Food Systems for Nutrition; 2017
 40. Montgomery DR, Biklé A, Archuleta R, Brown P, Jordan J. Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. *PeerJ*. 2022;10:e12848. doi:10.7717/peerj.12848
 41. Smith P, Haberl H, Popp A, et al. How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? *Glob Chang Biol*. 2013;19(8):2285-2302. doi:10.1111/gcb.12160
 42. Semba RD, Askari S, Gibson S, Bloem MW, Kraemer K. The potential impact of climate change on the micronutrient-rich food supply. *Adv Nutr*. 2022;13(1):80-100. doi:10.1093/advances/nmab104
 43. Sodium reduction in the food supply. US Food and Drug Administration. Updated September 3, 2024. Accessed December 20, 2024. <https://www.fda.gov/food/food-additives-petitions/sodium-reduction>
 44. How much sodium should I eat a day? American Heart Association. Updated November 1, 2021. Accessed June 30, 2023. <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/sodium/how-much-sodium-should-i-eat-per-day>
 45. De Pergola G, D'Alessandro A. Influence of Mediterranean diet on blood pressure. *Nutrients*. 2018;10(11):1700. doi:10.3390/nu10111700
 46. About community water fluoridation. Centers for Disease Control and Prevention. Updated May 15, 2024. Accessed

October 31, 2024. https://www.cdc.gov/fluoridation/about/?CDC_AAref_Val=https://www.cdc.gov/fluoridation/basics/index.htm

47. Cowan AE, Jun S, Tooze JA, et al. Total usual micronutrient intakes compared to the dietary reference intakes among U.S. adults by food security status. *Nutrients*. 2020;12(1):38. doi:10.3390/nu12010038
48. Klein EA, Thompson IM Jr, Tangen CM, et al. Vitamin E and the risk of prostate cancer: the Selenium and Vitamin E Cancer Prevention Trial (SELECT). *JAMA*. 2011;306(14):1549-1556. doi:10.1001/jama.2011.1437

Chapter 6: Dietary Supplements

By Mary Marian, DCN, RDN, FAND, FASPEN

INTRODUCTION

Culinary medicine prioritizes healthy eating patterns that provide adequate energy and essential nutrients from food. Sometimes conditions arise for which dietary supplementation is needed and helpful.

A **dietary supplement** is a product taken by mouth that is intended to supplement the diet and is labeled as a dietary supplement. Many thousands of supplements are available for purchase. These are promoted for a variety of uses, including improving overall general health and preventing disease(s), treating a current medical issue, promoting weight loss or increased muscle mass, increasing energy, and improving athletic and sexual performance.

Although the US Food and Drug Administration (FDA) has established Good Manufacturing Practices (GMPs) that set expectations for how dietary supplements must be manufactured, prepared, and stored, the safety and efficacy ultimately are left to the manufacturer and can be uncertain. Supplement labels cannot claim to treat, cure, mitigate, or prevent a disease. Still, they can reflect a relationship between a supplement ingredient and the possibility of reducing the risk for a medical issue or a disease, and

they may state how a product may affect the body and can make a health claim.

Deceptive advertising is common in the supplement industry. Products labeled “natural” are not necessarily safer and healthier, although consumers often assume this to be true. Adverse side effects have been reported related to ingredients not listed on the label and contaminants.

How the product is used or consumed, the amount consumed, and the individual’s health status can influence tolerance and outcomes. Many supplements are widely used without medical supervision, and many are ineffective related to their intended use. An important concern is that some supplements can alter the efficacy of prescribed medications. Given the prevalence of use and lack of oversight regarding safety and efficacy, it is vital that health-care professionals and consumers be aware of the safety issues associated with dietary supplements and how to determine if a supplement is needed, as well as how to make educated decisions when purchasing these products.

CULINARY MEDICINE AND DIETARY SUPPLEMENTS

Culinary medicine promotes healthy eating behaviors, focusing on the consumption of a healthy diet primarily composed of a variety of whole and unprocessed foods for disease prevention or disease management. However, food allergies and food preferences, medical conditions, and the lack of access to or costs of various types of foods may warrant a need for dietary supplements.

**Definition of a
Dietary
Supplement**
“A product

Dietary supplements, defined in the accompanying text box, are widely used by consumers of all ages, with use continuing to increase.¹ Estimates indicate consumers spend more than \$130 billion annually on various types of supplements.²

In the 1990s, prior to the passage of the

Dietary Supplement and Health Education Act (DSHEA), about 4,000 different supplements were available. Today, more than 85,000 different supplement types can be purchased in stores and/or online. Reportedly, almost 58% of adults in the United States use dietary supplements, with 63.8% of women reporting using supplements in comparison to 50.8% of men.³ According to Mishra et al., use also increases with aging.³

More than 35% of individuals surveyed reported using 2 or more supplements in the past 30 days. In this survey, the most common types of supplements used were multivitamin/mineral, vitamin D, fish oils, and vitamin C products.³ Other commonly used supplements include **botanicals**, calcium, and vitamin B₁₂. Reported supplement use increased from 48.4% in 2007 to almost 58% in 2017–2018 for all adults.³ When adjusted by age, 74.3% of adults aged 60 years or older reported taking at least 1 supplement daily, with 24.9% taking 4 or more supplements.

This chapter reviews safety concerns and considerations, efficacy, when to consider supplementation, and guidelines for evaluating supplement use and/or need.

Safety

Dietary supplement products are overseen by the FDA but, unlike pharmaceutical drugs, dietary supplements are not strictly regulated. Enacted in 1994, the DSHEA outlined rules for the labeling and safety of dietary supplements.¹ However, the DSHEA

(other than tobacco) that is intended to supplement the diet; contains 1 or more dietary ingredients (vitamins, minerals, botanicals), is intended to be taken by mouth as a pill, capsule, tablet or liquids, is labeled on the front panel as being a dietary supplement."¹

also stated that the “FDA is not authorized to review dietary supplement products for safety and effectiveness before they are marketed,” thereby placing the responsibility for safety on the manufacturers.¹

Products can only be removed from the market after the FDA has proved that a supplement is unsafe.¹ In these instances, the FDA will issue public notifications and press releases to alert the public of safety concerns.

In 2007, the FDA established requirements and guidelines (GMPs) for dietary supplements.⁴ The GMPs set forth expectations by which dietary supplements must be manufactured, prepared, and stored to ensure quality.⁵ Companies are expected to guarantee the identity, purity, strength, and composition of their products.¹ Reporting of serious adverse effects is also mandatory. The FDA must also be notified before products with new dietary ingredients are marketed.

Since January 2011, when the Food Safety Modernization Act was passed, the FDA has had the authority to recall products without relying on the manufacturer to voluntarily remove misbranded or adulterated products from the marketplace.⁵ Furthermore, passage of this act requires manufacturers to verify safety of ingredients used from foreign suppliers, because constituents used in supplements, as well as the supplements themselves, are now manufactured around the world.

Despite these regulatory changes, quality control regarding safety and efficacy are still the responsibility of the manufacturer. Although manufacturers are responsible for producing supplements that are safe, they do not need to establish safety or effectiveness before they are available in the marketplace.

Many supplements are widely used without medical supervision. Moreover, many have been found ineffective related to their intended use.⁶ In fact, the FDA issued a warning for consumers that supplements used for weight loss, increasing muscle mass, and

improving sexual function are more likely than other supplements to be deceptively marketed and contain with toxic ingredients.⁷

Dietary Supplement Claims

Drug labels can claim to treat, cure, mitigate, or prevent a disease, but this is prohibited for dietary supplements. Three types of claims are allowed on supplement labels: nutrient content, structure/function claim, and/or a health claim.¹ For instance, a supplement label may reflect a relationship between a supplement ingredient and the possibility of reducing the risk for a medical issue or a disease.

In a structure/function claim, a manufacturer may state how their product would possibly affect the body, but the statement cannot mention any specific medical problem. Products are also required to have a disclaimer that reads, “This statement has not been evaluated by the FDA. This product is not intended to diagnose, treat, cure, or prevent any disease.”¹

Consumers are often drawn to products that are advertised as “natural,” because as they equate the term natural with being healthier and safer. However, this assumption is not correct: a variety of adverse side effects have been reported related to the chemical makeup of products. In addition, some ingredients contained in a product may not be listed on the label, and some products may contain contaminants. How the product is used or consumed, the amount consumed, and the health status of the individual using it are other factors that influence tolerance. The amount and effect of a product ingredient can be dramatically different when consumed as a tea rather than as an extract. Common side effects that have been reported with use of these products include diarrhea, dehydration, nausea, vomiting, electrolyte alterations, cardiac arrhythmias, and liver damage.⁸

Reportedly, the FDA completes approximately 500 inspections of dietary supplements annually.⁹ Products are generally recalled if

they are found to be contaminated with medications, microbes, pesticides, and/or heavy metals.^{1,9} Information regarding products tainted with contaminants can be found in the [FDA's Health Fraud Product Database](#).¹⁰ Recalls occur also when product manufacturers make inaccurate claims and/or the product does not contain what the label states regarding amounts (e.g., they may contain too little or too much of a particular ingredient).

An additional concern is that more than 180 dietary supplements can alter the efficacy of a variety of prescribed medications (see Potential Medication-Supplement Interactions text box). For example, herbal supplements such as St. John's wort can reduce the efficacy of several drugs, including medications for heart disease, depression, HIV/AIDs, and birth control, to name a few.¹¹ Prior to surgery, a variety of dietary supplements should be discontinued, including commonly used products such as turmeric, vitamin E, fish oils, and melatonin because these increase the risk for bleeding. A [more in-depth list](#) is available from UCLA Health.¹²

Potential Medication-Supplement Interactions

- **Anticoagulants:** anise, dong quai
- **Antiplatelet aggregation properties:** fish oil, garlic, vitamin E, ginkgo
- **Altered drug clearance** (cytochrome P450 enzyme activation): St. John's wort, American ginseng
- **Alterations in blood glucose levels:**

ginseng, cinnamon, nopal¹¹

The FDA's [Dietary Supplement Ingredient Directory](#) provides information regarding safety concerns about components found in various supplements.¹³ The text box titled "Herbal Supplements that Should Be Avoided or Used with Caution" reflects current recommendations for avoiding or cautiously using various products.^{11,13}

Herbal Supplements that Should Be Avoided or Used With Caution

- Chaparral (avoid)
- Comfrey (avoid)
- Ephedrine alkaloids (avoid)
- Kava kava (avoid)
- LI-tryptophan (caution)
- Lobelia (avoid)
- Red rice yeast (caution)

- St. John's wort (caution)
- Willow bark (caution)
- Yohimbe (avoid)^{11,13}

WHEN TO CONSIDER SUPPLEMENTATION

Consideration for recommending dietary supplements is often required when working with populations at high risk for developing deficiencies. Malnourished patients also often require supplementation to correct deficiencies that are present. Furthermore, individuals who might be considered in overall general good health may present with deficiencies that require supplementation. For example, a healthy individual may be diagnosed with megaloblastic anemia due to a vitamin B₁₂ deficiency after taking a medication such as a proton-pump inhibitor (PPI) for many years, because PPIs reduce B₁₂ absorption.

The "Populations at Risk for Developing Nutrient Deficiencies" text box illustrates additional populations at risk for developing nutrient deficiencies where supplementation may be beneficial.

Populations at Risk for Developing Nutrient Deficiencies

- Chronic illness
- Individuals consuming <1,200 **calories** per day
- Individuals with inadequate dietary intake or have increased requirements
- Individuals who are pregnant, planning pregnancy, or lactating
- Malabsorptive conditions
- Poor lifestyle (e.g., abusing alcohol and drugs)
- Taking medications associated with drug-nutrient interactions

Completing a comprehensive nutrition assessment is essential for identifying individuals who have or are at high risk for developing nutritional deficiencies that may warrant need for supplementation (see Steps in Completing a Comprehensive Nutrition Assessment text box). Additionally, a nutrition-focused physical exam can help clinicians detect signs of deficiencies if they are present. Evaluating past medical history, current health status, and prescribed medication use provides more data for risk assessment.

Risk for a deficiency based on health status as well as risk for harm if using a supplement is also paramount when evaluating

and recommending supplements. For example, **probiotics** have generally been found to be safe when used by healthy individuals but have also been associated with adverse effects in patients requiring critical care.¹⁴ In addition to eliciting use of prescribed medications, use of all dietary supplements and rationale for use should be obtained. Laboratory data can also be used for confirming if deficiencies are present.

Steps in Completing a Comprehensive Nutrition Assessment

- Assess anthropometric measurements (e.g., height, weight, body composition).
- Assess biochemical data.
- Assess past medical history and current health status.
- Assess nutrition intake (including current dietary intake, food preferences, allergies).
- Assess ability to purchase and prepare food.
- Assess current living environment (e.g., living alone, residing in a retirement community or long-term care facility).
- Complete a nutrition-focused physical exam (observe for macro- and micronutrient deficiencies).

Lastly, completing a thorough evaluation of dietary intake—including eliciting food preferences, allergies, and intolerances—is essential when completing a risk assessment. The ability to purchase and prepare meals provides additional details related to the possibility of developing deficiencies. Moreover, assessing dietary intake in addition to supplement use is necessary to evaluate whether individuals are consuming too little or too much of specific nutrients. Consumers often do not consider that intake of fortified foods in addition to supplement use can result in overconsumption of various nutrients. Although this usually is not a concern, toxic levels of certain vitamins (e.g., pyridoxine [B₆]) can lead to adverse outcomes. Table 6.1 provides details regarding commonly used supplements, doses, and additional information that should be considered.

Table 6.1. Commonly Used Supplements¹¹⁻⁴³

	Conditions that may warrant supplementation	Dose	M
Vitamins			
Thiamin (vitamin B ₁)	Congestive heart failure, alcohol abuse, malabsorptive disorders, persistent nausea and vomiting	100-500 mg/d	D c c i a c
Riboflavin (vitamin B ₂)	Migraine headaches, vegan diet, individuals with lactose intolerance	400 mg/d for migraines; RDA for age and sex	D
Niacin (vitamin B ₃)	Therapeutic doses prescribed to reduce serum cholesterol levels	>500-2,000 mg/d with medical supervision	A f h li

<p>Folate (vitamin B₉)</p>	<p>Female individuals of childbearing age, alcohol abuse, megaloblastic anemia, malabsorptive disorders, and cognitive disorders</p>	<p>Women of childbearing age: 400-800 mcg/d See RDA for age and sex 1 mg/d for individuals with an alcohol dependence</p>	<p>T s c v s s s r r a f c s</p>
<p>Vitamin B₁₂</p>	<p>Megaloblastic anemia, medications, bariatric surgery, ostomies, and cognitive disorders</p>	<p>1,000 mcg/d orally or intramuscularly to correct deficiency</p>	<p>T s c v s</p>

Vitamin C	Smokers, wound healing, and colds	Smokers: ≥ 30 mg/d; individuals with wounds: 500 mg/d	P i a
Vitamin D	Vitamin D deficiency, malabsorptive syndromes, end-stage renal and liver diseases, limited sun exposure, individuals with darker skin, obesity, malnutrition, some medications and chemotherapy agents	Varies based on vitamin D status; RDA based on age and sex; 50,000 IU/week for 6 weeks when levels < than normal limits	T r l 2 v t v r s
Vitamin E	NAFLD	800 IU/d for NAFLD	D r r c

Minerals		
Calcium	Bone health, and may reduce the risk for colorectal cancers or colon adenomas	Achieve RDA for age and sex through oral and/or supplementation

Iron	Microcytic anemia, pregnancy, medications, and bariatric surgery	Varies: prenatal supplements generally contain about 30 mg of elemental iron; for microcytic iron deficiency: 60 mg of elemental iron taken 3 times/d is recommended	S i a h
Magnesium	Constipation, improves glucose control, migraines, refeeding syndrome and malnutrition, alcohol abuse, and malabsorptive disorders	400 mg/d; 600 mg/d for migraines	S n t r c i f f

<p>Zinc</p>	<p>Wound healing, dysgeusia, malabsorptive disorders, vegan diet, and alcohol abuse</p>	<p><50 mg/d elemental zinc</p>	<p>S > le c c c r i a a c i z</p>
<p>Botanicals</p>			

Cinnamon	Lower blood glucose level in type 2 diabetes and prediabetes; has anti-inflammatory benefits	1-2 tsp/d	C r o c h i c o r c
Ginger	Reduce pain related to dysmenorrhea and osteoarthritis; may reduce nausea and vomiting during pregnancy	0.5-3 g/d	M a a r

Red yeast rice	Reduce serum cholesterol levels	600 mg twice daily	C n a i s a i c c l e n r
Resveratrol	Prevent cognitive decline, reduce glucose levels and blood pressure, reduce osteoarthritis and rheumatoid arthritis	250-1,000 mg/d	S l a b

Turmeric	NAFLD, inflammation, depression, and severe oral mucositis	1.5 g/d	E a e p a p n i n n a a a i v t
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Other supplements

Protein powders	Increase and meet protein needs	Varies	V b h t p s i n i a 3 c
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Probiotics	Antibiotic-associated diarrhea, bloating, constipation, and IBS	Varies, but products with 1 billion CFU containing species of <i>Lactobacillus</i> and <i>Bifidobacterium</i> typically are recommended	M b c i a c r c t a b p r c p
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Apple cider vinegar	Reduce blood glucose levels and weight loss	1 tbsp/d	F p g c v v r h l r r l r p
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Omega-3 fatty acids	Reduce risk for heart disease, hypertriglyceridemia, dementia, rheumatoid arthritis, inflammatory bowel disease	1-4 g/d	V t c r r c c t p v s v f l
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*Abbreviations: CFU, colony-forming unit; d= day; DHA = docosahexaenoic acid; EPA = eicosapentaenoic acid; g = gram; HDL = high-density lipoprotein; IBS = irritable bowel syndrome; ICU = intensive care unit; IU = international units; mcg = microgram; mg = milligram; NAFLD, nonalcoholic fatty liver disease; RDA = Recommended Daily Allowance; tbsp = table-
teaspoon; UL = Tolerable Upper Intake Level; VITAL = Vitamin and Omega-3 Trial.*

As discussed in [chapter 5 on micronutrients](#), several guidelines are

available to help determine if nutrient intake is adequate to avoid developing a deficiency. The Dietary Reference Intake values are reference standards to use for evaluating adequacy of intake and need for dietary supplementation to fill identified gaps.

Efficacy

Supplements can play a role in helping consumers achieve adequacy of intake for various nutrients when intake is insufficient or when food dislikes, allergies, and/or intolerances result in avoidance of particular foods or food groups. For example, adequate vitamin D intake is difficult to achieve because foods other than dairy products tend to have low levels. Supplementation can promote optimal serum levels when dietary intake and sun exposure are missing. Furthermore, individuals with compromised hepatic and renal function are unable to activate vitamin D and so require supplementation. Vitamin D is considered a hormone in addition to being classified as a vitamin, because it is associated with a number of pleiotropic benefits in the body, including promoting healthy skeletal mass, heart health, and overall good health.¹⁵

Other supplements are commonly recommended to avoid deleterious outcomes, such as neural tube defects. Pregnancy and planning for pregnancy often include recommendations for taking supplements with folic acid to avoid neural tube defects developing in babies. Additionally, supplements containing a combination of vitamins C and E, copper, zinc, lutein, and zeaxanthin may slow vision loss in adults with age-related macular degeneration.¹⁶

Individuals with conditions that reduce the availability or absorption of various micronutrients, including use of certain prescription medications (e.g., PPIs), resections of the gastrointestinal tract (e.g., ileal resections, bariatric surgery), or specific issues with organ function (e.g., kidney dialysis) may also

benefit from use of certain supplements to avoid developing deficiencies.

Efficacy can be difficult to determine, particularly in available botanical supplements. Difficulty arises when trying to identify plant parts and/or the active component contained in the plant when the active ingredient isn't known. Quality control and standardization of products are difficult because the makeup of plants varies worldwide. Botanicals can be used as infusions, tinctures or extracts, teas, creams, drinks, tablets, and in powder form. In the United States, there are no requirements or laws that products be standardized, which makes comparing products challenging.

Scientific evidence, the foundation for evidence-based practice, related to dietary supplements is often changing and challenging to discern, for many reasons. It can be difficult to make recommendations because information is often not available, available information is from small studies, evidence is from poorly designed and poorly controlled studies, research is conflicting, the funding source may influence study reporting, and/or standards are lacking to guide dosage and use.

PROVIDING GUIDANCE FOR USING DIETARY SUPPLEMENTS

When providing counseling and suggestions for using dietary supplements, several factors should be considered: Are dietary supplements safe? Which are the best? Are they effective? Is the individual likely to be compliant with taking the supplement?

Counsel individuals that following the guidelines for a healthy lifestyle, including consumption of a well-balanced diet and regular physical activity, is still necessary even when taking supplements. Supplements do not generally provide a variety of **phytonutrients** or fiber, which are necessary dietary components associated with health and wellness. Additional recommendations when

considering the need for supplements are outlined in the “Recommendations to Consider When Recommending Supplements” text box.

What to Consider When Recommending Supplements

- Review the literature for therapeutic efficacy and potential adverse effects.
- Are there gender sex differences for dosage?
- Consider convenience: is taking the supplement with food required?
- Consider supplement forms available (e.g., capsule, tablet, liquid, powder) for optimal patient compliance.
- Consider the cost.
- Consider the ratio of benefit to potential harm.
- Consider tolerance issues that may arise.
- Evaluate if medication-supplement interactions might occur.
- Evaluate in context of estimated dietary intake.

When recommending a supplement, it is important to consider if

it has been tested via a nonprofit third party with an accredited laboratory. Products with the US Pharmacopeia (USP) or NSF designation have been verified for quality, including that they don't contain contaminants or toxins, meet the FDA's GMPs, and can be digested and absorbed in a given time. Health-care professionals should also be aware if any safety recommendations have been issued by agencies, such as the FDA.

Reassessment of need for continued supplementation is warranted to determine if deficiencies have been corrected and to avoid overconsumption. For example, high doses of vitamin D are often prescribed with hypovitaminosis D. However, high-dose supplementation is often only recommended for established safe periods of time. Once levels are repleted, lower doses are generally needed to maintain status. See [chapter 5 \(Micronutrients\)](#) regarding doses to facilitate repletion when deficiencies are diagnosed.

Lastly, the Online Resources text box lists resources, available for health-care providers and consumers, that provide information on various supplements pertaining to clinical evidence, possible side effects, and doses. Resources such as the NATMED PRO database, the German E Commission, and Memorial Sloan Kettering Cancer Center provide essential information for clinicians regarding popular reasons to use various supplements, their clinical relevance, clinical evidence, side effects, and interactions with medications.

Online Resources

- [About Herbs, Botanicals & Other Products](#) (Memorial Sloan Kettering Cancer Center)
- [ConsumerLab.com](#) (*some content available only through paid membership*)
- [Dietary Supplements](#) (FDA)
- [Dietary Supplements: What You Need to Know](#) (National Institutes of Health's Office of Dietary Supplements)
- [German Commission E monographs](#) (American Botanical Council)
- [NatMed Pro database](#) (*subscription required; check your library*)
- [Resources for Health Care Providers](#) (National Institutes of Health's National Center for Complementary and Integrative Health)

SUMMARY

Dietary supplements are used by millions of adults in the United States, and the supplement market is ever growing and generating billions of dollars. Supplements have become a global enterprise, with ingredients and products coming from a variety of countries

worldwide. Hence, safety concerns abound, due to lack of oversight and regulation.

Consumers and health-care providers should be knowledgeable and aware of potential benefits and risks associated with use before purchasing and consuming supplements. Dietary approaches should be the foundation for obtaining the necessary nutrients for overall health and wellness, with supplementation supporting dietary intake and considered only when gaps exist for individuals at an increased risk for developing a deficiency or when deficiencies have been diagnosed.

Check your understanding of this chapter with these 2 interactive activities:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=671#h5p-57>



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=671#h5p-56>

Key Takeaways

- Supplements can be considered to meet nutritional needs.
- Supplements may be effectively used for some medical conditions instead of drugs.
- Manufacturers are not required to demonstrate safety of products before offering them in the marketplace.
- Consumers should be counseled to use a whole-foods approach for health and wellness; supplements are meant to “supplement” the diet, not be a substitute.
- Fiber, carotenoids, phenols, flavonoids, or other phytonutrients often are not included in supplements.

REFERENCES

1. US Food and Drug Administration. Questions and answers on dietary supplements. Updated February 2, 2024. Accessed December 20, 2024. <https://www.fda.gov/food/information-consumers-using-dietary-supplements/questions-and-answers-dietary-supplements>
2. Zion Market Research. Global dietary supplements market will reach USD 220.3 billion in 2022: Zion Market Research. January 11, 2017. Accessed November 1, 2024. <https://globenewswire.com/news-release/2017/01/11/905073/0/en/Global-Dietary-Supplements-Market-will-reach-USD-220-3-Billion-in-2022-Zion-Market-Research.html>.
3. Mishra S, Stierman B, Gahche JJ, Potischman N. Dietary

- supplement use among adults: United States, 2017-2018. *NCHS Data Brief*. 2021;(399):1–8.
4. US Food and Drug Administration. FDA 101: dietary supplements. Updated June 2, 2022. Accessed July 1, 2023. <https://www.fda.gov/consumers/consumer-updates/fda-101-dietary-supplements#:~:text=If%20a%20product%20is%20found,dangerous%20product%20from%20the%20market>
 5. US Food and Drug Administration. Current Good Manufacturing Practice (CGMP) regulations. Updated May 19, 2023. Accessed July 1, 2023. <https://www.fda.gov/drugs/pharmaceutical-quality-resources/current-good-manufacturing-practice-cgmp-regulations>
 6. Austin SB, Yu K, Liu SH, Dong F, Tefft N. Household expenditures on dietary supplements sold for weight loss, muscle building, and sexual function: disproportionate burden by gender and income. *Prev Med Rep*. 2017; 6;236–241. doi: 10.1016/j.pmedr.2017.03.016
 7. US Food and Drug Administration. Tainted products marketed as dietary supplements. Updated May 18, 2020. Accessed November 2, 2024. <https://www.fda.gov/about-fda/fda-pharmacy-student-experiential-program/tainted-products-marketed-dietary-supplements>
 8. National Institutes of Health Office of Dietary Supplements. Dietary supplements: what you need to know. Updated January 4, 2023. Accessed June 28, 2023. <https://ods.od.nih.gov/factsheets/WYNTK-Consumer/>
 9. Long J. FDA audits climb in FY 2022 for dietary supplement facilities. 2022. Accessed June 30, 2023. <https://www.naturalproductsinsider.com/regulatory/fda-audits-climb-fy22-dietary-supplement-facilities>
 10. US Food and Drug Administration. Health Fraud Product

Database. Updated April 14, 2023. Accessed June 30, 2023. <https://www.fda.gov/consumers/health-fraud-scams/health-fraud-product-database>

11. Asher GN, Corbett AH, Hawke RL. Common herbal dietary supplement-drug interactions. *Am Fam Physician*. 2017;96(2):101–107.
12. Plastic surgery: medications to avoid before surgery. UCLA Health System. Accessed June 30, 2023. <https://www.uclahealth.org/medical-services/surgery/plastic-surgery/patient-resources/medications-avoid-before-surgery>
13. US Food and Drug Administration. Information on select dietary supplement ingredients and other substances. Reviewed May 16, 2024. Accessed November 2, 2024. <https://www.fda.gov/food/dietary-supplements/information-select-dietary-supplement-ingredients-and-other-substances>
14. Johnstone J, Meade M, Lauzier F, et al.; Prevention of Severe Pneumonia and Endotracheal Colonization Trial (PROSPECT) investigators and the Canadian Critical Care Trials group. Effect of probiotics on incident ventilator-associated pneumonia in critically ill patients: a randomized clinical trial. *JAMA*. 2021;326(11):1024–1033. doi: 10.1001/jama.2021.13355
15. National Institutes of Health Office of Dietary Supplements. Vitamin D. Updated July 26, 2024. Accessed November 2, 2024. <https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/>
16. Chew EY, Clemons TE, Agron E, et al. Long-term outcomes of adding lutein/zeaxanthin and omega-3 fatty acids to the AREDS supplements on age-related macular degeneration progression: AREDS2 Report. *JAMA*

- Ophthalmol.* 2022;140(7):692–698. doi: 10.1001/jamaophthalmol.2022.1640
17. Drake VJ. Thiamin. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated July 2021. Accessed May 13, 2023. <https://lpi.oregonstate.edu/mic/vitamins/thiamin>
 18. Drake VJ. Riboflavin. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated August 2021. Accessed May 13, 2023. <https://lpi.oregonstate.edu/mic/vitamins/riboflavin>
 19. Delage B. Niacin. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated December 2017. Accessed June 21, 2023. <https://lpi.oregonstate.edu/mic/vitamins/niacin>.
 20. Drake VJ. Folate. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated October 2023. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/vitamins/folate>
 21. Drake VJ. Vitamin B₁₂. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated October 2023. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-B12>
 22. Delage B. Vitamin C. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated July 2018. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-C>
 23. Delage B. Vitamin D. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated July 2017. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/vitamins/vitamin-D>
 24. Lonn E, Bosch J, Yusuf S, et al. HOPE and HOPE-TOO Trial

- Investigators. Effects of long-term vitamin E supplementation on cardiovascular events and cancer: a randomized controlled trial. *JAMA*. 2005;293(11):1338–1347. doi:10.1001/jama.293.11.1338
25. Jha P, Flather M, Lonn E, Farkouh M, Yusuf S. The antioxidant vitamins and cardiovascular disease: a critical review of epidemiologic and clinical trial data. *Ann Intern Med*. 1995;123:860–872. doi:10.7326/0003-4819-123-11-199512010-00009
 26. Klein EA, Thompson IM Jr, Tangen CM, et al. Vitamin E and the risk of prostate cancer: the Selenium and Vitamin E Cancer Prevention Trial (SELECT). *JAMA*. 2011;306(14):1549–1556. doi:10.1001/jama.2011.1437
 27. Delage B. Calcium. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated May 2017. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/minerals/calcium>
 28. Lopez-Caleya JF, Ortega-Valín L, Fernández-Villa T, Delgado-Rodríguez M, Martín-Sánchez V, Molina AJ. The role of calcium and vitamin D dietary intake on risk of colorectal cancer: systematic review and meta-analysis of case-control studies. *Cancer Causes Control*. 2022;33(2):167–182. doi:10.1007/s10552-021-01512-3
 29. Delage B. Iron. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated April 2016. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/minerals/iron>
 30. Volpe SL. Magnesium. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated November 2018. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/minerals/magnesium>
 31. Institute of Medicine Panel on Micronutrients. Chapter 12.

Zinc. Dietary Reference Intakes for Vitamin A, Vitamin K, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. National Academies Press; 2001:442–501.

32. Deyno, S, Eneyew, K, Seyfe S, et al. Efficacy and safety of cinnamon in type 2 diabetes mellitus and pre-diabetes patients: a meta-analysis and meta-regression. *Diabetes Res Clin Pract.* 2019;156:107815. doi:10.1016/j.diabres.2019.107815
33. Kizilaslan N, Erdem NZ. The effect of different amounts of cinnamon consumption on blood glucose in healthy adult individuals. *Int J Food Sci.* 2019;2019:4138534. doi:10.1155/2019/4138534
34. NatMedPro. Ginger. Updated June 29, 2023. Accessed July 10, 2023. <https://naturalmedicines-therapeuticresearch-com.ezproxy4.library.arizona.edu/databases/food,-herbs-supplements/professional.aspx?productid=961>
35. Tavan A, Noroozi S, Zamiri B, et al. Evaluation the effects of red yeast rice in combination with statin on lipid profile and inflammatory indices; a randomized clinical trial. *BMC Nutr.* 2022;8(1):138. doi:10.1186/s40795-022-00639-z
36. Zhou DD, Luo M, Huang SY, Effects and mechanisms of resveratrol on aging and age-related diseases. *Oxid Med Cell Longev.* 2021;2021:9932218. doi:10.1155/2021/9932218
37. Delage B. Curcumin. Oregon State University, Linus Pauling Institute, Micronutrient Information Center. Updated February 2016. Accessed November 2, 2024. <https://lpi.oregonstate.edu/mic/dietary-factors/phytochemicals/curcumin>
38. Nichele S, Phillips SM, Boaventura BCB. Plant-based food patterns to stimulate muscle protein synthesis and

- support muscle mass in humans: a narrative review. *Appl Physiol Nutr Metab*. 2022;47(7):700–710. doi:10.1139/apnm-2021-0806
39. Hill C, Guarner F, Reid G, et al. The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. *Nat Rev Gastroenterol Hepatol*. 2014;11:506–514. doi: 10.1038/nrgastro.2014.66
 40. Jafarnejad S, Shab-Bidar S, Speakman JR, Parastui K, Daneshi-Maskooni M, Djafarian K. Probiotics reduce the risk of antibiotic-associated diarrhea in adults (18-64 years) but not the elderly (>65 years): a meta-analysis. *Nutr Clin Pract*. 2016;31:502–513. doi:10.1177/0884533616639399
 41. Hadi A, Pourmasoumi M, Najafgholizadeh A, Clark CCT, Esmailzadeh A. The effect of apple cider vinegar on lipid profiles and glycemic parameters: a systematic review and meta-analysis of randomized clinical trials. *BMC Complement Med Ther*. 2021;21(1):179. doi:10.1186/s12906-021-03351-w
 42. Skulas-Ray AC, Wilson PWF, Harris WS, et al. Omega-3 fatty acids for the management of hypertriglyceridemia: a science advisory from the American Heart Association. *Circulation*. 2019;140(12) e673–e691. doi:10.1161/CIR.0000000000000709
 43. Manson JE, Cook NR, Lee IM, et al. VITAL Research Group. Marine n-3 fatty acids and prevention of cardiovascular disease and cancer. *N Engl J Med*. 2019;380(1):23–32. doi:10.1056/NEJMoa1811403

Chapter 7: Bioactive Compounds

By Amy A. Drescher, PhD, RDN

INTRODUCTION

Bioactive compounds are nonessential biomolecules present in foods, spices, and beverages that can influence metabolic processes and promote health but are not required for growth. Phytochemicals, also called **phytonutrients**, include **polyphenols**, **terpenes**, and **organosulfur compounds** that give fruits and vegetables their distinct flavors, odors, and colors, which is why “eat a colorful” diet is practical advice aimed at ensuring the consumption of a range of bioactive compounds.^{1,2}

There are likely many more as-yet unidentified phytochemicals in food. Other important bioactive components in foods include **probiotics**, **omega-3 fatty acids**, **isoflavones**, **sterols**, and **stanols**.

The potential benefits of various diet patterns are discussed in [chapter 8](#). Although culinary medicine seeks to promote a healthy eating pattern and does not necessarily promote 1 diet over another, the Dietary Approaches to Stop Hypertension (DASH) diet and Mediterranean diet have emerged as examples of eating patterns with multiple benefits for health promotion, disease prevention, and treatment.³ It has been hypothesized that the presence of multiple bioactive compounds in these diet patterns

may be playing key roles mechanistically in the numerous health benefits that have been demonstrated.

Bioactive compounds have multiple mechanisms of action, often acting synergistically to promote health effects. Any diet that promotes a variety of nutrient-rich whole foods should provide a wide range of bioactive compounds, although bioavailability does vary among plant varieties and can be affected by farming practices and food preparation techniques.¹

Differences among individuals—including hereditary factors, past medical history, and lifestyle habits—can further affect how bioactive components are absorbed and metabolized and, ultimately, how they exert their effects within the body. Culinary medicine encourages diets inclusive of bioactive compounds that create overall nutritious eating patterns with a focus on preventing diet-sensitive disease.

BIOACTIVE COMPOUNDS

You're likely familiar with the term "superfoods," which identifies nutritious foods highly regarded for their positive impact on health. You may have experimented with integrating more of these foods into your diet. Supermarkets stock their shelves with the latest superfoods, and restaurants, recipe developers, and social media influencers also promote the latest superfood trends.

Have you wondered if there is scientific support behind the hype? Although the popularity of so-called superfoods can partly be attributed to effective marketing by skilled influencers, the public's tendency to seek out the latest nutrition quick fixes and easy answers to complex health questions is also at play. Most experts would likely agree that the concept of superfoods has been overhyped; however, it turns out that the concept is not entirely without scientific merit. However, it is important to recognize that there are many health-promoting foods to choose from, regardless of whether they are labeled a superfood.

What makes a food earn the title of “super”? Even though there isn’t a standardized, scientific definition of the term superfood, there is an entry for it in the *Merriam-Webster Dictionary* describing a superfood as rich in compounds considered beneficial to a person’s health.⁴ Nutrition experts refer to these health-promoting compounds as bioactive compounds, or secondary metabolites (see Table 7.1).¹

Some of the most impactful bioactive compounds come from the more than 5,000 identified phytonutrients that have been discovered in plants.² However, it’s believed that there are many more phytochemicals yet to be identified.²

Types of Bioactive Compounds

Some of the most well-researched bioactive compounds are phytonutrients, including polyphenols, **carotenoids**, terpenes, and organosulfur compounds. Other examples of bioactive compounds in food include omega-3 fatty acids, **fibers**, prebiotics, probiotics, sterols, and stanols (see Table 7.1). This chapter explores some of the major bioactive compounds identified in the foods we eat, highlights some of the scientific evidence of their potential health benefits, and discusses applications in culinary medicine.

Table 7.1. Bioactive Compounds

Bioactive food component	Food sources	Health benefits
Phytoestrogens	Soybeans, flaxseeds, oats, beans, lentils, apples, barley	Help manage menopausal symptoms, bone health, cardiovascular health, cancer prevention ⁵⁻¹⁰
Polyphenols	Green tea, berries, cocoa, red wine, beans, nuts, vegetables, grains, herbs, fruits, potato, turmeric, ginger, olive oil	Antioxidant properties, anti-inflammatory effects, protect against cancer, stroke, diabetes Alzheimer's disease, and cardiovascular diseases. ¹¹⁻¹⁶

Prebiotics	Fruits, vegetables, whole grains, legumes, garlic, onions, leeks, cocoa	Provide fuel for beneficial bacteria in the gut. Indigestible carbohydrates , soluble fibers, and resistant starches in plant-based foods increase probiotic bacteria populations. ¹⁷⁻¹⁹
Probiotics	Yogurt, kefir, fermented foods (e.g., miso, kimchi)	Improve gut health, enhance immune function, potential mental health benefits, metabolism improvements ²⁰⁻²²

Carotenoids	Yellow, orange, and red fruits and vegetables, leafy greens, herbs, carrots, melons, tomatoes	Promote eye health, antioxidant properties, prevent cancer ²³⁻²⁶
Omega-3 fatty acids	Fatty fish (e.g., salmon, mackerel), chia seeds, flaxseeds, enriched eggs	Cardiovascular support, brain health, relief from dry eye symptoms, help manage rheumatoid arthritis ²⁷⁻²⁹

Terpenes	Citrus fruits, herbs and spices, cannabis	Anti-inflammatory, potential anticancer properties ^{23,26}
Sterols and stanols	Nuts, seeds, vegetable oils	Lowers cholesterol levels, immune-enhancing properties, anticancer ^{1,2,10,30,31}
Sulfur compounds	Garlic, onions, cruciferous vegetables	Antioxidant properties, potential anticancer effects, immune-enhancing properties, blood pressure regulation ^{7,32}

Over the past century, nutrition scientists have continued to investigate and debate what defines a healthy diet. In the past 25 years, the DASH and Mediterranean diets and their variations (see [chapter 8](#)) have emerged as examples of eating patterns that are beneficial in multiple areas of health and disease prevention and treatment.

Research has focused on the underlying mechanisms of these dietary patterns, which include lipid-lowering, anti-inflammatory, and metabolic effects on the gut **microbiota**. The DASH and Mediterranean diet patterns are based on a variety of nutrient-rich whole foods and reduction of more highly processed foods, simple sugars, and **saturated fats**. The Mediterranean diet also emphasizes the intake of fish, olive oil, fresh herbs, and wine. It is being increasingly recognized that the multiple bioactive compounds in these diet patterns are likely a main contributing factor in the many demonstrated health benefits²

In vitro and animal studies indicate that bioactive compounds exert multiple mechanisms of action, often acting synergistically to promote health effects.^{3,33} For example, research on adding extra portions of foods rich in bioactive compounds, such as nuts and olive oil, to the Mediterranean diet have notably increased the risk reduction for cardiovascular and breast cancer compared with levels previously demonstrated.^{3,34,35}

Polyphenols

Polyphenols are naturally occurring plant phytochemicals that have health-promoting properties, including acting as a free radical scavenger and reactive oxygen species that counters oxidative damage that contributes to inflammation and associated diseases such as cancer, cardiovascular disease (CVD), and type 2 diabetes.¹² Polyphenols comprise several categories, including **flavonoids**, lignans, **stilbenes**, and phenolic acids. Each type has numerous subcategories (see Table 7.2).

Table 7.2. Polyphenol Categories and Health Benefits

Polyphenol type	Food sources	Facts and health benefits
Flavonoids	Citrus, grapes, berries, cherries, apples, currents, buckwheat, nuts, seeds, onions, broccoli, purple cabbage, blue potatoes, parsley, red peppers, mint, tea, cocoa	Two-thirds of polyphenols and most bioactive; antioxidant properties; anti-inflammatory effects; protect against cardiovascular disease (CVD), cancer, stroke, type 2 diabetes, Alzheimer's disease. ³⁶⁻³⁹

Phenolic acids	Fruits, vegetables, whole grains	Combat free radicals and protect against cancer, arthritis, autoimmune disorders, CVD, and neurodegenerative disease ⁴⁰⁻⁴³
Other polyphenols	Ginger	Health effects are mainly attributed to gingerol, a phenolic compound used for antinausea, antioxidant, and anti-inflammatory properties. ⁴⁴

Lignans	Extra-virgin olive oil, garlic, onions, vegetables, grains, fruits, seeds	Reduced risk of CVD and stroke ^{11,45}
Stilbenes	Grapes, berries, peanuts, red wine	Anti-inflammatory, promote cardiovascular health antioxidant properties ¹³

There is an extensive amount of research on individual polyphenols, but it's often unclear how it applies to habitual intakes of mixed diets. Diets rich in polyphenols are associated with a reduced risk of type 2 diabetes. Studies exploring their impact on CVD risk are ongoing, and findings have been largely positive.^{13,14}

Factors in the discrepancies include challenges common to nutrition research, including differences in methodologies, recall bias, genetic variations in metabolism, bioavailability among plant varieties, farming practices, and food preparation.² To address some of these challenges, a repository compiling science regarding polyphenolic compounds, their classifications, underlying mechanisms, and culinary implications, has been compiled into a comprehensive database called Phenol-Explorer.⁴⁶



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Flavonoids

Flavonoids account for most of the dietary phenolic compounds and are the most bioactive.³⁸⁻⁴⁰ Flavonoids can be further divided into 6 structural groups or families. Some of the most researched types include quercetin, catechins, and anthocyanins, which are present in fruits, vegetables, tea, and cocoa. The flavonoids found in berries and citrus fruits are potent antioxidants and anti-inflammatory agents, which may protect against oxidative stress, chronic inflammation, and Alzheimer's disease.³⁶⁻³⁸

Flavonoids Subtypes

- **Quercetin** is contained in fruits, especially citrus, berries, cherries, and apples, and in buckwheat, nuts, seeds, onions, broccoli, olive oil, and green tea. Exhibits a strong potential for reducing the risk of CVD and certain cancers and preventing tissue injury.^{37,39,47}



Figure 7.1. Berries are rich in flavonoids. "Berries" by PublicDomainPictures is licensed under a Pixabay License.

- **Curcumin** is contained in the spice turmeric, which has been used in Eastern medicine for centuries, curcumin has anti-inflammatory and antioxidant mechanisms still being defined. Some research findings have been positive, whereas others have been inconclusive. One theory being investigated is that differences in the gut **microbiome** profile may influence the bioavailability and pharmacological activity of curcumin.⁴⁸ It has been discovered that adding an alkaloid agent in black pepper called piperine increases bioavailability of curcumin.⁴⁹
- **Anthocyanins** are water-soluble pigments responsible for red, purple, and blue fruits and vegetables such as berries, acai, currants, grapes, purple cabbage, and blue potatoes. Anthocyanins possess antioxidant, vasorelaxation, free radical scavenging, and antimicrobial activities that improve visual and neurological health and

help prevent cancer and CVD.⁵⁰ Mild heat, such as blanching, is recommended when trying to preserve the bioactivity of foods high in anthocyanins.³⁶

- **Flavones** are considered some of the most powerful antioxidants and protect against reactive oxygen species.³⁶ Food sources include celery, parsley, red peppers, chamomile, mint, peels of citrus fruits, onions, and tea.^{12,46,51,52}

Phenolic acids

Subtypes of phenolic acids include caffeic acid and ferulic acid, which are widely distributed in fruits, vegetables, and whole grains. Health benefits of ferulic acid include the ability to combat free radicals related to oxidative damage associated with chronic diseases such as cancer, arthritis, autoimmune disorders, CVD, and neurodegenerative diseases.¹⁶

Isoflavones

Soybeans are the only commonly consumed food with a significant amount of isoflavones. There are many positive health effects from isoflavone intake, such as reduced bone loss and decreased osteoporosis risk.⁵ Soy protein intake greater than 10 g/day has been found to reduce fracture risk in postmenopausal women.⁹ Soy food intake over a lifetime is common in Japan, where women report significantly fewer menopause-related symptoms, such as hot flashes and night sweats, compared with women in countries in North America and Europe.⁶

Isoflavones have demonstrated cardiovascular benefits such as decreasing blood lipid levels, inflammation, and hypertension.⁹ Soy intake has been associated with both a reduction of breast cancer risk and risk of its recurrence.⁷⁻¹⁰ However, there may be

differences in breast cancer risk with isoflavone intake, due to genetic factors.⁸

Isoflavone Subtypes

- **Stilbenes** are phenolic compounds found in just a few plants, such as grapes, berries, and peanuts. Some health-promoting effects of stilbenes include inhibiting transcription factors involved in inflammation and inducing antioxidant enzymes.⁵³ **Resveratrol**, the most well-researched stilbene, is found primarily in grapes and red wine. It has gained considerable attention for its potential to promote cardiovascular health and longevity. Resveratrol has been associated with the so-called French paradox—the surprising lower incidence of heart disease in France despite a high intake of saturated fats.³⁹
- **Lignans** are the second most abundant polyphenol present in extra-virgin olive oil, which has been associated with reduction of risk of CVD and stroke in numerous large-scale human studies.^{11,45} Other notable lignan sources are garlic, onions, vegetables, grains, fruits, and seeds.⁴⁶

Sulfur compounds

Sulfur compounds are a group of bioactive compounds found predominantly in cruciferous vegetables, such as cabbage, **bok choy**, kale, and broccoli, and in garlic, onions, leeks, and shallots. These compounds are responsible for the characteristic pungent aroma and taste of these foods, but they also serve as antioxidants and fight inflammation, promoting cardiovascular health, enhancing aspects of immune function, and assisting in halting cancer cell development.^{32,42,54}

There are several organosulfur compounds that influence heart health, including allicin, found in garlic. Allicin promotes the production of nitric oxide in blood vessels, which helps them relax and improves blood flow to lower blood pressure and reduce the risk of hypertension.²⁴ Allicin also inhibits formation of cholesterol plaques; thus, it can reduce the risk of atherosclerosis. Allicin also has antiplatelet properties that can prevent excessive blood clotting and blockages.⁵⁵

Sulfur compounds have been associated with potential anticancer effects such as antioxidant effects and inducing **apoptosis** in cancer cells, as well as inhibiting tumor growth and spread (i.e., metastasis). Sulfur compounds may also inhibit the formation of carcinogens and act to detoxify potential carcinogens in the body.⁷

To maximize the bioactive components in sulforaphanes, meals containing raw or gently steamed cruciferous vegetables are recommended.² Sulfur compounds offer unique flavors and health-enhancing properties. It is important to note that the bioactive components of foods with organosulfur compounds are only released through cutting, chewing, or crushing, which causes activation of the compounds to their bioactive forms.³²

Research on the health benefits of garlic has revealed the benefits of using the bioactive-rich garlic skin, which is typically discarded, and informed development of newer varieties of garlic, such as purple varieties, with additional bioactive compounds that can be used in culinary medicine interventions and dishes.¹

Phytosterols and Stanols

Phytosterols are plant counterparts of cholesterol in animals.¹ The most common bioactive phytosterols are beta-sitosterol, campesterol, and stigmasterol.¹⁰ Plant stanols are similar in structure but much less common in the diet, representing approximately 10% of phytosterol dietary intake.³¹

The main food sources are nuts, seeds, unrefined plant oils, and legumes, which are sometimes referred to as pulses and beans. It is believed that early human diets were rich in phytosterols, but the typical Western diet is relatively low in these compounds.⁵² After phytosterols are absorbed in the small intestine, where they interfere with the absorption of dietary cholesterol by displacing cholesterol and by facilitating excretion of cholesterol in the feces.³⁰

There has been significant research interest in the past 20 years in using foods with supplemental phytosterols to decrease serum levels of low-density lipoprotein.³⁰ Although research on phytosterols' anti-inflammatory effects and their effects on cancer cells have shown promise in cell culture and animal studies, human research is in the preliminary stages.³¹



Figure 7.2. Nuts are a source of phytosterols. "Nuts" by ExplorerBob is licensed under a Pixabay License.

Probiotics and Prebiotics

Probiotics are a unique category of essential bioactive food components that mainly arise from various fermented foods, including yogurt, kefir, sauerkraut, and kimchi, or can be added to foods such as juices, protein bars, dairy products, cereals, and prunes (see Table 7.3). Fermentation techniques create various textures and flavors and also result in populations of beneficial bacteria that enhance the amount and diversity of intestinal bacteria that compose the microbiota.¹⁹



Figure 7.3. Yogurt is rich in probiotics. "Yogurt" by lpegasu is licensed under a Pixabay License.

Prebiotics are indigestible carbohydrates (types of dietary fiber) that are fermented in the colon and stimulate the growth or activity of specific types of beneficial bacteria.^{17-19,21} Dietary fibers in foods cannot be digested by human enzymes, but they can serve as fuel for gut bacteria and lead to both improvements in nutrient absorption and enhancement of the bacterial environment in the gut.¹⁸ Food sources of prebiotics include cocoa, garlic, onions, leeks, whole grains, seeds, nuts, pulses, and other fruits and vegetables.^{19,21} Much is still being investigated about the role and mechanism of prebiotics before specific recommendations can be made.

The diversity and balance of the gut microbiota play a crucial role in digestive function and general health.¹⁹ The human microbiota consists of 10 trillion to 100 trillion symbiotic cells.¹⁷ Microbiome projects worldwide are researching the roles these bacteria may have in maintaining health and well-being.

Although much of the research is focused on individual strains

of bacteria given as supplements, foods can potentially provide a variety of live cultures, and there is some evidence they survive digestion.^{21,56} However, there remain many questions about the ability to change the microbiota, and research is ongoing. One of the most researched uses of probiotics is to help promote gut health by decreasing unpleasant gastrointestinal symptoms such as diarrhea.²² An emerging area of probiotic research is the potential to enhance nutrient production. Certain probiotics can produce B vitamins and short-chain fatty acids, which have numerous health benefits, such as enhancing intestinal energy metabolism, homeostasis, and intestinal barrier function.¹⁸ This suggests a role for probiotics to contribute to the nutrient pools in the body.

Research is ongoing, with topics related to the interrelationships between the gut microbiome and the gastrointestinal tract, the immune system, neurological systems, and brain through various signaling systems.¹⁹ Disturbances of the microbiota are being investigated to determine if there are potential relationships between neurological, mental health, and gastrointestinal disorders. Probiotics also help prevent the overgrowth of pathogenic species and maintain a healthy balance in the microbial environment of the gut.²⁰ This becomes especially relevant when antibiotic treatments are used, because they can impair the diversity of the gut bacteria.¹⁷

Current research is examining relationships between probiotic intake and gut and mental well-being, known as the gut-brain axis (Figure 7.4). Data suggest that probiotics affect mental health by modulating the gut microbiota and producing neurotransmitters and metabolites that favorably influence brain function.¹⁷ Some studies have suggested probiotics have a role in mood enhancement, reduction of depression symptoms, improved anxiety, and cognitive abilities.¹⁹

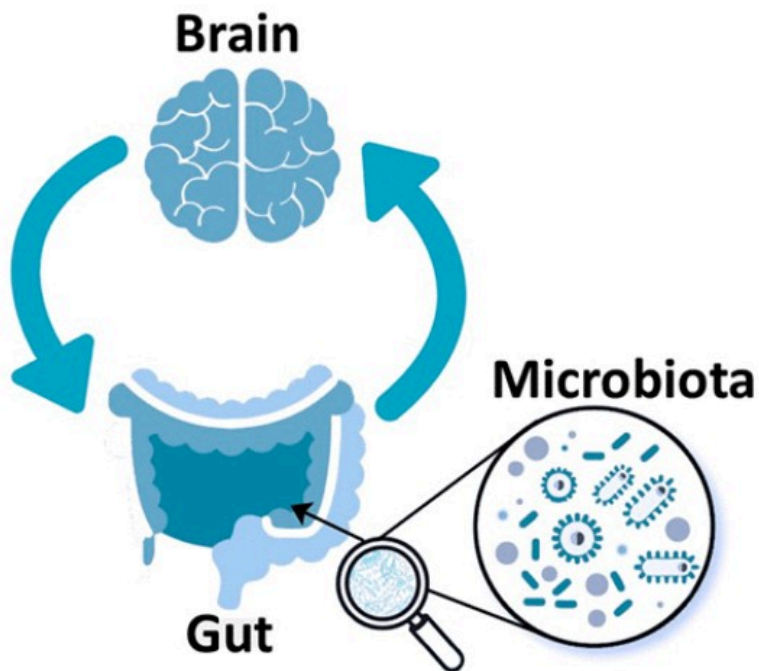


Figure 7.4. The interrelationship of the gut microbiota and the brain. "Gut-Brain Axis," published in ACS Chemical Neuroscience, is licensed CC BY 4.0.

Table 7.3. Probiotic Food Sources

Probiotic food source	Definition	Probiotic-related health benefits
Yogurt, Greek yogurt	Varied amounts of minimum of 100 million CFU to have a Live and Active Cultures Seal	<p>Varied number of beneficial bacteria (<i>Lactobacillus bulgaris</i> and <i>Streptococcus thermophiles</i> are required, and others may also be present).⁵⁶</p> <p>May benefit transit time, immune function, and lactose intolerance.²²</p>

Kefir	Made from fermented milk and either kefir starter cultures, kefir grains, a variety of lactic acid-producing bacteria, acetic acid bacteria-producing, and yeasts containing up to 20 billion CFU ⁵⁹	Well tolerated by those with lactose intolerance. ⁵⁶ Some evidence of benefit in cases of constipation and flatulence, complementing treatment for <i>Helicobacter pylori</i> infection. ²² More evidence is needed on the impact on gastrointestinal disorders and microbiome of humans.
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Miso	Traditional Japanese fermented soybean paste with bacteria	Limited high-quality human data. Cancer prevention evidence, but confounding factor is isoflavone content. ²²
Tempeh	Indonesian food made with boiled and dehulled soybeans with a fungal starter	Limited high-quality human data. One small open trial demonstrated increased stool bacteria diversity, suggesting microbiome change. ²²

Kimchi	Korean fermented cabbage (fermented either naturally or with a starter)	Limited high-quality human data. Some ongoing research on gut microbiota targeting cancer risk. Results suggest benefits to microbiota and inconclusive results for cancer risk. ²²
Kombucha	Fermented tea; originated in China using symbiotic culture of bacteria and yeast	Limited high-quality human data despite wide popularity

Sauerkraut	Fermented cabbage	Some human trials showing modest improvement in irritable bowel syndrome (IBS) severity, but without demonstrating a significant change in the microbiome ²²
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Natto	Traditional Japanese dish consisting of yellow soybeans fermented with <i>Bacillus subtilis</i>	Limited high-quality human data. A natto study with miso soup demonstrated increased stool frequency and increased beneficial stool bacteria and decreased pathogenic bacteria. ²²
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Sourdough bread	Made with sourdough starter with many types of lactic acid and yeasts	Limited high-quality human data. Preliminary data suggest sourdough bread helped manage gastrointestinal symptoms in IBS compared with regular bread. ²²
<i>Abbreviations: CFU = colony-forming unit</i>		



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Omega-3 Fatty Acids

Our diets contain a mixture of lipids with fatty acids (FAs) as their fundamental building blocks. The fate of FAs in the diet includes using them for energy production, storage in adipose tissue, or integration into other lipid species such as phospholipids, which form the major structural components of cellular membranes.⁵⁷

In this role at the membrane level, the different forms of essential FAs—omega-3 and omega-6—are precursors to eicosanoids, which can be used for inflammatory or anti-inflammatory pathways in the body, with omega-3 favoring anti-inflammatory pathways and omega-6 being associated with risk of blood clots, pain, and inflammation (Figure 7.6).⁵⁸ Omega-3 FAs act as precursors to less inflammatory versions of bioactive molecules such as eicosanoids, which positively influence health. For example, eicosanoids act as powerful hormones that control many other hormones and essential body functions, such as the immune system, central nervous system, cardiac cell health, and blood pressure regulation.⁵⁹

Culinary options for incorporating foods rich in omega-3 FAs—such as fatty fish (e.g., salmon, herring, sardines, mackerel, cod), flaxseeds, chia seeds, and walnuts—enhance taste and provide bioactive FAs for health and nutrition. Although omega-6 FAs are often consumed in higher quantities than optimal in the **Standard American Diet**, this doesn't imply that they should be avoided; however, it may be advisable to reduce their intake.⁵⁷ In



Figure 7.5. Eat salmon to boost omega-3 fatty acids in your diet. "Salmon" by cattalin is licensed under a Pixabay License.

the US food supply, soybean oil intake has dramatically increased with concurrent evidence of decreased omega-3 FAs in human tissue.⁵⁷ Nevertheless, it is reasonable to emphasize healthy options for omega-3 essential and long-chain polyunsaturated FAs in culinary medicine interventions.

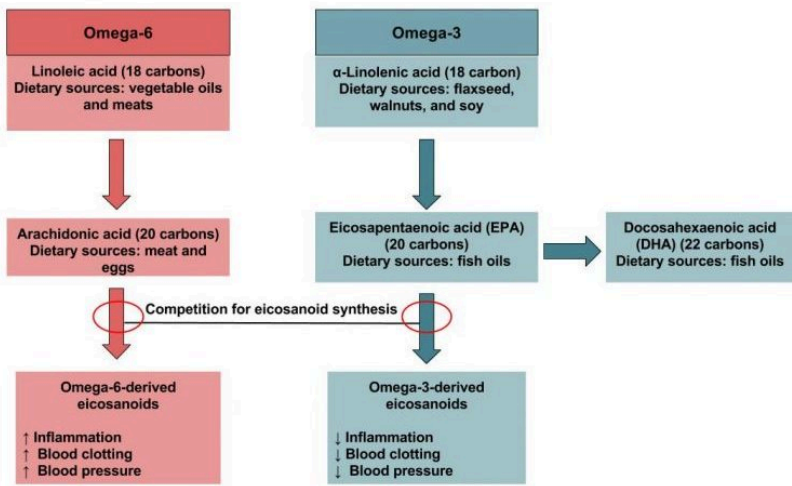


Figure 7.6. Essential fatty acids must be obtained from food. They fall into 2 categories: omega-3 and omega-6. "Essential Fatty Acids" by Allison Calabrese is licensed CC BY 4.0.

Terpenes

Terpenes are highly aromatic compounds that are involved in producing the signature odor of many plants and herbs, such as rosemary, lavender, and thyme. Some of the better-known terpenes in our food supply include limonene, which is a common terpene in the rinds of citrus fruits, giving them their pleasant citrusy fragrance. Another terpene, beta-caryophyllene, is found in many herbs and vegetables (e.g., cloves, black pepper) and has anti-inflammatory effects and possibilities for pain reduction.²³

Carotenoids

Carotenoids belong to the terpene family and are important and widely distributed pigments determining the various colors of plants. For example, dietary sources rich in beta-carotene are typically in the form of yellow, red, orange, and green leafy fruits and vegetables. A review of carotenoid food sources is found in Table 7.4.

Lycopene is a pigment molecule that imparts color to many fruits and vegetables, including tomatoes, which supply 85% of the lycopene in the American diet.^{23–25} Carotenoids are lipophilic, meaning that they follow the same digestive processes as lipids, which are also essential for carotenoid absorption.

Several carotenoids, such as beta-carotene and beta-cryptoxanthin, are provitamin A carotenoids, plant pigments that are converted to vitamin A in the small intestine.²⁴ All dietary carotenoids, including non-vitamin A varieties such as lutein, lycopene, and zeaxanthin, are considered to play a role in the prevention of chronic diseases such as CVD, age-related macular degeneration, and cancer.²³ Carotenoids also have protective effects on cardiovascular health by preventing damage to blood vessel walls. In a study with 31 years of follow-up, carotenoid intake was inversely related to strokes and other causes of death.^{2,23,24} The impact of culinary practices on bioavailability of carotenoids has been extensively researched.



Figure 7.7. Cruciferous vegetables include green cauliflower, white cauliflower, and cabbage (seen in center of photo). "Vegetables" by Tyna Janoch is licensed under a Pixabay License.

Enhanced release of carotenoids is found with cooking and processing methods that break down the plant cell walls, making the carotenoids more accessible.²⁵ For example, heating and cooking vegetables such as spinach, carrots, and tomatoes can break down cell walls and release carotenoids. Blending, such as making smoothies or purees from fruits and vegetables, also can break down cell walls, making the carotenoids more readily available for absorption, and chopping, mincing, and cutting before cooking can help release fat-soluble cells to enhance absorption when they're consumed with dietary fat.^{23,26}

Most carotenoids are heat stable; however, some (e.g., beta-carotene) are more sensitive to heat and can be degraded during cooking. Boiling vegetables can cause leaching of carotenoids into the cooking water, reducing bioavailability; using the cooking water in a soup or sauce can help you recover benefits from these nutrients.²³ Steaming is a gentler cooking method that can help preserve carotenoids. Processing techniques such as canning, freezing, and drying can affect carotenoid levels. The impact of these changes depends on the specific carotenoid, which processing methods are used, and the duration of storage.²³



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Table 7.4. Carotenoid Food Sources²³

Carotenoid	Food sources
Beta-carotene	Carrots, sweet potatoes, squash, pumpkin, spinach, kale, mangoes, apricots, red bell peppers
Lutein	Spinach, kale, parsley, collard greens, Swiss chard, broccoli, peas, corn, eggs, raspberries, okra, basil
Lycopene	Tomatoes, watermelon, pink grapefruit, guava, papaya, red cabbage, asparagus, persimmon
Zeaxanthin	Corn, spinach, kale, collard greens, Swiss chard, beet greens, peas, eggs, oranges, pumpkin, brussels sprouts, pistachios

Cryptoxanthin	Butternut squash, red bell peppers, papaya, mangoes, oranges, tangerines, peaches, apricots, persimmon, nectarines, watermelon, paprika
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It is believed that additional bioactive compounds have yet to be discovered. When considering culinary applications to promote health and well-being, incorporating foods with bioactive compounds can elevate the nutritional value and health impact of the meal beyond its basic nutrient composition.

Key Takeaways

Some ideas to incorporate bioactive compounds into culinary medicine applications include

- Consider ways to maximize bioavailability of the bioactive compounds in your cooking.
- Choose spices and fresh herbs to help reduce use of sodium and make healthy foods flavorful.
- Plan meals that offer a variety of vegetables and fruits of many different colors.
- Use healthy fats along with lipophilic bioactive compounds such as carotenoids. For example, try an olive oil-based dressing on a salad with broccoli and cauliflower florets.
- Incorporate fatty fish and enriched eggs regularly as

sources of omega-3 fatty acids.

- Include nuts (especially walnuts), chia, and flax seeds as sources of alpha-linolenic acid that convert to omega-3 FAs and provide antioxidants, healthy fats, and fiber.
- Use garlic, onions, leeks, or shallots to impart flavor and provide bioactive sulfur compounds.
- Include fermented foods to provide bioactive probiotics to enrich the microbiota.

REFERENCES

1. Swanson JE. Bioactive food components. In: *Encyclopedia of Food and Culture*. October 14, 2024. Accessed November 3, 2024. <https://www.encyclopedia.com/food/encyclopedias-almanacs-transcripts-and-maps/bioactive-food-components>
2. Liu RH. Health-promoting components of fruits and vegetables in the diet. *Adv Nutr*. 2013;4(3):384S–392S. doi:10.3945/an.112.003517
3. Estruch R, Ros E, Salas-Salvadó J, et al. Primary prevention of cardiovascular disease with a Mediterranean diet supplemented with extra-virgin olive oil or nuts. *N Engl J Med*. 2018;378(25):e34. doi:10.1056/NEJMoa1800389
4. Superfood. Merriam-Webster Dictionary Online. Accessed October 27, 2023. <https://www.merriam-webster.com/dictionary/superfood>
5. Inpan R, Na Takuathung M, Sakuludomkan W, Dukaew N, Teekachunhatean S, Koonrungsesomboon N. Isoflavone intervention and its impact on bone mineral density in

- postmenopausal women: a systematic review and meta-analysis of randomized controlled trials. *Osteoporos Int*. 2024;35(3):413–430. doi:10.1007/s00198-023-06944-y
6. Lock M. Menopause: lessons from anthropology. *Psychosom Med*. 1998;60(4):410–419. doi:10.1097/00006842-199807000-00005
 7. Ritikraj Arya, Sabita N. Saldanha. Chapter 10. Dietary phytochemicals, epigenetics, and colon cancer chemoprevention. In: Bishayee A, Bhatia D, eds. *Translational Epigenetics, Epigenetics of Cancer Prevention*. Volume 8. Academic Press; 2019;205–229. doi:10.1016/B978-0-12-812494-9.00010-X
 8. Caan BJ, Natarajan L, Parker B, et al. Soy food consumption and breast cancer prognosis. *Cancer Epidemiol Biomarkers Prev*. 2011;20(5):854–858. doi:10.1158/1055-9965.EPI-10-1041
 9. Patisaul HB, Jefferson W. The pros and cons of phytoestrogens. *Front Neuroendocrinol*. 2010;31(4):400–419. doi:10.1016/j.yfrne.2010.03.003
 10. Woyengo TA, Ramprasath VR, Jones PJH. Anticancer effects of phytosterols. *Eur J Clin Nutr*. 2009;63(7):813–820. doi:10.1038/ejcn.2009.29
 11. Reis Giada MDL. Food phenolic compounds: main classes, sources and their antioxidant power. In: Morales-Gonzalez JA, ed. *Oxidative Stress and Chronic*

Degenerative Diseases – A Role for Antioxidants. InTech; 2013. doi:10.5772/51687

12. De La Rosa LA, Moreno-Escamilla JO, Rodrigo-García J, Alvarez-Parrilla E. Phenolic compounds. In: Yahia EM, ed. *Postharvest Physiology and Biochemistry of Fruits and Vegetables*. Elsevier; 2019:253–271. doi:10.1016/B978-0-12-813278-4.00012-9
13. Woodward KA, Draijer R, Thijssen DHJ, Low DA. Polyphenols and microvascular function in humans: a systematic review. *Curr Pharm Des*. 2018;24(2):203–226. doi:10.2174/1381612823666171109103939
14. Anê FF, Desjardins Y, Pilon G, et al. Polyphenols and type 2 diabetes: a prospective review. *PharmaNutrition*. 2013;1(4):105–114. doi:10.1016/j.phanu.2013.07.004
15. Tangney CC, Rasmussen HE. Polyphenols, inflammation, and cardiovascular disease. *Curr Atheroscler Rep*. 2013;15(5):324. doi:10.1007/s11883-013-0324-x
16. Rudrapal M, Khairnar SJ, Khan J, et al. Dietary polyphenols and their role in oxidative stress-induced human diseases: insights into protective effects, antioxidant potentials and mechanism(s) of action. *Front Pharmacol*. 2022;13:806470. doi:10.3389/fphar.2022.806470
17. Sasso JM, Ammar RM, Tenchov R, et al. Gut microbiome–brain alliance: a landscape view into mental

- and gastrointestinal health and disorders. *ACS Chem Neurosci*. 2023;14(10):1717–1763. doi:[10.1021/acschemneuro.3c00127](https://doi.org/10.1021/acschemneuro.3c00127)
18. Liu H, Wang J, He T, et al. Butyrate: a double-edged sword for health? *Adv Nutr*. 2018;9(1):21–29. doi:[10.1093/advances/nmx009](https://doi.org/10.1093/advances/nmx009)
 19. Valdes AM, Walter J, Segal E, Spector TD. Role of the gut microbiota in nutrition and health. *BMJ*. 2018;361:k2179. doi:[10.1136/bmj.k2179](https://doi.org/10.1136/bmj.k2179)
 20. Al Sharaby A, Abugoukh TM, Ahmed W, Ahmed S, Elshaikh AO. Do probiotics prevent *Clostridium difficile*-associated diarrhea? *Cureus*. 2022;14(8):e27624. doi:[10.7759/cureus.27624](https://doi.org/10.7759/cureus.27624)
 21. Maldonado-Contreras A, Noel SE, Ward DV, Velez M, Mangano KM. Associations between diet, the gut microbiome, and short-chain fatty acid production among older Caribbean Latino adults. *J Acad Nutr Diet*. 2020;120(12):2047–2060.e6. doi:[10.1016/j.jand.2020.04.018](https://doi.org/10.1016/j.jand.2020.04.018)
 22. Dimidi E, Cox S, Rossi M, Whelan K. Fermented foods: definitions and characteristics, impact on the gut microbiota and effects on gastrointestinal health and disease. *Nutrients*. 2019;11(8):1806. doi:[10.3390/nu11081806](https://doi.org/10.3390/nu11081806)
 23. Maiani G, Periago Castón MJ, Catasta G, et al. Carotenoids: actual knowledge on food sources, intakes, stability and bioavailability and their protective role in humans. *Mol Nutr Food Res*. 2009;53(S2):S194–S218. doi:[10.1002/mnfr.200800053](https://doi.org/10.1002/mnfr.200800053)

24. Merhan O. The biochemistry and antioxidant properties of carotenoids. In: Cvetkovic DJ, Nikolic GS, eds. *Carotenoids*. InTech; 2017. doi:[10.5772/67592](https://doi.org/10.5772/67592)
25. Arunkumar R, Gorusupudi A, Bernstein PS. The macular carotenoids: a biochemical overview. *Biochim Biophys Acta Mol Cell Biol Lipids*. 2020;1865(11):158617. doi:[10.1016/j.bbaliip.2020.158617](https://doi.org/10.1016/j.bbaliip.2020.158617)
26. Daly T, Jiwan MA, O'Brien NM, Aherne SA. Carotenoid content of commonly consumed herbs and assessment of their bioaccessibility using an in vitro digestion model. *Plant Foods Hum Nutr*. 2010;65(2):164–169. doi:[10.1007/s11130-010-0167-3](https://doi.org/10.1007/s11130-010-0167-3)
27. Saini RK, Prasad P, Sreedhar RV, Akhilender Naidu K, Shang X, Keum YS. Omega-3 polyunsaturated fatty acids (PUFAs): emerging plant and microbial sources, oxidative stability, bioavailability, and health benefits—a review. *Antioxidants*. 2021;10(10):1627. doi:[10.3390/antiox10101627](https://doi.org/10.3390/antiox10101627)
28. Harris WS. Linoleic acid and coronary heart disease. *Prostaglandins Leukot Essent Fatty Acids*. 2008;79(3-5):169–171. doi:[10.1016/j.plefa.2008.09.005](https://doi.org/10.1016/j.plefa.2008.09.005)
29. Johnson GH, Fritsche K. Effect of dietary linoleic acid on markers of inflammation in healthy persons: a systematic review of randomized controlled trials. *J Acad Nutr Diet*. 2012;112(7):1029-1041.e15. doi:[10.1016/j.jand.2012.03.029](https://doi.org/10.1016/j.jand.2012.03.029)

30. Noakes M, Clifton P, Ntanos F, Shrapnel W, Record I, McInerney J. An increase in dietary carotenoids when consuming plant sterols or stanols is effective in maintaining plasma carotenoid concentrations. *Am J Clin Nutr.* 2002;75(1):79–86. doi:10.1093/ajcn/75.1.79
31. Delage B. Phytosterols. Oregon State University Linus Pauling Institute, Micronutrient Information Center. Updated November 2016. Accessed November 3, 2024. <https://lpi.oregonstate.edu/mic/dietary-factors/phytochemicals/phytosterols>
32. Louis XL, Murphy R, Thandapilly SJ, Yu L, Netticadan T. Garlic extracts prevent oxidative stress, hypertrophy and apoptosis in cardiomyocytes: a role for nitric oxide and hydrogen sulfide. *BMC Complement Altern Med.* 2012;12(1):140. doi:10.1186/1472-6882-12-140
33. De Luca I, Di Cristo F, Valentino A, Peluso G, Di Salle A, Calarco A. Food-derived bioactive molecules from Mediterranean diet: nanotechnological approaches and waste valorization as strategies to improve human wellness. *Polymers.* 2022;14(9):1726. doi:10.3390/polym14091726
34. Hoffmann G, Schwingshackl L. Mediterranean diet supplemented with extra virgin olive oil reduces the incidence of invasive breast cancer in a randomised controlled trial. *Evid Based Med.* 2016;21(2):72. doi:10.1136/ebmed-2015-110366
35. Bahramsoltani R, Farzaei MH, Ram M, Nikfar S, Rahimi R. Bioactive foods and medicinal plants for cardiovascular complications of type ii diabetes: current clinical evidence

- and future perspectives. *Evid Based Complement Alternat Med*. 2021;2021:1–26. doi:[10.1155/2021/6681540](https://doi.org/10.1155/2021/6681540)
36. Panche AN, Diwan AD, Chandra SR. Flavonoids: an overview. *J Nutr Sci*. 2016;5:e47. doi:[10.1017/jns.2016.41](https://doi.org/10.1017/jns.2016.41)
 37. Hooper L, Kroon PA, Rimm EB, et al. Flavonoids, flavonoid-rich foods, and cardiovascular risk: a meta-analysis of randomized controlled trials. *Am J Clin Nutr*. 2008;88(1):38–50. doi:[10.1093/ajcn/88.1.38](https://doi.org/10.1093/ajcn/88.1.38)
 38. Bondonno CP, Bondonno NP, Dalgaard F, et al. Flavonoid intake and incident dementia in the Danish Diet, Cancer, and Health cohort. *Alzheimers Dement (NY)*. 2021;7(1):e12175. doi:[10.1002/trc2.12175](https://doi.org/10.1002/trc2.12175)
 39. Perez-Vizcaino F, Fraga CG. Research trends in flavonoids and health. *Arch Biochem Biophys*. 2018;646:107–112. doi:[10.1016/j.abb.2018.03.022](https://doi.org/10.1016/j.abb.2018.03.022)
 40. Oteiza PI, Heiss C. Introduction to special issue on polyphenols and health. *Arch Biochem Biophys*. 2018;652:1–2. doi:[10.1016/j.abb.2018.05.022](https://doi.org/10.1016/j.abb.2018.05.022)
 41. Vázquez-Fresno R, Rosana ARR, Sajed T, Onookome-Okome T, Wishart NA, Wishart DS. Herbs and spices-biomarkers of intake based on human intervention studies – a systematic review. *Genes Nutr*. 2019;14(1):18. doi:[10.1186/s12263-019-0636-8](https://doi.org/10.1186/s12263-019-0636-8)

42. Kurek M, Benaida-Debbache N, Elez Garofulić I, et al. Antioxidants and bioactive compounds in food: critical review of issues and prospects. *Antioxidants (Basel)*. 2022;11(4):742. doi:10.3390/antiox11040742
43. Rathod NB, Elabed N, Punia S, Ozogul F, Kim SK, Rocha JM. Recent developments in polyphenol applications on human health: a review with current knowledge. *Plants*. 2023;12(6):1217. doi:10.3390/plants12061217
44. Zagórska J, Pietrzak K, Kukula-Koch W, Czop M, Laszuk J, Koch W. Influence of diet on the bioavailability of active components from *Zingiber officinale* using an in vitro digestion model. *Foods*. 2023; 12(21):3897. doi:10.3390/foods12213897
45. Rodríguez-García C, Sánchez-Quesada C, Toledo E, Delgado-Rodríguez M, Gaforio J. Naturally lignan-rich foods: a dietary tool for health promotion? *Molecules*. 2019;24(5):917. doi:10.3390/molecules24050917
46. Neveu V, Perez-Jimenez J, Vos F, et al. Phenol-Explorer: an online comprehensive database on polyphenol contents in foods. *Database*. 2010;2010:bap024-bap024. doi:10.1093/database/bap024
47. Woodward KA, Draijer R, Thijssen DHJ, Low DA. Polyphenols and microvascular function in humans: a systematic review. *Curr Pharm Des*. 2018;24(2):203–226. doi:10.2174/1381612823666171109103939

48. Scazzocchio B, Minghetti L, D'Archivio M. Interaction between gut microbiota and curcumin: a new key of understanding for the health effects of curcumin. *Nutrients*. 2020;12(9):2499. doi:10.3390/nu12092499
49. Hewlings S, Kalman D. Curcumin: a review of its effects on human health. *Foods*. 2017;6(10):92. doi:10.3390/foods6100092
50. Khoo HE, Azlan A, Tang ST, Lim SM. Anthocyanidins and anthocyanins: colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food Nutr Res*. 2017;61(1):1361779. doi:10.1080/16546628.2017.1361779
51. Rahman M, Rahaman S, Islam R, et al. Role of phenolic compounds in human disease: current knowledge and future prospects. *Molecules*. 2021;27(1):233. doi:10.3390/molecules27010233
52. Yamine A, Namsi A, Vervandier-Fasseur D, Mackrill JJ, Lizard G, Latruffe N. Polyphenols of the Mediterranean diet and their metabolites in the prevention of colorectal cancer. *Molecules*. 2021;26(12):3483. doi:10.3390/molecules26123483
53. El Khawand T, Courtois A, Valls J, Richard T, Krisa S. A review of dietary stilbenes: sources and bioavailability. *Phytochem Rev*. 2018;17(5):1007–1029. doi:10.1007/s11101-018-9578-9
54. Alves-Silva JM, Zuzarte M, Girão H, Salgueiro L. Natural products in cardiovascular diseases: the potential of plants from the Alliioideae subfamily (ex-Alliaceae family) and their sulphur-containing compounds. *Plants*.

- 2022;11(15):1920. doi:[10.3390/plants11151920](https://doi.org/10.3390/plants11151920)
55. Nahar L, Xiao J, Sarker SD. Introduction of phytonutrients. In: Xiao J, Sarker SD, Asakawa Y, eds. *Handbook of Dietary Phytochemicals*. Springer Singapore; 2021:1–17. doi:[10.1007/978-981-15-4148-3_2](https://doi.org/10.1007/978-981-15-4148-3_2)
 56. Elli M, Callegari ML, Ferrari S, et al. Survival of yogurt bacteria in the human gut. *Appl Environ Microbiol*. 2006;72(7):5113–5117. doi:[10.1128/AEM.02950-05](https://doi.org/10.1128/AEM.02950-05)
 57. Blasbalg TL, Hibbeln JR, Ramsden CE, Majchrzak SF, Rawlings RR. Changes in consumption of omega-3 and omega-6 fatty acids in the United States during the 20th century. *Am J Clin Nutr*. 2011;93(5):950–962. doi:[10.3945/ajcn.110.006643](https://doi.org/10.3945/ajcn.110.006643)
 58. University of Hawai'i at Mānoa Food Science and Human Nutrition Program. *Human Nutrition: 2020 Edition*. 2020. Accessed November 3, 2024. <https://pressbooks.oer.hawaii.edu/humannutrition2>
 59. Duan J, Song Y, Zhang X, Wang C. Effect of ω -3 polyunsaturated fatty acids-derived bioactive lipids on metabolic disorders. *Front Physiol*. 2021;12:646491. doi:[10.3389/fphys.2021.646491](https://doi.org/10.3389/fphys.2021.646491)

Chapter 8: Popular Diets and Health

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INTRODUCTION

Diet is a primary risk factor for chronic disease, and diet-sensitive disease is a major contributor to global health-care costs. Culinary medicine promotes a healthy eating pattern and a nourishing relationship with food that respects the different roles of foods in people's lives rather than a particular diet per se. Literally thousands of "diets" have been proposed, which can be loosely described as belief-based, food-specific, or nutrient-based; focused on weight loss or weight (muscle) gain; detoxification (detox) diets, and diets designed for specific medical reasons.

"Fad diets" are diets popular for a time without necessarily being based on a standard dietary recommendation. They often promote unreasonably fast weight loss or nonsensical health claims and are advertised to require little effort on the part of the adherent. The promise of easy gains, combined with societal pressure to achieve a certain body type, can leave the public susceptible to unfounded or exaggerated claims. Billions of dollars are spent by consumers each

year on ineffective and potentially risky fad diets and diet-related products.

In contrast, some evidence-based diets have emerged as reasonably robust, effective interventions for specific medical reasons. The diets most effective for disease prevention share similar characteristics: they encourage more intake of fruits, vegetables, and whole grains and generally discourage highly **processed** foods that are higher in sodium and added sugars.

In any case, dietary interventions (like any intervention for medical reasons) should be undertaken with the advice and supervision of a health-care professional, in conjunction with a registered dietitian. These health-care professionals can provide a personalized approach to find the best eating plan for the patient.

OVERVIEW OF POPULAR DIETS AND HEALTH

Chronic disease is responsible for more deaths worldwide than acute infectious conditions.¹ These major chronic conditions include cardiovascular disease (CVD; the number 1 killer globally), cancer, diabetes (>95% being type 2 diabetes), obesity, and noninfectious airway diseases (e.g., asthma, chronic obstructive pulmonary disease).

When examining the diseases of our time, it is evident that diet plays a key role. Diet is the number 1 risk factor for premature, preventable disease and death worldwide.² In the United States, diet has consistently been identified as the top risk factor for premature, preventable death and as a top risk factor for disability-adjusted life-years (DALYs; years affected by disease limiting full function and the ability to live a full life).³

Despite the importance of diet in contributing to human health, there is very little to no nutrition education in medical schools.⁴ Medical students in the United States receive an average of 19.6 hours of nutrition education across all 4 years of medical school.⁵ In addition to the gap of nutrition content in medical education,

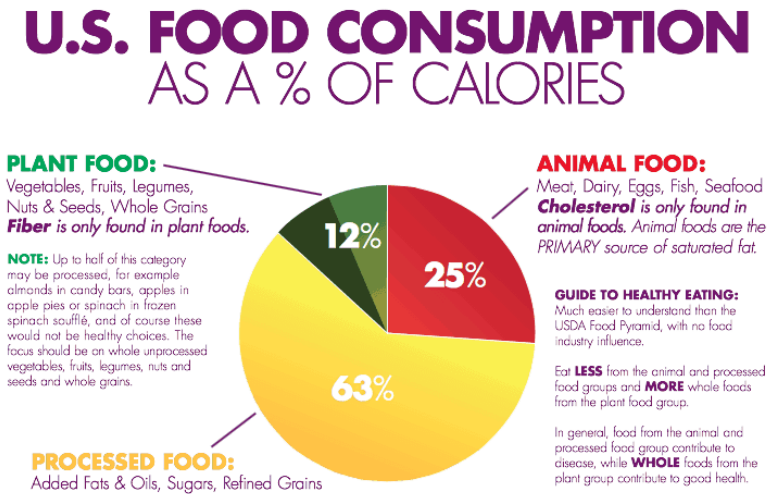
there is a need for more collaboration and interprofessional care involving medical doctors and registered dietitians. The persistence of this gap in training and interprofessional care has created a void in which popular diets have emerged to influence eating behavior of individuals and communities. Many people excitedly support their chosen popular diet. The goal of this chapter is to compare and evaluate the pros and cons of popular diets, based on the latest scientific evidence. In this chapter, we discuss several popular diets.

Before delving into each of these diets, it is important to know some key findings regarding the role of diet as a primary risk factor for premature disease and death. For example, in the case of CVD, studies have shown that close to half (45.4%) of cardiometabolic deaths were connected directly with diet.⁶ These studies found that the main contributors to this risk were a lack of healthy fats and proteins in the form of nuts, seeds, and fatty fish, as well as an excess amount of sodium.⁶

Additionally, a study of international data from 195 countries, assembled from studies over the course of nearly 20 years, showed that suboptimal diet is responsible for more deaths than any other risks globally (including tobacco smoking), which highlights the urgent need to improve diet around the world.² The same researchers also found that improvement of diet could potentially prevent 1 in every 5 deaths globally and that, unlike other risk factors, diet affected health outcomes regardless of sociodemographic development or age. Less than optimal intake of 3 dietary components (whole grains, fruits, and sodium) accounted for more than 50% of all deaths and 66% of DALYs attributed to diet.²

The **Standard American Diet (SAD)** is illustrative of the role that diet plays in the development of chronic disease. The SAD dietary pattern has been exported worldwide, which can account for the findings from the aforementioned 195-country study discussed

above. Figure 8.1 shows the breakdown of this typical diet consumed in the United States.



Source: USDA Economic Research Service, 2009; www.ers.usda.gov/publications/EIB333; www.ers.usda.gov/Data/FoodConsumption/FoodGuide/index.htm#calories
New York Coalition for Healthy School Food • www.healthy-school-food.org
Special thanks to Joel Fuhrman, MD, author of *Disease Proof Your Child: Feeding Kids Right* • Graphics by MichelleBands.com
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Figure 8.1. US food consumption as a percentage of calories. Source: Nine Charts That Show Why America Is Fat, Sick, and Tired

As seen in Figure 8.1, the SAD consists of more than 60% of **calories** coming from highly processed foods. Processed foods are most broadly defined as any raw commodity that is altered from its raw or natural state. Processed foods can be minimally processed (e.g., a bag of frozen vegetables), which is not concerning for health, or more processed, which usually involves adding more ingredients and transforming the food into a product with additional chemical preservatives and flavor enhancers, which can be of concern. Emerging research is showing a strong connection between **highly processed or ultra-processed foods** and poorer health outcomes,

including an increased risk for several cancers, diabetes, obesity, and CVDs.⁷

Some of the characteristics of these highly processed foods include more refined **macronutrients**, such as carbohydrates in the form of simple sugars without fiber or other nutrients. These same processed foods also have unhealthy forms of fat and excessive amounts of sodium. It is no surprise that processed food makes up greater than 60% of the SAD.

In addition to this diet being the most common diet consumed in the United States, the global expansion of this characteristic Western diet has had a negative impact on physical and mental health around the world.⁸ Given the components of the SAD, anyone who embarks on 1 of the popular diets discussed in this chapter will experience some health benefits. Studies have shown that when people begin keeping track of the food they eat by using an app or as requested by a health-care professional, the quality of food choices improves.⁹ In the case of the popular diets outlined in this chapter, any change from the SAD toward less-processed foods and more thoughtful consideration of food choices will result in some benefits. As we review each of the diets, we will consider how each has benefits as well as potential drawbacks based on the scientific evidence that has been developed to date.

LOW-CARBOHYDRATE DIETS

A low-carbohydrate (low-carb) diet is an eating pattern that restricts the intake of carbohydrates, typically replacing them with higher amounts of protein and fat. The ketogenic diet is a form of a low-carb diet that is high in fat relative to protein and carbohydrate intake. The macronutrient breakdown for a ketogenic diet is 70% fat, 20% protein, and 10% carbohydrate.

The goal with ketogenic diet is to induce **ketosis**, a metabolic state that occurs when a body burns fat for energy instead of glucose, which induces weight loss. Ketosis is evidenced by

ketones in the blood that can be measured by a finger stick, much like glucometers measure glucose levels. Other low-carb diets include the Atkins diet, which is a bit less clear on the breakdown, with 55% to 65% fat, 20% to 30% protein, and 10% to 15% carbohydrate.

One of the key issues to consider with any form of a lower-carbohydrate diet that generally limits carbohydrates to less than 20% of total calories is the quality of the calories. For example, protein and fat can be sourced from processed meats and inflammatory fat sources, such as lunch meats or vegetable **oils**, respectively. Or these macronutrients can be sourced from healthy fat sources, such as extra virgin olive oil that is high in monounsaturated fats or lean, unprocessed, grass-fed meats (without added hormones or antibiotics).

The source of the higher amounts of protein and fat can affect the potential health benefits associated with it. For example, processed meats have been identified as a **carcinogen** associated with colorectal cancer,¹⁰ and **fats** such as hydrogenated oils found in processed foods may increase shelf life while also increasing the risk of inflammation leading to **atherosclerosis** and other chronic diseases.¹¹ The pros of a low-carb diet include:

- Weight loss and body composition
- Several studies have shown that low-carb diets can lead to greater weight loss compared with low-fat diets.¹²
- Low-carbohydrate diets may promote greater fat loss and preservation of lean muscle mass, which is important for metabolic health.¹³
- Low-carbohydrate diets may also lead to reduced hunger and increased satiety, potentially aiding in adherence to the diet.¹⁴
- Blood sugar control and **insulin** sensitivity
- Low-carbohydrate diets improve blood sugar control and

insulin sensitivity in individuals with type 2 diabetes.¹⁵

- They may lead to lower fasting blood glucose levels and reduced insulin requirements.¹⁵
- Low-carbohydrate diets may also be beneficial for individuals with insulin resistance or metabolic syndrome.¹⁵
- Cardiovascular risk factors
- Some study findings suggest that low-carb diets can improve cardiovascular risk factors, such as reducing triglyceride levels and increasing high-density lipoprotein cholesterol levels.¹⁶
- They may also lead to greater reductions in blood pressure compared with low-fat diets. However, the long-term effects on cardiovascular health are still debated and require further research.¹⁶

And the cons of a low-carb diet include:

- Nutrient deficiencies
- Restricting carbohydrates may lead to inadequate intake of certain nutrients, such as fiber, vitamins, and minerals.¹⁴ It is important to carefully plan a low-carb diet to ensure adequate nutrient intake and consider supplementation if necessary.¹⁴
- Sustainability and adherence
- Low-carbohydrate diets may be challenging to sustain in the long term due to their restrictive nature and potential social limitations. Adherence to a low-carb diet may also be difficult for individuals who enjoy carbohydrate-rich foods or have cultural dietary preferences.¹⁴
- Potential health risks

- Some studies suggest that long-term adherence (at least 1 year) to low-carb diets may be associated with an increased risk of CVDs and overall mortality.¹⁷ It is important to consider the quality of the food choices within a low-carb diet, because high intake of processed meats and **saturated fats** may increase health risks.¹⁷

It is crucial to note that the effects of a low-carb diet may vary among individuals, and it is advisable to consult with a health-care professional or registered dietitian before starting any dietary regimen, especially for individuals with specific health conditions or concerns.



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The Ketogenic Diet: A Form of Low-Carb Diet

As noted, the ketogenic diet is a high-fat, low-carbohydrate, and moderate-protein diet that has gained popularity for its potential health benefits. The primary goal of the ketogenic diet is to restrict carbohydrate intake to a level that triggers ketosis. Typically, this involves consuming less than 50 g of carbohydrates per day, although individual requirements may vary. Instead, the diet emphasizes consuming high amounts of healthy fats found in

sources such as avocados, nuts, seeds, and oils, along with moderate protein from sources such as meat, fish, and dairy products.

The same potential challenges associated with low-carb diets may apply to ketogenic diets. Here is brief list of potential health benefits as supported by scientific literature:

- **Epilepsy management:** The ketogenic diet has been used as a therapeutic approach for drug-resistant epilepsy, particularly in children. Multiple studies have shown its effectiveness in reducing seizure frequency and improving seizure control.¹⁸
- **Weight loss:** A systematic review and meta-analysis of randomized controlled trials found that the ketogenic diet was more effective for short-term weight loss compared with low-fat diets.¹⁴
- **Improved insulin sensitivity:** Research suggests the ketogenic diet may improve insulin sensitivity and glycemic control, making it beneficial for individuals with type 2 diabetes or prediabetes.¹⁹
- **Neurological disorders:** Emerging evidence suggests the ketogenic diet may have potential benefits for various neurological disorders, including Alzheimer's disease, Parkinson's disease, and traumatic brain injury. However, more research is needed to establish its efficacy and mechanisms of action.²⁰

It is important to note that the ketogenic diet may not be suitable for everyone. Anyone considering making dietary changes should consult with a health-care professional before starting any changes, especially individuals with certain medical conditions (e.g., risk of osteoporosis, digestive disorders, breastfeeding or pregnant people) or those taking medications.

The following is a list of potential cons of a ketogenic diet:

- The ketogenic diet is very low in carbohydrates, which may lead to nutrient deficiencies if not carefully planned and monitored.¹⁴ Less carbohydrate intake leads to less fiber intake, which is the primary food source for the **microbiome**, so the lack of fiber in carbohydrate-rich foods (e.g., vegetables, fruits) can be a potential hazard for this popular diet.
- A ketogenic diet can cause side effects such as constipation, bad breath, and nutrient imbalances.¹⁴
- The long-term effects of the ketogenic diet on overall health and disease prevention are still not well understood, and more research is needed.²⁰



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PALEO DIET

The Paleo diet, also known as the Paleolithic diet or caveman diet, is a dietary approach that aims to mimic the eating habits of our ancient ancestors from the Paleolithic era. It emphasizes consuming whole, unprocessed foods that would have been available to early humans, such as lean meats, fish, fruits,

vegetables, nuts, and seeds, and excluding grains, legumes, dairy products, processed foods, and added sugars.

Although the Paleo diet has gained popularity, it is important to note that scientific evidence supporting its specific health benefits is limited. However, some studies have explored selected health benefits of the Paleo diet. Potential pros of the Paleo diet include:

- **Weight loss:** A small study comparing the Paleo diet with a standard low-fat diet found that the Paleo diet led to greater weight loss and improvements in waist circumference and blood pressure. However, the study had a small sample size and a short duration.²¹
- **Metabolic health:** Another study compared the Paleo diet with a standard diabetes diet in individuals with type 2 diabetes and found that the Paleo diet led to greater improvements in glycemic control, triglyceride levels, and blood pressure. However, this study also had a small sample size and a short duration.²¹
- **Nutrient composition:** The Paleo diet can be nutrient-dense, providing adequate amounts of vitamins, minerals, and antioxidants. However, it may be lower in certain nutrients, such as calcium and vitamin D, due to the exclusion of dairy products.²²

It is important to consider that the Paleo diet may not be suitable for everyone, depending on certain medical factors (e.g., risk for osteoporosis, heart, kidney, pancreatic disease), and long-term adherence to the diet may be challenging due to its restrictive nature. Additionally, the evolutionary premise of the diet has been debated because our ancestors' diets varied significantly depending on geographic location and time period.



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PLANT-BASED DIETS: VEGETARIAN AND VEGAN

Vegetarian Diet

The vegetarian diet is a dietary pattern that excludes the consumption of meat, poultry, and seafood while allowing for the consumption of plant-based foods such as fruits, vegetables, grains, legumes, nuts, and seeds. There are different variations of vegetarian diets, including lacto-vegetarian (includes dairy products), ovo-vegetarian (includes eggs), and lacto-ovo-vegetarian (includes both dairy products and eggs). Scientific research has explored the health effects of vegetarian diets; following are some key findings:

- Cardiovascular health: Several studies have shown that vegetarian diets are associated with a reduced risk of CVDs. A meta-analysis of observational studies found that vegetarians had a 25% lower risk of dying from heart disease compared with nonvegetarians.²³
- Blood pressure control: Research suggests that vegetarian diets may help lower blood pressure. A systematic review and meta-analysis of clinical trials found that vegetarian

diets were associated with significant reductions in both systolic and diastolic blood pressures.²⁴

- **Diabetes management:** Vegetarian diets are beneficial for individuals with type 2 diabetes. A systematic review and meta-analysis of randomized controlled trials found that vegetarian diets led to greater improvements in glycemic control, weight management, and cholesterol levels compared with conventional diets.²⁵
- **Cancer prevention:** Some studies have suggested that vegetarian diets may be associated with a reduced risk of certain types of cancer, particularly colorectal cancer. However, the evidence is not consistent across all studies, and more research is needed to establish a definitive link.²⁶

It is important to note that vegetarian diets can be nutritionally adequate if well planned to ensure sufficient intake of essential nutrients such as protein, iron, calcium, vitamin B₁₂, and **omega-3 fatty acids**. Consulting with a health-care professional or registered dietitian is recommended to ensure proper nutrient balance.

Vegan or Plant-Based Diet

The vegan diet is a plant-based dietary pattern that excludes the consumption of all animal products, including meat, poultry, seafood, dairy products, eggs, and honey. It focuses on consuming a variety of plant-based foods, such as fruits, vegetables, grains, legumes, nuts, and seeds. Scientific research has explored the health benefits of vegan diets and shown the benefits are similar to the health benefits of vegetarians diets (see previous section). Beyond this, some research has found additional benefit to being fully plant-based without dairy or eggs including for treating and

preventing coronary artery disease,²⁷ cancer risk,²⁸ and longevity.²⁹

It is important to note that although vegan diets can be nutritionally adequate, attention must be given to ensure sufficient intake of essential nutrients such as protein, iron, calcium, vitamin B₁₂, and omega-3 fatty acids. Proper meal planning and potential supplementation may be necessary. Consulting with a health-care professional or registered dietitian is recommended.

Potential cons of plant-based diets include that certain nutrients, such as vitamin B₁₂ found in red meat, are often deficient in vegetarian diets. Another con to this diet is being a “junk food vegetarian,” whereby meat is avoided and replaced with processed foods, making it less healthy (e.g., chips, french fries, refined grains—all of which are vegetarian). Protein needs may vary per age group. For example, older people have higher protein requirements that require vegetarians in this age group to be mindful of adding more plant-based protein to their diet.

DIETARY APPROACHES TO STOP HYPERTENSION DIET

The Dietary Approaches to Stop Hypertension (DASH) diet is a dietary pattern specifically designed to help lower blood pressure and promote overall heart health. It emphasizes consuming a variety of nutrient-rich foods, including fruits, vegetables, whole grains, lean proteins, and low-fat dairy products, and limiting the intake of sodium, saturated fats, and added sugars. Scientific research has demonstrated the effectiveness of the DASH diet in reducing blood pressure and improving cardiovascular health. Some key findings are listed here:

- Blood pressure control: Multiple studies have shown that the DASH diet can significantly lower blood pressure. A systematic review and meta-analysis of randomized controlled trials found that the DASH diet led to

significant reductions in both systolic and diastolic blood pressures, particularly in individuals with hypertension.³⁰

- Cardiovascular health: The DASH diet has been associated with a reduced risk of CVDs. A large, prospective cohort study found that adherence to the DASH diet was associated with a lower risk of coronary heart disease and stroke.³¹
- Weight management: The DASH diet can also support weight management. A randomized controlled trial comparing the DASH diet with a control diet found that the DASH diet led to greater weight loss and improvements in body composition.³²
- Nutrient composition: The DASH diet is rich in essential nutrients such as potassium, magnesium, calcium, fiber, and antioxidants. These nutrients have been associated with various health benefits, including blood pressure regulation and cardiovascular health.³³

On the other hand, potential challenges to the DASH diet include adherence, due to the lack of convenience or processed foods and no organized support groups; food-tracking requirement; and limited focus on specific dietary restrictions.

The DASH diet is considered a well-balanced and evidence-based dietary approach for individuals looking to improve their blood pressure and overall heart health. It is important to note that individual variations and specific dietary needs should be considered, and consulting with a health-care professional or registered dietitian is recommended.

MEDITERRANEAN DIET

The Mediterranean diet is a dietary pattern inspired by the traditional eating habits of countries bordering the Mediterranean

Sea. It is characterized by high consumption of fruits, vegetables, whole grains, legumes, nuts, and olive oil; moderate intake of fish and poultry; and low consumption of red meat, processed foods, and sweets. The health benefits of the Mediterranean diet have been investigated in numerous studies. Some key findings are as follows:

- Cardiovascular health: A critical review of the Mediterranean Diet and Health found that better conformity with the traditional Mediterranean Diet is associated with better cardiovascular health outcomes including clinically significant reductions in coronary artery disease rates, ischemic stroke, and total cardiovascular disease.³⁴
- Diabetes prevention: The Mediterranean diet may help prevent type 2 diabetes. A large randomized controlled trial called PREDIMED (Prevención con Dieta Mediterránea [Prevention with the Mediterranean Diet]) demonstrated that individuals assigned to follow a Mediterranean diet supplemented with extra-virgin olive oil or nuts had a lower incidence of diabetes compared with those following a low-fat diet.³⁵
- Cognitive function: Several studies have indicated that adherence to the Mediterranean diet is associated with better cognitive function and a reduced risk of cognitive decline and Alzheimer's disease. A systematic review and meta-analysis of observational studies found that higher adherence to the Mediterranean diet was associated with a 33% lower risk of Alzheimer's disease.³⁶
- Cancer prevention: The Mediterranean diet has been linked to a reduced risk of certain types of cancer, including breast cancer and colorectal cancer. A meta-analysis of observational studies found that higher

adherence to the Mediterranean diet was associated with a 10% lower risk of breast cancer.³⁷

MEDITERRANEAN-DASH DIET INTERVENTION FOR NEURODEGENERATIVE DELAY DIET

The Mediterranean-DASH Diet Intervention for Neurodegenerative Delay (MIND) diet is a dietary pattern specifically designed to promote brain health and reduce the risk of neurodegenerative diseases, such as Alzheimer's disease. It combines elements of the Mediterranean diet and the DASH diet, focusing on consuming foods that are beneficial for brain health (e.g., fish, berries, nuts, seeds). Although the MIND diet is a relatively new concept, some scientific research has explored its potential benefits, including the following pros and cons:

- **Cognitive function:** A study found that adherence to the MIND diet was associated with a slower rate of cognitive decline and a reduced risk of Alzheimer's disease. The study followed older adults over several years and found that those who closely followed the MIND diet had a 53% reduced risk of developing Alzheimer's disease compared with those who did not adhere to the diet.³⁸
- **Neuroprotective effects:** The MIND diet emphasizes consuming foods that are rich in nutrients and antioxidants, such as berries, leafy greens, nuts, and olive oil. These components have been associated with neuroprotective effects and may help reduce oxidative stress and inflammation in the brain, which are believed to contribute to neurodegenerative disease.³⁸
- There is the potential for higher amounts of fat and calorie intake and for challenges in adherence for some individuals.

- It may be difficult to translate Mediterranean diet foods across different cultures.

It is important to note that the Mediterranean diet is not a 1-size-fits-all approach, and individual variations and cultural adaptations exist. Additionally, the Mediterranean diet is not solely defined by specific foods but also by the overall dietary pattern and lifestyle factors, such as physical activity and social interactions.

PESCATARIAN DIET

The pescatarian diet is a dietary pattern that includes plant-based foods along with seafood. It is similar to a vegetarian diet in that it excludes meat and poultry, but it allows for the consumption of fish and other seafood. Scientific research on the pescatarian diet specifically is limited, but studies on similar dietary patterns provide some insights, as follows:

- Cardiovascular health: Several studies have shown that increased fish consumption, which is a key component of the pescatarian diet, is associated with a reduced risk of CVDs. A systematic review and meta-analysis of prospective cohort studies found that greater amounts of fish intake were associated with a lower risk of death from coronary heart disease.³⁹
- Omega-3 fatty acids: Fish is a rich source of omega-3 fatty acids, particularly eicosapentaenoic acid and docosahexaenoic acid. These fatty acids have been associated with various health benefits, including reduced inflammation, improved heart health, and potential cognitive benefits.⁴⁰
- Nutrient intake: The pescatarian diet can provide a range of essential nutrients, including high-quality protein, omega-3 fatty acids, vitamins (such as vitamins D and

B₁₂), minerals (e.g., iodine, selenium), and antioxidants. However, attention should be given to ensure a balanced intake of nutrients, especially if other animal products such as dairy and eggs are limited or excluded.

It is important to note that specific dietary needs should be considered when following a pescatarian diet. Additionally, the sustainability and environmental impact of seafood consumption should also be taken into account. For example, consumers can educate themselves on which producers are not overfishing, follow fishery laws, and enact best practices that support marine biodiversity. Identifying community-supported fisheries, buying from trusted retailers and restaurants, and prioritizing US-caught fish (and thereby following US fishing laws) are some of the ways that consumers can consider the environmental impacts of their choices.⁴¹

ANTI-INFLAMMATORY DIET

The anti-inflammatory diet is a dietary pattern that focuses on consuming foods that reduce inflammation in the body. Chronic inflammation is associated with various health conditions, including CVDs, diabetes, and certain types of cancer. The anti-inflammatory diet aims to promote overall health and well-being by incorporating foods with anti-inflammatory properties.

Scientific research has identified several key components of the anti-inflammatory diet, including:

- Fruits and vegetables: Numerous studies have shown that fruits and vegetables, particularly those rich in antioxidants and **phytochemicals**, have anti-inflammatory effects. A systematic review and meta-analysis of observational studies found that higher amounts of fruit and vegetable intake were associated with reduced levels of inflammatory markers.⁴²

- Whole grains: Whole grains, such as whole wheat, brown rice, and oats, are rich in fiber and other nutrients that have been associated with anti-inflammatory effects. Higher whole-grain intake was associated with lower levels of inflammatory markers in a meta-analysis.⁴³
- Healthy fats: The anti-inflammatory diet emphasizes the consumption of healthy fats, such as those found in olive oil, avocados, nuts, and seeds. These foods are rich in monounsaturated and polyunsaturated fats, including omega-3 fatty acids, which have anti-inflammatory properties.⁴⁴
- Fish and seafood: Fatty fish (e.g., salmon, mackerel, sardines) are sources of omega-3 fatty acids, which have been associated with reduced inflammation. A systematic review and meta-analysis of randomized controlled trials found that omega-3 supplementation led to significant reductions in inflammatory markers.⁴⁴

It is important to note that the anti-inflammatory diet is not a specific diet plan but rather a general approach to eating that emphasizes whole, unprocessed foods and limits the consumption of processed foods, refined sugars, and unhealthy fats. Individual variations and specific dietary needs should be considered, and consulting with a health-care professional or registered dietitian is recommended.

INTERMITTENT FASTING

Intermittent fasting (IF) is an eating pattern that involves alternating periods of fasting and eating. Participants usually fast for 14-16 hours or more and then have an eating window of 8-10 hours. For example, one can stop eating at 8 PM and then have their first meal the next morning at 10 AM (a 14-hour fast and a 10-hour eating window, or 14:10) or stop eating at 8 PM and have their first meal

at noon (a 16-hour fast and an 8-hour eating window, or 16:8). Here are the pros and cons of IF, supported by scientific references:

- Weight loss and body composition
- Several studies have shown that IF can be an effective approach for weight loss and improving body composition.^{45,46}
- Intermittent fasting may lead to a reduction in calorie intake and increased fat burning, resulting in weight loss.^{46,47}
- It may help preserve lean muscle mass during weight loss, which is important for overall health and metabolic rate.⁴⁵
- Insulin sensitivity and blood sugar control
- Intermittent fasting improves insulin sensitivity and blood sugar control, potentially reducing the risk of type 2 diabetes.⁴⁸
- It may lead to lower fasting insulin levels and improved insulin response, which can enhance metabolic health.^{45,46}
- Cellular repair and longevity
- Findings from studies in animals and some human trials suggest that IF may promote cellular repair processes and increase lifespan.⁴⁹
- It can induce autophagy, a cellular recycling process that removes damaged molecules and organelles, potentially reducing the risk of age-related diseases.⁵⁰
- Adherence and sustainability
- Intermittent fasting may be challenging for some individuals to adhere to in the long term due to the

restricted eating windows or extended fasting periods.⁴⁷

- It may not be suitable for individuals with certain medical conditions, such as diabetes or eating disorders, and should be approached with caution.⁴⁷
- Nutrient deficiencies
- Intermittent fasting may increase the risk of nutrient deficiencies if not carefully planned and balanced.⁵⁰
- It is important to ensure adequate intake of essential nutrients, vitamins, and minerals during eating periods to support overall health.⁵¹
- Potential disordered eating patterns
- For some individuals, IF may trigger or exacerbate disordered eating patterns or an unhealthy relationship with food.⁴⁷
- It is crucial to prioritize a balanced and nourishing diet during eating periods and to maintain a healthy mindset toward food and body image.

It is important to note that the effects of IF may vary among individuals, and it is advisable to consult with a health-care professional or registered dietitian before starting any fasting regimen, especially for individuals with specific health conditions or concerns.



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— version of the text. You can view it online here:
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culinarymedicine/?p=1463#h5p-64](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1463#h5p-64)

Table 8.1. Summary of Comparative Analysis of Popular Diets

Diet name	Definition	Pros	Con
Ketogenic diet	Low-carbohydrate, high-fat diet focused on weight loss	Weight loss, improved insulin sensitivity, potential therapeutic benefits for epilepsy	Nutr def pot effe lon res
Vegetarian diet	A no-meat diet	Reduced risk of chronic diseases, lower environmental impact, potential weight loss	Nutr def cha me nee reli pro

Vegan diet	No meat or animal products (e.g., eggs, dairy products)	Reduced risk of chronic diseases, environmental sustainability, potential weight loss	Nutr def cha me nut pot and cha
Mediterranean diet	Based on traditional foods of countries bordering the Mediterranean Sea, including France, Spain, Greece, and Italy	Reduced risk of cardiovascular diseases, improved cognitive function, potential weight loss	Pot fat inta in a son

Paleo diet	Eating plan based on foods that humans might have eaten during the Paleolithic era	Potential weight loss, improved glucose tolerance, increased nutrient density	Nutr def lim res pot cha me rec
Dietary Approaches to Stop Hypertension (DASH) diet	A diet to control hypertension rich in fruits, vegetables, whole grains, and low-fat dairy	Lowered blood pressure, reduced risk of cardiovascular diseases, improved overall diet quality	Pot cha adh lim spe res

In reviewing the popular diets of our time, it is clear that what is popular will continue to change. Unfortunately, it is easy for anyone to get caught up in the hype about any given diet and feel compelled to follow it as the only way to better health. It is our view, as noted in the review of pros and cons for each popular diet, that

each of these diets has potential health benefits. Therefore, it is important to work with the patient in terms of which diet they want to try.

Our goal as health-care providers ought to include guidance on the evidence, as outlined in this chapter, to help patients choose wisely and follow the healthiest version of whichever popular diet they want to consider. Knowing the potential benefits of each diet and the particular health conditions and risk factors for each patient will help in determining the right diet for each person. Additionally, it is also important to recognize what the patient's particular health goals are so evidence can be provided to support the right diet to achieve their specific goals.

Overall, it is important to communicate with patients about the 2020-2025 Dietary Guidelines for Americans, which are the high-level dietary pattern recommendations.⁵² The similarities of many of the popular diets included in this chapter include increased intake of fruits, vegetables, whole grains, nuts, seeds, legumes, healthy fats, dairy products, and fish protein, some of which are reviewed in Table 8.2.

At their best, all the diets presented in this chapter encourage decreased consumption of processed foods in the healthiest versions of them, whether these are processed plant- or animal-based food sources. Health professionals must ensure they understand a patient's current eating habits and consider making a few key recommendations to improve their overall dietary pattern.⁵³ A few tangible recommendations can be more effective than prescribing a very specific or specialized diet, which may feel overwhelming or unnecessarily complex to a patient.

Table 8.2. Comparison of Food Recommendations for Mediterranean, Vegetarian, and DASH Eating Patterns⁵⁰

Foods	Mediterranean	Vegetarian	DASH
Vegetables	2.5 c/d	2.5 c/d	4-5 servings/d
Fruit	2 c/d	2 c/d	4-5 servings/d
Grains	6 oz/d of whole grains	6 oz/d of whole grains	6-8 servings/d
Dairy	2 c/d	3 c/d	2-3 servings, specifically low-fat
Nuts, seeds, legumes	5 oz/wk	1-2 c/d	2-3 servings/d
Fats and oils	27 g (2 tbsp)/d; extra-virgin olive oil is the preferred source	3 c/wk of legumes; 14 oz/wk of seeds and nuts	2-3 servings/d

Meats, poultry, eggs, fish	6.5 oz/d fish/seafood; 15 oz/wk of meat poultry; 26 oz/wk of eggs	3.5 oz/d; 3.5 oz/wk of eggs	6 oz/d
Sweets and sugars	>13% of calories (260 calories) from sugars, solid fats, added refined starches, and alcohol	>15% of calories (290 calories) from sugars, solid fats, added refined starches, and alcohol	≤5 servings/wk
Sodium	Less added salt; use of herbs and spices encouraged		>2,300 mg or <1,500 mg for those with high blood pressure

Alcohol	Mainly wine during meals		<2 drinks/d for men; <1 drink/d for women
Water	6-8 c/d		
<i>Abbreviations: c = cup; d = day; g = gram; mg = milligram; oz = ounce; tsp = teaspoon; wk = week.</i>			

Health professionals should make recommendations that promote small, gradual changes and feel realistic and tangible to patients. Examples might be trying 1 meatless meal a week, or adding a fruit as a snack each day.⁵² Health professionals should also focus on the quality of foods eaten and encourage increased consumption of whole foods, fruits, vegetables, and whole grains as much as possible (vs processed or packaged foods that may still fit a specific Paleo or vegan diet plan).⁵³

When making recommendations, it is important to consider individuals' needs, sociocultural, and socioeconomic factors. Please see [chapter 12](#) for more information on how to incorporate these considerations into patient recommendations, which will support adherence and long-term adoption success.⁵²

In conclusion, it is important to continue researching dietary patterns and health while keeping an open mind to new ideas about eating. It's important to realize that these diets are still in dire need of research of long-term effects and responses to each specific popular diet that surfaces through social media. To identify

the most accurate methods of assessing individual dietary patterns as well as their outcomes, short- and long-term research is necessary. Additionally, it is important to ensure that dietary advice or food prescriptions are practical and personalized, to be a key part of patients' success.

Key Takeaways

- Diet is a primary risk factor for chronic disease, and diet-sensitive disease is a major contributor to global health-care costs.
- The SAD diet is mostly processed foods, with only 12% of calories consumed originating from plants.
- There are many popular diets that aim to prevent chronic disease outcomes; all diets have pros and cons.
- The most successful diet plans are practical and personalized to the patient's needs, culture, and socioeconomic factors.
- Overall, focusing on the similarities between diet plans (e.g., increasing consumption of fruits and vegetables, nuts, seeds, lean meats) helps patients focus on creating a healthy dietary pattern for life and focus less on adherence to any 1 diet.

REFERENCES

1. World Health Organization. WHO reveals leading causes of death and disability worldwide: 2000-2019. December 9, 2020. Accessed October 31, 2023. <https://www.who.int/news/item/09-12-2020-who-reveals-leading-causes-of->

[death-and-disability-worldwide-2000-2019](#).

2. Afshin A, Sur PJ, Fay KA, et al. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2019;393(10184):1958–1972. doi:10.1016/S0140-6736(19)30041-8
3. Mokdad AH, Ballestreros K, Echko M, et al.; US Burden of Disease Collaborators. The state of US health, 1990-2016: burden of diseases, injuries, and risk factors among US states. *JAMA*. 2018;319(14):1444–1472. doi:10.1001/jama.2018.0158
4. Crowley J, Ball L, Hiddink GJ. Nutrition in medical education: a systematic review. *Lancet Planet Health*. 2019 Sep;3(9):e379–e389. doi:10.1016/S2542-5196(19)30171-8
5. Adams KM, Kohlmeier M, Zeisel SH. Nutrition education in US medical schools: latest update of a national survey. *Acad Med*. 2010 Sep;85(9):1537–1542. doi:10.1097/ACM.0b013e3181eab71b
6. Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, Mozaffarian D. Association between dietary factors and mortality from heart disease, stroke, and type 2 diabetes in the United States. *JAMA*. 2017;317(9):912–924. doi:10.1001/jama.2017.0947
7. Fiolet T, Srour B, Sellem L, et al. Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. *BMJ*. 2018;360:k322. doi:10.1136/bmj.k322
8. Clemente-Suárez VJ, Beltrán-Velasco AI, Redondo-Flórez L, Martín-Rodríguez A, Tornero-Aguilera JF. Global impacts of Western diet and its effects on metabolism and health: a narrative review. *Nutrients*. 2023;15(12):2749. doi:10.3390/nu15122749

9. Ingels JS, Misra R, Stewart J, Lucke-Wold B, Shawley-Brzoska S. The effect of adherence to dietary tracking on weight loss: using HLM to model weight loss over time. *J Diabetes Res.* 2017;2017:6951495. doi:10.1155/2017/6951495
10. Aykan NF. Red meat and colorectal cancer. *Oncol Rev.* 2015;9(1):288. doi:10.4081/oncol.2015.288 [PDF download]
11. Iqbal MP. Trans fatty acids – a risk factor for cardiovascular disease. *Pak J Med Sci.* 2014;30(1):194–197. doi:10.12669/pjms.301.4525
12. Bueno NB, Viera de Melo IS, <https://doi.org/10.4081/oncol.2015.288>Lima de Oliveria S, da Rocha Ataide T. Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. *BJ Nutr.* 2013;110(7):1178–1187. doi:10.1017/S0007114513000548
13. Hall KD, Bemis T, Brychta R, et al. Calorie for calorie, dietary fat restriction results in more body fat loss than carbohydrate restriction in people with obesity. *Cell Metab.* 2015;22(3):427–436. doi:10.1016/j.cmet.2015.07.021
14. Gibson AA, Seimon RV, Lee CMY, et al. Do ketogenic diets really suppress appetite? A systematic review and meta-analysis. *Obes Rev.* 2015;16(1):64–76. doi:10.1111/obr.12230
15. Saslow LR, Kim S, Daubenmier JJ, et al. A randomized pilot trial of a moderate carbohydrate diet compared to a very low carbohydrate diet in overweight or obese individuals with type 2 diabetes mellitus or prediabetes. *PLoS One.* 2017;12(2):e0170952. doi:10.1371/journal.pone.0091027
16. Santos FL, Esteves SS, da Costa Pereira A, Yancy WS Jr,

- Nunes JPL. Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors. *Obes Rev*. 2012;13(11):1048–1066. doi:10.1111/j.1467-789X.2012.01021.x
17. Noto, H., Goto A, Tsujimoto T, Noda M. Low-carbohydrate diets and all-cause mortality: a systematic review and meta-analysis of observational studies. *PLoS One*. 2013;8(1):e55030. doi:10.1371/journal.pone.0055030
 18. Kossoff EH, Zupec-Kania B, Rho JM. Ketogenic diets: an update for child neurologists. *J Child Neurol*. 2018;33(10):629–634. doi:10.1177/0883073809337162
 19. Hussain TA, Mathew TC, Dashti AA, Asfar S, Al-Zaid N, Dashti HM. Effect of low-calorie versus low-carbohydrate ketogenic diet in type 2 diabetes. *Nutrition*. 2012;28(10):1016–1021. doi:10.1016/j.nut.2012.01.016
 20. McDonald TJW, Cervenka MC. Lessons learned from recent clinical trials of ketogenic diet therapies in adults. *Curr Opin Clin Nutr Metab Care*. 2019;22(6):418–424. doi:10.1097/MCO.0000000000000596
 21. Masharani U, Sherchan P, Schloetter M, et al. Metabolic and physiologic effects from consuming a hunter-gatherer (Paleolithic)-type diet in type 2 diabetes. *Eur J Clin Nutr*. 2015;69(8):944–948. doi:10.1038/ejcn.2015.39
 22. Manheimer EW, van Zuuren WJ, Fedorowicz Z, Pijl H. Paleolithic nutrition for metabolic syndrome: systematic review and meta-analysis. *Am J Clin Nutr*. 2015;102(4):922–932. doi:10.3945/ajcn.115.113613
 23. Dinu M, Abbate R, Gensini GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: a systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr*. 2017;57(17):3640–3649. doi:10.1080/

[10408398.2016.1138447](https://doi.org/10.10408398.2016.1138447)

24. Yokoyama Y, Nishimura K, Barnard ND, et al. Vegetarian diets and blood pressure: a meta-analysis. *JAMA Intern Med.* 2014;174(4):577–587. doi:10.1001/jamainternmed.2013.14547
25. Barnard ND, Cohen J, Jenkins DJA, et al. A low-fat vegan diet and a conventional diabetes diet in the treatment of type 2 diabetes: a randomized, controlled, 74-wk clinical trial. *Am J Clin Nutr.* 2009;89(5):1588S–1596S. doi:10.3945/ajcn.2009.26736H
26. Tantamango-Bartley Y, Jaceldo-Siegl K, Fan J, Fraser G. Vegetarian diets and the incidence of cancer in a low-risk population. *Cancer Epidemiol Biomarkers Prev.* 2013;22(2):286–294. doi:10.1158/1055-9965.EPI-12-1060
27. Ornish D, Scherwitz LW, Billings JH, et al. Intensive lifestyle changes for reversal of coronary heart disease. *JAMA.* 1998;280(23):2001–2007. doi:10.1001/jama.280.23.2001. Erratum in: *JAMA.* 1999;281(15):1380.
28. Sargsyan A, Dubasi HB. Milk consumption and prostate cancer: a systematic review. *World J Mens Health.* 2021;39(3):419–428. doi:10.5534/wjmh.200051
29. Landry MJ, Ward CP, Cunanan KM, et al. Cardiometabolic effects of omnivorous vs vegan diets in identical twins: a randomized clinical trial. *JAMA Netw Open.* 2023;6(11):e2344457. doi:10.1001/jamanetworkopen.2023.44457
30. Siervo M, Lara J, Chowdhury S, Ashor A, Oggioni C, Mathers JC. Effects of the Dietary Approaches to Stop Hypertension (DASH) diet on cardiovascular risk factors: a systematic review and meta-analysis. *Br J Nutr.* 2015;113(1):1–15. doi:10.1017/S0007114514003341

31. Fung TT, Chiuve SE, McCullough ML, Rexrode KM, Logroscino G, Hu FB. Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. *Arch Intern Med*. 2008;168(7):713–720. doi:10.1001/archinte.168.7.713
32. Azadbakht L, Rashidi Pour Fard N, Karimi M, et al. Effects of the Dietary Approaches to Stop Hypertension (DASH) eating plan on cardiovascular risks among type 2 diabetic patients: a randomized crossover clinical trial. *Diabetes Care*. 2016;39(4):e38–e39. doi:10.2337/dc10-0676
33. Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. *N Engl J Med*. 2001;344(1):3–10. doi:10.1056/NEJM200101043440101
34. Martínez-González MA, Gea A, Ruiz-Canela M. The Mediterranean diet and cardiovascular health: a critical review. *Circ Res*. 2019;124(5): 779–798. doi:10.1161/CIRCRESAHA.118.313348
35. Salas-Salvadó J, Bulló M, Estruch R, et al. Prevention of diabetes with Mediterranean diets: a subgroup analysis of a randomized trial. *Ann Intern Med*. 2014;160(1):1–10. doi:10.7326/M13-1725
36. Lourida I, Soni M, Thompson-Coon J, et al. Mediterranean diet, cognitive function, and dementia: a systematic review. *Epidemiology*. 2013;24(4):479–89. doi:10.1097/EDE.0b013e3182944410
37. Schwingshackl L, Schwedhelm C, Galbete C, Hoffman G. Adherence to Mediterranean diet and risk of cancer: an updated systematic review and meta-analysis. *Nutrients*. 2017;9(10):1063. doi:10.3390/nu9101063
38. Morris MC, Tangney CC, Wang Y, Sacks FM, Bennett Dam

- Aggarwal NT. MIND diet associated with reduced incidence of Alzheimer's disease. *Alzheimer Dement*. 2015;11(9):1007–1014. doi:10.1016/j.jalz.2014.11.009
39. Zheng J, Huang T, Yu Y, Hu X, Yang B, Li D. Fish consumption and CHD mortality: an updated meta-analysis of seventeen cohort studies. *Public Health Nutr*. 2012;15(4):725–737. doi:10.1017/S1368980011002254
40. Swanson D, Block R, Mousa SA. Omega-3 fatty acids EPA and DHA: health benefits throughout life. *Adv Nutr*. 2012;3(1):1–7. doi:10.3945/an.111.000893
41. Greenfield N. The smart seafood and sustainable fish buying guide. January 22, 2024. Natural Resources Defense Council. Accessed November 4, 2024. <https://www.nrdc.org/stories/smart-seafood-buying-guide>
42. Shivappa N, Hebert JR, Marcos A, et al. Association between dietary inflammatory index and inflammatory markers in the HELENA study. *Mol Nutr Food Res*. 2017;61(6):1600707. doi:10.1002/mnfr.201600707
43. King DE, Wan Q, Feng J, Du L, Li K, Zhou Y. Whole grain consumption and systemic inflammation: a meta-analysis of observational studies. *Nutr Res*. 2016;36(8):845–854. doi:10.1097/MD.0000000000012995
44. Calder PC. Omega-3 fatty acids and inflammatory processes: from molecules to man. *Biochem Soc Trans*. 2017;45(5):1105–1115. doi:10.1042/BST20160474
45. Tinsley GM, Forsse JS, Butler NK, et al. Time-restricted feeding in young men performing resistance training: a randomized controlled trial. *Eur J Sport Sci*. 2019;19(6):864–873. doi:10.1080/17461391.2016.1223173
46. Sun ML, Yao W, Wang XY, et al. Intermittent fasting and health outcomes: an umbrella review of systematic

- reviews and meta-analyses of randomised controlled trials. *EClinicalMedicine*. 2024;70:100845. doi:10.1016/j.eclinm.2024.102519
47. Harris L, Hamilton S, Azavedo LB, et al. Intermittent fasting interventions for treatment of overweight and obesity in adults: a systematic review and meta-analysis. *JBI Database System Rev Implement Rep*. 2018;16(2):507–547. doi:10.11124/JBISRIR-2016-003248
 48. Antoni R, Johnston KL, Collins AL, Robertson MD. Effects of intermittent fasting on glucose and lipid metabolism. *Proc Nutr Soc*. 2017;76(3):361–368. doi:10.1017/S0029665116002986
 49. Mattson MP, Longo VD, Harvie M. Impact of intermittent fasting on health and disease processes. *Ageing Res Rev*. 2017;39:46–58. doi:10.1016/j.arr.2016.10.005
 50. Longo VD, Mattson MP. Fasting: molecular mechanisms and clinical applications. *Cell Metab*. 2019;30(3):394–406. doi:10.1016/j.cmet.2013.12.008
 51. Patterson RE, Laughlin GA, Sears DD, et al. Intermittent fasting and human metabolic health. *J Acad Nutr Diet*. 2015;115(8):1203–1212. doi:10.1016/j.jand.2015.02.018
 52. US Department of Agriculture, US Department of Health and Human Services. *Dietary Guidelines for Americans, 2020-2025*. 9th ed. December 2020. Accessed December 20, 2024. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf
 53. Benson G, Hayes J. An update on the Mediterranean, vegetarian, and DASH eating patterns in people with type 2 diabetes. *Diabetes Spectr*. 2020;33(2):125–132. doi:10.2337/ds19-0073

Chapter 9: Anatomy of a Food Demonstration

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INTRODUCTION

Culinary medicine aims to give audiences the necessary knowledge and skills to adopt and sustain a nutritious eating pattern that promotes good health. A **food demonstration** can be a helpful tool when implementing culinary medicine education in many settings, including in the community. By preparing a recipe either in person or virtually, educators can provide details about the culinary techniques, ingredients, and kitchen tools needed to replicate recipes at home. For health professionals who advise patients, it is valuable to participate in or even host food demonstrations to better understand what is required of their patients to follow through with their recommendations.

An engaging food demonstration can take on a variety of formats and incorporate many different topics, such as nutrition information, mindfulness, or cultural stories, depending on the needs and interests of the audience. Food demonstrations can effectively connect with an audience in a fun and interactive way and provide an opportunity to discuss how to tailor foods and

recipes for populations with diet-related conditions without sacrificing flavor or enjoyment.

Effective food demonstrations must adhere to local health department food safety guidelines; honor the participants' culture and traditions; convey clear messages about nutrition and health; and consider participants' cooking skills, access to nutritious food, budget, and health challenges. This chapter summarizes these considerations and helps readers think through how they might develop a successful food demonstration.

FOOD DEMONSTRATIONS

This chapter discusses essential considerations for food demonstrations, including food safety, understanding your audience, and planning for in-person and virtual meetings. There are many types of food demonstrations. Three types are discussed in Table 9.1, including their unique advantages.

Table 9.1. Three Types of Food Demonstrations

Type of food demonstration	An effective way to...	Other considerations
A tasting of a single food item	<p>Introduce new foods to audiences and have conversations about seasonality. For example, sample slices of a locally grown apple can be offered at a farmers market.</p> <p>Introduce concepts such as mindful eating. For example, mindful eating</p>	<p>The demonstration setup, breakdown, ingredients, and time required will likely be minimal. This is a good demonstration for short periods of time or locations with limited utilities and resources available.</p>

Type of food demonstration	An effective way to...	Other considerations
	<p>questions may include:</p> <ul style="list-style-type: none">• What does the food item look like?• What does the food item smell like?• What does the	

Type of food demonstration	An effective way to...	Other considerations
	food item taste like?	

Type of food demonstration	An effective way to...	Other considerations
<p>A tasting of many different varieties of a single food item</p>	<p>Educate about substitutions for recipes and how a single ingredient may or may not change the flavor of a dish (e.g., using different kinds of beans for a soup and providing samples of each soup). Demonstrate how modifications to foods may or may not</p>	

Type of food demonstration	An effective way to...	Other considerations
	<p>affect the taste (e.g., providing samples of meat with different amounts of fat content to experience the texture, visual appeal, or taste differences).</p> <p>Teach children vocabulary when encountering foods that are the same and different. For</p>	

Type of food demonstration	An effective way to...	Other considerations
	<p>example, have a tasting of various apples to discuss the differences in color, texture, and taste.</p> <p>Introduce varieties of foods that may be unusual while having foods that are more recognizable present. For example, a tasting of various citrus, including navel oranges</p>	

Type of food demonstration	An effective way to...	Other considerations
	and pomelos.	

Type of food demonstration	An effective way to...	Other considerations
<p>Demonstrating a whole dish or recipe</p>	<p>Introduce a wide variety of culinary techniques, from basic to advanced.</p> <p>Educate on reading a recipe; understanding how to modify it; and using substitutions based on servings needed, dietary needs, or availability of products.</p> <p>This is an opportunity to</p>	<p>Though this is the most complex food demonstration, it does not need to be complicated to be effective.</p> <p>The demonstration can be simple and still achieve many teaching objectives.</p>

Type of food demonstration	An effective way to...	Other considerations
	<p>discuss using recipes as a template so that ingredients can be easily substituted and the recipe can be modified according to the audience's needs (e.g., demonstrating a pesto recipe to understand the framework of making an herb sauce and discussing</p>	

Type of food demonstration	An effective way to...	Other considerations
	alternative ingredients for the recipe based on seasonality).	

Why Include Food Demonstrations in Culinary Medicine?

As outlined in previous chapters, food is essential to culinary medicine. Food demonstrations can provide a way to connect with learners by engaging their senses, including sight, hearing, smell, and taste. Food demonstrations can effectively connect with an audience in a fun and interactive way and provide an opportunity to discuss how to tailor foods and recipes for populations with diet-related conditions while maintaining flavor and enjoyment.

Pleasure seeking has been identified as a notable contributor to food intake and can be used to promote more nutritious eating patterns, as observed from a body of research studies.^{1,2} Health- and pleasure-related messaging related to food can positively influence client and patient perceptions about food too.^{1,2}

ESSENTIAL INFORMATION ABOUT FOOD DEMONSTRATIONS

Understanding and Following Health Department Guidelines

This section provides an overview of health department guidelines

for food demonstrations. As a case study, the information shared pertains to public food demonstrations in Yavapai County, Arizona, as of May 2023. It is important to note that requirements may vary based on state and local regulations. Before providing food demonstrations, verify specific food demonstration requirements with your local regulatory agency.

Permit requirements: Permits are often required to conduct a food demonstration; see your local health department guidelines for specific information. For example, in Yavapai County:

- A permit is required to conduct a food demonstration when the audience consumes the food or samples are provided to the public.
- Permit applications must be submitted at least 21 days before the demonstration date and must include the location, date, and time of the event.

Food preparation and handling requirements: Preparation and handling of foods are essential to avoid cross-contamination and overall food safety. For example, the following are requirements in Yavapai County:

- Food preparation must be done in a licensed kitchen or on site with prior approval from the health department.
- Food must be served at safe temperatures using proper serving utensils.
- Food must be stored, transported, and displayed to prevent contamination, including protection from insects and rodents.
- Demonstrators or servers must wear appropriate clothing, including hairnets and gloves.
- Handwashing stations must be available by demonstrators or anyone handling food.

Cleanliness requirements: Cleanliness of the demonstration area is essential to ensure the safety of food samples. For example, in Yavapai County:

- The demonstration area must be clean and free from clutter.
- Tables and other surfaces must be wiped down and sanitized before and after the event.
- Trash and other waste must be disposed of appropriately.

By securing the necessary permits and adhering to the established guidelines, demonstrators can establish an enjoyable and secure environment for all parties involved. For more information, see [Food Code 2017](#) from the US Food and Drug Administration (FDA).

YOUR AUDIENCE AND THEIR MOTIVATIONS

Understanding your audience and its motivations is essential for creating compelling and engaging demonstrations. These factors will influence the audience's receptiveness and learning experience, including cultural background, participant cooking-skill level, and budget considerations.

Cultural Backgrounds

When planning and implementing food demonstrations, you can promote diversity and inclusion by respecting, honoring, and being aware of cultural considerations, such as dietary restrictions, practices, and norms. Not only does this foster inclusivity, it also allows for better alignment of the food demonstration with the audience's needs.

Considerations for Cultural Backgrounds

- **Cultural and religious dietary restrictions.**

Consider the culture and religion of the audience. For example, avoid combining meat and dairy products on 1 serving dish if cooking for a **kosher** audience. For a Muslim audience, avoid using ingredients such as wine or alcohol in sauces or marinades.

- **Cultural norms and practices.** Think about staple ingredients, flavors, cooking methods, utensils, and appliances specific to the audience's culture and what they will likely use when preparing food. Also, consider the family structure of the participants and how that may influence how and when they prepare food. For example, participants living alone may have very different mealtime needs than a family of 5 with small children.

- **Food accessibility and familiarity.** Often, ingredients are readily available in some regions or countries but may



Figure 9.1. When planning a food demonstration, consider your audience's cooking equipment and methods, available ingredients, budgets, and cultural backgrounds. "Africa, Zimbabwe, Human" by Albrecht Fietz is licensed under a Pixabay License.

be difficult to find in others. Foods also vary in availability, depending on the season. Consider the foods the audience will have access to and be familiar with when planning the demonstration.

- **Equipment and cooking methods.** Consider the equipment and cooking methods the audience will have access to and be familiar with when preparing food. In China, for example, ovens are rarely used but woks and grills are common.
- **Use clear and simple language.** Avoid terms that might be unfamiliar to the audience.
- **Visual aids and written instructions.** Visual aids, such as printed recipes, ingredient lists, and written instructions, can bridge the language gap and provide clear instructions on techniques, ingredient sizes, and cooking times. When providing these resources, consider the audience's primary language and reading level, and align terms used in the food demonstration with any written instructions to ensure instructions are easy to understand. Also [consider differing abilities](#) within the audience, and ensure that written documents, especially when shared electronically, are [accessible](#).
- **Body language and gestures.** Functions such as cutting, stirring, or rotation can be visually expressed to enhance understanding regardless of language barriers.
- **Multilingual support.** If possible, provide multilingual support by having an interpreter or translator assist with real-time translation or subtitling during a food demonstration. This ensures that participants who do not understand the primary language can still follow the demonstration and understand instructions. See ADA.gov's advice on [Communicating Effectively with](#)

[People with Disabilities](#) for more detailed information.

- **Encourage questions and feedback.** Promote a judgment-free, inclusive, and supportive environment by having participants give feedback on their understanding of the ingredients, cooking techniques, and the demonstration overall. This will provide an opportunity to discuss barriers and potential language-related challenges.
- **Adapt to participants' needs.** Use the audience's cues and feedback to adjust the teaching style and cooking skill level accordingly, and provide additional explanations as needed.

Remember that traditional, cultural, and ethnic foods can be nutritious without **healthifying** them. “Healthifying” a recipe (i.e., altering a recipe to make it more healthy) can be taking out the fat source, substituting key ingredients with those that have more vitamins or less salt, or a variety of other changes that alter the essential character of the recipe. An example is changing a braised greens dish that traditionally includes bullion and bones to one that includes no salt or meat.

Let the audience know you are a health-care and/or nutrition expert but that you understand that the audience is the expert in their culture, and you are always



Figure 9.2. Food demonstrations can introduce audiences to dishes they may not have tried before. “Food, Naan, Curry” by Adrega is licensed under a Pixabay License.

learning from the audience. If the audience wants more nutritious options within cuisines, focus on reducing sodium, sugar, and saturated fat. It is important not to demonize any foods, because all foods fit into a balanced eating pattern.

The “Considerations for Cultural Backgrounds” section in this chapter provides general guidance. More research and discussion with individuals from specific cultural and religious groups are necessary to ensure accuracy and appropriateness in meeting specific dietary needs and preferences. See [chapter 12](#) for more details on culturally centered approaches to culinary medicine.

To learn more about traditional, cultural, and ethnic foods, see these additional resources:

- [Cultural and Traditional Foods](#) (US Department of Agriculture’s National Agricultural Library)
- [Food, Culture, and the Secret Ingredient to Address Lack of Diversity in the Nutrition Field](#) (American Heart Association)
- [Culture and Food](#) (US Department of Agriculture’s Nutrition.gov)
- [Cultural Considerations in Nutrition and Food Prep](#) (California Department of Social Services)

Participant Cooking Skill Level

It is crucial to consider the participants’ cooking skill level when choosing a recipe and the culinary skills that will be explained during the demonstration. Use the below activity to test your knowledge about cooking skill levels.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

[https://opentextbooks.library.arizona.edu/](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-68)

[culinarymedicine/?p=425#h5p-68](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-68)

Based on varying skill levels, consider how a food demonstration or recipe can be modified to fit the audience's needs. This is an important way to ensure the audience gets the most use of the information provided. For more information on culinary skills, see [chapter 2](#).

Budget Considerations

When conducting food demonstrations, it is important to consider budget and food availability to ensure the practicality and accessibility of the recipes and ingredients. Consider the following questions when planning a food demonstration:

- How many servings does the standard recipe make, and how much will this recipe cost to make per person or serving?
- Does the audience have access to all the ingredients in the recipe at what they would consider a reasonable cost?
- If the recipe is scaled up or down, how does this affect the cost?

For more information on food costs, refer to [chapter 1](#).

Recipe Selection

For recipe options and potential recipe modifications, refer to [appendix B](#). Consider these additional factors when planning food demonstrations:

- The state of wellness or illness and possible health challenges to address with the audience (see [chapter 12](#)).
- How easy or difficult it is to increase or decrease the serving size (scale up or down) the food demonstration relative to the audience and their needs. For example, factors in making a double recipe to provide enough samples for the entire audience or when discussing the recipe with a participant who cooks for their larger family.
- Consider the amount of time available for the demonstration and choose a recipe that will fit the schedule. For example, if preparing a long recipe in a short amount of time, choose a recipe that allows for the advanced preparation of ingredients.

Recipe Analysis

Nutritional recipe analysis may be beneficial for a food demonstration to promote the health and nutritional benefits of the ingredients used. The use of calculated nutrition data can assist in this. Although many nutritional analysis software programs require a subscription, [Cronometer](#) has a user-friendly mobile and desktop application and can be used to create custom recipes.

Use these resources to learn how to create custom recipes in Cronometer:

- [Desktop version](#)
- [Mobile version](#)

Health Messaging

An important part of a food demonstration is the messaging during the demonstration. Always use messaging that is true, accurate, relevant, and evidence based. It is important to note that specific and effective health information can be provided without framing health as only physical health, using weight as the end goal of health, or making assumptions about food access. When planning messaging for a food demonstration, refer to the health considerations in other chapters and consider the following questions:

- What type of health or nutrition information will be meaningful to the audience? For example, health messaging for a prediabetic audience may differ from the messaging for a cancer prevention group.
- How can the demonstration or recipe be modified to provide the best information for an audience's specific health concerns? What questions might the audience have about the recipe or foods discussed?
- What are the important nutrients in the foods featured and how can the demonstrator make this relevant to the audience?
- What other points are important to mention during this demonstration that do not solely focus on physical health?

PREPARING AND PRESENTING A FOOD DEMONSTRATION

Food Safety Practices

When conducting a food demonstration, prioritize food safety practices to guarantee that the food served is delicious and safe.^{3,4} To ensure food safety, check with your local health department (see section above) and follow these guidelines^{3,4}:

- Ensure that the demonstrator's hands and the audience's hands are thoroughly washed before handling any food. Personal hygiene is the most essential aspect of food safety.
- Store cooked and raw foods properly in accordance with **time/temperature control for safety (TCS)** food regulations. Raw produce, dairy, eggs, and raw meat products are all highly vulnerable to bacterial growth if not stored and cooked at appropriate temperatures.
- Sanitize all cooking utensils and surfaces regularly to prevent cross contamination.
- Prioritize the safety of food samples during demonstrations involving perishable food.



Figure 9.3. If you share food samples, follow strict safety guidelines and alert the audience to potential allergens. "Food Market, Parliament Street, Cooking Demonstration" by alh1 is licensed under CC BY-NC-ND 2.0.

- Carefully consider all aspects of the process (including procurement, preparation, transportation, and consumption) to prevent contamination and ensure food safety.

Temperature Control

Maintaining proper temperature control is important for TCS foods and preventing microbial contamination. To achieve safe conditions, keep the ingredients at or below 40 °F (4 °C) in the refrigerator and at 0 °F (−18 °C) in the freezer.⁵ There are a variety of factors when ensuring the cold holding temperature of the foods to be used in the demonstration, including transportation conditions and packaging. See the accompanying activity for additional guidelines (select the > to read more).



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-66>

Cross-Contamination

To safeguard against the risks of biological and chemical cross-contamination, it is important to take comprehensive precautions. See the accompanying activity for guidelines to follow.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-65>

Allergens

When conducting a food demonstration, it is important to consider potential allergens and hidden ingredients. See the accompanying activity for guidelines to follow.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-67>

Informing the audience about food allergens during a cooking demonstration is important to ensure safety and prevent potential allergic reactions. By actively and effectively sharing allergy profiles, a safe and inclusive environment can be created at the food

demonstration. The accompanying activity provides strategies for communicating about allergens to the audience.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-69>

IN-PERSON AND VIRTUAL VENUE CONSIDERATIONS

In-person and virtual food demonstrations are similar, with a few exceptions. The following sections detail their differences and similarities.

In-Person Food Demonstrations

In-person food demonstrations require understanding of the logistics and location needs of a face-to-face audience while simultaneously preparing food and engaging them. Factors such as sanitation, food safety, location, utilities, equipment, and audience accommodations must all be considered when planning the food demonstration. See earlier sections in this chapter for more information on health department requirements and audience considerations. Here are some questions to ask and answer to have a successful face-to-face presentation:

Sanitation and Safety

- Does this location allow for following all local health department guidelines?
- How will audience members' allergies or food sensitivities be handled to ensure participants' safety?

Location, Utilities, and Equipment

- Will the food demonstration be inside, outside, or in an area that will pose restrictions (e.g., in a space with no open-flame requirements)?
- Is the recipe appropriate for this location?
- What utilities will be available at the location (e.g., water, electricity)? Are they in a convenient location for the food demonstration?
- If using commercial equipment, consider that conventional or home equipment may be very different to work with when participants create the foods at home. Be sure to mention the differences, if necessary.

Audience Accommodations

- Have audience considerations (e.g., cultural background, skill level, budget) been addressed?
- Where will participants watch the food demonstration and how many people will fit comfortably in the area?
- Will all participants be able to see and hear what the demonstrator is doing?

Virtual Food Demonstrations

As mentioned previously, there are different considerations for virtual food demonstrations. These include:

- **Camera, sound, and lighting setup.** Be careful with camera lenses, lighting, and angles to ensure participants can see the cooking process and ingredients clearly. Position the camera with a clear view of the cooking area and use adequate lighting to maximize the field of view. Make sure the audience will be able to always hear the demonstrator, especially during the cooking process, when equipment can create background noise.
- **Interactive elements.** Include interactive elements to increase engagement, such as polls, question-and-answer sessions, or live discussions. During the food demonstration, encourage participants to ask questions, provide feedback, and share their experiences. This may require having an additional person working at the food demonstration as a moderator.



Figure 9.4. Camera equipment, lighting, and audio are some of the many logistics to consider. “Camera, Camera Equipment, Interview” by Pexels is licensed under a Pixabay License.

Table 9.2 lists contrasting elements of an in-person vs virtual food demonstration.

Table 9.2. Considerations for In-Person, Virtual, or Hybrid Food Demonstrations

Consideration	In person	Virtual	Hybrid
Audience	Expect or promote much interaction, questions, need to engage audience	If interactive virtual platform is used, provide a moderator for questions in chat or technical difficulties	Appeal to audience senses using vivid descriptions

Consideration	In person	Virtual	Hybrid
Location and logistics	Ability for audience to see and hear food demonstration comfortably without distractions	Camera type (built-in vs handheld with tripod), video streaming/recording platform (e.g., Zoom, Panopto, Teams, WebEx, YouTube, Facebook, Instagram)	Stay with allotted time, light (natural or artificial), audio (microphone) and speakers necessary

Consideration	In person	Virtual	Hybrid
Accommodations	Awareness of food safety and allergies, if sampling	Moderator to address needs of audience	Suggestion for substitution or alternative ingredients; discussion of recipe

Food Demonstration Tips and Tricks

- **Introduce yourself.** The demonstrator should introduce and share information about themselves to gain credibility and trust.

- **Engage with the audience.** Ask questions throughout and pause to allow the audience to ask questions.

- **Share cost-effective and time-efficient tips.** Provide time- and money-saving suggestions throughout the food demonstration.

- **Motivate the audience.** Provide scientific evidence for why ingredients or recipes are beneficial for their specific needs.

- **Share evidence-based information and personal experience.** Balance science information with your brief personal experience with ingredients to provide inclusivity.

- **Promote nutrition-related tips.** Provide ideas for substitutions and ingredient alternatives.

- **Stay positive.** If everything does not go as planned, that



Figure 9.5. Stay positive and engage with the audience when presenting a food demonstration. Using a headset keeps your hands free while amplifying your voice. “Food Market, Parliament Street, Cooking Demonstration” by alh1 is licensed under CC BY-NC-ND 2.0.

is okay. Many tips and tricks can be learned from mistakes.

Review key points about food demonstrations with this activity.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=425#h5p-75>

See the resources below for more information on conducting a food demonstration:

- [Food Demonstration Guide](#) (AZ Health Zone)
- [How to Do a Food Demonstration](#) (Cornell Cooperative Extension of Erie County, NY)
- [How to Do a Food Demonstration](#) (Cornell Cooperative Extension of Oswego County 4-H Program)
- [Safe Food Sampling \(University of Minnesota Extension\)](#)
- [Recipe for Success](#) (Center for Rural Health)
- [How to Make Documents Accessible](#) (AbilityNet)
- [The Language of Health Style Guide](#) (AZ Health Zone)

VIDEOS ON HOW TO CONDUCT FOOD DEMONSTRATIONS

- [How to Deliver a Virtual Cooking Demonstration](#) (AZMilkProducers)
- [Kitchen Studio Tour: Facilitating a Live Cooking Demo](#) (Living Plate Rx)

ADDITIONAL FOOD DEMONSTRATION VIDEOS

These food demonstration videos provide a diversity of education styles and demonstrate the variety of ways to present food education:

- [Chicken and Sausage Gumbo](#) (Smokin' & Grillin with AB)
- [Knife Skills: How to Break Down a Whole Chicken](#) (Serious Eats)
- [Classic French Omelette](#) (Jock Zonfrillo)
- [Kale Chips](#) (Food & Nutrition with Diane Saenz, University of Wyoming Extension)
- [Variety of short food demonstrations](#) (UTHealth Houston School of Public Health)
- [Variety of short food demonstrations](#) (The Permanente Medical Group, Inc.)

Key Takeaways

- Food demonstrations can be an effective way to connect

with an audience and educate them on a variety of culinary medicine topics.

- Food demonstrations must follow strict food safety guidelines to ensure the safety of the audience.
- Understanding the audience is a key factor in creating effective food demonstrations.
- When planning a food demonstration, it is important to keep in mind that there are differences between in-person and virtual demonstrations. Although many considerations are similar, specific factors should be considered for each type of demonstration.

REFERENCES

1. Vaillancourt C, Bédard A, Bélanger-Gravel A, et al. Promoting healthy eating in adults: an evaluation of pleasure-oriented versus health-oriented messages. *Curr Dev Nutr*. 2019;3(5):nzz012. <https://doi.org/10.1093/cdn/nzz012>
2. Bédard A, Lamarche PO, Grégoire LM, et al. Can eating pleasure be a lever for healthy eating? A systematic scoping review of eating pleasure and its links with dietary behaviors and health. *PLoS One*. 2020;15(12):e0244292. <https://doi.org/10.1371/journal.pone.0244292>
3. Direct to Consumer Delivery Committee, 2018-2020 Conference for Food Protection. Guidance document for direct-to-consumer and third-party delivery service food delivery. 2020. Accessed August 7, 2023. <http://www.foodprotect.org/media/guide/guidance-document-for-direct-to-consumer-and-third-party->

[delivery.pdf](#)

4. James K. “Out of the box” food safety considerations for meal kits. National Collaborating Centre for Environmental Health. March 11, 2022. Accessed August 7, 2023. <https://ncceh.ca/resources/evidence-briefs/out-box-food-safety-considerations-meal-kits>
5. Are you storing food safely? US Food and Drug Administration. Accessed November 20, 2024. <https://www.fda.gov/consumers/consumer-updates/are-you-storing-food-safely#>

Chapter 10: Seed-to-Table Programs

By Hope Wilson, MPH, RDN; Jennifer Parlin, MPH

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INTRODUCTION

Seed-to-table programs promote ecologically friendly agriculture and teach how to grow, buy, store, and cook foods, often emphasizing the local food system and seasonal foods, which can be more nutritious and flavorful, given their local origin. Seed-to-table programs are diverse, vary by community, and can include (depending on the community) home gardens, **community gardens, farmers markets, mobile markets, community-supported agriculture (CSA), food hubs, gleaning** programs, and **farm-to-institution programs**. Communities may have multiple seed-to-table programs that can strengthen local and regional **food systems** and increase access to fruits, vegetables, and other nutritious foods. Culinary medicine programs can partner with organizations to build connections among health-care providers, communities, and patients they serve.

This chapter covers how culinary medicine can complement seed-to-table programming, concepts related to seed-to-table

concepts, and examples of different types of seed-to-table programs that can be integrated into culinary medicine.

WHAT IS SEED-TO-TABLE?

Seed-to-table programs, also known as farm-to-fork or farm-to-table, narrow the gap between where food is produced and where it is consumed, connecting food consumers and food producers. They also provide opportunities for partnering with nutrition education and culinary medicine programs to support and enhance potential health benefits.

OPPORTUNITIES FOR CULINARY MEDICINE

There are many opportunities to connect culinary medicine and seed-to-table initiatives, such as helping raise awareness about a variety of seed-to-table initiatives; promoting nutrition assistance programs that can be used to access local produce; demonstrating how to prepare new foods; providing nutrition education; and teaching storage and preservation methods.

Special considerations for culinary medicine programming include seasonality, climate, and geography, which are all factors that affect when and what foods are available. Because fruits and vegetables can become overly abundant at the peak of the season, there are some important skills, knowledge, and processes that are needed to capture all the harvest for use throughout the year. Safe and effective food storage and food preservation methods—such as freezing, dehydrating, and canning—help stretch food dollars, extend the use of produce throughout the year, and save food for when it is needed outside the growing season. See [chapter 2](#) for advice on preparing and storing nutritious food and preventing food waste.

Community-supported agriculture programs, gleaning projects, and food pantries may provide foods to consumers that they have

never seen before. Consumers may be new to purchasing fresh produce at farmers markets or harvesting vegetables from a garden. As a result, they may not have the skills or knowledge to prepare some of the food received. For example, education may be needed to demonstrate what to do with whole beets that still have greens attached or how to prepare vegetables such as kohlrabi that are not commonly found on most plates in the United States.

Culinary medicine programs can conduct cooking demonstrations and provide nutrition education, resources, and recipes for participants who are picking up food at food pantries and other emergency food sites. Similar programming would benefit CSA members by partnering with farmers to plan for what will be in the upcoming share and provide education or demonstrations at CSA pickup locations.

Culinary medicine programs can provide nutrition education, resources, and recipes for participants picking up food at **food pantries** and other emergency food sites through gleaning programs and food purchased at farmers markets and through CSA programs. Knowledge of local programs can help patients develop an affordable food-access plan that maximizes food access and sustains a healthy eating plan.

Connecting with other community nutrition programs such as the Supplemental Nutrition Assistance Program Education (SNAP-Education) or the Expanded Food and Nutrition Education Program (EFNEP) can help to expand reach to many underserved audiences. [AZ Health Zone](#) is Arizona's SNAP-Education program and the University of Arizona Cooperative Extension delivers [EFNEP in Arizona](#).

Nutrition education—particularly education that is culturally sensitive, regionally relevant, and age appropriate—through the US Department of Agriculture (USDA) Farmers Market Nutrition Programs (FMNP) and other seed-to-table related outlets, can result in people increasing their consumption of fruits and vegetables.¹ Many farmers markets provide space for local chefs or educational organizations to provide food demonstrations, taste

tests, nutrition education, and tips. More information about FMNP can be found in Table 10.1.

Culinary medicine programs can also work with clients and health-care providers to increase awareness of seed-to-table programs that might best meet their needs or connect them with nutrition assistance programs or fruit and vegetable incentive programs that can help them purchase local and fresh fruits and vegetables.

SEED-TO-TABLE CONCEPTS

Seed-to-table programs are connected to local and regional food systems and, as a result, come with some unique opportunities for culinary medicine and potential partnerships with other community organizations, such as farmers markets, **food banks**, local health departments, housing organizations, hospitals, and Cooperative Extension, to name just a few. See [chapter 11](#) for more information about community partnerships. The following concepts are important to better understand seed-to-table programs and how they can be connected to culinary medicine.

Food systems are composed of the different elements that are necessary to bring food from seed to table. These are often characterized as linear, beginning with producers and ending with consumers. This might also be called a **supply chain**. However, according to the USDA, “the concept of a food system represents a contrast to notions of agriculture and food production and consumption as a simple, linear chain from farm to table.”² Instead, as shown in Figure 10.1, food systems are cyclical and comprise complex networks. The USDA continues by stating “food systems can vary substantially from place to place and over time, depending on location specific conditions. The food systems concept provides a comprehensive framing through which to assess the social, economic, and environmental dimensions of sustainability.”²

Food systems can look very different with different inputs and

outputs to consider, as well as location, availability of foods, and local resources all contributing to those differences. With so much variability, understanding the local food system can help physicians, dietitians, and other health-care providers advise and support patients in developing an eating plan that promotes sustained access to nutritious and affordable foods.

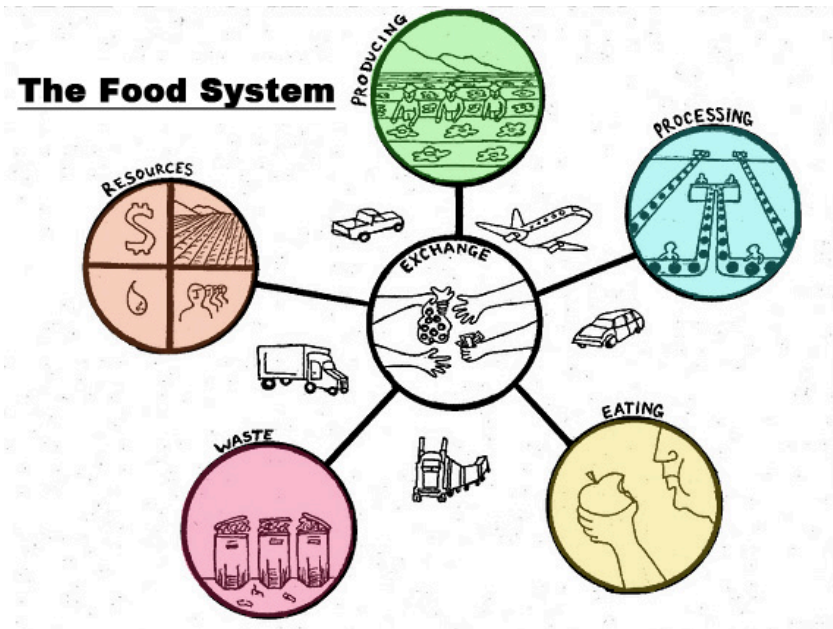


Figure 10.1. Food systems are cyclical and comprise complex networks. "Food System" by Hunt041 is licensed under CC BY-SA 3.0.

Urban food systems often have more access to foods within a smaller radius, but this is not always the case. In fact, older research suggested that individuals in urban environments had better diets because of their access to more foods, but this does not extend to the whole population of urban areas. Individuals with lower incomes in urban areas had less access to fresh produce, beans, or tubers and more access to foods that were processed

and had higher amounts of fat and sugar.³ This reinforces the need to understand the local food system in which work will take place, as well as societal factors that contribute to differences in food access for specific populations (see [chapter 12](#) for more information).

Test your knowledge with the activity below:



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Urban and rural areas that were once classified as “food deserts” are now referred to as “low-access areas.” In the Food Access Research Atlas, “low access to healthy food is defined as being far from a supermarket, supercenter, or large grocery store. A census tract is considered to have low access if a significant number or share of individuals in the tract is far from a supermarket.”⁴

Learn more in the activity below:



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When thinking about food systems, it is important to consider **food sovereignty**, which, as described by [US Food Sovereignty Alliance](#), “puts the aspirations and needs of those who produce, distribute, and consume food at the heart of food systems and policies, rather than the demands of markets and corporations.”⁵

There is often a power imbalance in food systems that should be carefully considered when thinking about culinary medicine programming and how it will look in each community. To learn more about the aspirations of the community, it is important to engage with the community in a thoughtful manner. See [chapter 11](#) for more on **community engagement**.

To continue learning about food systems and the benefits of a local food system, [see the suggested/additional reading list](#) at the end of this chapter.



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The term **“local” food** does not have 1 clear definition. In many cases, it may be based on the geographic proximity between the producer and consumer—also known as a **food shed**. For example, in the 2008 Farm Bill, “local” included a measured distance in miles, so that the “total distance the product is transported is less than 400 miles from its origin.”⁶ However, there may be other factors to consider, such as population density, regional identities, or political boundaries such as counties or state borders.⁷ Finally, “local” may depend on the relationship between the producer and consumer and, as the National Agricultural Library (NAL) describes, the “complex social and economic forces that affect the producers and consumers of local food.”⁸

TYPES OF SEED-TO-TABLE PROGRAMS

Gardens

There are a variety of options for consumers to grow their own food, including home gardens, community gardens, and educational gardens like those at schools or childcare sites.

Home gardens can vary in size and production capability, from producing enough to feed a household all year to a small windowsill herb garden. Generally, home gardeners will need to supplement their harvest with other food sources. [University of](#)

[Arizona Cooperative Extension](#) and its [Master Gardeners](#) are an excellent resource for home gardeners.

Community Gardens

Community gardens can help increase access to fruits and vegetables for people living in apartments or other housing options that do not have access to an outdoor space to grow a garden. Community members may lease a plot or bed in the garden to plant and care for their own vegetable garden. In some situations, community gardens are also sources of produce to be donated to food pantries or may be located on the property of a housing facility to be used in the communal kitchen or for individual use by residents.

Historically, there have been many community garden initiatives in the United States during national food shortages, depressions, recessions, or times of war to address hunger or other social issues. These include the wartime or liberty gardens during World War I or the Victory Gardens of World War II.⁹

[Community Gardens of Tucson](#) is a nonprofit organization that works with public and private partners to develop and maintain community gardens in the area. It has a website that includes [a map of its community gardens](#) and [other resources](#).

School Gardens

Some gardens, such as school gardens, also serve an educational purpose. They can be large plots of land on school grounds or nearby land, or they can be small pots on a classroom windowsill. The primary purpose of a school garden is to provide hands-on experiential learning opportunities for students. School gardens can be used for teaching health and nutrition, science, mathematics, language, arts, and nearly any other classroom

subject. Gardens can also be used to complement classroom learning experiences.

In most cases, school gardens do not produce enough food for use in cafeterias, but what is produced may be used for fruit or vegetable taste tests, cooking activities, or other nutrition education activities. School gardens, specifically with garden-based nutrition education, are likely to increase students' willingness to try vegetables and their preference for fruits and vegetables. They can also increase students' vegetable consumption.¹⁰⁻¹⁵

Watch this [video from the OC Johnson Elementary School Community Garden in Yuma, Arizona](#), to see the opening of a combined school and community garden:



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Urban Agriculture

According to the NAL, **urban agriculture** “allows for the development of a variety of environmental, economic, and social benefits to the surrounding communities. Urban farming can reduce transportation costs, help reduce runoff associated with heavy rainfall, and lead to better air quality.”¹⁶ Community gardens may fall under the umbrella of urban agriculture; however, in many cases, urban agriculture produces food on a larger scale to be sold for a profit. Due to limited space in many urban areas, urban

agriculture may make use of spaces such as rooftops, edible landscapes, or vertical farming.

DIRECT MARKETING

According to the University of California Sustainable Agriculture Research & Education Program, **direct marketing** allows farmers “to earn a greater portion of the consumer food dollar by eliminating intermediary brokers, buyers, and distributors.”¹⁷ Direct markets can “contribute to sustainable agriculture and food systems by increasing farmer profitability, promoting the local economy, and providing consumers with higher quality and healthier products.”¹⁷ Examples of direct marketing include farmers markets, CSA, and farm-to-institution programs.

Farmers Markets

Farmers markets can be operated by nonprofits or small business organizations that provide space for farmers and other food vendors to sell their products directly to consumers. In some cases, it might simply be a group of farmers who regularly gather to sell their products at a specific time and place. How a farmers market operates and what is sold may vary based on state and local laws and regulations.

Because farmers markets do not require the infrastructure and permanent space needed for



Figure 10.2. Customers can purchase vegetables directly from growers at farmers markets. “Deering Oaks Farmers Market” by Corey Templeton is licensed under CC BY-NC-ND 2.0.

brick-and-mortar businesses such as **grocery stores**, the overhead for operations is much lower, and they provide opportunities for small food businesses or farmers to get started and increase their profit. They can also provide access to fruits and vegetables in locations that would not be able to support a permanent or large retail food store, especially in urban areas that may only have small **corner stores**, liquor stores, or fast-food chains and are lacking an outlet for healthy foods such as fresh fruits and vegetables.

Farmers markets often serve as more than places to buy food. They can be community gathering spots, providing opportunities to build community connections and for consumers to interact with those in the community who grow food.

For a behind-the-scenes look at a farmers market and how it connects with communities, watch this [video from the Prescott Farmers Market](#) in central Arizona:



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Watch this [video from the Community Food Bank of Southern Arizona](#) to learn about its farmers market:



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Mobile Markets

A mobile market could act as a farmers market on wheels, but rather than farmers and consumers all traveling to 1 location to sell and purchase fresh produce, the mobile market takes all the produce from 1 farm or aggregated produce from multiple farms directly to consumers who have limited access. They allow some flexibility, such as adjusting dates or times of arrival or customizing products offered based on community preferences, to better serve communities with low food access.¹⁸

[Read this success story of a mobile market in Albuquerque, New Mexico](#), which was established to increase access to fruits and vegetables in a low-access area.

Community-Supported Agriculture

With CSA, “growers and consumers provide mutual support and share the risks and benefits of food production.”⁶ Usually, the share or membership is a full payment made to the farmer for the upcoming season or for the whole year ahead. The farmer uses these funds to cover costs for equipment and other supplies needed to prepare for the upcoming growing season. In return,

CSA members receive a portion of whatever is produced, usually vegetables, fruits, and herbs. Some CSA programs might also include other products such as flowers, eggs, cheese, or baked goods.^{19,20} Sometimes, a farmer might offer reduced membership costs in exchange for time spent working on the farm.

Community-supported agriculture programs vary by farm and community, but most arrange for local pickup locations or on the farm. Some employers may include CSA membership as an incentive for employees as part of their health promotion programs.

Community-supported agriculture programs may be challenging for some because, unlike farmers markets, members usually do not select items they are buying from the farmer. Therefore, they do not know what they will receive, because the harvest depends on the season, weather, what was planted earlier in the year, and other factors that affect what and how well the farm will produce that year. As a result, members must be willing to try new things and have the skills and creativity to prepare meals with what they receive. Members may receive foods with which they are unfamiliar and may not have the culinary skills and/or experience to be flexible with recipes and ingredients. See [chapter 2](#) for more information on how to safely prepare and store nutritious food.

For more information about CSAs, watch the [“What is a CSA? | From the Ground Up video”](#) from University of Wyoming Extension for a short and simple introduction:



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For a more comprehensive explanation from a young farmer who also provides education with her CSA, [watch this Farming Matters webinar about Soul Food Project's Urban CSA](#).

Farm-to-Institution Programs

Farm-to-institution programs connect local and regional farms with institutions such as schools, childcare centers, hospitals, prisons, universities and colleges, worksites, and faith-based organizations. Many farm-to-institution programs include educational components such as cooking classes or demonstrations, nutrition education, taste tests, information about local agriculture and food systems, and gardening. Some institutions may also feature on-site farmers markets or sponsor food boxes or CSA shares.²¹

[Watch this video from American Farmland Trust](#) to see how farm-to-institution programs operate in New York.

For more information about different farm-to-institution models, [this brochure from the USDA outlines a variety of farm-to-institution programs](#) with short case studies for each.

Farm to school is perhaps the most recognized type of farm-to-institution program. They vary by location, but always include at least 1 of the following components:

- Procurement (purchase) of local food for use in school meals, snacks, taste tests, or other educational activities

- Gardening activities either as part of an outdoor school garden or small containers inside or outside the classroom; providing hands-on educational activities
- Educational activities related to food, agriculture, nutrition, and so forth²²

Watch this [USDA video](#) that briefly outlines farm-to-school programs:



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Farm to hospital is a farm-to-institution program that is focused on health-care institutions. This may include hospital food services procuring food from local sources, connecting health promotion programs to local fruit and vegetable producers, a **Fruit and Vegetable Prescription Program**, employee CSA membership, or farmers markets at the hospital. The University of Arizona partners with Sun Produce Coop to conduct a [Fruit and Vegetable Prescription Program](#).

Watch this [video](#) from [North Central Region Sustainable Agriculture Research and Education](#), which illustrates an example of a farm to hospital program that also include cooking demonstrations and connections to farmers markets.

STRENGTHENING LOCAL AND REGIONAL SYSTEMS

The following are examples of strategies that can be used to strengthen local and regional food systems and develop connections with seed-to-table programs.

Gleaning

Gleaning initiatives can support community food security and reduce food waste. Farms may have bins in the fields for collecting produce that does not meet retail outlets' specific criteria, such as shape or color. This food will be donated to an emergency food provider. Other gleaning initiatives may harvest produce from fruit trees at private homes, public spaces, or produce not collected from community, school, and backyard gardens. Many gleaning initiatives rely on volunteers to harvest, pick up, sort, and deliver fresh fruits and vegetables to emergency food providers or charitable organizations to help distribute the produce to families with low incomes.

Gleaning projects can be mutually beneficial for producers and consumers. For example, collecting fruit from trees in backyards or in public spaces removes food that would otherwise pile up, attract wildlife and pests, or rot because homeowners or governments do not have time or resources to remove the fruit themselves. This also is a source of fresh produce for food pantries that can be provided to families.

For an example of a gleaning program that provides produce to a food bank, watch this [video about Maryland Food Bank: Farm to Food Bank Program](#):



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Food Hubs

Food hubs can help strengthen local and regional food systems and increase access to fruits and vegetables in communities with low incomes.²³ Food hubs can be for profit or nonprofit and can facilitate a direct marketing link between local fruit and vegetable producers and retail and institutional buyers and other mainstream markets such as retail outlets, schools, and hospitals.²⁴

Many food hubs may serve as an aggregation point for small local food producers to sell to larger markets. They may also include space and resources such as training and access to a community or shared kitchen to assist local food producers develop **value-added** agricultural products to increase the variety of products they offer and increase the number of markets to which they can sell their products. [Watch this video from the Utah Department of Agriculture and Food](#), which describes how food hubs operate within local and regional food systems.

Shared-Use Kitchens

The [Shared Kitchen Toolkit](#) by The Food Corridor states that small

or new food businesses that rent space in a **community or shared-use kitchen** “on an hourly, daily, or monthly basis . . . can produce food in compliance with regulatory requirements without needing to invest in their own facility during a stage when capital and cash flow are a challenge.”²⁵ [Read this case study about Chiknegg Kitchen in Virginia](#) from the USDA Agricultural Marketing Services to better understand how a shared-use kitchen can affect local communities.

Nutrition Assistance Programs

There are several **nutrition assistance programs** that can help individuals and families purchase food from local food systems. Table 10.1 lists just a few examples.

Table 10.1. Examples of Nutrition Assistance Programs

Program	Description
Supplemental Nutrition Assistance Program (SNAP)	<p>Administered through the USDA's Food and Nutrition Service, SNAP provides eligible households with monthly benefits they can use to purchase nutritious food, vegetable seeds, and food-producing plants, roots, and trees. Families and individuals who meet income guidelines may be eligible to receive SNAP benefits. Recipients receive their SNAP benefits on an Electronic Benefits Transfer (EBT) card (an electronic payment system debit card). Benefits can be redeemed at many farmers markets, allowing shoppers with low incomes to access fresh, locally grown foods.²⁶</p>

Fruit and vegetable incentive programs

These programs provide matching funds to participants to purchase fresh fruits and vegetables. Many programs match participants' SNAP benefits that are spent to provide additional benefits that can be redeemed at farmers markets, mobile markets, or through CSA shares to purchase fresh fruits and vegetables. These incentive programs are often funded by nonprofit organizations, private foundations, or state or local governments.²⁷

Double Up Food Bucks is a fruit and vegetable incentive program that operates in 25 states and matches SNAP EBT dollars so participants can get twice the amount of fruits and vegetables. In Arizona, [Double](#)

	<p>Up Food Bucks allows current SNAP participants to receive additional fruits and vegetables.</p> <p>Watch this video from North Dakota State University Extension to learn more about how Double Up works in that state.</p>
<p>Farmers Market Nutrition Programs (FMNP)</p>	<p>Through the Special Supplemental Nutrition Program for Women, Infants, and Children (commonly known as WIC), FMNP and the Senior FMNP provide low-income women, children, and older adults with vouchers for fresh, locally grown fruits and vegetables that can be redeemed at farmers markets and produce stands, or for shares in CSAs.^{28,29} See the Arizona Farmers Market Nutrition Programs.</p>



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Key Takeaways

- Seed-to-table programs can help build connections between consumers and producers, increase access to fruits and vegetables, and support local and regional food systems.
- There are many different models of seed-to-table that can be implemented in partnership with culinary medicine. Evidence suggests that many of the health and nutrition benefits of select seed-to-table programs are more pronounced when paired with nutrition education, cooking demonstrations, and hands-on experiential learning opportunities.
- Nutrition assistance programs such as SNAP, FMNP, fruit and vegetable incentives, and emergency food providers that participate in seed-to-table programs can help reduce disparities in access to fresh fruits and vegetables in communities with low incomes.
- Communities may contain multiple seed-to-table

programs that can strengthen local and regional food systems and increase access to fruits and vegetables. Culinary medicine programs can partner with these programs to build connections with underserved communities and health-care providers.

SUGGESTED/ADDITIONAL READING

- [Best Practices for Utilizing Local Food in Nutrition Education and Cooking Classes](#) (North Carolina State University Extension)
- [Local Food System Supply Chain](#) (North Carolina State University Extension)
- [Grown from the Past: A Short History of Community Gardening in the United States](#) (Smithsonian Gardens' Community of Gardens)
- [Arizona Sustainable Community Garden Resource Guide: Your Guide to Establishing and Sustaining a Community Garden in Your Neighborhood](#) (Arizona Department of Health Services and Vitalyst Health Foundation)
- [Farmers Markets](#) (USDA's Nutrition.gov)
- [National Gleaning Project](#) (Center for Agriculture & Food Systems)
- [Let's Glean! United We Serve Toolkit](#) (USDA)
- [National Farm to School Network](#)

REFERENCES

1. O'Dare Wilson K. Community food environments and

- healthy food access among older adults: a review of the evidence for the Senior Farmers' Market Nutrition Program (SFMNP). *Soc Work Health Care*. 2017;56(4):227–243. <https://doi.org/10.1080/00981389.2016.1265631>
2. Definitions: sustainability and food systems. US Department of Agriculture. Accessed August 5, 2023. <https://www.usda.gov/oce/sustainability/definitions>
 3. Vilar-Compte M, Burrola-Méndez S, Lozano-Marrufo A, et al. Urban poverty and nutrition challenges associated with accessibility to a healthy diet: a global systematic literature review. *Int J Equity Health*. 2021;20(1):40. doi:10.1186/s12939-020-01330-0
 4. Food Access Research Atlas. Economic Research Service, US Department of Agriculture. Updated October 31, 2024. Accessed November 3, 2024. <https://www.ers.usda.gov/data-products/food-access-research-atlas/>
 5. Food sovereignty. US Food Sovereignty Alliance. Accessed September 20, 2023. <http://usfoodsovereigntyalliance.org/what-is-food-sovereignty/>
 6. Mailboxes, Mom and Pop Stands, and Markets: Local Foods Then and Now. What makes a food “local?” Distance between producer and consumer. National Agricultural Library, US Department of Agriculture. Accessed April 24, 2023. <https://www.nal.usda.gov/exhibits/ipd/localfoods/exhibits/show/food-locality/local-distance>
 7. Mailboxes, Mom and Pop Stands, and Markets: Local Foods Then and Now. What makes a food “local?” Context of producer and consumer. National Agricultural Library, US Department of Agriculture. Accessed April 24, 2023.

<https://www.nal.usda.gov/exhibits/jpd/localfoods/exhibits/show/food-locality/local-context>

8. Mailboxes, Mom and Pop Stands, and Markets: Local Foods Then and Now. What makes a food “local?” Relation between producer, consumer, and marketing environment. National Agricultural Library, US Department of Agriculture. Accessed April 24, 2023. <https://www.nal.usda.gov/exhibits/jpd/localfoods/exhibits/show/food-locality/local-relation>
9. Community of Gardens. Grown from the past: a short history of community gardening in the United States. Smithsonian Institution. Accessed November 26, 2024. <https://communityofgardens.si.edu/exhibits/show/historycommunitygardens/intro>
10. Savoie-Roskos MR, Wengreen H, Durward C. Increasing fruit and vegetable intake among children and youth through gardening-based interventions: a systematic review. *J Acad Nutri Diet*. 2017;117(2):240–250. [doi:10.1016/j.jand.2016.10.014](https://doi.org/10.1016/j.jand.2016.10.014)
11. Langelotto GA, Gupta A. Gardening increases vegetable consumption in school-aged children: a meta-analytical synthesis. *HortTech*. 2012;22(4):430–445. [doi:10.21273/HORTTECH.22.4.430](https://doi.org/10.21273/HORTTECH.22.4.430)
12. Ratcliffe MM, Merrigan KA, Rogers BL, Goldberg JP. The effects of school garden experiences on middle school-aged students’ knowledge, attitudes, and behaviors associated with vegetable consumption. *Health Promot Pract*. 2011;12(1):36–43. [doi:10.1177/1524839909349182](https://doi.org/10.1177/1524839909349182)
13. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc*. 2007;107(4):662–665. [doi:10.1016/j.jada.2007.01.015](https://doi.org/10.1016/j.jada.2007.01.015)

14. Parmer SM, Salisbury-Glennon J, Shannon D, Struempfer B. School gardens: an experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *J Nutr Educ Behav.* 2009;41(3):212–217. doi:10.1016/j.jneb.2008.06.002
15. Cialdella J. Introduction: grown from the past: a short history of community gardening in the United States. Community of Gardens. Accessed August 17, 2023. <https://communityofgardens.si.edu/exhibits/show/historycommunitygardens/intro>
16. Agricultural Law Information Partnership, Alternative Farming Systems Information Center. Urban agriculture. National Agricultural Library, US Department of Agriculture. Accessed August 23, 2023. <https://www.nal.usda.gov/farms-and-agricultural-production-systems/urban-agriculture>
17. Archer L, Ransom B, Coley M. Direct marketing. Sustainable Agriculture Research & Education Program. January 3, 2019. Accessed August 18, 2023. <https://sarep.ucdavis.edu/sustainable-ag/direct-marketing>
18. Mari E. Healthy food on wheels: an exploration of mobile produce markets through a food justice lens. In: Werkheiser I, Piso Z, eds. *Food Justice in US and Global Contexts: Bringing Theory and Practice Together*. Springer International Publishing; 2017:141–157. doi:10.1007/978-3-319-57174-4_12
19. Alternative Farming Systems Information Center. Community supported agriculture. National Agricultural Library, US Department of Agriculture. Accessed August 17, 2023. <https://www.nal.usda.gov/farms-and-agricultural-production-systems/community-supported->

agriculture

20. What we do. FairShare CSA Coalition. Accessed August 17, 2023. <https://www.csacoalition.org/about-us/>
21. Harris D, Lott M, Lakins V, Bowden B, Kimmons J. Farm to institution: creating access to healthy local and regional foods. *Adv Nutr*. 2012;3(3):343–349. doi:10.3945/an.111.001677
22. About farm to school. National Farm to School Network. Accessed November 3, 2024. <https://www.farmtoschool.org/about/what-is-farm-to-school>
23. Matson J, Thayer J. The role of food hubs in food supply chains. *J Agric Food Syst Community Dev*. 2013;3(4):43–47. doi:10.5304/jafscd.2013.034.004
24. Levkoe CZ, Hammelman C, Craven L, et al. Building sustainable communities through food hubs: practitioner and academic perspectives. *J Agric Food Syst Community Dev*. 2018;8(2):107–122. doi:10.5304/jafscd.2018.082.008
25. Meader McCausland D, Miller R, Colpaart A, King M. Shared Kitchen Toolkit: a practical guide to planning, launching and managing a shared-use commercial kitchen. 2018. The Food Corridor. Accessed November 3, 2024. <http://www.thefoodcorridor.com/resources/>
26. Farmer/producer. Food and Nutrition Service, US Department of Agriculture. Updated January 18, 2023. Accessed August 17, 2023. <https://www.fns.usda.gov/snap/farmer-producer>
27. King M, Dixit-Joshi S, MacAllum K, Steketee M, Leard S. Farmers Market Incentive Provider Study. March 2014. Food and Nutrition Service, US Department of Agriculture, March 2014. Accessed November 3, 2024. <https://fns->

[prod.azureedge.us/sites/default/files/
FarmersMarketIncentiveProvider.pdf](https://prod.azureedge.us/sites/default/files/FarmersMarketIncentiveProvider.pdf)

28. Farmers Market Nutrition Program. Food and Nutrition Service, US Department of Agriculture. Updated July 1, 2024. Accessed November 3, 2024. <https://www.fns.usda.gov/fmnp/wic-farmers-market-nutrition-program>
29. Seniors Farmers Market Nutrition Program. Food and Nutrition Service, US Department of Agriculture. Accessed August 17, 2023. <https://www.fns.usda.gov/sfmnp/senior-farmers-market-nutrition-program>

Chapter 11: Creating Partnerships in Your Community

By Hope Wilson, MPH, RDN; Stephanie Grutzmacher, PhD; Lauren McCullough, MPH; Jennifer Parlin, MPH; Lily McNair, PSM, RDN

INTRODUCTION

Whether you are working in a clinical nutrition setting, providing nutrition education to small groups, or participating in a large public health nutrition campaign, it is essential to understand the community where you are working, engage the audience you are trying to reach, and develop and nurture partnerships within the community to successfully implement interventions that meet nutrition and health objectives.

This chapter describes methods for understanding the community with whom you are working and outlines the role that **community engagement** and partnerships play in implementing culinary medicine programs in those communities.

SOCIAL DETERMINANTS OF HEALTH

All people live within a larger societal context that shapes our health behaviors. The **social-ecological model**, which describes the different levels of influence on individuals, gives us a tool to understand the many complex factors that shape our health. To learn more about the social-ecological model, see [chapter 1 of *An Ecological Approach to Obesity and Eating Disorders* by Greg Goines](#). These environmental conditions in which people are born, live, work, play, worship, and age are often collectively referred to as the **social determinants of health (SDOH)**.

The [Social Determinants of Health in Rural Communities Toolkit](#) lists several SDOH that affect health and well-being, including¹:

- Access to health-care services
- Access to nutritious foods
- Access to transportation
- Availability of safe streets and green space
- Education

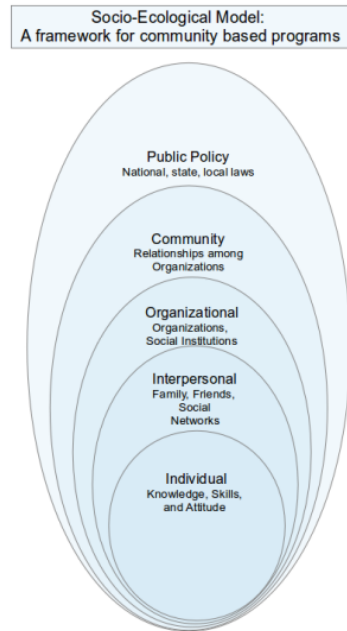


Figure 11.1. The social-ecological model describes different levels of influence. "Social-Ecological Model" by Umich Hudsonmh is in the public domain.

- Employment and financial opportunities
- Housing quality and affordability
- Income and poverty
- Racism and discrimination
- Social support

In the interactive activity that follows, select the information symbols (i) to learn more about each level of the social-ecological model.



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<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=630#h5p-74>

SDOH essentially are resources that are inequitably distributed among people, shaping inequitable health risks, functioning, quality of life, and outcomes. These inequitable outcomes are called **health disparities**. To reduce health disparities, culinary medicine initiatives must aim to address their root causes. One strategy for reducing health disparities is partnering with community organizations and members who have a range of experiences with and knowledge about SDOH, such as community planners, social service staff, teachers, childcare providers, economic development commissions, and housing authorities. Involving diverse community partners can help you effect upstream, sustainable changes in individuals' environments and

health.¹ For more information on SDOH, see the following interactive activity and the [suggested additional readings](#) at the end of this chapter.



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UNDERSTANDING YOUR COMMUNITY

Addressing differences in SDOH makes progress toward **health equity**. According to the Centers for Disease Control and Prevention (CDC), “achieving this requires focused and ongoing societal efforts to address historical and contemporary injustices; overcome economic, social, and other obstacles to health and healthcare; and eliminate preventable health disparities.”² According to Healthy People 2030, “SDOH have been shown to have a greater influence on health than either genetic factors or access to healthcare services.”³ Without understanding the greater context of individual people’s lives, health information given to them may be of no use, particularly if the SDOH they experience prevent them from making suggested changes.

To learn more about health equity, see the [suggested additional readings](#) at the end of this chapter.

Before you can successfully develop and implement a culinary medicine program within a community, it is necessary to

understand that community so that the intervention is appropriate for the intended audience and considers the needs and assets of the community.

According to the CDC, a community is “typically defined by a geographic area,” however, a community “can also be based on shared interests or characteristics such as religion, race, age, or occupation.”⁴ Communities can be thought of as systems, networks of relationships, digitally mediated connections, or individuals’ sense of belonging and membership in groups or activities.⁵



Figure 11.2. Communities can be defined by shared interest or characteristics as well as a geographic area. “AI Generated Inclusion Community” by Franz Bachinger is licensed under a Pixabay License.

To better understand the community you are working with, there are many different aspects to explore, such as history, demographic characteristics of the population, community leadership, community culture, existing organizations and institutions, economics, government/politics, social structure, infrastructure, commerce and industry, and attitudes and values.⁶

The methods for collecting information about the community you are working with depend on what information already exists, the type of information being collected, the scope of the intervention, and the specific audience for the intervention.

One way to learn more about your community is to conduct a **community needs assessment**. This process can include using existing information and collecting new information about the health, economic, and social statuses of the community, and resources in the community. Existing information collected by the government, other organizations, or researchers (often called

secondary data) may include demographic characteristics of the population, vital statistics, rates of risk factors, and disease prevalence. These data sources are often collected using high-quality methods and represent the whole population in a community.

If needed information has not yet been collected, your community needs assessment could seek new information (often called primary data) using surveys, focus groups, interviews with community leaders, public meetings, asset mapping, observations, and other strategies. These sources of information are often highly valuable for representing the complexity and diversity within a community and capturing tailored or unique information.

Examples

The following are examples of secondary or existing data sources:

- Federal government websites such as the [US Census](#), the [National Institutes of Health](#), the [Centers for Disease Control and Prevention](#), and the [Department of Health and Human Services](#).
- [County Health Rankings & Roadmaps](#)
- State and local government statistics
- Universities and other academic institutions' research studies

This list was adapted from [Community Tool Box](#) (chapter 3, section 1).

Community needs assessments should not focus only on what needs to be improved within a community. Gathering information about community resources and assets is important to understanding a community and informing culinary medicine

programming. Furthermore, emphasizing these resources and assets can help ensure that you are using a strengths-based approach, which seeks a holistic treatment of both positive and negative aspects of underlying determinants of health, as well as opportunities and challenges in addressing those determinants.⁷

Asset mapping is a strengths-based strategy that can be used to capture the existing resources and assets in a community to help plan and implement interventions or programs that build upon what a community already has.

Before beginning a new community needs assessment, determine if one has been conducted recently, because many community organizations and government agencies regularly conduct needs assessments. For example, to receive accreditation from the [Public Health Accreditation Board](#), state, tribal, local, and territorial health departments are required to complete and document a collaborative community health assessment at least every 5 years.^{8,9} Charitable hospital organizations are required to conduct community health assessments at least every 3 years to maintain their nonprofit 501(c)(3) status with the Internal Revenue Service.¹⁰

For more information about conducting a community needs assessment, review the process and strategies included in chapter 3 of the [Community Tool Box](#) from the University of Kansas Center for Community Health and Development. The [CDC's Public Health Professionals Gateway](#) includes a [guided index](#) with resources and information for completing a community health assessment.

Watch this [video from Maricopa County Public Health](#) in Arizona to learn how it conducts its community health assessment:



One or more interactive elements has been excluded from this version of the text. You can view them online

here: <https://opentextbooks.library.arizona.edu/culinarymedicine/?p=630#oembed-1>

Community engagement is another approach to better understanding your community. Each community has unique needs and assets related to community members' health and wellness and the prevention of diet-related diseases. How to best support culinary medicine programs or education will vary depending on a community's population, resources, needs, and priorities.^{10,11} When developing culinary medicine programs or initiatives in your community, it is important to integrate perspectives and insights from the community into the program's goals and design. For example, if your geographic area is affected by limited access to affordable food, then you may need to work with the community to address the issue of food access to meet the needs and goals of your community.

The type of culinary medicine intervention or education would vary greatly for English-speaking, older individuals living alone in rural areas with low food access compared with large, Spanish-speaking families living in an urban area. In either case, working closely with the community enables you to better understand how your culinary medicine initiative fits with the population's circumstances and context.

The International Association for Public Participation's [Spectrum of Public Participation](#) describes a continuum of community engagement using the following levels: inform, consult, involve, collaborate, and empower. Each level corresponds to different goals and activities, ranging from informing the community of problems and solutions to empowering the community to make final decisions about implementation.

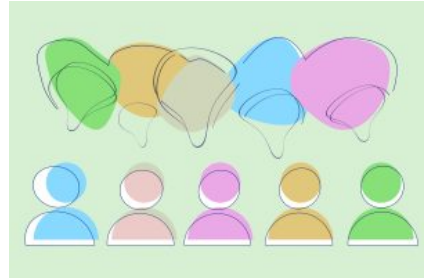


Figure 11.3. Community engagement is an approach to better understanding your community. “Feedback Focus Group” by Gerd Altmann is licensed under a Pixabay License.

The process of community engagement can be rewarding; however, there are many factors health professionals should consider when engaging with communities. At the University of Arizona, the [Supplemental Nutrition Assistance Program Education \(SNAP-Ed\) program](#), from the School of Nutritional Sciences and Wellness, collaborated with the [Community Research, Evaluation, and Development \(CRED\) team](#) from the Norton School of Human Ecology to develop a series of 7 interactive, online learning modules called the [Community Engagement Training Series](#).



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version of the text. You can view it online here:

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IMPORTANCE OF COMMUNITY PARTNERS



Figure 11.4. Community partnerships play an important role in culinary medicine. "Team Spirit, Teamwork, Community" by Anemone123 is licensed under a Pixabay License.

Culinary medicine seeks to help individuals achieve proper nutrition to help prevent or manage chronic diseases such as diabetes and heart disease. As mentioned previously, lack of access to nutritious foods, limited food preparation experience or skills, and lack of nutrition information are among many systemic and individual barriers to nutrition. Because of the complexity of these challenges, there is no single policy, government entity, or organization that can address them alone. By

working with other community leaders, organizations, agencies, and individuals, the work is spread out among multiple partners, each with their own strengths, audience, and areas of expertise to work toward shared goals but in different spheres of influence and addressing different SDOH.

Working With Community Partners

The success of community partnerships is often the key to the success of community programs. Community organizations are ideal partners for developing and sustaining community programs because they offer invaluable insight and experience with a wide range of populations that live in a community. Building community partnerships can also help effectively and efficiently provide programs while strategically using time and resources, in addition to building strong networks that lead to long-term, sustainable change.¹² Culinary medicine offers a unique opportunity to synergistically work with a variety of different types and sizes of businesses and organizations within the community.

Partnerships may exist in different stages of collaboration. Some partnerships are informal collaborations between organizations, whereas others are formal contract agreements.¹² The Partnership Continuum, outlined in Figure 11.5, describes the different stages of building a community partnership. It is important to note that not every collaboration will end in a full partnership, but each stage is important and can result in beneficial outcomes and shared information.¹²

Figure 11.5. Partnership Continuum¹²



Source: *Engaging Your Community: A Toolkit for Partnership, Collaboration, and Action* (John Snow Inc.)

5 Steps for Working with Community Partners

1. **Identify and engage potential partners.** Identify interested parties in the community and initiate conversations to determine community engagement potential.
2. **Establish relationships and build trust.** After identifying and engaging with potential community partners, establish collaborative relationships founded on mutual trust and respect.

3. **Clarify goals and objectives.** Identify at the start each partner's goals and objectives, to develop a shared process. Determine mutually agreed-upon standards for achieving goal.
4. **Implement mutually beneficial partnerships.** Choose a partnership that will benefit both organizations and the community. Be flexible and practice consistent, clear communication.
5. **Establish structure for governance.** Develop an equitable decision-making structure and establish governance, procedures, and ground rules. Commit to transparency to maintain trust.

Source: *Engaging Your Community: A Toolkit for Partnership, Collaboration, and Action*

The John Snow Research & Training Institute's [Engaging Your Community: A Toolkit for Partnership, Collaboration, and Action](#) identifies 5 key steps to implementing a partnership with a community organization:

Step 1: Identify and engage potential community partners who will help build and sustain a community program.¹² Three common types of community partnerships include those that are community based, government based, and faith based.¹²

When approaching potential community partners, it is helpful to

do some research in advance. Make notes of the organization's mission, vision, contact persons, and current programs. This will help better prepare you for approaching potential partners, because you will have a better idea of the organization's needs and goals, which, in turn, will help you identify areas where the proposed community program can help support the organization.

After developing a list of potential partners, develop a plan for reaching out to them. Communication methods may differ depending on the organization but can include networking, emails, and phone calls. It is helpful to have a sample letter and a 1-minute "elevator pitch" that introduces you, provides a brief description of the proposed program, and explains why the proposed program can benefit the community partner and how the community partner can be involved. Also, provide contact information and proposed times and/or dates to discuss further, because the next stage often involves a partner meeting.

Step 2: Establish relationships and build trust with community partners, who may be seen as subject matter experts and opinion leaders.¹³ This step is essential to gain insight and better understanding of the community's concerns and priorities. Those who live and work within a community are the best to identify the needs and the assets of knowledge of the community to effectively develop a relevant, community-specific program. Review with partners the resources that already exist and identify what may be used and what materials still need to be developed.

Identify how community partners can take an active role in the program, from development and promotion to implementation and maintenance. Now is also a good time to determine what your partners' capacity is to help support the community program and work with the team, so as not to strain the community partners or hinder the implementation of community programs.¹³

Step 3: Clarify goals and objectives at the start of the program and continually evaluate them throughout the process.¹² Be clear about intentions and goals for the proposed community program.

In the case of culinary medicine, the community partner must understand what is expected to implement both culinary and nutrition education aspects. Make sure community members can honestly share their opinions; it is essential to make sure the partner feels heard and that the community voice is respected and represented.²

For a community program to be successful, goals and objectives should be mutually decided upon to develop a strong shared purpose and common agenda. Before implementing, it is also a good practice to develop shared parameters for measurement of success.¹³ In developing these parameters, it is important to also establish the roles and responsibilities of each partner to avoid or minimize confusion.¹³

Step 4: Implement a mutually beneficial partnership. The type of partnership will be based on the ability of each organization to commit time and resources.¹² Therefore, it is critical to maintain clear and consistent communication.¹³ Communications must be timely and transparent, willing to address any concerns or barriers, as well as provide accountability.¹³ Ensure that each partner understands their individual roles and responsibilities as the partnership develops and schedule regular check-ins to assess progress, identify areas for improvement, and note successes.¹³

Step 5: Establish a structure for governance as the partnership and program continue to develop.¹² This includes developing written ground rules at the initiation of a community partnership but allowing for dynamic procedures and governance that are adaptable as programs and partnerships grow and develop. A shared structure of governance ensures that each community partner's voice is heard and that partners can participate in shared decision making.¹² Transparency is essential for decisions regarding budget, resource allocation, adaptations to community programs, and opportunities for program growth.¹²

Collective Impact

The **collective impact** framework is the commitment of various actors or partners from different sectors to a common agenda to support positive outcomes to a social problem at scale. In this case, the barriers to a nutritious diet are many, and the solutions will require many partners to collaborate to solve this complex problem.

Five conditions are associated with the relative success of collective impact collaborations. These are described in the following text box.

5 Conditions for Collective Impact Success

1. **Common agenda:** All participants share a vision for change that includes a common understanding of the problem and a joint approach to solving the problem through agreed-upon actions.
2. **Shared measurement:** All participating organizations agree on the ways success will be measured and reported, with a short list of common indicators identified and used for learning and improvement.
3. **Mutually reinforcing activities:** A diverse set of partners, typically across sectors, coordinate a set of differentiated activities through a mutually reinforcing

plan of action.

4. **Continuous communication:** All players engage in frequent and structured open communication to build trust, assure mutual objectives, and create common motivation.
5. **Backbone support:** An independent, funded staff dedicated to the initiative provides ongoing support by guiding the initiative's vision and strategy, supporting aligned activities, establishing shared measurement practices, building public will, advancing policy, and mobilizing resources.

Source: Based on Kania and Kramer.¹⁴

The following case study provides some suggestions for potential culinary medicine collaborators to engage and support a collective impact model in your community. It also explains how the 5 conditions for collective impact success were met to build healthy communities in Cochise County, Arizona.

CASE STUDY ON COLLECTIVE IMPACT: BUILDING HEALTHY COMMUNITIES IN COCHISE COUNTY

In 2018, the Legacy Foundation of Southeast Arizona awarded

strategic grant funding to a community collaborative in Cochise County, Arizona, to expand and support county-wide health efforts with a focus on healthy foods access, nutrition, and active living. The grant was awarded to community partners that included University of Arizona Cooperative Extension, Cochise County Health and Social Services, Cochise County Superintendent of Schools, and the Community Food Bank of Southern Arizona. The Family, Consumer and Health Sciences agent for Cochise County Cooperative Extension was selected to be the principal investigator on the grant, and the evaluation specialist and lead of the [CRED](#) team within the [Norton School of Human Ecology](#) at the University of Arizona was selected to lead the evaluation.

The project, [Building Healthy Communities \(BHC\)](#), generated 3 main goals stemming from the county health assessment:

- Increase the community's capacity for healthy change through leadership and collaboration.
- Increase the capacity of and access to the food system to reduce disparities in food security and nutrition in the county.
- Support the health and wellness of community youth through expanded school health initiatives.

These goals were approached from within a collective impact framework, which is a structured and formalized method of collaborating that includes the following core conditions:

- **A common agenda**, shaped by collectively defining the problem and creating a shared vision to solve it. This was established by forming community groups within each of the town centers and an overall committee and coordinator that ensured that the direction of the community groups focused on the 3 goals. The partners were included in the process to ensure that their efforts

also focused on the same goals.

- **Shared measurement**, based on an agreement among all participants to track and share progress in the same way, which allows for continuous learning, improvement, and accountability. The University of Arizona CRED team led the evaluation efforts, and data were shared with the community groups and other interested parties to evaluate progress.
- **Mutually reinforcing activities**, integrating the participants' many different activities to maximize the result. The community groups, community leadership, and other interested parties focused their efforts to address the common goals.
- **Continuous communication**, which helps build trust and forge new relationships. The community groups were updated about progress at a monthly county meeting. Partners were provided updates at meetings and through email and social media. Attending meetings or community events, meeting with members of the community who were in food service and food production, meeting with community members—basically, going anywhere there were people, and talking to them—helped to continually make new community connections.
- A **“backbone support”** team, dedicated to aligning and coordinating the work of the group. University of Arizona Cooperative Extension staff served as the backbone team and was tasked with coordinating the work of the initiative.

As more groups use a collective impact framework, they have been adding to these principles. From their experience with BHC, the University of Arizona Cooperative Extension staff found that the following additional principles are imperative to the success of this

project: growing leadership, engaging community members, and centering equity.



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The [Cochise Community Leadership Academy \(CLA\)](#) was formed to grow new leadership to practice the collective impact model. The CLA curriculum was initially adapted from the [Arizona Community Training](#), a training curriculum developed by University of Arizona Cooperative Extension faculty and intended to promote personal, grassroots, and civic leadership in emerging community leaders. The training is designed to develop leadership from within communities to focus on emerging needs of the community and, ultimately, produce policy, systems, and environmental changes or other significant outcomes.

The ongoing collective impact work is strategic and straightforward in Cochise County, where partners come together for recurring half-hour calls during which they move through strategic plans step by step to ensure that they are making timely progress on their agreed-upon tasks.

The BHC project continues to build on its past successes, which are outlined in the [summative report](#) of its first 3 years of funded work. Outcomes from each BHC goal are highlighted in Table 11.1.

Table 11.1. Highlighted Outcomes of BHC's Collective Impact Model

Goal	Outcomes
Increase capacity for healthy change through leadership and collaboration.	Five new Healthy Community Committees (HCCs) formed, for a total of 11 HCCs. Ten HCCs created vision and mission statements and 5 held strategic planning sessions. Six HCCs applied for and received additional funding, bringing more than \$1 million to Cochise County communities.

Goal	Outcomes
<p>Increase the capacity of and access to the food system to reduce disparities in food security and nutrition in the county.</p>	<p>Total amount of food, foods selected according to Feeding America's "Foods to Encourage" framework, and the amount of fresh fruits and vegetables all increased by more than 50% over the first 3 years of the initiative.</p> <p>Tripled the number of Produce on Wheels With-Out Waste (P.O.W.W.O.W) sites in the county.</p>

Goal	Outcomes
Support the health and wellness of community youth through expanded school health initiatives.	<p>Nearly 500 fifth- and sixth-grade students participated in a youth survey aimed at understanding attitudes and behaviors related to fresh fruit and vegetables, water, sugary drinks, physical activity, and screen time.</p> <p>Eight new food pantries were established by BHC via local schools and communities.</p>

For the full 2018-2021 report, please refer to the [Cochise Building Healthy Communities](#) website.

Key Takeaways

- In developing a culinary medicine program that positively influences the health of those being served, it is essential to understand the community that is being reached. Community needs assessments, asset mapping, and community engagement are valuable tools that can be used to better understand communities.

- Community engagement is used to cultivate the buy-in of those being served, understand their priorities, and understand how they view their own communities. It is also important when working in communities not to focus only on the needs and gaps but also build upon the strengths, assets, and opportunities that already exist in the community.
- Many factors affect health other than individual choices or preferences. Interventions that address social determinants of health and target multiple levels of the social-ecological model help improve health equity.
- To make lasting change within communities, partnerships can help increase reach and work in different spheres of influence to influence not only individual health behaviors but the systems, environments, and policies in which individuals live.
- Partnerships can be developed at different levels of engagement. Using the collective impact framework, working with others in the community can be mutually beneficial to all organizations while also effecting change.

SUGGESTED/ADDITIONAL READING

- [Community Tool Box](#) (Center for Community Health and Development at the University of Kansas)
- [What Is Health Equity?](#) (CDC)
- [Extension's National Framework for Health Equity and Well-Being](#) (Connect Extension)

- [Social Determinants of Health](#) (Healthy People 2030)
- [Social Determinants of Health in Rural Communities Toolkit](#) (Rural Health Information Hub)
- [Community Engagement Learning Modules](#) (University of Arizona SNAP-Ed Community Engagement Training Series)

REFERENCES

1. Rural Health Information Hub. Social Determinants of Health in Rural Communities Toolkit. Accessed December 20, 2024. <https://www.ruralhealthinfo.org/toolkits/sdoh>
2. Health equity. Centers for Disease Control and Prevention. Accessed October 20, 2024. <https://www.cdc.gov/healthequity/index.html>
3. Social determinants of health (SDOH). Centers for Disease Control and Prevention. January 17, 2024. Accessed October 20, 2024. <https://www.cdc.gov/about/priorities/why-is-addressing-sdoh-important.html>
4. Centers for Disease Control and Prevention. Community needs assessment: a step-by-step guide. Accessed November 25, 2024. https://web.archive.org/web/20240916222211/https://www.cdc.gov/globalhealth/healthprotection/fetp/training_modules/15/community-needs_pw_final_9252013.pdf
5. Agency for Toxic Substances and Disease Registry. Principles of community engagement. In: *Principles of Community Engagement*. US Department of Health and Human Services. Last reviewed June 25, 2015. Accessed December 20, 2024. https://www.atsdr.cdc.gov/community-engagement/php/chapter-1/concepts-community.html?CDC_AAref_Val=https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html

6. Hampton C, Haven C. Understanding and describing the community. In: *Community Tool Box*. KU Center for Community Health and Development, University of Kansas; chapter 3. Accessed October 20, 2024. <https://ctb.ku.edu/en/table-of-contents/assessment/assessing-community-needs-and-resources/describe-the-community/main>
7. Global health equity. Using a global public health equity lens. In: *Guiding Principles for Global Health Communication*. Centers for Disease Control and Prevention; May 15, 2024. Accessed October 20, 2024. <https://www.cdc.gov/global-health-equity/php/publications/equity-lens.html>
8. Public Health Accreditation Board. Standards & measures for initial accreditation. Version 2022. 2022. Accessed October 20, 2024. <https://phaboard.org/wp-content/uploads/Standards-Measures-Initial-Accreditation-Version-2022.pdf>
9. Centers for Disease Control and Prevention, Division of Community Health. *A Practitioner's Guide for Advancing Health Equity: Community Strategies for Preventing Chronic Disease*. US Department of Health and Human Services; 2013. Accessed October 20, 2024. <https://www.cdc.gov/dnpao-state-local-programs/php/practitioners-guide/index.html>
10. Office of Disease Prevention and Health Promotion. Social determinants of health. Accessed October 20, 2024. <https://health.gov/healthypeople/priority-areas/social-determinants-health>
11. McCullough L, Leih R, Wash M, Farrell VA. Community engagement for Cooperative Extension: what is community engagement? Cooperative Extension, The

- University of Arizona. October 10, 2023. Accessed November 25, 2024. <https://repository.arizona.edu/bitstream/handle/10150/671200/az2023-2023.pdf?sequence=1&isAllowed=y>
12. John Snow, Inc. Engaging Your community: a toolkit for partnership, collaboration, and action. January 2012. Accessed October 20, 2024. https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=14333&lid=3
 13. Shakespeare J, Mizota M, Martinez R, Daly H, Falkenburger E. Fostering partnerships for community engagement. October 2021. Accessed October 20, 2024. https://www.urban.org/sites/default/files/publication/104935/fostering-partnerships-for-community-engagement_0.pdf
 14. Kania J, Kramer M. Collective impact. *Stanf Soc Innov Rev*. 2011;9(1):36–41. <https://doi.org/10.48558/5900-KN19>

H5P REFERENCES

1. McCloskey DJ, McDonald MA, Cook J, et al. Chapter 1: Models and frameworks. In: *Principles of Community Engagement*. 2nd ed. NIH Publication No. 11–7782. US Department of Health and Human Services; December 6, 2018. Accessed December 20, 2024. https://www.atsdr.cdc.gov/community-engagement/php/chapter-1/models-frameworks.html?CDC_AAref_Val=https://www.atsdr.cdc.gov/communityengagement/pce_models.html
2. American College Health Association. Ecological model. Accessed November 25, 2023. https://web.archive.org/web/20240529093645/https://www.acha.org/HealthyCampus/HealthyCampus/Ecological_Model.aspx

3. Healthy People 2030. Economic stability. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/economic-stability>
4. Healthy People 2030. Reduce household food insecurity and hunger—NWS-01. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/nutrition-and-healthy-eating/reduce-household-food-insecurity-and-hunger-nws-01>
5. Healthy People 2030. Education access and quality. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/education-access-and-quality>
6. Healthy People 2030. Health care access and quality. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/health-care-access-and-quality>
7. Healthy People 2030. Neighborhood and built environment. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/neighborhood-and-built-environment>
8. Healthy People 2030. Social and community context. Accessed October 20, 2024. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/social-and-community-context>

Chapter 12: Culturally Centered Approaches to Culinary Medicine

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INTRODUCTION

Food, diet, and culture are inextricably linked. Efforts to support a healthy eating plan must be grounded in an understanding and respect for the individual's culture and its foods. Although the ideas about what is a "healthy" diet have been heavily influenced by Westernized ideals about what is or is not a healthy eating pattern, no single diet has proved best for all.

Indeed, genetics likely play an important role in food selection, preferences, and health outcomes by influencing sensory pathways that affect taste, smell, texture, and the brain's reward response, as well as how people respond to specific nutrients. Local culture, environment, and family customs also influence food choices, dietary behaviors, and cooking and food shopping practices.

Consuming a wide variety of nutritious foods and beverages in the amounts recommended is a central tenet of healthy eating. However, evidence-based meal plans such as the Dietary

Approaches to Stop Hypertension (DASH) diet, and others recommended in the United States may not adequately include **cultural foods**. Cultural foods are strongly anchored to familial customs and passed down from generation to generation. Cultural foods, including dietary staples, often stem from regional preferences influenced by local crops or from past influences of different cultures living in the same location. These foods may also be integral to religious or ceremonial functions, often including specific food preparation methods and uses.

Many people connect with their heritage through the foods they eat. The tendency of health-care providers to recommend the removal of cultural foods from a person's diet causes some individuals to struggle with making dietary modifications because they don't know how or don't want to exclude these foods. Understanding cultural foods in the context of meal planning, affordability, and accessibility is paramount to engaging individuals seeking to improve their nutritional health.

Culinary medicine works with clients to support the pursuit of a varied diet to take in adequate energy and essential nutrients within cultural preferences and traditions. Within all diets, opportunities can be found to make small changes compatible with a person's culture and traditions that promote health. Small, culturally appropriate adaptations are easier for people to adopt and sustain, which is the key to achieving better health.

CULTURALLY CENTERED APPROACHES TO CULINARY MEDICINE

Traditional nutrition counseling and community nutrition education have focused on modifying foods and behaviors to create healthy eating patterns using tools provided by the US Department of Agriculture (USDA), including MyPlate, or others like the DASH diet.¹⁻³ However, the healthy eating patterns described in these tools are modeled after Western culture and may not apply to culturally diverse populations.¹⁻⁶



Figure 12.1. An example of a food market featuring cultural foods. "Outdoor Food Stalls" by Choo Yut Shing is licensed under CC BY 2.0.

To effect dietary change among individuals with **nutrition-sensitive conditions**, nutrition and medical professionals must be able to engage with their clients on a personal level and to tailor nutrition care plans and education. Although there is increased interest in culturally tailored nutrition education interventions, there are few, if any, practical guides that empower nutrition professionals to develop and implement comprehensive culturally centric culinary medicine plans.

This chapter aims to provide nutrition professionals with an understanding of **cultural foods** in the context of applied culinary medicine and to describe specific culturally tailored nutrition strategies that can be implemented to address nutritionally sensitive diseases.⁷

RETHINKING “HEALTHY” EATING



Figure 12.2. The Westernized concept of a healthy diet usually includes fish, a whole grain, and a vegetable, yet Westernized ideals of healthy may not apply to other cultures. “Delicious Fish Dinner” is in the public domain (CCO 1.0).

Search “healthy diet” on the internet and you’re likely to see images of carefully plated salmon, a green leafy vegetable, and a whole grain (see Figure 12.2). Such “healthy” dietary constructs are heavily influenced by Westernized ideals about what is or is not a healthy eating pattern. Definitions of healthy eating are variable, but central to all healthful eating constructs is consuming a wide variety of nutritious foods and beverages in the amounts recommended. The Healthy Food Pyramid, My Plate, DASH diet, and other meal plans recommend specific food groups to encourage the consumption of nutrient-dense foods and beverages designed to counter diseases.¹⁻³ However, these meal patterns may not include cultural foods.⁴⁻⁷

Certain foods closely linked to cultural identity may be perceived as “unhealthy,” causing some ethnic minority subgroups to shun traditional foods and cooking preparation methods in favor of Westernized meal patterns. This phenomenon, known as **dietary acculturation**, has been identified as a chronic disease risk factor for Latinos in the United States.⁵

Another example, the Mediterranean diet, is widely accepted as an ideal diet. However, some researchers have noted that bias has historically shaped which diets are studied.⁶ For example, a PubMed search using the phrase “Mediterranean diet” yields more than 4 times as many results as searches using the phrases “traditional Chinese diet,” “traditional African diet,” and “traditional Mexican diet” combined.

Indeed, the Mediterranean diet recommends foods favored by Europeans and Americans, rather than foods of the region it purports to represent.⁶ Other critiques of the Mediterranean diet are the lack of affordability, emphasis on liquid **oils**, and that it’s not an appropriate substitution of other cultural diets. Thus, as is, the Mediterranean diet may not be a culturally appropriate dietary solution to prevent and manage disease. However, as with all standardized meal constructs, modifications can be made to be more culturally inclusive.^{4,6}

WHAT ARE CULTURAL FOODS?



Figure 12.3. Cultural foods are often passed down from generation to generation, influenced by local crops, and prepared for ceremonial or celebratory occasions. “The Ukrainian Folk Festival With Ukrainian Cultural Traditions Presentation in Town of Bar, Vinnytsia Region, State of Ukraine” by Viktor O. Ledenyov is licensed by CC BY-SA 4.0.

Cultural foods are strongly anchored to familial customs and passed down from generation to generation. Cultural foods may stem from regional preferences influenced by local crops or from past influences of different cultures living in the same location. These foods may also be integral to religious or ceremonial functions, which often include specific food preparation methods and uses (Figure 12.3).

Regardless of culture, most meal patterns typically include a protein (e.g., meat, fish, legumes, nuts), a starch (e.g., potato, corn,

breadfruit, rice, taro), and fruits and vegetables. The presence of the latter often is influenced by seasonality, locality, cost, and availability. Understanding cultural foods in the context of meal planning, affordability, and accessibility is paramount to engaging with individuals seeking to optimize their nutritional health.

Select the words and phrases that describe aspects of cultural foods:



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<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1322#h5p-85>

SOCIOECONOMIC FACTORS INFLUENCE FOOD SELECTION

Income, education, and food access all play a role in food selection, cooking patterns, and portion size. These 3 factors generally affect racial and ethnic minorities more.^{8,9} As such, a tailored nutrition care plan should include evaluation of income, education, and food access, and it should explore ways to improve overall health without compromising cultural sensitivity.

Income and Food Access

Income can influence choices about the types of foods individuals purchase and consume regularly. Individuals with lower incomes tend to purchase and consume more energy-dense, nutrient-poor foods, such as fast food and processed snacks, compared with

individuals with higher incomes.¹⁰ More nutritious foods, such as fresh fruits and vegetables, lean meats, and whole grains, are often more expensive and may be out of reach for those with lower incomes.⁹ One solution is to encourage consumption of more affordable dietary proteins, such as beans, lentils, tofu, and eggs, which can be used in a variety of dishes.

Adopting healthy eating behaviors is more challenging for those with lower incomes, and they are less likely to consume a healthy diet, even when healthy foods are available, due to a lack of knowledge about healthy eating and limited access to nutritious food options.¹¹ As an example, people who live in **low-access regions** have limited access to nutritious foods because they either do not live close to a food market or have inadequate transportation to reach a market. Food deserts tend to affect people living in rural areas and/or urban areas lacking **grocery stores** (see Figure 12.4). Nutrition knowledge and education have been significantly associated with improved individual health status.¹²

The term **food deserts** has historically referred to regions with low access to affordable, healthy foods. However, the term food desert has been met with criticism because it carries negative connotations and does not adequately capture all factors related to food access. Efforts are being made to adopt alternative terminology, such as low-access region, to acknowledge diverse perspectives and facets of the issue.¹³ Therefore, the reader should be aware of both the historical term *food desert* and more inclusive terminology, such as *low-access area*.

Food Deserts in the United States

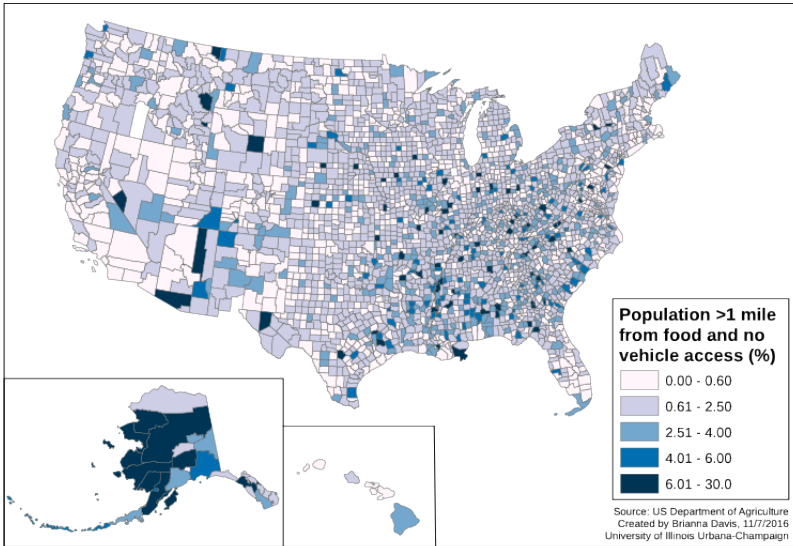


Figure 12.4. Factors influencing food security include food deserts. “Food Deserts in the United States by Counties as Reported by the USDA in 2010” by Brianna Davis is licensed under CC BY-SA 4.0.

Education

Education is also a significant factor that affects nutrition patterns, food accessibility, and affordability. Higher levels of education are associated with healthier eating patterns, because individuals with more education tend to have more knowledge about healthy eating habits.¹⁰ Higher education levels correlate with higher incomes, which can allow individuals to purchase healthier foods.

A 2009 Food and Research and Action Center study found that individuals with higher levels of education were less likely to experience food insecurity, which can negatively affect diet quality.¹⁴ Additionally, individuals with higher levels of education

are more likely to have access to information about healthy food choices and cooking methods, which can further improve diet quality.¹⁵

Food Insecurity

Food insecurity, or the lack of access to sufficient, safe, and nutritious food to meet needs, is a growing issue that affects millions of people worldwide, and disproportionately affects certain minority populations and cultures.¹⁶ It may culminate from a lack of resources (e.g., income) and food access.

Food insecurity contributes to nutritional deficiencies and poor diet quality. In a 2015 study, food-insecure Canadian households had a lower intake of calcium and magnesium when compared with food-secure households,¹⁷ suggesting food insecurity may limit access to and procurement of healthy foods, favoring low-cost, poor-nutrient foods to meet basic needs.¹²

Additionally, food insecurity has a bearing on weight status and chronic disease risk.^{18,19} Individuals who are food insecure are more likely to consume energy-dense, nutrient-poor foods, which can lead to weight gain and an increased risk for chronic diseases such as diabetes, heart disease, and hypertension.²⁰ Food insecurity is also associated with stress and anxiety, which may affect eating behaviors such as overeating or making unhealthy food choices.²¹

Supporting Optimal Nutrition

There is significant evidence to suggest that socioeconomic factors have a significant influence on nutrition patterns. Education, income, and access to healthy food all play crucial roles in determining dietary choices and, ultimately, overall health outcomes. People from lower socioeconomic backgrounds often have limited access to nutritious foods, leading to a higher risk

of malnutrition, obesity, and chronic diseases. Addressing these socioeconomic factors is a priority and integral to promoting healthier diets and improving overall public health.^{9,10,12} With this in mind, the nutrition professional can foster improvements in nutrition patterns and help reduce health inequalities through targeted, comprehensive, and culturally responsive nutrition education.

CULTURAL FOOD STAPLES



Figure 12.5. Multicultural food staples include rice, pulses, lentils, and other plant-based foods. "India Street Food Traditional Culture in Jaipur" by Pijarn Jangsawang is in the public domain (CC0 1.0).

A **staple** (see Figure 12.5) is a food that comprises most of a population's diet.²² Staples are eaten regularly, often daily, and supply most of a person's energy and nutritional needs. Staples vary by culture and location and are typically plant-based foods (see Table 12.1). There are 50,000 edible plants in the world, but

only 15 make up 90% of the world's food energy intake.²² Rice, corn, and wheat make up two-thirds; other staples include millet, sorghum, and tubers (e.g., potatoes, cassava, yams, taro).

Tropical climates favor growth of starchy fruits such as **plantains** and breadfruit, whereas in parts of Africa and Asia, legumes (e.g., beans, lentils) are considered traditional foods. In regions where plants are scarce, such as in polar climates, meat and fish are staples.²²

Table 12.1. Staple Foods and Dishes of Certain Cultures

Culture	Staple foods	Staple dishes
African Diaspora	Rice, beans, tubers, okra, leafy greens, seafood, chicken, peanuts, squashes, plantains, fruits, and juices such as mango and guava	Soups, stews, chicken dishes, fish cakes, rice, vegetables platters

<p>Mexican</p>	<p>Rice, beans, vegetables (e.g., onions, garlic, squash, corn, avocados), chicken, seafood, corn-based flour, spices such as cumin and cinnamon</p>	<p>Tortillas (flour and corn), tamales, ceviche, burritos, tacos, nopales, fajitas</p>
<p>Chinese</p>	<p>Rice, seafood, noodles, pork, spring onions, bok choy, ginger, bean sprouts, snow peas, soybean products such as tofu</p>	<p>Steamed dumplings, rice dishes, noodle dishes, mooncakes, soups, congee</p>

<p>American Indian (Native American)</p>	<p>Corn, beans, squash, pumpkins, peppers, tomatoes, yams, peanuts, wild rice, wild game (e.g., deer, buffalo, rabbit)</p>	<p>Three sisters stew; grayish-blue bread called piki made by the Hopis; pemmican. Panocha is a traditional Native American cuisine dish. In New Mexico and southern Colorado, panocha is a pudding made from ground sprouted wheat and piloncillo (sugar).</p>
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Alaskan Native	Salmon, halibut, reindeer, seafood, wild blueberries, strawberries	Salmon dishes, muktuk (whale skin and blubber), akutaq (Eskimo ice cream)
Pacific Islander Hawaii and Samoa	Taro, sweet potatoes or yams, breadfruit, cassava, banana, plantain, pandanus , arrowroot	Poi, kalua pork, lau lau, breadfruit , dried fish

Caribbean Islands	Beans, rice, coconut milk, green bananas, plantains, breadfruit, cassava, dasheen (taro), peppers, seafood, tropical fruits (e.g., mango, papaya, pineapple), okra	Cou cou , crab, and callaloo
Eastern Indian	Rice, wheat, millet, pulses , dairy, vegetables, spices, beans, fruits	Machher Jhol , dalma

The population often reflects the local demographic fingerprint of the region in which health providers practice. Determining the predominant culture of the town, city, or county of practice may assist in the development of **cultural competency**.

The state of Arizona is demographically 1 of the most diverse in

the United States.²³ As of 2022, among the more than 7 million residents, 53.2% identify as White, 32.3% as Hispanic or Latino, 5.4% as Black or African American, and 5.3% as American Indian or Alaska Native.²² The percentage of people born outside the United States and reside in Arizona from 2017 to 2021 was 13%.²³

Arizona's population is also age diverse, with nearly one-fourth under the age of 18 years and 18.3% over the age of 65 years; more than 400,000 military veterans call Arizona home and more than 50% of Arizona's population is female. Each city in Arizona has a unique cultural fingerprint, with diversity of ethnicity and age varying significantly within cities, towns, and neighborhoods.²⁴

Nutrition professionals in Arizona are encouraged to learn more about local diversity by visiting the University of Arizona's Community, Research, and Evaluation Development [Resources webpage](#), especially noting the "secondary data resources," including the "[existing data resources handout](#)."²⁵ Also, local hospitals and organizations may have demographic data available that will reveal a bit more about the population in a specific area. Understanding the surrounding community is key to developing nutrition care tools tailored to the primary population in the region. Another method of getting to know your local culture is through **community engagement**, as referenced in [chapter 11](#).

Clinical Pearl:

It is important to identify the local cultural profile snapshot to help create culturally tailored nutrition education.

Cultures in Arizona

Arizona's culinary heritage is richly influenced by local crops as well as Hispanic-Latino and American Indian cultures, giving rise to the state's reputation as the home of some of the oldest documented food traditions in North America.²⁵ Arizona became the 48th state

in 1912, but cultivation of corn and squash in the region dates back 4,100 years.²⁶



Figure 12.6. Food culture in Arizona includes edible cactus fruit such as the prickly pear. "Prickly Pears" by Tomás Castelazo is licensed CC BY-SA 2.5.

In Arizona, crop production differs by location, and despite modernization, today's local farmers maintain tradition by growing more than 160 heirloom varieties of fruits, grains, and vegetables that were available at the time of statehood.²⁶ Arizona is home to numerous varieties of cacti, lending to long-held traditions of harvesting **saguaro cactus fruit** and **prickly pear fruit** to make syrups, candy, and fruit

spreads. Figure 12.6 shows prickly pear fruit prepared at different degrees of ripeness.

Local culture, environment, and familial customs influence food choices, dietary behaviors, and cooking and food shopping practices. Genetics also may play a role in food selection, preferences, and how people's bodies respond to specific nutrients. Nearly 500 genes influence food preferences, with several genes influencing sensory pathways that affect taste, smell, texture, and, in turn, the brain's reward response (Figure 12.7).²⁷

Defining **cultural awareness** from the standpoint of the nutrition professional sets the foundation for creating an inclusive and welcoming nutrition education environment.



Figure 12.7. Cultural dishes often include spices native to the regions in which they are grown. Both genetics and exposure to local flavors can influence food preferences. “Spices Bazaar” by Christophe Schindler is in the public domain (CC0 1.0).

EMBRACING CULTURAL FOODS

Many people connect with their heritage through the foods they eat. Therefore, individuals may be hesitant to seek dietary advice from a nutrition professional for fear of being advised not to eat core cultural foods. However, efforts have been made to address and include culturally tailored dietary modifications for those with nutrition-sensitive diseases through the development of cookbooks and culture-centric nutrition intervention programs, thus reducing the tendency of health-care providers to recommend removal of cultural foods altogether.²⁸⁻³⁰ Cultural influences on dietary self-management of diseases such as diabetes also include social aspects of eating.²⁸⁻³⁰

Research has found that certain dietary changes may compromise the taste of traditional food, and there are concerns that making changes in diet will exclude them from familial meals, thus reducing the joy of dining as a family, a value deeply held by some cultures.²⁸⁻³⁰

Clinical Pearl: Many traditional foods are rich in nutrients and tradition, which are part of a balanced and sustainable approach to nutrition.³¹ When engaging with an individual seeking nutrition advice, it is important to understand if their current diet includes staples and, if so, to determine what those staple foods are, how they are prepared, the frequency of consumption, and the portion size. Reassuring the client that staple foods will not be eliminated may ease concerns about drastic dietary changes.

The [USDA's Dietary Guidelines for Americans](#) are a gold standard for nutrition guidelines and recommend including **cultural foodways**.³² However, the [MyPlate](#) food recommendations skew toward North American preferences.^{1,32,33} For example, grains in **MyPlate** include bread, pasta, cereals, rice, and tortillas and lack foods such as taro, breadfruit, and other starchy foods considered "cultural foods." Similarly, the widely recommended DASH diet discourages refined carbohydrates, such as white rice; however, rice is a staple of many culturally centric diets.^{22,26,29,34}

The USDA has made advances in providing resources dedicated to American Indian and Alaska Native Communities, including [My](#)

Native Plate, which depicts balanced meals with reasonable portion sizes and sample meals with traditional foods.³⁴ However, tools for other cultures are lacking.

Clinical Pearl: Instead of using the traditional dietary guidelines or established meal plans verbatim, modify them according to the person's cultural and personal preferences. For example, find out what grains the person eats daily and incorporate those into the overall meal plan. Determine their favorite fruits and vegetables: ask how they are prepared, then consider what could be added to increase nutritional quality or satiety. Through active listening and cultural sensitivity, a tailored plan can be created.

COOKING TRADITIONS AND METHODS

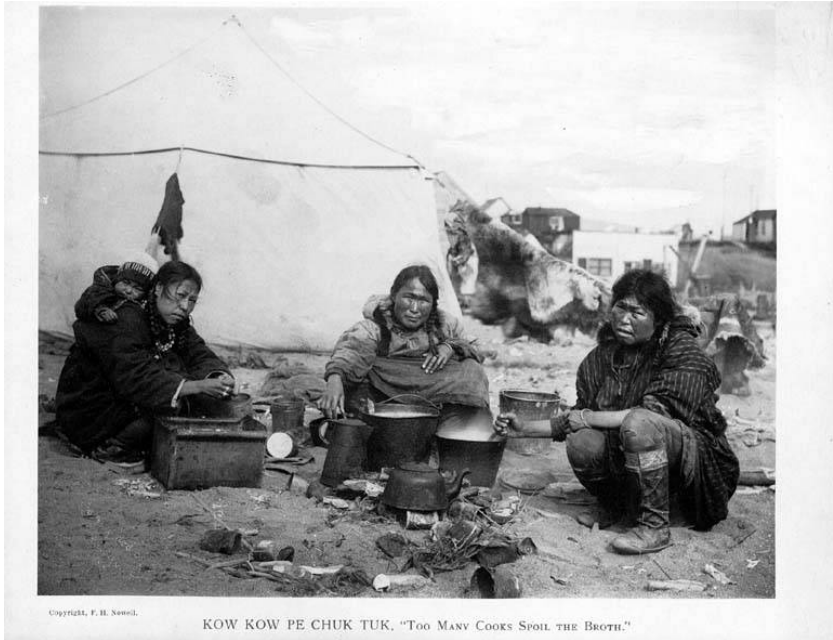


Figure 12.8. Cooking methods vary by culture and are influenced by tradition and availability of cooking tools and methods. In this photo, a group of Arctic Indigenous women in Alaska prepare a meal over an open fire; some of these methods are used today. "Group of Eskimo Women Around Cooking Fire, Alaska, ca. 1904" by Frank H. Nowell is in the public domain.

Cooking traditions and methods are as varied and diverse as the many nations and ethnicities from which they originated. Many cultures include nutritious dishes prepared with healthy ingredients (see Table 12.1) and cooking methods. For example, in Mexico and the Global South, dishes such as ceviche contain fish that has been prepared by marinating it in citrus such as lemon or lime juice. Steam is often used by many cultures as a primary cooking method. In Mexican culture, **tamales** are prepared by steaming them. **Dumplings** originated in China during the Han dynasty and today are cooked by various methods, including steaming, boiling, steam frying, or deep frying.

When working with a community member or individual who expresses an interest in modifying a cultural recipe to reduce sodium, increase fiber, or make other modifications for disease prevention or management, it is important to be prepared with culturally appropriate suggestions, or to know what resources exist to guide modifications. In the example shown in Figure 12.9, dumplings could be steamed instead of fried to reduce saturated fat. Another



Figure 12.9. Dumplings are prepared with different ingredients and by varied cooking methods as part of the Lunar New Year celebration. “Galician Dumplings as a Symbolic Food for the Lunar New Year” by Silar is licensed by CC BY-SA 4.0.

consideration is the practical impact such a modification would make. For example, if a patient rarely consumes a particular food or if the portion size is routinely small, nutritional modifications in the name of “health” would have minimal impact on overall nutrition quality, and may, in fact, impair rapport with the patient.

As mentioned, white rice is a staple in many ethnic diets (see Table 12.1); however, it tends to be lower in nutrients and fiber than brown rice. Brown rice may be swapped for white rice, but if this substitution is not acceptable to the individual due to tradition, preference, or cost, dietary instruction encouraging reduced portions of white rice is recommended. Other ways to help individuals make gentle dietary changes is to suggest fiber-rich lentils or unpeeled whole potatoes as occasional substitutes for low-fiber choices (e.g., peeled potatoes). Also, modifying cooking methods or recipes using high-fat condiments, sauces, and or **saturated fats** is recommended. For example, collard greens are

often prepared with bacon fat; suggest preparation with a mono- or polyunsaturated fat (e.g., olive oil) as an alternative.

Clinical Pearl: Understanding how foods are cooked and which ingredients are used to make recipes or meals can help nutrition professionals make alternative suggestions while preserving cultural integrity. Ask about the use of cooking oils, fats, and added sugars in traditional recipes and dishes. Then, make suggestions on how to swap out less optimal choices for more nutrient-dense alternatives.

An Example of Cultural Sustainability: Reuniting the 3 Sisters

For centuries, Native Americans grew corn, squash, and beans together in plots (Figure 12.10). The term “3 sisters” describes how the 3 plants thrived when cultivated together, the planting and harvesting of these Native American staples is making a comeback. Planting corn, beans, squash, and sunflowers produces synergistic growing conditions favoring these plants. Corn stalks create a trellis for the beans to climb while the beans stabilize corn stalks against the high winds. Corn and beans grow well together because bacteria on the bean plant’s roots draw in nitrogen from the air, encouraging growth of both plants. Squash provides essential ground cover, preventing weeds and preserving water, and sunflowers around the edge serve as natural fencing and attract pollinators. Some squash vines have thorns that discourage deer, racoons, and other animals from eating crops.³⁵



Figure 12.10. The “3 sisters”—corn, squash, and beans—grow in a single garden plot; the crops thrive together and are food staples among many Indigenous peoples in the United States. “Three Sisters Garden” from the National Parks Service’s NPGallery is in the public domain.

Native Americans are disproportionately affected by high rates of obesity and diabetes.³⁶ By revisiting and reinitiating farming practices of their ancestors, access to cultural food staples may expand and help reduce rates of these diseases.^{31,35-37}

CULTURAL HUMILITY AND COMPETENCE

Cultural humility involves understanding the complexity of identities and cultivating conversations that attempt to understand a person's identities related to race, ethnicity, gender, socioeconomic status, and other factors.³⁸ A culturally competent provider needs to have knowledge and awareness of health-related beliefs, practices, and cultural values of diverse populations; illness and diagnostic incidence and prevalence among culturally and ethnically diverse populations; and treatment efficacy and safety data for diverse populations.³⁸

Certain nutritionally sensitive diseases disproportionately affect many ethnic minorities, due to several factors, including somewhat modifiable factors such as environment and lifestyle choices but also nonmodifiable factors such as genetics and social-systemic constructs fostering **health disparities**.³⁹ Diabetes, hypertension, heart disease, and obesity may be managed, in part, through nutrition education and strategies. However, successful nutrition intervention requires a tailored approach attentive to cultural food aspects.³⁷

In Arizona, the 2 most common and costly chronic highly nutrition-sensitive diseases are heart disease and diabetes.³⁸ Poor nutrition and lack of physical activity are the most frequently cited risk factors.⁴⁰ However, both factors are influenced by environmental limitations to nutritional variety (e.g., low-access areas), access to healthier food options, and access to locations conducive to physical activity.⁴¹

In 2019, Banner Health Banner Thunderbird Medical Center (Maricopa County) undertook a needs assessment survey to identify and understand community health needs. Surveys were administered to 152 professionals who were identified as health or community experts familiar with target populations and demographic areas in Maricopa County.⁴² The survey asked respondents about factors that would improve quality of life, most

important health problems in the community, risky behaviors of concern, and their overall rating of the health of the community.

When asked to rank the 3 most important risky behaviors seen in the community, the top 5 answers included being overweight (57.2%), alcohol abuse (42.8%), poor eating habits (39.5%), drug abuse (35.5%), and lack of exercise (34.2%). The report also identified perceived lack of cultural competency and health literacy as barriers to health improvement and chronic disease management. The Partnership to Fight Chronic Disease for Arizona found that 62% of the population is overweight or obese, with 40% eating fewer than 1 fruit per day and 24% eating fewer than 1 vegetable a day. It's thought that these risk factors contribute, in part, to higher rates of heart disease and diabetes in the state.⁴³

ADDRESSING NUTRITION-SENSITIVE DISEASES



Figure 12.11. Dietitians play a key role in educating consumers about living with nutrition-sensitive diseases such as heart disease and diabetes. Often, education conducted in grocery stores can assist individuals and their families in optimizing their food choices. “Eating Healthy With Diabetes” by USDA is licensed by CC BY 2.0.

Heart Disease

Heart disease ranks as the number 1 cause of death in Arizona.⁴⁴ People can help prevent heart disease by understanding the risks and taking simple steps to address them. Among these steps is modification of nutritional habits. Helping individuals at risk for cardiac ailments to be mindful of the type and amount of dietary fats found in foods and fats used in cooking is essential to help reduce cardiac disease mortality and morbidity. Encouraging plant-based, fruit- and vegetable-rich meal plans, while being aware of

economic constraints that prevent or limit purchasing ability, is key to help those with cardiac risk factors to make lasting change.⁴⁵

Clinical Pearl: When providing nutritional counseling to individuals with cardiac risk factors, ask about their cultural foods and recipes. Having a conversation about recipes and typical cooking methods can help you and the individual make collaborative changes that encourage consumption of foods with known cardiac benefits, such as fruits, vegetables, high-fiber grains, lean proteins, low-fat dairy, and use of poly- or monounsaturated fats.⁴⁵

Diabetes

Diabetes is the seventh leading cause of death in the United States.^{46,47} Although diabetes affects people of all cultures, races, and ethnicities, higher rates are reported among Hispanics, Black people, Asian Americans, and American Indians and Alaskan Natives.⁴⁶

It is important to recognize that rates of **type 2 diabetes mellitus (T2DM)** vary within cultures as well. For example, South Asian, Filipino, Pacific Islander, and certain Japanese groups have a higher prevalence of T2DM compared with the East Asian subpopulation (i.e., populations originating from China, Korea, Japan, and Taiwan).⁴⁸⁻⁵¹

Body weight is a strong predictor of diabetes risk.⁵² Chronic elevated blood glucose level is associated with increased risk of

cardiac and renal **comorbidities**.^{46,47} Stabilizing one's blood glucose level throughout the day is critical to managing diabetes. This is done through a combination of meal planning, meal timing, and portion control. Educating those with diabetes or diabetes risk factors about portion size and focusing on limitation instead of elimination will encourage meaningful dietary change. However, many cultures view special diets as disruptive to social harmony and burdensome to others.^{51,53}

For example, among East Asian individuals with T2DM undergoing nutritional counseling, dietary recommendations did not always align with their beliefs of food as medicine or as a source of balance in life or healing. Chinese American, Korean American, and other subpopulations of Asian Americans found it difficult to adapt to T2DM dietary modifications because doing so caused them to feel distanced from familiar and shared cultural food habits and practices.^{30,48-51} Chinese American patients noted that rice is a vital food, both physically and symbolically, and to remove such a critical cultural staple from their diet is difficult.^{30,48-51} For many Asian cultures, dietary management and food preparation are the responsibility of the patient and the spouse or partner.^{30,51} Therefore, including significant others in conversations about dietary change, food preparation, and even meal timing is essential to supporting the individual on their journey to make dietary changes.

Check your understanding with this case study:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

[https://opentextbooks.library.arizona.edu/
culinarymedicine/?p=1322#h5p-83](https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1322#h5p-83)

SIGNIFICANCE OF MEALTIMES



Figure 12.12. The practice of dining together is central to many cultures and meal plans, such as the Mediterranean diet. “Group of People Making Toast” by fauxels is licensed under Pexels License.

Commensality is central to many cultures.^{54,55} Mealtimes offer opportunities for people to engage in eating and socialization. For children, mealtimes can be a time of apprenticeship, where they can actively observe and participate in mealtime customs and

traditions. Mealtimes vary within and across social groups in relation to participation, setting, duration, meal items, meal sequence, and food symbolism. Regardless, commensal meals are a time for participants to master cultural knowledge and practices associated with shared gatherings. A key tenet of the Mediterranean diet is the concept of conviviality, which involves enjoying family meals as a way to promote healthy eating.⁵⁶

Clinical Pearl: A goal in developing culturally centric diabetes meal plans is to limit but not eliminate foods and food groups and to understand about timing of meals. Learning about the food staples included in the individual's daily meal plan, their usual portion size, and the time of day when meals are eaten and with whom can help the nutrition professional design comprehensive and mutually agreeable meal plans. When culturally appropriate, nutrition counseling should involve both patient and their partner and supporters and strive to preserve cultural integrity while limiting the perceived social disharmony often caused by special diets.

Test your understanding with this crossword puzzle:



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://opentextbooks.library.arizona.edu/culinarymedicine/?p=1322#h5p-84>

A CALL TO ACTION: BECOME A CULTURALLY COMPETENT NUTRITION PROFESSIONAL

Culturally tailored nutrition education efforts have resulted in effective dietary change among those seeking to optimize their nutrition patterns. Providing single recipes or cooking demonstrations as part of multicomponent intervention to decrease meat consumption among Latinos and other populations has increased purchasing of produce.⁵⁷ The positive results from these dietary interventions, along with culinary medicine approaches, are low-cost and high-impact initiatives to improve dietary attitudes, culinary skills, and dietary intake, and can



Figure 12.13. Creating an environment that conveys conversation is key to communicating with individuals seeking nutrition counseling. “Medical Nutrition Therapy” by Kendl123 is licensed under CC BY-SA 3.0.

increase self-efficacy and competence with regard to nutrition knowledge.^{30,33,55,56} Although these interventions have produced positive results, there is a need for broader cultural competency, because better diet adherence, improvements in disease management, and lower chronic disease burden were found when cultural elements are incorporated.³⁴

So how can one enhance cultural competency in everyday nutritional education and counseling? Start by expanding your knowledge of the local community in which you practice. What are the demographic, socioeconomic, and food-shopping characteristics of the community? What are the most common chronic diseases affecting the community?

Next, identify resources to help you learn more about the predominant cultural foods and locate any nutritional counseling resources. Develop some screening questions to learn more about how an individual's food selections may be influenced by cultural aspects and socioeconomic factors, and query your clients about their cultural food preferences. Use the **Prepare-Engage-Respond** model explained in the next section to address key areas with your clients or patients.⁵⁷

Examples of Cultural Nutrition Counseling Questions

- What foods do you typically eat every day?
- Are there any foods you “can’t live without”?
- Are there occasions, such as holidays or events, for which you prepare special dishes? If so, what are those dishes? What are the ingredients?
- What are some cooking methods you use every day? For example, do you fry? Bake? Steam? Boil?
- What 2-3 foods do you consume nearly every day?
- How many fruits and vegetables do you eat every day?

- How do you prepare fruits and vegetables?
- Do you have challenges buying food?
- Are your food selections influenced by concerns about wasting food? For example, do you avoid buying fresh fruits and vegetables because they may ripen too quickly?
- Who primarily prepares meals in the household?
- What is your typical meal pattern—when do you eat (time of day)? Where (home, work)? With whom do you eat these meals (family, friends)?
- What is your greatest concern about potentially changing your meal patterns?

PREPARE-ENGAGE-RESPOND

There are many ways for nutrition professionals to engage with clients of all cultures. Prior to an encounter with an individual, whether as an outpatient or inpatient, here are ways to prepare, engage, and respond to them.⁵⁶

Prepare

- Learn about the community and the individual's culture before interacting.
- Take the time to familiarize yourself with foods considered staples of the culture of the client and/or the community.
- Gather available, culturally applicable dietary resources that may assist with nutritional counseling at the time of the appointment.
- Reach out your institution's language translation services; if you are in private practice or lack institutional services,

contact a local medical interpreter in advance of the appointment; these services are typically available for a small fee, either for in-person or telephonic translation. Translation services are free if associated with a hospital or other organization.

Engage

- Ask questions about family traditions, recipes, and ceremonies.
- Query about the type of foods eaten, as well as quantity and environment, time of day meals are typically eaten, and with whom.
- Encourage clients to share their health-related values and beliefs.
- Have clients describe examples of how culture plays a role in eating habits.
- Ask about traditional spices used in dishes.
- Actively listen to what is important to the individual about their concerns or hesitancy to make dietary or meal pattern changes.
- Involve other family members or supporters in dietary modification discussions.

Respond

- Provide tips on how to involve family when preparing meals.
- Provide reasonable and practical modifications to traditional recipes.
- Encourage the use of traditional foods with attention to

portion sizes.

- Include tips on incorporating traditional flavors using lower sodium or reduced-fat options.
- Give positive feedback regarding dietary changes.

TAKING A MINDFUL APPROACH

Creating cultural humility and practicing cultural competency in the context of the application of culinary medicine are a recipe for success. The act of bridging these 2 elements is largely dependent on the practitioner's motivation to seek resources to expand understanding of cultural food preferences, choices, and beliefs of the individuals they encounter.

Although the medical literature may be lacking evidentiary support of best practices on how to enhance nutritional cultural competency, the best source of this knowledge is the individuals themselves, who can offer the practitioner a firsthand accounting of the food traditions and cultural aspects that influence their nutritional behaviors. By partnering with those seeking nutritional guidance, the nutrition professional can optimize personal development toward the goal of offering culturally centered approaches to culinary medicine.

Key Takeaways

- Many popular meal constructs are skewed to Western dietary patterns and preferences but can be modified to be more culturally inclusive.
- Cultural foods can and should be part of optimal nutrition plans.

- Environmental, socioeconomic, and cultural factors influence dietary customs and/or behaviors that affect nutrition patterns, food selection, food preparation, food purchasing, meal timing, and commensality.
- Using the best available science to foster cultural humility and competency through thoughtful and engaging nutrition intervention strategies is a path to help optimize health outcomes in ethnically diverse groups while maintaining cultural integrity.

REFERENCES

1. What is MyPlate? 2022. US Department of Agriculture. Accessed July 10, 2023. <https://www.myplate.gov/eat-healthy/what-is-myplate>
2. Description of the DASH eating plan. National Heart, Lung, and Blood Institute. Updated December 29, 2021. Accessed July 10, 2023. <https://www.nhlbi.nih.gov/education/dash-eating-plan>
3. Healthy Eating Pyramid. Harvard T.H. Chan School of Public Health. 2008. Accessed December 20, 2024. <https://nutritionsource.hsph.harvard.edu/healthy-eating-pyramid>
4. Wang VH, Foster V, Yi SS. Are recommended dietary patterns equitable? *Public Health Nutr*. 2022;25(2):464–470. doi:10.1017/S1368980021004158
5. Ramírez AS, Golash-Boza T, Unger JB, Baezconde-Garbanati L. Questioning the dietary acculturation paradox: a mixed-methods study of the relationship between food and ethnic identity in a group of Mexican-

- American women. *J Acad Nutr Diet*. 2018;118(3):431–439. doi:10.1016/j.jand.2017.10.008
6. Lopez I. Culture and Mediterranean diet. *Int J Nutr*. 2019; 3(2):13–21. doi:10.14302/issn.2379-7835.ijn-18-2272
 7. Alexis A. Healthy eating includes cultural foods. Healthline. July 7, 2021. Accessed June 29, 2023. <https://www.healthline.com/nutrition/healthy-eating-cultural-foods>
 8. Coleman-Jensen A, Rabbitt M, Gregory CA, Singh A. Household food security in the United States in 2018. ERR-270. Economic Research Service, US Department of Agriculture. 2019. Accessed July 23, 2023. <https://www.ers.usda.gov/webdocs/publications/94849/err-270.pdf?v=7154.9.4>.
 9. Kern DM, Auchincloss AH, Stehr MF, et al. Neighborhood prices of healthier and unhealthier foods and associations with diet quality: evidence from the multi-ethnic study of atherosclerosis. *Int J Environ Res Public Health*. 2017;14(11):1394. doi:10.3390/ijerph14111394
 10. Drewnowski A. Obesity, diets, and social inequalities. *Nutr Rev*. 2009;67(s1):S36–S393. doi:10.1111/j.1753-4887.2009.00157.x
 11. Brunner TA, van der Horst K, Siegrist M. Convenience food products. Drivers for consumption. *Appetite*. 2010;55(3):498–506. doi:10.1016/j.appet.2010.08.017
 12. Sun Y, Dong D, Ding Y. The impact of dietary knowledge on health: evidence from the China Health and Nutrition Survey. *Int J Environ Res Public Health*. 2021;18(7):3736. doi:10.3390/ijerph18073736
 13. Johnson R, Stewart N. Defining low-income, low-access food areas (*food deserts*). Updated July 6, 2023. Accessed

- October 14, 2024. <https://crsreports.congress.gov/product/pdf/IF/IF11841>
14. McGuire S, Nord M, Coleman-Jensen A, Andrews M, Carlson S. Household food security in the United States, 2009. EER-108. *Adv Nutr*. 2011;2(2):153–154. doi:10.3945/an.110.000216
 15. Moreira PA, Padrão PD. Educational and economic determinants of food intake in Portuguese adults: a cross-sectional survey. *BMC Public Health*. 2004;4:58. doi:10.1186/1471-2458-4-58
 16. What is food insecurity? Feeding America. 2023. Accessed April 4, 2023. <https://www.feedingamerica.org/hunger-in-america/food-insecurity>
 17. Kirkpatrick SI, Dodd KW, Parsons R, Ng C, Garriguet D, Tarasuk V. Household food insecurity is a stronger marker of adequacy of nutrient intakes among Canadian compared to American youth and adults. *J Nutr*. 2015;145(7):1596–1603. doi:10.3945/jn.114.208579
 18. Morales ME, Berkowitz SA. The relationship between food insecurity, dietary patterns, and obesity. *Curr Nutr Rep*. 2016;5(1):54–60. doi:10.1007/s13668-016-0153-y
 19. Food insecurity. Healthy People 2030. 2023. US Department of Health and Human Services. Accessed July 25, 2023 <https://health.gov/healthypeople/priority-areas/social-determinants-health/literature-summaries/food-insecurity>
 20. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr*. 2010;140(2):304–310. doi:10.3945/jn.109.112573
 21. Wolfson JA, Garcia T, Leung CW. Food insecurity is

- associated with depression, anxiety, and stress: evidence from the early days of the COVID-19 pandemic in the United States. *Health Equity*. 2021;5(1):64–71. doi:10.1089/ [heq.2020.0059](https://doi.org/10.1089/health.2020.0059)
22. Rutledge K, McDaniel M, Teng S, et al. Food staple. *National Geographic*. May 19, 2022. Accessed June 10, 2023. <https://education.nationalgeographic.org/resource/food-staple>
 23. Quick facts. Arizona. July 1, 2022. US Census. Accessed July 11, 2023. <https://www.census.gov/quickfacts/AZ>
 24. Race, diversity, and ethnicity in Arizona City, AZ. Best Neighborhood. 2023. Accessed July 10, 2023. <https://bestneighborhood.org/race-in-arizona-city-az>
 25. Community, Research, and Evaluation Development (CRED) Resources. Resources for grant writing, needs assessment and evaluation. The University of Arizona Norton School of Human Ecology. 2023. Accessed December 20, 2024. <https://norton.arizona.edu/cred-resources>
 26. Mishev D. A sense of taste: Arizona's food culture. *Visit Arizona*. 2023. Accessed June 10, 2023. <https://www.visitarizona.com/like-a-local/a-sense-of-taste-arizonas-food-culture>
 27. Lamontagne N. Gene patterns shaping our food choices revealed. *Neuro News*. 2023. Accessed September 2, 2023. <https://neurosciencenews.com/genetics-food-preference-23676/>
 28. Sijangga MO, Pack DV, Yokota NO, Vien MH, Dryland ADG, Ivey SL. Culturally-tailored cookbook for promoting positive dietary change among hypertensive Filipino Americans: a pilot study. *Front Nutr*. 2023;10:1114919. doi:10.3389/fnut.2023.1114919

29. Johnson-Kozlow M, Matt GE, Rock CL, de la Rosa R, Conway TL, Romero RA. Assessment of dietary intakes of Filipino-Americans: implications for food frequency questionnaire design. *J Nutr Educ Behav*. 2011;43:505–510. doi:10.1016/j.jneb.2010.09.001
30. Li-Geng T, Kilham J, McLeod KM. Cultural Influences on dietary self-management of type 2 diabetes in East Asian Americans: a mixed-methods systematic review. *Health Equity*. 2020;4(1):31–42. doi:10.1089/heq.2019.0087
31. Ghosh S, Meyer-Rochow VB, Jung C. Embracing tradition: the vital role of traditional foods in achieving nutrition security. *Foods*. 2023;12(23):4220. doi:10.3390/foods12234220
32. US Department of Agriculture, US Department of Health and Human Services. Nutrition across the lifespan. Customizing the Dietary Guidelines framework. In: *Dietary Guidelines for Americans, 2020–2025*. 9th ed. US Government Publishing Office; 2020;28-29. https://www.dietaryguidelines.gov/sites/default/files/2020-12/DGA_2020-2025_CustomizingTheDietaryGuidelines.pdf
33. Snetselaar LG, de Jesus JM, DeSilva DM, Stoody EE. Dietary Guidelines for Americans, 2020–2025: understanding the scientific process, guidelines, and key recommendations. *Nutr Today*. 2021;56(6):287–295. doi:10.1097/NT.0000000000000512
34. Vanstone M, Rewegan A, Brundisini F, Giacomini M, Kandasamy S, DeJean D. Diet modification challenges faced by marginalized and nonmarginalized adults with type 2 diabetes: a systematic review and qualitative meta-synthesis. *Chronic Illn*. 2017;13:217–235. doi:10.1177/1742395316675024

35. Marsh E. The three sisters of indigenous American agriculture. National Agriculture Library, US Department of Agriculture. 2023. Accessed June 1, 2023
<https://www.nal.usda.gov/collections/stories/three-sisters>
36. Education materials and resources. My Native Plate. Indian Health Service, US Department of Health and Human Services. 2023. Accessed July 14, 2023.
<https://www.ihs.gov/diabetes/education-materials-and-resources/index.cfm?module=productDetails&productID=2468>
37. Villalona S, Ortiz V, Castillo WJ, Garcia Laumbach S. Cultural relevancy of culinary and nutritional medicine interventions: a scoping review. *Am J Lifestyle Med*. 2021;16(6):663–671. doi:10.1177/15598276211006342
38. Khan S. Cultural humility vs. cultural competence—why providers need both. *Healthcity*. March 9, 2021. Accessed August 7, 2023. <https://healthcity.bmc.org/policy-and-industry/cultural-humility-vs-cultural-competence-providers-need-both>
39. Center for Medicare Advocacy. Racial and ethnic health care disparities. 2023. Accessed August 7, 2023.
<https://medicareadvocacy.org/medicare-info/health-care-disparities>
40. Arizona Department of Health. Arizona Chronic Disease State Strategic Plan. 2012-2017. Accessed December 20, 2024. <https://www.azdhs.gov/prevention/chronic-disease/index.php#about>
41. Lenhart CM, Wiemken A, Hanlon A, Perkett M, Patterson F. Perceived neighborhood safety related to physical activity but not recreational screen-based sedentary behavior in adolescents. *BMC Public Health*. 2017;17(1):722. doi:10.1186/s12889-017-4756-z

42. Banner Health, Banner Thunderbird Medical Center. Community Health Needs Assessment. 2019. Accessed June 1, 2023. https://www.bannerhealth.com/-/media/files/project/bh/chna-reports/2019/arizona/banner-thunderbird_-2019-chna-report.ashx
43. Arizona. Partnership to Fight Chronic Disease. 2023. Accessed May 14, 2023. <https://www.fightchronicdisease.org/states/arizona>
44. Stats for the state of Arizona. Centers for Disease Control and Prevention National Center for Health Statistics. 2017. Accessed July 26, 2023. <https://www.cdc.gov/nchs/pressroom/states/arizona/arizona.htm>
45. Yu E, Malik VS, Hu FB. Cardiovascular disease prevention by diet modification: JACC health promotion series. *J Am Coll Cardiol*. 2018;72(8):914–926. doi:10.1016/j.jacc.2018.02.085
46. Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2017: estimates of diabetes and its burden in the United States. Updated May 15, 2024. Accessed November 4, 2024. https://www.cdc.gov/diabetes/php/data-research/?CDC_Aref_Val=https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf
47. Diabetes. Healthy People 2030. US Department of Health and Human Services. 2023. Accessed July 23, 2023. <https://health.gov/healthypeople/objectives-and-data/browse-objectives/diabetes>
48. Nam S, Song HJ, Park SY, et al. Challenges of diabetes management in immigrant Korean Americans. *Diabetes Educ*. 2013;39:213–221. doi:10.1177/0145721713475846
49. Pistulka GM, Winch PJ, Park H, et al. Maintaining an outward image: a Korean immigrant's life with type 2

- diabetes mellitus and hypertension. *Qual Health Res.* 2012;22:825–834. doi:10.1177/1049732312438778
50. Chesla CA, Chun KM, Kwan CML. Cultural and family challenges to managing type 2 diabetes in immigrant Chinese Americans. *Diabetes Care.* 2009;32:1812–1816. doi:10.2337/dc09-0278
 51. Chesla CA, Chun KM. Accommodating type 2 diabetes in the Chinese American family. *Qual Health Res.* 2005;15:240–255. doi:10.1177/1049732304272050
 52. Abe M, Fujii H, Funakoshi S, et al. Comparison of body mass index and waist circumference in the prediction of diabetes: a retrospective longitudinal study. *Diabetes Ther.* 2021;12(10):2663–2676. doi:10.1007/s13300-021-01138-3
 53. Ochs E, Shohet M. The cultural structuring of mealtime socialization. *New Dir Child Adolesc Dev.* 2006;(111):35–49. doi:10.1002/cd.154
 54. Al Bochi R. I'm a dietitian with Syrian roots—this is the Mediterranean Diet that I know and love. *EatingWell.* July 18, 2023. Accessed July 25, 2023. <https://www.eatingwell.com/longform/8059162/dietitian-syrian-roots-mediterranean-diet>
 55. Ayala GX, Pickrel JL, Baquero B, et al. The El Valor de Nuestra Salud clustered randomized controlled trial store-based intervention to promote fruit and vegetable purchasing and consumption. *Int J Behav Nutr Phys Act.* 2022;19(1):19. doi:10.1186/s12966-021-01220-w
 56. Medina FX. Looking for commensality: on culture, health, heritage, and the Mediterranean diet. *Int J Environ Res Public Health.* 2021;18(5):2605. doi:10.3390/ijerph18052605
 57. Cartwright MM. The prepare-engage-respond model to

develop cultural competency in the practice of dietetics.
[Manuscript submitted for publication]; *J Am Acad Nutr
Diet.*

Appendix A: Case Studies

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INTRODUCTION

This appendix consists of 7 case studies. Each case study includes a patient history and interview, as well as student application questions for practice developing patient-focused medical and nutrition interventions using culinary medicine principles to promote health and treat different conditions. With each case study, learners will have the opportunity to:

- Develop assessment, monitoring, and treatment skills
- Review the etiological and risk factors of the condition
- Gain knowledge related to patient's experience of the condition
- Recommend patient-focused interventions, including medical, nutrition, and culinary medicine, based on patient's background, diet, lifestyle, and condition
- Understand the roles of an interdisciplinary health-care team

These case studies are based in a clinical, individual patient setting. Because culinary medicine principles and interventions are relevant to diverse health professionals who may work in a variety of community and clinical health settings with individual visits and group classes, these case studies may be shortened and/or adapted (as relevant to the setting, needs, and role of the learner), as long as they include the core culinary medicine principles.

Resources are provided to support use of culinary medicine principles into screening, assessment, and interventions in clinical practice.

CASE STUDY NO. 1: ANEMIA

Chief complaint: Fatigue, feeling tired all the time

History of present illness: Andrea is a 23-year-old woman who has come to the clinic and is presenting with generalized fatigue. Andrea states she changed her eating habits 6 months ago because she wanted to become a vegan and heard that the vegan diet was healthier. She's made an appointment with you because she often feels tired and weak. She also tells you she's having trouble concentrating, is dizzy at times, and she can feel some tingling in her feet.

Care team members:

- Physician
- Registered dietitian nutritionist (RDN)

Past medical history: Gastrointestinal reflux disease

Family medical history: Breast cancer (maternal grandmother), hypertension (brother and father)

Social history: Andrea lives alone in a small apartment in an urban area. She moved out of her family home at age 21 years to go to college and has been living independently since then. She currently is a full-time college student pursuing a degree in

environmental science. She works part-time at a local café to support herself while in school. She maintains a close relationship with her family, who live in a different state. She regularly communicates with them but feels somewhat isolated in her current city. She has a small circle of friends, primarily from her college, but mentions feeling overwhelmed and less engaged in social activities due to her fatigue.

Medications/supplements: Pantoprazole (a proton pump inhibitor [PPI])

Allergies/intolerances: none

Diet history:

- **Breakfast:** one-half cup of oatmeal with honey, almonds, and apples; 8 oz black coffee
- **Morning snack:** one-half cup of edamame (soybeans)
- **Lunch:** salad and a candy bar from a grab-and-go coffee shop
- **Afternoon snack:** 2 small bags of potato chips
- **Dinner:** lentil soup, side garden salad (mixed greens, olives, vegan feta cheese, and tomatoes), 2 slices of sourdough bread
- **Dessert:** fruit sorbet

Positive exam findings: You notice her skin looks pale and her tongue is smooth and red.

Vital signs	Reference range	Date: 8/19/23
BP, mm Hg	<120/80	124/79
HR, bpm	60-100	77
RR, per minute	12-20	14
Temperature, °C (°F)	36.1-38 (~97-100.4)	37.2 (~99)
Height, feet (') and inches (")		5' 5"
Weight, lb		146
<p><i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i></p>		

Laboratory value	Reference range	Date: 8/19/23
Mean corpuscular volume, fL	80-100	105
Hb, g/dL	14-18	12.8
<p><i>Abbreviations: dL = deciliter (one-tenth of a liter); fL = femtoliter (10^{-15} L); g = gram; Hb = hemoglobin.</i></p>		

Student Application Questions

1. What type of anemia do her laboratory values reflect?

Answer: Macrocytic anemia

2. What vitamin is she most likely deficient in? Discuss factors that can contribute to this deficiency? What is Andrea's greatest risk factor?

Answer: Vitamin B₁₂. The laboratory values support that her symptoms of fatigue are caused by macrocytic anemia. Fatigue as well as numbness and tingling in extremities all point to a vitamin B₁₂ deficiency as a likely cause of her symptoms. Factors that can contribute to a vitamin B₁₂ deficiency include malnutrition, malabsorption, and medications such as proton pump inhibitors (PPIs) and metformin. Andrea's greatest risk factor is vegan diet.

3. This vitamin deficiency can mask another vitamin deficiency. What other nutrient levels must be checked before starting intervention?

Answer: Folate, because a folate deficiency can contribute to macrocytic anemia. Additionally, magnesium can be checked, because PPIs deplete magnesium levels in addition to B₁₂ and this can contribute to symptoms of anxiety, as well as to muscle cramps.

4. List components of the medical treatment and monitoring plan.

Answer:

- Daily multivitamin supplement containing vitamin B₁₂
- Oral vitamin B₁₂ supplementation with crystalline **cyanocobalamin**
- Consider sublingual vitamin B₁₂ instead of oral because this is better absorbed and is as effective as intramuscular injections
- Supplemental folate
- Monitor methylmalonic acid levels [>150 picograms/mL is normal]

Vitamin B₁₂ and folate **deficiencies** mask each other, so an underlying cause must be preferentially addressed.

- Long-term PPI use not only can deplete B₁₂ and magnesium levels, it can also increase the risk of osteoporosis and pneumonia. Advise Andrea to discuss with her physician options to wean off PPI as soon as possible, consider alternative medications such as histamine type 2 blockers (**H2 blockers**) that do not have the same side effects.

5. Develop nutrition and culinary medicine interventions for this patient and condition.

Answer:*Nutrition and Lifestyle Interventions*

- Increase dietary intake of target nutrient.
 - Animal proteins typically contain higher amounts of vitamin B₁₂; if Andrea was not following a plant-based diet, her clinician could recommend increased intake of animal products such as meat, dairy, and fish. However, because she follows a vegan diet, it is important to work with her to identify plant-based sources of food that are rich in vitamin B₁₂ (see the following section).
- Recommend she take vitamin B₁₂ supplements to support plant-based diet.
- Provide teaching on vitamin B₁₂. Handouts are helpful tools to provide to patients.
 - Example: [Vitamin B₁₂ Fact Sheet for Consumers](#) (National Institutes of Health)

Culinary Medicine Interventions

- Advise Andrea to eat a whole-food, plant-based diet with the rainbow of whole vegetables and fruits, as well as nuts and seeds.
- Advise Andrea to avoid processed foods that may still be vegan (e.g., french fries, potato chips, candy bars) because these processed foods are high in **calories** and low in nutrients.

- Vitamin B₁₂ is only naturally found in animal products, so people who follow vegan eating patterns may have more difficulty in consuming adequate vitamin B₁₂ through their diet. See [chapter 5](#) for additional information.
- Many foods are fortified with vitamin B₁₂; thus, people who follow vegan diets can still consume vitamin B₁₂ through their diet by planning consistent intake of foods that are fortified with vitamin B₁₂.
 - Common foods that are fortified with vitamin B₁₂ include fortified nondairy milk, breakfast cereals, and nutritional yeast.
 - Fortified nondairy milk may be substituted for milk in a 1:1 ratio in most recipes.
 - Nutritional yeast is a multipurpose seasoning that has a savory, **umami**-rich **flavor**. Most nutritional yeast is fortified with B vitamins, including B₁₂. Nutritional yeast can be used like grated cheese, sprinkled over salads, rice, pasta, vegetables, and popcorn. It can also be used in soups, stews, and smoothies. Links to a few recipes that use nutritional yeast are provided here. For more information on recipes and recipe adaptations, see [appendix B](#).

- [Vegan Pesto Spaghetti Squash With Mushrooms and Sun-Dried Tomatoes](#) (EatingWell)
- [Vegan Mac and Cheese](#) (EatingWell)
- [Easy Vegan Pizza](#) (EatingWell)
- It is important to teach patients how to pay careful attention to Nutrition Fact labels, because not all fortified foods contain vitamin B₁₂ or contain it in adequate amounts. See [chapter 1](#) for more information about Nutrition Fact labels and meal planning.

CASE STUDY NO. 2: BERIBERI

Chief complaint: Too much weight loss

History of present illness: Yasin is a 45-year-old Turkish American man who has come to the clinic to meet with his health-care team. His doctor referred him to a dietitian for unintentional weight loss secondary to gastric bypass surgery 2 months ago. Yasin's doctor referred him because he's lost 90 lb since the surgery. Yasin shared he has felt irritable and easily forgets things lately. He's had persistent vomiting, blurred vision, and numbness and tingling in his hands and feet. He also notes that he has been forgetting to take his daily multivitamin, and when he has, he just vomits it back up. The persistent vomiting has been going on since 2 weeks after his surgery.

Care team members:

- Physician

- Registered dietitian nutritionist (RDN)

Past medical and surgical history: Roux-en-Y gastric bypass, hypertension, **type 2 diabetes mellitus (T2DM)**

Family medical history: T2DM (paternal grandfather, father, brother and cousin); heart disease (paternal grandfather and father)

Social history: Yasin holds a bachelor's degree in business administration and works as a project manager at a local construction company. He has been with the same employer for over a decade. He lives with his wife and 2 teenage children. He has a strong support system, including his wife and children, who are concerned about his health and well-being.

Medications/supplements: Multivitamin/mineral supplement, metformin, ondansetron

Allergies/intolerances: none

Diet history:

- **Breakfast:** one-half cup of black tea and half-slice simit bread (Turkish sesame bread)
- **Morning snack:** whey protein supplement mixed into 8 oz of almond milk, cucumber slices
- **Lunch:** one-half cup red lentil soup and one-half cup shepherd's salad (tomatoes, cucumbers, green peppers, radishes, onions, parsley)
- **Afternoon snack:** whey protein supplement mixed into 8 oz of almond milk
- **Dinner:** one-half of a stuffed eggplant (eggplant, ground beef, pepper, and tomato), one-half cup white rice
- **Drinks:** adequate water throughout day

He tends to vomit about 2 to 3 times per day, so he's only able to follow this type of meal pattern 1 or 2 days/week.

Vital signs	Reference range	Date: 9/29/24
BP, mm Hg	<120/80	131/86
HR, bpm	60-100	87
RR, per minute	12-20	17
Temperature, °C (°F)	36.1-38 (~97-100.4)	37.4 (99.3)
Height, feet (') and inches (")		6' 1"
Weight, lb		234
<p><i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i></p>		

Laboratory values: No current laboratory values available

Student Application Questions

1. What vitamin is Yasin likely deficient in? What are the risk factors for this vitamin deficiency and why?

Answer: Thiamin (vitamin B₁). Bariatric surgery is a risk

factor for thiamin deficiency because it can cause malabsorption, which leads to nutrient deficiencies. Other common micronutrient deficiencies that may occur after gastric bypasses include vitamin B₁₂, vitamin D, iron, and copper. An additional risk factor is malnutrition, because it could lead to dietary insufficiency of thiamin. Yasin has had a 90 lb weight loss over 2 months and his estimated oral intake is less than 50% of estimated energy intake. Yasin should also receive a malnutrition assessment and nutrition-focused physical exam.

2. List components of the medical treatment and monitoring plan.

Answer: Thiamin supplementation (intravenously or oral thiamin alone, in B complex or multivitamin containing thiamin). Measure erythrocyte transketolase.

3. Develop nutrition and culinary medicine interventions for this patient and condition.

Answer:

Nutrition and Lifestyle Interventions

- Increase dietary intake of thiamin (grains, fortified and enriched foods, beans, fish, dairy).
- Take a thiamin supplement.
- Take a daily multivitamin supplement containing thiamin.
- Provide teaching on thiamin. Use handouts whenever possible to help provide patients with tangible and reputable sources of information.
 - Example: [Thiamin Fact Sheet for Consumers](#) (National Institutes of Health)

Culinary Medicine Interventions

- It is important to note that although Yasin has other factors (likely malabsorption, symptoms of nausea and vomiting, having had gastric bypass) affecting his ability to orally consume adequate thiamin in his diet and will require supplementations, there are recommendations that can be made to help Yasin optimize thiamin intake through culinary interventions.
- At the 2-month post-operation mark, Yasin should be able to consume regular foods; however, he has persistent symptoms of nausea and vomiting. It is important to be mindful of these gastrointestinal symptoms when recommending thiamin-rich foods. For instance, the stronger odors of fish, a thiamin-rich food, may not be appropriate. However, counseling Yasin on how to identify if the breads and plant-based milk (identified in his 24-hour recall) in his diet are fortified with thiamin would be patient-focused and appropriate. (See [chapter 1](#) for more information about nutrition labeling.) Furthermore, it would also be helpful to acknowledge the thiamin-rich foods that Yasin is already eating, such as lentils.
- For nutrition interventions to help with nausea and vomiting, vitamin B₆ supplementation may be indicated. Additionally, infusing water with ginger, peppermint, or lemon may also be beneficial for nausea symptom management.
- It would also be helpful to ask open-ended questions regarding Yasin's cultural and religious

background. For example, Muslim and Jewish dietary laws forbid the eating of pork, a thiamin-rich food. For more information regarding culturally centered approaches, see [chapter 12](#).

CASE STUDY NO. 3: CANCER

Chief complaint: Weight gain

History of present illness: Jennifer is a postmenopausal 49-year-old, non-Hispanic White woman who has an appointment with her oncology treatment team in the outpatient clinic. She wants to know how to improve her lifestyle and diet to prevent a recurrence of breast cancer. She reports gaining weight during chemotherapy and has been unable to lose the weight. She finished chemotherapy 2 months ago and has slowly increased her physical activity. She is now walking for 20 minutes, 3 days/week.

Care team members:

- Physician
- Nurse practitioner, certified in oncology
- Registered dietitian nutritionist (RDN), certified in oncology
- Pharmacist
- Exercise physiologist

Past medical history: Bilateral mastectomy for stage 2 breast cancer (estrogen-receptor positive [ER⁺] and progesterone-receptor positive) with reconstructive surgery (3 months ago) and chemotherapy (docetaxel and doxorubicin) followed by radiation (6 weeks). Jennifer became menopausal due to chemotherapy. Her dual-energy X-ray absorptiometry T-score (measures bone density) is -2.2.

Family medical history: Jennifer was adopted and she doesn't

have any information about her family history. She was born in New York but raised in Illinois and has lived there all her life.

Social history: Married to Matt for 20 years; 2 children (18 and 15 years). She just went back to work; she teaches second grade but is only teaching half days for now. She is very fatigued by noon when she's done with her day, so she goes home and takes a nap. Jennifer has no remaining side effects related to chemotherapy besides the fatigue. Matt and the children have been making most meals because Matt is the primary cook in the family.

Medications/supplements:

1. An aromatase inhibitor that increases bone loss; it is prescribed for ER⁺ breast cancer tumor types after treatment for breast cancer. Most women will take it for 5 to 10 years to reduce their risk of recurrence.
2. No supplements, because she was told to stop all supplements before beginning chemotherapy.

Allergies/intolerances: None

Diet history:

- **Breakfast:** cinnamon toast with peanut butter (3 tbsp) and 2 cups of black coffee
- **Lunch:** turkey sandwich (wheat bread and 3 oz deli turkey) and apple or tuna sandwich with large banana; water or bottled iced tea (not a lot of time to eat lunch)
- **Snack:** grabs crackers, pretzels, raisins, or cookies while finishing up the day at school
- **Dinner:** snacks (e.g., nuts, olives, chips, cheese) when she gets home because the kids are busy with sports activities until 8 PM. Family tend to eat dinner when traveling to activities (e.g., fast food [hamburgers, french fries, large soda; chicken sandwiches; bean burros, tacos]). When the family eats at home, dinner typically consists of some type

of meat, chicken, or fish; rice, mashed potatoes, or macaroni; salad with tomatoes, and a vegetable (e.g., green beans, spinach, corn, carrots); wine or beer with dinner at home (1-2 servings on Fridays, Saturdays, and Sundays).

- **Snacks while watching TV:** popcorn or nuts (2-3 times/week)

Survivorship treatment plan:

- Continue surveillance for breast cancer recurrence: follow up with medical oncologist and/or nurse practitioner every 3 months for the first year after treatment for breast cancer. Continue the aromatase inhibitor.
- The RDN will collaborate with Jennifer to design a lifestyle plan that meets her desires and promotes risk reduction.
- The exercise physiologist will design a therapeutic physical activity plan including both aerobic and weight-resistance activities.

Vital signs	Reference range	Date: 3/17/23
BP, mm Hg	<120/80	137/84
HR, bpm	60-100	89
RR, per minute	12-20	15
Temperature, °C (°F)	36.1-38 (~97-100.4)	36.6 (97.9)
Height, feet (') and inches (")		5' 10"
Weight, lb		210-218
Weight prior to diagnosis, lb		170-175
<p><i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i></p>		

Laboratory value	Reference range	Date: 3/17/23
Na, mEq/L	136-145	136
K, mEq/L	3.5-5.1	3.5
Cl, mEq/L	96-110	101
HCO ₃ , mEq/L	20-29	28
BUN, mg/dL	7-20	20
SCr, mg/dL	0.5-1.2	0.8
Glu, mg/dL	70-110	189
Vitamin D, nmol/L	30-100	27
CBC count		
WBC count	3.4-10.4 × 10 ³ /mm ³	4.0
Hb, g/dL	13.5-17.5	13.9
Hct, %	40-54	41
LDL, mg/dL	<100	100
HDL, mg/dL	>45	40

TRG, mg/dL	<150	190
Total cholesterol, mg/dL	<200	178

Abbreviations: BUN = blood urea nitrogen; CBC = complete blood cell; Cl = chloride; dL = deciliter (one-tenth of a liter); fL = femtoliter (10^{-15} L); g = gram; Glu = glucose; Hb = hemoglobin; HCO_3^- = bicarbonate; Hct = hematocrit; HDL = high-density lipoprotein; K = potassium; LDL = low-density lipoprotein; mEq = milliequivalent; mg = milligram; mm = milliliter; Na = sodium; nmol = nanomole; SCr = serum creatinine; TRG = triglyceride; WBC = white blood cell.

Student Application Questions

1. List risk factors for a reoccurrence of Jennifer's breast cancer.

Answer: Age, history of breast cancer, diet, alcohol intake, increase in weight, and low physical activity level.

2. Develop nutrient and culinary medicine interventions for this patient and condition.

Answer: Based on the practice guidelines for lifestyle modifications, the following are recommended:

Nutrition and Lifestyle Interventions

- Educate regarding the benefits of making lifestyle changes to improve prognosis and to optimize overall health after treatment.
- Collaborate with the patient to develop an individualized plan to slowly incorporate lifestyle changes.
- Address nutritional needs based on personal and cultural preferences; maintain pleasure of eating through positive health messages.
- Create eating plans that promote an energy intake deficit and so promote weight loss (individualized based on Jennifer's personal preferences and resources), may reduce the risk for a recurrence, reduce mortality and cardiovascular disease (CVD) risk factors, and improve quality of life are recommended for individuals who have excess **adiposity**.¹
 - Weight gain is common during cancer treatment due to multiple factors, including eating comfort foods, less physical activity due to fatigue, and possible reduced metabolic rate from chemotherapy. Weight gain during treatment has consistently been associated with a higher risk for breast cancer-related death, and further weight gain after treatment is common in the breast cancer population with 30% to 35% of breast cancer survivors meeting the guidelines for obesity.² Furthermore, excess adiposity is associated with an

increased risk of recurrence and poorer survival from breast cancer, as well as overall survival and reduced quality of life.^{2,3} Although the exact mechanisms involved are unknown, **adipokines**, chronic low-grade inflammation, and metabolic dysfunction are thought to play a role. Breast cancer survivorship practice guidelines recommend survivors achieve a healthy weight through diet and physical activity.³ However, data reflect that 37% of breast cancer survivors meet these guidelines for physical activity, whereas only 18% do so for diet.⁴

- Whether weight loss reduces the risk for recurrence is unclear, although some data reflect positive benefits related to reduced recurrence and increased disease-free survival.⁵ Several randomized clinical trials are under way to evaluate whether weight loss after treatment will reduce the risk for a recurrence. Weight loss, however, may reduce the risk for developing common chronic conditions such as CVD, hypertension, and type 2 diabetes. Research also reflects successful long-term maintenance of weight loss by breast cancer survivors.⁵
- Achieve ≥ 150 min/week of physical activity incorporating both aerobic and weight resistance training (at least twice weekly). A recent review of the effect of lifestyle factors on breast cancer-associated deaths concluded that physical activity has the most robust effect of all

lifestyle factors on reducing breast cancer recurrence.⁶ Lowered endogenous hormone levels, reduction of inflammation, and reversal of **insulin** resistance have all been hypothesized to mediate the effects of exercise.⁷

- Consume 1,200 mg/d calcium and at least 800 IU/d vitamin D through diet and supplementation as needed, given Jennifer's history of osteoporosis.

Culinary Medicine Interventions

- Encourage clinically meaningful weight loss of 5% to 10% for risk reduction of breast cancer recurrence. Eating plans that promote an energy intake deficit and so promote weight loss (individualized based on personal preferences and resources) may be recommended for individuals who have excess adiposity.¹ It is important to provide counseling and coaching to both Matt (because he is primary cook) and Jennifer. Some helpful strategies for weight management include:
 - Pairing proteins with each meal and snack to promote satiety. Work with Matt and Jennifer on how to incorporate proteins with snacks such as cheese with crackers or peanut butter with celery. Also identify lean proteins that can be easily cooked at home or purchased at the store or restaurant when necessary, such as grilled chicken or steamed fish. See [chapter 2](#) for additional

recommendations.

- Start the day with a protein-rich meal that is also low in added sugar to promote satiety throughout the day. Recommend that Matt and Jennifer use whole-grain bread and no-sugar-added peanut butter.
 - Smoothies could be recommended, which are a helpful way to increase fruit and/or vegetable consumption by blending with a protein source (including milk, yogurt, and/or chia seeds, flax seed, peanut butter) while maximizing time and energy.
- Recommend that Jennifer identifies how much she is currently eating, using measuring cups or scales, and reduce portion sizes of foods. If Jennifer is too busy or is unable to use a measuring cup, using hand-portion-size methods can be a helpful strategy on the go.
 - See [Serving-Size Chart](#) (Dairy Council of California)
- Slowly move to a plant-based diet aiming for 2 to 3 servings of vegetables and 2 servings of fruits daily; focus on getting a variety of colorful fruits and vegetable daily. Clinical practice guidelines highlight the importance of consuming a healthy diet for reducing the risk for breast cancer recurrence, CVD, and type 2 diabetes, and

improving quality of life.^{3,8,9} A healthy eating plan includes a plant-based diet rich in fruits, vegetables, whole grains, and **omega-3** fatty acid-rich foods. These dietary components reflect the foundation of the Mediterranean-style diet, which also aligns with the dietary principles of culinary medicine. See [chapter 8](#) for more information about popular diets.

- Omega-3-rich foods tend to be cold-water fish and seafood (e.g., tuna, salmon, sardines), nuts and seeds (e.g., chia seeds, walnuts, canola oil), as well as some vegetables, including spinach, brussels sprouts, and soybeans. Soy contains isoflavones (a natural plant compound found in soy foods) that have a similar structure to estrogen, but function differently in the body. It is important to note that soy-containing products in orally consumed foods are safe for patients with breast cancer and breast cancer survivors. These foods may be incorporated as parts of snacks or meals based on Matt and Jennifer's lifestyle and eating habits.
- It is sometimes easier to start by incorporating new foods as snacks (e.g., eating walnuts instead of cookies) or adding foods to existing meals (e.g., using spinach greens regularly for side salads or added to sandwiches).

- Afterward, in a step-wise fashion, Matt and Jennifer can start to incorporate more omega-3-rich foods using energy- and time-saving meal techniques (e.g., 1-pan salmon) to center meals around these foods.
- It is important that Jennifer is aware she can use fresh, frozen, and canned (low- or no-sodium vegetables or no-sugar-added fruits and fruits in water or juice) for meals or snacks to help reduce time needed to prepare vegetables and fruits.
 - Additionally, other strategies of increasing vegetables to existing foods, such as adding lettuce and tomatoes to sandwiches, may also help promote vegetable consumption. Fruits may be used as snacks, added to breakfasts, or blended into smoothies. These fruits and vegetables are not only rich in fiber (which will help increase satiety), they are also rich in **phytonutrients** and antioxidants that can help promote health. See [chapter 7](#) for more information on **bioactive compounds**. Certain fruits and vegetables may also be more affordable and fresher,

depending on when they are in season.

- [Make the Most of Your Vegetables](#) (MD Anderson Cancer Center)
 - [Your Seasonal Guide to Cancer-Fighting Foods](#) (Loma Linda University Health)
- While increasing consumption of plant-based foods for reducing risk of breast cancer recurrence and improving cardiometabolic health, it is also important to increase consumption of calcium-rich and vitamin D-rich foods after a new diagnosis of osteopenia, which is related to the aromatase inhibitor treatment.
 - Animal sources of calcium, such as milk and yogurt, are generally more bioavailable than plant-based sources of calcium. However, bioavailability varies, and both animals and plants are good sources of calcium.
 - Vitamin D-rich foods include fortified cereals, milks, juices, eggs, and mushrooms, as well as omega-3-rich foods such as salmon and tuna. Mindful

planning of ingredients can be beneficial to maximize nutritional benefits for health.

CASE STUDY NO. 4: CARDIOVASCULAR

Chief complaint: Follow-up for laboratory results

History of present illness: Norma is a 42-year-old Hispanic woman who has an appointment with her health-care team in the outpatient clinic to discuss her laboratory results. Norma reports that during the **COVID-19** pandemic, she wasn't eating "healthy" or taking care of her health, due to family responsibilities and death of father and uncle 2 years prior. She states that she still daily experiences feelings of grief and has trouble sleeping at night. She shared that she feels anxious most days and lacks energy and motivation to do anything except what is "absolutely necessary." Norma states that now is the time for her to "focus on her health" and she is motivated to make significant dietary and physical activity changes to promote her health and prevent disease. She also states that she has experienced muscle pain and weakness and read online that those were common side effects of atorvastatin; she would like to reduce the number of medications she is taking, if possible. Norma also notes that she has noticed her family only wants to eat out and is not physically active; she wants to incorporate healthier changes with her whole family.

Care team members:

- Physician
- Nurse practitioner
- Registered nurse
- Registered dietitian nutritionist
- Pharmacist

- Behavioral health counselor

Past medical history: History of gestational diabetes, prediabetes, dyslipidemia, hypertension, generalized anxiety disorder, prolonged grief disorder

Family medical history: Mother with type 2 diabetes (T2DM) and osteoporosis; father had T2DM (died of COVID-19–related causes in 2021); uncle had T2DM, chronic kidney disease stage III (died of COVID-19–related causes in 2021); and brother and sister with T2DM and dyslipidemia. Her spouse with dyslipidemia.

Social history: Norma has been married 21 years. Her husband works as a field supervisor for an agricultural company. She is a busy stay-at-home mom and has 4 children: a 17-year-old daughter, 15-year-old daughter, 12-year-old son, and 10-year-old daughter. Norma also states she is primary caregiver for her 64-year-old mother, who lives in separate city 20 minutes away. She does not smoke. She drinks alcohol occasionally, mostly during holidays or birthdays.

Medications/supplements: Lisinopril (10 mg/day), atorvastatin (20 mg/day)

Allergies/intolerances: No known drug allergies

Diet history: Norma follows a combination of traditional Mexican diet and **Standard American Diet**. She states she normally eats 2 meals (skips breakfast) and 1 or 2 snacks per day. Norma states that she and the family eat out 4 to 5 times/week; she often picks up food on the way home from taking care of her mother. She shares that she used to enjoy cooking and would like to cook more but is too tired to cook during the week. Norma also reports that she knows she and her family do not eat enough fruits and vegetables (no more than 1-2 servings per day). During the winter and spring, the family eats vegetables almost daily because her husband brings them home from work, but during summer and fall, they only eat vegetables about once per week. Norma states that she is willing to try a diet if recommended but doesn't

want to end up cooking a meal for herself and separate meals for her family. She also states that she likes to eat seafood but doesn't eat it much anymore because salmon is too expensive and she heard shrimp is high in cholesterol. Norma states that in the past 2 weeks, she is "cutting back on carbs" and reports that she misses eating tortillas.

Usual diet recall:

Breakfast: around 4:30 AM during agricultural harvest season or around 5:30 AM during nonpeak agricultural times (makes breakfast of eggs, chorizo, tortillas, and salsa for husband)

- 1 cup of coffee with no creamer, no sugar, 1-2 flour tortillas with 1 tbsp butter (occasionally)

Snack: around 9:30 or 10 AM

- 1-2 cups of coffee with 1-2 tbsp creamer, no sugar
- 1-2 servings of pan dulce (Mexican pastries [e.g., conchas, cuernos, empanadas])
- Sometimes in the spring and summer, she also eats 1 cup of melon or 1 orange

Lunch: usually around 1:30 or 2 PM

- 1 cup of sweetened tea
- 1 cup of salad greens with one-quarter cup combined tomatoes, cucumber, and carrots, 2 tbsp reduced-fat salad dressing, 2 tbsp croutons; **or** a sandwich (2 slices multigrain bread, 3 oz sandwich meat, 2 tbsp full-fat mayonnaise, 1 slice full-fat cheese)
- Quesadilla (8-in flour tortilla, one-quarter cup cheddar cheese, 1 tbsp butter or lard), one-quarter cup salsa **or** burrito (8-in flour tortilla, one-half cup pinto beans), one-quarter cup salsa

Dinner: usually around 5:30 or 6 PM

- 1-2 cups of sweetened tea
- 3-4 oz carne asada, grilled chicken, or pork, three-quarters cup white rice, one-quarter cup refried beans; **or** 1-1/2 cups of soup (e.g., sopa de fideo [noodle soup], caldo de res [Mexican beef soup], albondigas [meatball soup]) with 1 or 2, 4-in corn tortillas
- Three-quarters cup spaghetti and 4 to 5 medium-sized meatballs with one-quarter cup tomato sauce
- Takeout: burgers and fries, pizza, orange chicken and rice, tacos or flautas or sopes (corn tortilla with meat, cheese, and/or veggies)

Snacks

- Will sometimes snack on chips or crackers. Prefers savory to sweet.

Drinks: Drinks 2 to 3 cups of coffee and 2 to 3 cups of sweetened tea, occasionally water, rarely alcohol.

Physical activity: 15-20 minutes walking in neighborhood (in winter and spring), 1-2 days/week.

Vital signs	Reference range	Date			
		9/8/23	8/30/23	8/16/21	2/8/20
BP, mm Hg	<120/80	134/78	135/82	142/87	129/72
HR, bpm	60-100	84	89	95	80
RR, per minute	12-20	17	18	20	15
Temperature, °C (°F)	36.1-38 (~97-100.4)	36.4 (97.5)	37.3 (99.1)	37.8 (100)	36.8 (98.2)
Height, feet (') and inches (")		5'3"	5'3"	5'3"	5'3"
Weight, lb		181	183	187	164

Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.

Laboratory value	Reference range	Date		
		9/8/23	8/16/21	2/8/20
BMP				
Na, mEq/L	136-145	138	142	137
K, mEq/L	3.5-5.1	4.4	4.8	4.2
Cl, mEq/L	96-110	99	102	101
HCO ₃ , mEq/L	20-29	23	25	22
BUN, mg/dL	7-20	17	18	16
SCr, mg/dL	0.5-1.2	0.7	1.0	0.9
Glu, mg/dL	70-110	135	150	120
CBC count				
WBC count	3.4-10.4 × 10 ³ /mm ³	3.8	4.0	3.8
Hb, g/dL	13.5-17.5	14.5	14	15
Hct, %	40-54	44	47	43

Plt	150-425 × 10 ³ /mm ³	180	201	175
Lipid panel				
LDL, mg/dL	<100	130	140	99
HDL, mg/dL	>45	36	33	44
TRG, mg/dL	<150	240	220	199
Total lipids, mg/dL	<200	253	260	185
Liver panel				
Albumin, g/ dL	3.5-5.5	4.4	5.2	4.0
AST, Units/L	10-36	33	31	29
ALT, Units/L	8-48	32	30	27
Alk phos, Units/L	44-147	126	124	100
Miscellaneous				
HbA _{1C} , %	5-5.8	6.2	6.4	5.8
PT, sec	11-15	13	12	13

INR	<1.3	0.8	0.9	0.8
Ca, mg/dL	8.5-10.8	9.5	9.1	9.3
Mg, mEq/L	1.5-2.2	1.9	1.8	2.1
Phosphorus, mg/dL	2.5-4.5	3.3	3.1	2.7

Abbreviations: Alk phos = alkaline phosphatase; ALT = alanine transaminase; AST = aspartate transaminase; BMP = basic metabolic panel; BUN = blood urea nitrogen; Ca = calcium; CBC = complete blood cell; Cl = chloride; dL = deciliter (one-tenth of a liter); g = gram; Glu = glucose; Hb = hemoglobin; HbA_{1C} = glycated hemoglobin; HCO₃ = bicarbonate; Hct = hematocrit; HDL = high-density lipoprotein; INR = international normalized ratio; K = potassium; L = liter; LDL = low-density lipoprotein; mEq = milliequivalent; mg = milligram; Mg = magnesium; mm = milliliter; Na = sodium; Plt = platelet; PT = prothrombin time; SCr = serum creatinine; sec = second; TRG = triglyceride; WBC = white blood cell.

Student Application Questions

1. Explain the significance of the lipid panel results for this patient and how they relate to the diagnosis of prediabetes.

Answer: Norma has an elevated triglyceride level at 240 mg/dL and low HDL at 37mg/dL. This pattern of high **triglycerides** and low HDL is a sign of insulin resistance.

2. What is the top dietary contributor to the patient's high triglyceride levels?

Answer: Outside of familial hypercholesterolemia, high triglyceride levels in most patients, including this patient, come from excess sugar in the form of refined **carbohydrates** or grains and other high-sugar and low-fiber processed foods. Excess sugar in the diet is converted to triglycerides and deposited as fat mostly in the liver (contributing to fatty liver disease) and abdomen.

3. List components of the medical treatment and monitoring plan.

Answer:

- Recommend daily blood pressure monitoring while implementing dietary changes (Dietary Approaches to Stop Hypertension principles [e.g., reduced salt, increased potassium]). May need to increase lisinopril to 20 mg/day if blood pressure does not improve. Follow up in 3 months.
- Begin an exercise program to raise heart rate eventually to goal of 80% of maximum for 30 to 45 minutes 4 times/week; work up to this gradually.
- Refer to behavior health counseling for grief and anxiety counseling.
- Refer to registered dietitian for medical nutrition

therapy.

- Recommend enrollment in the local diabetes prevention program to support healthy eating and lifestyle behaviors, education on diabetes prevention, moral support, cooking tips, and sharing of healthy recipes. Online and in-person classes exist.
- Maintain atorvastatin at 20 mg/day while initiating therapeutic lifestyle changes to lower LDL level by decreasing saturated fat intake, increasing fiber intake, and increasing healthy fat intake, including monounsaturated fat, tree nuts, and seeds. Repeat a follow-up lipid panel in 3 months to assess progress. If Norma is able to implement and maintain lifestyle changes and her lipid panel levels improve, consider reducing statin dose.

4. Develop nutrition and culinary medicine interventions for this patient and condition.

Answer:

Nutrition and Lifestyle Interventions

- Increase dietary intake of **omega-3 fatty acids** (including omega-3 fatty acid fish, and plant-derived omega-3 fatty acid foods). See [chapter 7](#) on bioactive compounds for more information.
- Recommend total fat limited to 25% to 35% of total energy intake, saturated and trans fat <7%, cholesterol limited to 200 mg/day.
- Recommend Norma consume plant **stanols** and **sterols**: 2 to 3 g/day. See [chapter 7](#) for more

information.

- Increase intake of fruits and vegetables to at least 5 to 10 servings per day.
- Goal fiber intake: 21 to 25 g/day (women) and 25 to 38 g/day (men)
- Limit sodium to 2,300 mg/day initially.
- Limit added sugar to 6 tsp or 25 g/day.
- Increase foods higher in potassium, magnesium, and calcium. Provide teaching on thiamin. Use handouts whenever possible to help provide patients with tangible and reputable sources of information.
 - Example: Potassium Fact Sheet for Consumers in [English](#) or [Spanish](#) (National Institutes of Health)
 - Example: Magnesium Fact Sheet for Consumers in [English](#) or [Spanish](#) (National Institutes of Health)
- Recommend avoiding grapefruit consumption while taking the statin medication.
- May recommend limiting caffeine intake in beverages. Although chronic caffeine consumption's effect on blood pressure may not adversely affect hypertension, and some coffee intake may be beneficial for hypertension, high amounts of caffeine can increase anxiety and insomnia. Because Norma is diagnosed with generalized anxiety disorder, limited caffeine is recommended.

Culinary Medicine Interventions

- A key intervention for Norma will be reducing food consumed from restaurants and takeout. It will be important to provide coaching and expert advice on how to increase home cooking in a way that is manageable for her lifestyle.
 - Culinary skills training is not indicated, because Norma has indicated that she knows how to cook. The focus would be on optimizing cooking for her lifestyle.
 - It would be warranted to provide resources to help increase home cooking, such as batch cooking, multipurpose meals, and meal prepping, to provide Norma with the tools to keep healthy ingredients and meals on hand to help increase consumption of fruits and vegetables while decreasing consumption of takeout or restaurant food. See [chapter 1](#) for more information. Other consumer resources include:
 - [Staple Ingredients for Quick Healthy Meals](#) (American Heart Association)
 - [Cook Once, Eat Safely throughout the Week](#) (Academy of Nutrition and Dietetics)
 - [The 39 Best Base Recipes to Make for Meal Prep](#) (EatingWell)
- It's always important to recognize what

individuals are already doing well. Acknowledge that Norma is eating beans and whole-grain bread, which are both high in fiber, and evaluate cooking and preparation methods for nutrition optimization.

- Also recommend other foods that are high in fiber that may be used as snacks (e.g., fruit or avocado). Encourage patients to use a combination of fresh, frozen, or canned (low- to no-salt or sugar) vegetable and fruits as ways to increase fiber intake.
- Norma specifically stated that she is cutting back on carbohydrates but is missing a common cultural staple food: tortillas. It is important for Norma to receive nutrition education so she can make informed decisions of what type of carbohydrates she can eat, including tortillas.
 - Nutrition education can include different types of carbohydrates (limit simple, refined and increase whole, complex) and timing and portion size of carbohydrates (limit to 2-3 carbohydrate servings with each meal, pair with proteins).
 - Discuss with Norma how to increase other whole grains in her diet, such as identifying how to buy whole-grain corn tortillas or nopal tortillas (tortillas that increase fiber amount by adding **nopales** [a vegetable]).
- When recommending changes in dietary fat

consumption, it's important to assess what type of **fats** that Norma already cooks with and/or eats.

- A diet promoting decreased saturated fat intake would recommend more plant **oils** such as canola, avocado, or olive oil, while decreasing amounts of butter, lard, or shortening. See [chapter 4](#) on **macronutrients** for a more in-depth breakdown of types of fats in commonly consumed solid fats and oils.
- Norma mentioned concerns about dietary cholesterol in shrimp. Although shrimp is higher in dietary cholesterol than other lean proteins, recent research has indicated dietary cholesterol does not have a significant impact on blood lipid levels. In recommended serving sizes (about 3 oz/day), shrimp is a heart-healthy option because it is a lean protein (low in calories and total fat) and high in omega-3 fatty acids.
- Other plant sources of omega-3 fatty acids include chia seeds, walnuts, and canola oil.
- Plant stanols and sterols are also important interventions to help promote healthy lipid levels (see [chapter 7](#) for more information about plant stanols and sterols). Plant stanols are in foods such as broccoli, avocados, tomatoes, lentils, and many whole grains. Plant sterols are in olive oil, certain spices (e.g., thyme, oregano, paprika),

and some nuts including pistachios and almonds. Discuss with Norma how these ingredients may be realistically added into her diet and her family's.

- It is essential to meet individuals where they are and respect traditional ingredients for cultural dishes. It would be important to ask Norma how willing she would be to swap fats, in which dishes, and ask about her culinary comfort level in substituting fats in recipes. See [chapter 2](#) on preparing food, [chapter 12](#) on culturally centered approaches, and [appendix B](#) for recipes and recipe modifications.
- To increase potassium, magnesium, and calcium while reducing sodium, it is important to make sure Norma knows how to identify amounts on Nutrition Facts labels. See [chapter 1](#) for more information.
- When reducing sodium intake, it is important to also increase other flavors, including sour, sweet, bitter, and umami, through addition of ingredients such as vinegar, peppers, herbs, spices, and citrus.
 - Some seasonings, including hibiscus and cardamom, may help lower blood pressure. These doses may be higher than normally consumed in a diet; however, overall antioxidant effects of a combination of seasonings may be beneficial. Ask Norma what other herbs and spices she may use and work with her to integrate other flavors. See [chapter 2](#) for additional information.

- Also, Norma reports eating sandwich meat and chips or crackers, which tend to be high in added salt. Help Norma identify low- and no-sodium options that she can incorporate into her diet and meals. Also recommend other options for sandwich meat, such as sliced homecooked chicken breast, tuna, or other meats that are less processed. Low-sodium nuts can also be helpful alternative to crackers and chips.
- For reducing sweetened tea consumption (to decrease added sugar), it may be helpful to recommend ways to increase flavor of water. For instance, infuse water with fruit or no-sugar flavorings.

CASE STUDY NO. 5: LIVER DISEASE

Chief complaint: Fatty liver

History of present illness: Juan is a 46-year-old Peruvian man with nonalcoholic fatty liver disease (NAFLD) who has an appointment with his health-care team in the outpatient clinic. Juan is here today for follow-up; things are going relatively well related to his treatment plan. He has been taking his medication consistently and he always gets enough exercise through work. He reports, however, that he has been trying to follow a diet that is good for NAFLD but feels frustrated. He has tried seeking nutrition information for NAFLD, but he feels the information isn't culturally relevant to him.

Care team members:

- Physician
- Registered nurse

- Registered dietitian nutritionist
- Social worker
- Exercise physiologist

Past medical history: Diagnosed with NAFLD 2 years ago and hyperlipidemia 1 year ago.

Family medical history: Father with NAFLD, hypertension, and hyperlipidemia; mother with hyperlipidemia

Social history: Juan is married to Paula and they have 2 children together; they live in New York. Juan is originally from Peru and moved to the United States in 2002; he primarily speaks Spanish and knows minimal English. He follows a traditional Peruvian diet, and this helps him feel more connected to his family and culture. He works for a local moving company, which is very physically demanding. He and his family earn enough money to pay for their basic needs, but their income is limited, and this is stressful for them. Juan used to drink 3 to 4 beers per day, but he has stopped drinking alcohol completely since being diagnosed with NAFLD.

Medication/supplements: Lisinopril 20 mg, 1 tablet daily

Allergies/intolerances: None

Diet history: Juan follows a traditional Peruvian diet, and this helps him feel more connected to his family and culture. Juan describes that in his culture, “food is love,” and preparing and eating traditional Peruvian foods together is very important to his family. He has had past providers recommend the Mediterranean diet for his NAFLD, but the foods in this diet don’t match his cultural food preferences. Juan reports he has been trying to avoid sugar and carbohydrates because he reports they are “bad” for him. He has seen recipes for the Mediterranean diet (e.g., salad, salmon, brown rice). He does not like brown rice and prefers white rice, because he grew up eating this and it reminds him of his mother. A few of his friends at work have told Juan about how the ketogenic (“keto”) diet can “reverse” liver disease and that he should try

cutting out all breads and starches. Potatoes are a cultural staple in his diet, and Juan reports that he feels guilty for eating them.

Usual diet recall:

Breakfast: usually eaten at ~7 AM. Common breakfasts include:

- 1 bread roll with 4 oz chicharron (fried pork, typically used as a topping, snack, or part of a larger dish), 1.5 cups of coffee with 1 tsp sugar
- 2 to 3 **tamales** made with eggs and vegetables, 1.5 cups of coffee with 1 tsp sugar

Lunch: usually the “main” meal of the day eaten at around noon. Common lunches include:

- 2 cups lomo saltado (stir-fried beef with vegetables) served over 1 cup of white rice; side salad with lettuce, tomato, cucumber, with lime juice as the dressing
- 12 oz ceviche served over 1 cup of white rice; side salad with lettuce, tomato, cucumber, with lime juice as the dressing
- Arroz con pollo (1 cup of cilantro white rice with 12 oz chicken) served with one-half cup peas, carrots, and onions
- Papa a la huancaína (1 potato with 1 cup of spicy cheese sauce) served with 2 hard-boiled eggs and one-quarter cup olives
- Papa rellena (2 small potatoes stuffed with one-half cup of ground beef and onion), served with 1 cup of cilantro rice, one-half cup of salad (peppers, onions, and carrots)

Dinner: something light; usually eaten at ~7 PM

- Whatever was eaten for lunch is also eaten for dinner; usually about half portion that was eaten at lunch.

- A 16 oz smoothie, either jugo surtido or jugo especial (fruit juice)

Drinks: 12 oz of chicha morada (beverage made from purple corn, water, cinnamon, cloves, sugar, and fruit) once per day, 12 oz of coffee in the morning, 64 oz of water, occasionally one 12 oz can of Inca Kola (~3 times/week)

Physical activity: Juan works as a mover for a local moving company and his position is very physically demanding. He considers himself very active.

Vital signs	Reference range	Date: 3/17/23
BP, mm Hg	<120/80	127/81
HR, bpm	60-100	78
RR, per minute	12-20	18
Temperature, °C (°F)	36.1-38 (~97-100.4)	36.9 (98.4)
Height, feet (') and inches (")		5' 6"
Weight, lb		150
Waist circumference, inches	<35 for women, <40 for men	42
Usual body weight, lb		145-155
<p><i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i></p>		

Laboratory value	Reference range	Date: 3/17/23
Na, mEq/L	136-145	141
K, mEq/L	3.5-5.1	3.9
Cl, mEq/L	96-110	107
HCO ₃ , mEq/L	20-29	22
BUN, mg/dL	7-20	15
SCr, mg/dL	0.5-1.2	0.7
Glu, mg/dL	70-110	100
HbA _{1c} , %	Normal <5.7; prediabetes 5.7-6.4; diabetes >6.5	5.8
Vitamin D, nmol/L	30-100	37
CBC count		
WBC count	3.4-10.4 × 10 ³ /mm ³	3.5
Hb, g/dL	13.5-17.5	15.5

Hct, %	40-54	49
LDL, mg/dL	<100	136
HDL, mg/dL	>45	37
TRG, mg/dL	<150	285
Total cholesterol, mg/dL	<200	253

Abbreviations: BUN = blood urea nitrogen; CBC = complete blood cell; Cl = chloride; dL = deciliter; g = gram; Glu = glucose; Hb = hemoglobin; HCO₃ = bicarbonate; Hct = hematocrit; HDL = high-density lipoprotein; K = potassium; L = liter; LDL = low-density lipoprotein; mEq = milliequivalent; mg = milligram; mm = milliliter; nmol = nanomole; SCr = serum creatinine; TRG = triglyceride; WBC = white blood cell.

Student Application Questions

1. What other chronic conditions is Juan at high risk for, given he has NAFLD?

Answer: NAFLD is closely linked to metabolic syndrome. Does Juan meet criteria for metabolic syndrome? Metabolic

syndrome is defined as having any 3 of the following 5 factors: hypertension, high triglyceride level, low HDL level, increased waist circumference, prediabetes.

Juan has a high triglyceride level (285 mg/dL), low HDL (37 mg/dL); he also has hypertension, is prediabetic, and also has an increased waist circumference, so he meets all 5 criteria for metabolic syndrome. This syndrome is a common pathway to cardiovascular disease (CVD), diabetes, and obesity. Having several metabolic abnormalities confers an even greater risk of histological progression of nonalcoholic steatohepatitis and all-cause mortality. NAFLD can be progressive and is associated with increased mortality risk from CVD, extrahepatic cancers, and liver complications.¹⁰⁻¹²

2. Considering the social determinants of health, what factors might have affected or are currently affecting the development and progression of Juan's NAFLD?

Answer: Juan is part of a racial/ethnic minority, he is first-generation immigrant, and he is limited in his English proficiency. He and his family have a limited income, and they report this is stressful for them. Given that the patient is Hispanic, male, and has lower socioeconomic status, he may be at higher risk for development of other chronic diseases, disease progression, and poorer outcomes, when considering health inequities, **health disparities**, and genetic profiles for patients with NAFLD.^{13,14} See [chapter 12](#) for further information on culturally centered approaches to helping Juan.

3. Complete a comprehensive nutrition assessment.

Answer: A 46-year-old Peruvian man presents as adequately nourished as evidenced by no recent weight changes and diet recall showing adequate kilocalorie and protein intake. Weight has been stable for the past 3 years. Laboratory values show elevated total cholesterol, LDL, and TRG levels. Prior diagnoses include NAFLD (2 years) and

hyperlipidemia (1 year). BP is within normal limits. Diet recall and patient preference shows a traditional Peruvian diet. He reports he has been trying to avoid sugar and carbohydrates because they are “bad” for him. He feels frustrated because the nutrition tips and recipes for people with NAFLD aren’t culturally relevant to him. He feels guilty for eating potatoes even though they are a cultural staple in his diet. Current intake shows regular meals and snacks throughout the day. The patient does not drink alcohol. There is room for improvement in the addition of monounsaturated fats and fiber to support heart health and long-term prevention of diabetes, CVD, and hypertension. Patient reports he has a physically demanding job and considers himself to be very active. Will provide nutrition counseling to discuss heart-healthy diet and lifestyle recommendations in a way that is relevant to the patient. Special consideration should be given to help him maintain the joy he feels with eating his traditional Peruvian foods while making additions or adjustments to meet his goals.

4. List components of the medical treatment and monitoring plan.

Answer:

1. Continue lisinopril and consider the Dietary Approaches to Stop Hypertension (DASH) diet and cardiovascular exercise to improve hypertension management.
2. Continue lifestyle interventions for NAFLD and hyperlipidemia (avoiding refined and simple carbohydrates and, instead, increasing fiber and nutrient-rich, healthy carbohydrate sources as well as healthy fats; exercise).
3. Meet with dietitian to discuss culturally relevant nutrition recommendations.

4. Repeat laboratory values in 3 to 4 months to verify if patient's values are stable and improving. Consider an annual liver ultrasound for fatty liver disease reassessment.

5. Develop nutrition and culinary medicine interventions for this patient and condition.

Answer:

Nutrition and Lifestyle Interventions

First, it is important to recognize that NAFLD is primarily caused by excess simple carbohydrates or refined carbohydrates or grains in the diet with inadequate fiber usually found in processed foods and juices. So, the primary target of dietary management will be to educate the patient on the types of carbohydrates and to decrease the refined and processed as well as excess simple carbohydrates in his diet. For a great discussion on the biochemistry of NAFLD and fructose, we recommend the YouTube video "[Sugar: the Bitter Truth](#)" by Dr. Robert Lustig.

1. When possible, diets with limited carbohydrates and saturated fat and enriched with high fiber and unsaturated fats (e.g., Mediterranean diet, cardiometabolic protective eating pattern) should be encouraged, due to their additional cardiovascular benefits.

Given this patient's cultural food preferences, rather than recommending that he stops eating Peruvian foods and adopt a Mediterranean diet, his health-care team can work with him to incorporate heart-healthy components of the Mediterranean diet, such as increasing fruit and vegetable intake, increasing monounsaturated fat intake, and decreasing saturated and trans fat intake. Dietary changes should maintain the important connection of this patient's

culture. Health-care providers can work with this patient to determine what aspects of a heart-healthy diet, if any, would be reasonable and/or realistic to adopt.¹⁵

This patient also reports limited income, so he should be screened for food insecurity. If food insecurity is present, this can have a profound impact on the patient and his health outcomes. The health-care team can work together to provide resources and support for accessing enough food. Before implementing any other nutrition interventions, it is important for the patient to have adequate access and intake of food.¹⁴

If the patient has adequate access to food, nutrition recommendations would also include prevention or treatment of other comorbid conditions that are commonly associated with NAFLD, including CVD, type 2 diabetes, hyperlipidemia, and hypertension. Addressing carbohydrate intake specifically will be important for this patient because he has disclosed that he is trying to avoid them altogether. A modest intake of carbohydrates balanced with protein, healthy fat, and fiber can help support **glucose** levels for people at risk for diabetes. Avoiding carbohydrates altogether is a sign of an unhealthy relationship with food and may lead to other disordered eating thoughts or behaviors.^{16,17}

Instead, the patient should learn about healthy sources of carbohydrates that are from whole vegetables and whole grains and that also are high in fiber, rather than refined carbohydrates. If he wants to continue to eat potatoes and white rice, the concept of resistant starches can be introduced and Juan can be advised to let these foods cool down, or cook enough for the week, then reheat them so as to lower their glycemic load and prevent further worsening of the NAFLD.

In patients with NAFLD, alcohol can be a cofactor for liver

disease progression, and intake should be assessed regularly. This patient previously consumed 2 to 3 beers per day, but no longer consumes alcohol. His health-care providers can provide support in continuing to consume limited amounts of alcohol. His health-care providers also regularly can reassess his intake of alcohol.^{11,12}

2. Recommending weight loss may not be appropriate for lean patients with NAFLD, but dietary modifications and exercise in this group may be beneficial.

This patient's health-care providers should monitor his weight to ensure unintended weight loss does not occur. As liver disease progresses, a patient's risk for malnutrition also increases. Unintended weight loss could be an early or late indicator of malnutrition.¹⁶

3. Patients with NAFLD should be strongly encouraged to increase their activity level to the extent possible. Individualized prescriptive exercise recommendations may increase sustainability and have benefits independent of weight loss.

This patient is doing some physical activity at baseline, and it would be important to get more information about the intensity and duration. Additionally, the patient notes that there are limited places where he can exercise outside of his current activity; his health-care team should obtain more information about this, too. The health-care team should work with the patient to develop an individualized plan for how he can increase his activity level in a safe, sustainable way.

Culinary Medicine Interventions

- It is important to identify and share resources and interventions that are appropriate for Juan's language and cultural and social background. It

would be helpful to ask more open-ended, nonjudgmental questions regarding the culinary preparation of foods that Juan eats. It is common for Juan's wife to be primarily responsible for preparation of meals. Nutrition and culinary interventions should include Juan's family and eating habits; it will also increase likelihood of sustaining dietary changes. If the Peruvian diet is not familiar to the clinician, it is appropriate to demonstrate openness and curiosity regarding dishes and foods. See [chapter 12](#) for examples of cultural nutrition counseling questions and the prepare-engage-respond model for engaging with clients of diverse cultural backgrounds.

- Because Juan has shared interest and questions regarding the ketogenic diet, it would be important to provide education regarding the pros and cons of the keto diet. It should be emphasized that although the keto diet is a low-carbohydrate diet, it is also a high-fat diet, which would be contraindicated for patients with NAFLD, because it is difficult to consume the recommended macronutrient distribution for NAFLD (particularly consuming adequate fiber and less saturated or trans fat) with the strict macronutrient intake recommendations that are an inherent part of the keto diet. It is appropriate to reinforce recommendations of heart-healthy diets with Juan while discussing the indications and contraindications of the keto diet. For more information about the keto diet and other popular diets, see [chapter 8](#).
- Juan has expressed guilt about eating certain

foods, the importance of “food is love,” and eating for family and social relationships. It is essential to honor Juan’s cultural food preferences, not stigmatize certain food groups or ingredients, as well as not treat any food or diet as a panacea. Knowledge is power, and providing objective nutrition education about different food groups and their roles in health is key. See [chapter 3](#) for more information on enjoying food at home and beyond.

- It is helpful to keep a collection of recipes that highlight traditional meals of different cultural backgrounds of patients a clinician may see. Even having 1 recipe available for patients helps to demonstrate cultural awareness. For Juan, an example of a nutrient-rich traditional coastal Peruvian dish is [quinotto \(Peruvian quinoa risotto\)](#). Additionally, it is important to learn from Juan and his family how they prepare meals, what staple ingredients they use, and, after providing foundational nutrition education, to use that information to help them personalize culinary changes to promote nutritional and overall health. See [appendix B](#) for recipes and recommendations for recipe adaptations.
- It is also best practice to be aware of the different food distribution resources available in the community to help promote access to fresh fruits and vegetables, as well as other nutritious food. These can include **farmers markets, mobile markets, community gardens**, and **gleaning** programs. See [chapter 10](#) for more information about these seed-to-table programs.

CASE STUDY NO. 6: METABOLIC SYNDROME

Chief complaint: Here for annual wellness exam

History of present illness: Lemond (Lee), a 49-year-old man, has an appointment with his medical team today for his annual wellness checkup. Lemond is interested in learning how to manage his blood pressure with diet if he can and asks if the team can suggest healthy meals that are easy to make for 1 person. He is curious if he should be taking any supplements to lower his blood pressure. In the past 3 years, his lifestyle changed due to having knee surgery to repair an old football injury and caring for his spouse, whom he lost to cancer. He has gained some weight and is doing some physical therapy to strengthen his knee so he can resume his physical activity.

Care team members:

- Physician
- Nurse practitioner
- Registered dietitian nutritionist
- Pharmacist
- Exercise physiologist

Past medical history: Kidney stone while in college, none since. Low vitamin D level 4 years ago; resolved after supplementing. Knee surgery related to old sports injury. Reinjured trying to get back into shape with running and lifting weights after a couple years of inactivity taking care of wife. Had repair surgery and is doing well. Has had “borderline” high blood pressure in past that he was able to control with increasing his exercise; no previous blood sugar elevation. Does not smoke and drinks alcohol moderately (limits to 3-4 beers/week).

Family medical history: Ethnicity: Polynesian. Parents have mild

hypertension. His father has type 2 diabetes; his brother has high blood pressure. His sister and his college-age son are healthy.

Social history: Lost wife to breast cancer 3 years ago. Was her primary caregiver for a year before her death. Has used a grief support network online and has a supportive friend group. Works from home in the technology industry in software business management.

Medications/supplements: Was briefly taking antidepressants (sertraline) but decided he was feeling better and weaned from them. Takes vitamin D “when he remembers,” because his level was low in the past; takes 1,000 international units (IU) 3 to 4 times/week.

Allergies/intolerances: Mild lactose intolerance. Tolerates cheese and yogurt. Shellfish allergy.

Diet history: He has been eating more convenience meals, packaged snacks, and fast food due to not being able to stand for cooking and challenges with using crutches while shopping. Since losing his wife and his son going away to college, he has struggled to make meals for himself.

Usual diet recall:

- **Breakfast/first meal:** sausage and egg biscuit, sweetened instant oatmeal, or frozen pancakes and syrup with bacon. 10 oz of coffee with cream.
- **Lunch:** 1 to 2 slices of pizza, or ham (4 oz) or turkey (4 oz) sub sandwich (4 in long), flavored chips (snack bag size), 32 oz of lemonade or **electrolyte** drink.
- **Snack:** 1 to 2 times per day: prepackaged fruit cups in syrup (4 oz), individual packs of cheese crackers or chips, ice cream bar or protein bar (provides 12 g of protein). Has chips, salsa, wings, and nachos when watching football.
- **Dinner:** 2 to 3 frozen burritos; 2 sub sandwiches (4 in long)

with 3 oz ham or turkey plus 2 oz provolone cheese); 2 to 3 cheese quesadillas; or 2 to 3 hot dogs; occasionally hamburger with fries or Caesar salad with chicken from fast-food place. 32 oz soda 1 to 2 times/week.

- **Alcohol:** Has “a few beers” weekly during football season, does not drink other alcoholic beverages.

Vital signs	Reference range	Date: 2/9/23
BP, mm Hg	<120/80	136/85
HR, bpm	60-100	75
RR, per minute	12-20	15
Temperature, °C (°F)	36.1-38 (~97-100.4)	38 (100.4)
Height, feet (') and inches (")		5' 10"
Weight, lb		218
Usual weight, lb		195-200
Waist circumference, inches	<40 for men, <35 for women	42
Hip circumference, inches		37

Waist to hip ratio	≤ 0.90 for men, ≤ 0.85 for women	1.05
<i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i>		

Laboratory value	Reference range	Date: 2/9/23
Na, mEq/L	136-145	140
K, mEq/L	3.5-5.1	3.5
Cl, mEq/L	96-110	100
HCO ₃ , mEq/L	20-29	22
BUN, mg/dL	7-20	17
SCr, mg/dL	0.5-1.2	.8
Glu, mg/dL	70-110	100
LDL, mg/dL	<100	125
HDL, mg/dL	>45	35
TRG, mg/dL	<150	197
Total cholesterol, mg/dL	<200	240
Albumin, g/dL	3.5-5.5	5.0
AST, Units/L	10-36	35
ALT, Units/L	8-48	45

Alk phos, Units/L	44-147L	
HbA _{1C} , %	Normal <5.7; prediabetes 5.7-6.4; diabetes ≥6.5	6.0
Fasting glucose, mg/dL	Normal level <99; prediabetes 100-125; diabetes ≥126	120
25-hydroxyvitamin D, ng/mL	30-50	32

Abbreviations: Alk phos = alkaline phosphatase; ALT = alanine transaminase; AST = aspartate transaminase; BUN = blood urea nitrogen; Cl = chloride; dL = deciliter; g = gram; Glu = glucose; Hb = hemoglobin; HbA_{1c} = glycated hemoglobin; HCO₃ = bicarbonate; Hct = hematocrit; HDL = high-density lipoprotein; K = potassium; L = liter; LDL = low-density lipoprotein; mEq = milliequivalent; mg = milligram; ng = nanogram; SCr = serum creatinine; TRG = triglyceride.

Student Application Questions

1. What are the criteria a patient needs to meet to be diagnosed with metabolic syndrome?¹⁸

Answer: Meets at least 3 of 5 criteria for metabolic syndrome:

- Prediabetes (HbA_{1c} 6.0)
- Stage 1 hypertension (BP >130/80 mm Hg)
- Low HDL level
- High triglyceride level
- Elevated waist circumference¹⁹

2. Complete a comprehensive nutrition assessment.

Answer: Lee's weight is 110% of his usual body weight, and his increased waist to hip ratio suggests increased health risk. He has elevated fasting glucose and HbA_{1c}

values, elevated lipid levels (high total, low HDL, and elevated TRG). From his diet history, Lee's intake reflects heavy reliance on convenience and processed foods, high-calorie meals, simple carbohydrates, and sodium. He has frequent sugar-sweetened beverage intake and moderate alcohol intake. He has a low intake of fiber and fruits, vegetables, whole grains, nuts, seeds, healthy fat sources, and fish. He does not drink adequate amounts of plain water.

Physical activity has been decreased due to knee surgery recovery period. He has been attending physical therapy. Lee has had family life changes and grief from loss of spouse and currently adjusting to living alone. He has a support system in place. Medical history includes elevated BP that he was able to control with lifestyle changes and "getting in shape." He missed his last annual medical appointment. He is currently not taking any medications. Plan to assess knowledge of nutrition and readiness to change, help elicit his motivation, assist Lee with making goals for meaningful lifestyle changes to achieve healthy BP, glycemic control, and stabilize his weight to prevent further gain and promote gradual return to his usual weight as appropriate. Provide education and resources on healthy meal planning for one. Recommend he continue his vitamin D supplementation and consider increasing it, because optimal levels are closer to 60 ng/mL, so he is still at low end of normal range.

3. What are some barriers based on Lee's life experiences that may influence him being successful with lifestyle changes, including use of culinary medicine practices?

Exercise

Answer: He is still in the healing phase from his knee surgery, which puts constraints on building an exercise routine. He is a currently deconditioned former athlete who

may need help with more gradual progression of exercise difficulty to avoid exacerbating knee healing and to help avoid injury. He has a sedentary job and spends the day seated in front of a computer screen.

Nutrition

Answer: Lee is adjusting to meal preparation for one and has experienced grief with loss of a spouse and adjustments in his routine with his son leaving for college. He may need help in this period of transition with planning meals and shopping and preparing meals that align with his goals of healthy, easy-to-prepare meals. His past nutrition and activity patterns as a former athlete are very different from what he needs at this stage of his life. He may need help making realistic lifestyle goals.

4. How can the health-care team approach this patient in a way that promotes collaboration and patient-centered care?

Answer: The use of motivational interviewing techniques assists patients making successful lifestyle changes.¹⁹ It is important to assess Lee's readiness to change, sources of personal motivation, and nutrition knowledge. Lee has expressed interest in learning to cook easy but healthy meals for one, showing readiness to change, and motivation for staying off medications. He has mentioned previous success controlling his BP through lifestyle changes. We can ask him open-ended questions to learn about his previous habits and knowledge. Information he offers can be used to offer affirmations to build his confidence in making lifestyle changes. By asking what strategies he has used in the past when trying to reduce his BP, Lee may be able to identify habits he is comfortable with reestablishing, or we can offer an opportunity to refine or modify the behavior for his

current stage in life, addressing barriers he may mention that may interfere with sustaining lifestyle changes.

Use motivational interviewing counseling techniques to see what changes Lee wants to focus on in terms of nutrition changes and goal setting, and to help him set his own goals for changes that align with his nutritional concerns and honor his culture and preferences. Assess his knowledge of nutrition principles to help with BP, blood lipid, and glycemic control, and ask his permission to offer education as applicable. We could help him define how to make meals healthier: Ask what he already knows about that and what changes he feels would help most for BP, lipids, and blood glucose control. Clarify anything that is incorrect as needed; ask if he has questions and what he wants to learn specifically. Asking permission before sharing education or information with him allows for him to feel in control of the conversation and more likely to engage in the change process.¹⁹

Lee has a Polynesian cultural background. Using motivational interviewing counseling techniques and cultural humility, be curious about foods and practices that are important to Lee and if there are any that honor his culture. Practicing cultural humility will build a stronger relationship with Lee and empower him to adhere to his treatment plan.²⁰ He may offer some cultural meal choices that could be built into his culinary medicine interventions to increase his meal enjoyment and adherence, and he may have physical activities or other lifestyle behaviors that align with his culture. See [chapter 12](#) for additional information about cultural approaches to culinary medicine.

5. List components of the medical treatment and monitoring plan.

Answer:

- **What should his first-line medication be if BP continues to rise?** Lisinopril (or other angiotensin-converting enzyme inhibitor)
- **What first-line medication should be considered if his blood sugar values do not decrease?** Metformin²¹
- **What medications or supplements may help improve his lipid levels?** In this case, Lee's triglyceride levels are elevated and can be lowered by supplementing with omega-3 fish oil (3-4 g/day eicosapentaenoic acid + docosahexaenoic acid split among meals). If his LDL level was more elevated, he could use a statin medication; however, these also worsen insulin resistance and can increase risk of diabetes.²¹

If Lee agrees to some diet changes and activity increases, his fasting glucose level could be retested in 1 to 2 months and HbA_{1c} in 3 to 4 months. Recommend frequent BP testing with a home monitor to ensure BP is trending down. His waist circumference and waist to hip ratio could be rechecked after 3 months of lifestyle change to assess if progress is being made; assess weight change if client desires. Consider assessing his sleep habits; these can affect his BP and glycemic control.

6. List nutrition and culinary medicine interventions for this patient and condition.

Answer:

Nutrition and Lifestyle Interventions

- Achieve ≥150 min/week of physical activity, incorporating both aerobic and weight resistance

training (at least twice weekly) and work up to 30 to 60 minutes of daily physical activity.^{22,23}

- Increase intake of fruits and nonstarchy vegetables, aiming for 2 to 3 servings of vegetables and 2 servings of fruits daily; focus on getting a variety of colorful fruits and vegetables daily to increase intake of nutrients and bioactive compounds in foods.²²
- Encourage reduction of simple and refined carbohydrates and increase use of nutrient-dense carbohydrate sources that are high in fiber, balance carbohydrate intake throughout the day, and increase fiber intake gradually to meet Daily Reference Intake of 38 g/day.²²
- Decrease intake of **saturated fats** to 10% or less of total calories by reducing processed and fast foods and cooking with olive or avocado oils.²²
- Increase use of fresh herbs and spices to assist with success of reducing sodium intake and increase intake of bioactive compounds that decrease inflammation and chronic disease risk.²⁴

Work up to 150 min/week of moderate exercise, or 75 minutes of vigorous activity, as recommended for healthy individuals per week. For metabolic syndrome, the literature recommends 30 to 60 min/day of activity. Suggest Lee start with swimming or other low-impact activity, starting with 20 min/day. His goal should be to increase vigorous and moderate activity for cardiovascular fitness and resume strength training at least twice per week using free weights or body weight exercises. Weight training can increase mitochondria in muscles, increase lean mass, help with

blood glucose management and metabolism, and decrease visceral fat. Lee could consider using a standing desk or taking regular walking breaks throughout the day to decrease hours of sedentary time.^{22,23}

Culinary Medicine Interventions

Answer:

- BP: Consider a modified Dietary Approaches to Stop Hypertension (DASH) diet, which has been clinically shown to decrease BP on par with medication.²⁵ The focus of this diet is increased fiber in the form of whole vegetable and fruits, as well as decreased sodium. One way to achieve this is to avoid processed and prepackaged foods, paying attention to labels regarding sodium content. In cooking, a good strategy is to cook with as little salt as possible and limit to salting to taste at the table while eating a meal, which reduces overall sodium consumption. Also increase foods rich in magnesium and potassium, because these **minerals** can contribute to decreased BP.²⁵
- Lipids: Increase fiber in the form of whole plant-based foods (e.g., whole vegetables and fruits, not juice), increase plant and lean proteins from beans, fish, seeds, and nuts. Additionally, increase healthy fats, focusing primarily on monounsaturated fats in foods, such as extra-virgin olive oil (cook with as little oil as possible, avoid reaching the oil **smoke point**, and consider adding it as a finishing oil on top of food). For polyunsaturated fats, focus on omega-3 from

wild seafood, flaxseeds, and walnuts. Decrease sources of saturated fats (increase LDL level), as well as simple sugars and refined grains (increase triglyceride levels).^{22,25}

- Glycemic control: Compare categories of carbohydrates based on the glycemic index and glycemic load of foods. Review carbohydrate counting and serving sizes and strategies to improve the quality, quantity, and distribution of carbohydrates, including smaller servings and consuming simple and refined carbohydrates, such as sugar-sweetened beverages, less often;²¹ explore options to increase use of high-fiber options and use of nuts and healthy fats for satiety and to aid blood lipid management.²⁵ Increase use of plain water as a beverage, nonstarchy vegetable intake, use **MyPlate** type tools to provide education on portion sizes and ways to balance meals.
- Meal preparation: Could use some Mediterranean diet and/or DASH diet recipe sources, including videos; refer patient to cooking seminars; healthy meal prep kits. Free meal plans may be found online, including through [EatingWell](#) and [Mount Sinai](#). Additionally, MyPlate offers free software, the [MyPlate Plan](#), in English and Spanish to help patients identify their food group targets so they can plan meals and snacks based on recommended food group servings. These tend to be more generic. A registered dietitian can help develop a personalized meal plan for patients.
- Culinary coaching is a combination of

motivational interviewing and nutrition education that uses coaching skills and expert nutrition, culinary, and sometimes medical knowledge to provide patient-centered education and counseling.

CASE STUDY NO. 7: DIABETES

Chief complaint: High blood sugar

History of present illness: Mrs. Fuentes is a 43-year-old Mexican American woman who has been referred to the clinic for diabetes management. She is coming to the clinic today to meet with the diabetes clinic care team. Mrs. Fuentes is employed as an operating room nurse and was recently diagnosed with type 2 diabetes mellitus (T2DM). She developed gestational diabetes while she was pregnant with her second child. Her blood glucose levels returned to normal in the postpartum period, and she was advised to get regular checkups, maintain a desirable weight, and engage in regular physical activity. Although she reports that she has been trying to consume a healthy diet and that she exercises regularly (1-2 times/week for 20 minutes), she has struggled with sticking to her eating plan and has had a history of weight cycling. She is 5 ft 3 in tall and currently weighs 153 pounds; her weight is stable. She is motivated to improve her health because she wants to lose some weight, and she has joined a gym because she is concerned about the long-term effects of diabetes and wants to avoid the possibility of needing insulin injections. She is also concerned about her husband and children because they are overweight and not very active. She has a healthy body image but knows that she can make some changes in her lifestyle to reduce the complications associated with poor glycemic control. She has been checking her blood glucose level a couple times a week in the morning before eating, and it is usually in the 140 to 150 mg/dL range.

Care team members:

- Physician
- Registered nurse*
- Registered dietitian nutritionist*
- Pharmacist*
- Exercise physiologist

*These team members are also Certified Diabetes Care and Education Specialists

Past medical history: T2DM recently diagnosed; history of gestational diabetes

Family medical history: Two daughters who are healthy (ages 9 and 5 years), mother with T2DM and osteoporosis, father deceased (stroke in 2001), brother with T2DM and hypertension

Social history: Married to Henrique for 15 years, has 2 daughters ages 9 and 5 years. Employed as a surgical nurse, works 3 days/week; 12-hour days. She reports not “drinking” too much but does report she will have a glass of wine on most nights to “unwind.” Does not, and never has, smoked.

Medications/supplements:

- Metformin 500 mg once daily
- Aspirin 81 mg once daily

Allergies/intolerances:

- Penicillin (rash)
- Enalapril (cough)

Diet history:

- **Breakfast:** 2 scrambled eggs, 2 pieces whole-wheat toast, 1 medium banana, and 8 oz of grape juice; or 1 cup of oatmeal with 1 medium banana and 6 oz of orange juice

- **Lunch:** turkey (2 oz) and cheese (1 slice) sandwich on 2 slices of whole-wheat bread with mayonnaise (1 tbsp), lettuce (1 large leaf), and 2 slices of tomato, and a diet soda; or a large green salad with turkey or chicken (2 oz of 1 or the other) and cheese (~1.5 oz) with just a few vegetables, like celery and tomatoes, diet soda, and large whole-grain roll with butter (1 pat).
- **Snack:** grazes on whatever is available at the hospital (e.g., popcorn, chips, nuts, cookies, hard-shelled chocolate candies). Difficult to estimate portion sizes but she guesstimates 1 to 3 handfuls except cookies, of which she might have 3 to 4; doesn't usually snack when she is not working.
- **Dinner:** approximately 4 oz of chicken, hamburger, steak, hot dogs (2 on buns), or pork chops with 1 cup of mashed potatoes, rice, or pasta with ~1 tbsp of margarine; typically approximately one-half cup of some type of veggies (e.g., peas, corn, mixed vegetables), or small salad with a few slices of cucumber and tomatoes. Usually has ~1 tbsp of ranch or Italian dressing on her salad. Also eats boxed hamburger casserole mix, tuna noodle casserole, Mexican food, and Italian, among others. She usually has some type of dessert (e.g., $\frac{3}{4}$ cup of pudding, 1 cup of ice cream, 2 cookies, a small slice of pie). Has a glass of wine (~5 oz) before or with dinner on most nights. Fuentes and her family eat out about twice a week (e.g., pizza, Chinese, gourmet hamburgers).

Mrs. Fuentes states she's too tired to cook on workdays, but her daughters love to cook.

Vital signs	Reference range	Date		
		3/16/ 21	3/7/ 21	3/1/ 20
BP, mm Hg	<120/80	132/ 84	134/ 85	129/ 72
HR, bpm	60-100	89	91	82
RR, per minute	12-20	15	16	
Temperature, °C (°F)	36.1-38 (~97-100.4)	36.6 (~98)	36.8 (98.2)	
Height, feet (') and inches (')			5'3"	5'3"
Weight, lb			153	145
<p><i>Abbreviations: BP = blood pressure; bpm = beats per minute; HR = heart rate; lb = pound; min = minute; mm Hg = millimeters of mercury; RR = respiratory rate.</i></p>				

Laboratory value	Reference range	Date		
		3/16/21	3/7/21	3/1/20
BMP				
Na, mEq/L	136-145		136	139
K, mEq/L	3.5-5.1		3.5	3.9
Cl, mEq/L	96-110		101	102
HCO ₃ , mEq/L	20-29		28	21
BUN, mg/dL	7-20		20	15
SCr, mg/dL	0.5-1.2		0.8	0.7
Glu, mg/dL	70-110		189	164
CBC count				
WBC count	3.4-10.4 × 10 ³ /mm ³		3.5	4.1
Hb, g/dL	13.5-17.5		13.5	14
Hct, %	40-54		45	41
Plt count	150-425 × 10 ³ /mm ³		175	201

Lipid panel				
LDL, mg/dL	<100		136	99
HDL, mg/dL	>45		37	41
TRG, mg/dL	<150		400	201
Total lipids, mg/dL	<200		253	180
Liver panel				
Albumin, g/dL	3.5-5.5		3.9	4.1
AST, Units/L	10-36		33	28
ALT, Units/L	8-48		40	30
Alk phos, Units/L	44-147		110	109
Miscellaneous				
HbA _{1C} , %	5-5.8		8.9	6.1
PT, sec	11-15		12	13
INR	<1.3		0.8	0.9
Ca, mg/dL	8.5-10.8		10	9.9

Mg, mEq/L	1.5-2.2		2.1	1.9
Phosphorus, mg/dL	2.5-4.5		2.9	2.9
Microalbumin, mg/g	0-30		36	24
Ankle-brachial index	1-1.4		1.1	

Abbreviations: Alk phos = alkaline phosphatase; ALT = alanine transaminase; AST = aspartate transaminase; BMP = basic metabolic panel; BUN = blood urea nitrogen; Ca = calcium; CBC = complete blood cell; Cl = chloride; dL = deciliter (one-tenth of a liter); g = gram; Glu = glucose; Hb = hemoglobin; HbA_{1C} = glycated hemoglobin; HCO₃ = bicarbonate; Hct = hematocrit; HDL = high-density lipoprotein; INR = international normalized ratio; K = potassium; L = liter; LDL = low-density lipoprotein; mEq = milliequivalent; mg = milligram; Mg = magnesium; mm = milliliter; Na = sodium; Plt = platelet; PT = prothrombin time; SCr = serum creatinine; sec = second; TRG = triglyceride; WBC = white blood cell.

Student Application Questions

1. Explain the significance of the lipid panel results for this patient and how they relate to the diagnosis of T2DM.

Answer: Mrs. Fuentes has elevated triglyceride level at 400 mg/dL and low HDL at 37 mg/dL. This pattern of high triglyceride and low HDL levels is a sign of insulin resistance.²⁶

2. What is the top dietary contributor to the patient's high triglyceride levels?

Answer: Outside of familial hypercholesterolemia, high triglyceride levels in most patients, including this patient, come from excess sugar in the form of refined carbohydrates or grains and other high-sugar and low-fiber processed foods. Excess sugar in the diet is converted to triglycerides and deposited as fat mostly in the liver (contributing to fatty liver disease) and abdomen.

3. List risk factors for acute and chronic complications for this patient with T2DM.

Answer: Hypoglycemia, cardiovascular disease (CVD), chronic kidney disease, nonalcoholic fatty liver disease, neuropathy, and retinopathy

4. List components of the medical treatment and monitoring plan.

Answer:

Medical Treatment and Monitoring Plan

- Develop a monitoring plan. Ask Mrs. Fuentes to check her blood glucose level every morning after fasting and 2 hours after either lunch or dinner, and to send this log to the care team every 2 weeks. She is encouraged to keep a diary of food, activity levels, sleep, and stress to make connections between these and her blood sugar levels. This will help her identify the foods and lifestyle components that can increase her blood sugar level and reinforce positive changes to lower it. Sending the log every 2 weeks will help with continued monitoring and accountability.
- Practice guidelines recommend a distribution of carbohydrate intake that is consistent at each meal, with protein, fiber, and healthy fats.²⁷

- Consider increasing metformin to 1,000 mg/day with meals and titrate up as needed. The maximum daily dose of metformin is 2,000 mg/day. Assess her vitamin B₁₂ status annually because metformin can reduce B₁₂ absorption.
- Check HbA_{1c} in 3 months or at least 4 times per year for individuals with poorly controlled glucose levels or when adjusting pharmacological therapy.²⁸
- Initiate therapeutic lifestyle changes to lower LDL level by decreasing saturated fat intake, increasing fiber intake, and increasing healthy fat intake, including monounsaturated fat, tree nuts, and seeds. Repeat a follow-up lipid panel in 3 months to assess progress.²⁷
- Although the diabetes practice guidelines recommend initiating any dietary pattern that incorporates healthy interventions that the patient will follow, initiation of the Dietary Approaches to Stop Hypertension (DASH) diet may also be useful, in addition to considering hibiscus tea to help lower BP. Also begin an exercise program to increase her HR eventually to a goal of 80% of her maximum HR for 30 to 45 minutes 4 times/week; work up to this gradually.²⁹ Advise patient to get a good BP monitor and monitor her BP at home, recording the measurements in a log; she should send log in every 2 weeks. If BP not improving, consider medication.
- Refer Mrs. Fuentes to a registered dietitian nutritionist for medical nutrition therapy.²⁷ Share information about group nutrition classes in the

community and refer to diabetes self-management education and support classes to support healthy eating and lifestyle behaviors, education on diabetes management, moral support, cooking tips, and sharing of healthy recipes. See [appendix B](#) for recipes and recipe adaptations.

- Curating a collection of recipes and nutrition education resources can be a helpful tool for clinicians to share with patients, especially in areas where there are dietitian and nutrition education shortages.

5. List nutrition and culinary medicine interventions for this patient and condition.

Answer:

Nutrition and Lifestyle Interventions

Based on the practice guidelines for diabetes²⁷, best practices include:

- Education on diabetes self-management:
 - Refer patients for individualized, focused education at time of diagnosis and as needed thereafter based on health status to build and support healthy eating patterns. Medical nutrition therapy education and counseling can help patient lower HbA_{1c} levels similarly or better than prescribed medications.
- Address nutritional needs based on personal and

cultural preferences; maintain pleasure of eating through positive health messages. (For additional information on how to make patient-centered nutrition interventions, see [chapter 3](#) on enjoying food at home and beyond, and [chapter 12](#) on culturally centered approaches.)

- Encourage regular physical activity; goal is ≥ 150 min/week. Continue to go to the gym but also plan family-centered activities to promote enjoyable family time.
- Goals include to improve HbA_{1c}, BP, and cholesterol levels (goals differ based on age, duration of diabetes, health status, and other factors).

Culinary Medicine Interventions

- Evidence reflects lack of ideal percentages for carbohydrates, protein, and fat; macronutrient distribution should be based on health status, eating patterns, and outcome goals. Individuals should be encouraged to meet the daily fiber recommendations for adults through diet or supplementation, because this may reduce HbA_{1c} levels. It is helpful to recommend different recipes that have high-fiber ingredients; these may include snacks, beverages, and meals. For recipes and recipe adaptation information, please see [appendix B](#).
- The quality of carbohydrates consumed ideally should be rich in fiber, vitamins, and minerals and low in refined grains, sodium, and simple carbohydrate sources such as processed foods or

food products with added sugar. The Mediterranean and DASH diets are good examples of evidence-based meal patterns that can be used as a foundation when providing dietary advice. Low-carbohydrate diets are also a viable approach for improving glycemic control. See chapters 2, 4, 5, 6, and 10 for further discussion. A teaching sheet on the different types of carbohydrates should be provided to the patient.

- Increase healthy fat consumption; focus on monounsaturated food sources, including extra-virgin olive oil, avocados, and tree nuts such as walnuts, pecans, pistachios, and almonds. Monounsaturated fats are the hallmark of the Mediterranean diet and can increase insulin sensitivity and decrease glucose absorption, leading to lower glucose levels and lower triglyceride levels. The Standard American Diet is high in **omega-6** and omega-9 polyunsaturated fats, so advise the patient to focus on omega-3 fatty acid food sources, including wild-caught, cold-water fish such as salmon, mackerel, or sardines. Plant sources of omega-3 include flaxseed and walnuts.
- Eating plans that promote positive dietary changes to promote diabetes management based on personal preferences and resources, improve glycemic control, reduce CVD risks factors, and improve quality of life are recommended for individuals who have excess adiposity. An energy deficit may occur from these dietary changes (especially if combined with

physical activity) that promotes weight loss. A loss of ~7% to 10% of starting weight can promote health benefits.

- Attend a nutrition and/or culinary medicine class to gain better insight to management for diabetes, learn more how to cook with a busy lifestyle, and encourage the children in preparing meals.
 - State Cooperative Extension agencies often offer nutrition courses that include food demonstrations, recipes sharing, and meal planning strategies. These classes are free and open to the community. Examples include:
 - [Rite Bite Diabetes Cooking School](#) (University of Georgia Cooperative Extension)
 - [Med instead of Meds](#) (North Carolina State Cooperative Extension)
 - Virtual and in-person culinary medicine classes are becoming more prevalent. Depending on the area, health-care organizations or individual clinicians may offer these classes for free or for a fee. A few virtual examples include:
 - [NuCook–The Recipe for a Healthy Life](#) (virtual, free)
 - [Thrive Kitchen](#) from Kaiser Permanente (nonmembers pay fee for virtual class; culinary skills cooking videos available)

- for free)
- [Pursuit App](#) from Rewire Health (fee for recipe and culinary skills app; designed to be implemented by organizations to be given to patients)

FURTHER RESOURCES

These additional resources are provided to help medical, nutrition, and other allied health students and professionals incorporate culinary medicine principles in their patient screening, assessment, and interventions. These resources may be used to help complete these culinary medicine case studies and in current and future clinical practice.

Nutrition Screening

The [Rapid Eating Assessment for Participants–Shortened Version \(REAPS\)](#) is a dietary screening tool that can be completed by patients in less than 10 minutes.³⁰ Findings from REAPS can be used by clinicians to provide insight into general trends and habits of a patient’s eating.³⁰ It is based on a scored rating, with higher scores correlating with lower dietary quality.³⁰

Nutrition Assessment and Intervention

The [Meal, Anthropometrics, Nutrition, and Activity \(MANA\)](#) pocket guide was adapted from the Weight, Activity, Variety, Excess (WAVE) pocket guide. The WAVE card was developed by the Nutrition Academic Award to help physicians and clinicians incorporate nutrition assessment and counseling into their clinical practice.³¹ The MANA was adapted from the WAVE card to promote a

clinician's ability to recommend nutrition and culinary medicine interventions. It is similarly designed to have 1 assessment side and 1 intervention or counseling side to promote use of nutrition and culinary medicine interventions in a clinician's practice.

REFERENCES

Cancer Case Study

1. Chan DS, Vierira AR, Aune D, et al. Body mass index and survival in women with breast cancer-systematic literature review and meta-analysis of 82 follow-up studies. *Ann Oncol.* 2014;25:1901–1914. doi:10.1093/annonc/mdu042
2. Greenlee H, Shi Z, Molmenti CLS, Rundle A, Tsai WY Trends in obesity prevalence in adults with a history of cancer: results from the US National Health Interview Survey, 1997 to 2014. *J. Clin. Oncol.* 2016;34:3133–3140. doi:10.1200/JCO.2016.66.4391
3. Ligibel JA, Basen-Engquist K, Bea JW. Weight management and physical activity for breast cancer prevention and control. *Am Soc Clin Oncol Educ Book.* 2019;39:e22–e33. doi:10.1200/EDBK_237423
4. Blanchard CM, Courneya KS, Stein K. Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: results from the American Cancer Society's SCS-II. *J. Clin. Oncol.* 2008;26:2198–2204. doi:10.1200/JCO.2007.14.6217
5. Lisevick A, Cartmel B, Harrigan M, et al. Effect of the Lifestyle, Exercise, and Nutrition (LEAN) study on long-term weight loss maintenance in women with breast cancer. *Nutrients.* 2021;13(9):3265. doi:10.3390/

[nu13093265](#)

6. Dieli-Conwright CM, Orozco BZ. Exercise after breast cancer treatment: current perspectives. *Breast Cancer (Dove Med Press)* 2015;7:353–362. doi:10.2147/BCTT.S82039
7. Lahart IM, Metsios GS, Nevill AM, et al. Physical activity, risk of death and recurrence in breast cancer survivors: a systematic review and meta-analysis of epidemiological studies. *Acta Oncol.* 2015;54:635–654. doi:10.3109/0284186X.2014.998275
8. World Cancer Research Fund, American Institute for Cancer Research. Diet, nutrition, physical activity and breast cancer. Continuous Update Project Expert Report 2018. Accessed December 20, 2024. <https://www.wcrf.org/wp-content/uploads/2024/10/Breast-cancer-report.pdf>
9. Porciello G, Montagnese C, Crispo A, et al. Mediterranean diet and quality of life in women treated for breast cancer: a baseline analysis of DEDiCa multicentre trial. *PLoS One.* 2020;15:e0239803. doi:10.1371/journal.pone.0239803

Liver Disease Case Study

10. Younossi ZM, Golabi P, Paik JM, Henry A, Van Dongen C, Henry L. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH): a systematic review. *Hepatology.* 2023;77(4):1335. doi:10.1097/HEP.0000000000000004

11. Younossi ZM, Zelber-Sagi S, Henry L, Gerber LH. Lifestyle interventions in nonalcoholic fatty liver disease. *Nat Rev Gastroenterol Hepatol.* 2023;20(11):708–722. doi:10.1038/s41575-023-00800-4

12. Rinella ME, Neuschwander-Tetri BA, Siddiqui MS, et al. AASLD practice guidance on the clinical assessment and management of nonalcoholic fatty liver disease. *Hepatology*. 2023;77(5):1797–1835. doi:10.1097/HEP.000000000000323
13. Talens M, Tumas N, Lazarus JV, Benach J, Pericàs JM. What do we know about inequalities in NAFLD distribution and outcomes? A scoping review. *J Clin Med*. 2021;10(21):5019. doi:10.3390/jcm10215019
14. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr*. 2010;140(2):304–310. doi:10.3945/jn.109.112573
15. Rose-Francis K, Alexis A. Healthy eating includes cultural foods. Healthline. July 7, 2021. Accessed August 3, 2023. <https://www.healthline.com/nutrition/healthy-eating-cultural-foods>
16. Nahikian-Nelms M. *Nutrition Therapy and Pathophysiology*. Cengage; 2020.
17. Thorne R. Everything you need to know about disordered eating, according to experts. Healthline Media; 2022. Accessed December 20, 2024. <https://www.healthline.com/health/disordered-eating-vs-eating-disorder#risk-factors-and-demographics>

Metabolic Syndrome Case Study

18. Huang PL. A comprehensive definition for metabolic syndrome. *Dis Model Mech*. 2009;2(5-6):231–237. doi:10.1242/dmm.001180
19. Chiang LC, Heitkemper MM, Chiang SL, et al. Motivational counseling to reduce sedentary behaviors and depressive symptoms and improve health-related quality of life among women with metabolic syndrome. *J Cardiovasc*

Nurs. 2019;34(4):327–335. doi:10.1097/JCN.0000000000000573

20. Dragomanovich HM, Shubrook JH. Improving cultural humility and competency in diabetes care for primary care providers. *Clin Diabetes.* 2021;39(2):220–224. doi:10.2337/cd20-0063

21. Blonde L, Umpierrez GE, Reddy SS, et al. American Association of Clinical Endocrinology clinical practice guideline: developing a diabetes mellitus comprehensive care plan—2022 update. *Endocr Pract Off J Am Coll Endocrinol Am Assoc Clin Endocrinol.* 2022;28(10):923–1049. doi:10.1016/j.eprac.2022.08.002

22. Pérez-Martínez P, Mikhailidis DP, Athyros VG, et al. Lifestyle recommendations for the prevention and management of metabolic syndrome: an international panel recommendation. *Nutr Rev.* 2017;75(5):307–326. doi:10.1093/nutrit/nux014

23. Pesta DH, Goncalves RLS, Madiraju AK, Strasser B, Sparks LM. Resistance training to improve type 2 diabetes: working toward a prescription for the future. *Nutr Metab.* 2017;14(1):24. doi:10.1186/s12986-017-0173-7

24. Anderson CA, Cobb LK, Miller ER, et al. Effects of a behavioral intervention that emphasizes spices and herbs on adherence to recommended sodium intake: results of the SPICE randomized clinical trial. *Am J Clin Nutr.* 2015;102(3):671–679. doi:10.3945/ajcn.114.100750

25. Castro-Barquero S, Ruiz-León AM, Sierra-Pérez M, Estruch R, Casas R. Dietary strategies for metabolic syndrome: a comprehensive review. *Nutrients.* 2020;12(10):2983. doi:10.3390/nu12102983

Diabetes Case Study

26. Alidu H, Dapare PPM, Quaye L, Amidu N, Bani SB, Banyeh

M. Insulin resistance in relation to hypertension and dyslipidaemia among men clinically diagnosed with type 2 diabetes. *Biomed Res Int.* 2023;2023:8873226. doi:10.1155/2023/8873226

27. Evert AB, Dennison M, Gardner CD, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. *Diabetes Care.* 2019; 42(5): 731–754. <https://doi.org/10.2337/dci19-0014>

28. Eyth E, Naik R. Hemoglobin A1c. StatPearls. March 13, 2023. Accessed July 4, 2023. <https://www.ncbi.nlm.nih.gov/books/NBK549816>

29. Reimers AK, Knapp G, Reimers CD. Effects of exercise on the resting heart rate: a systematic review and meta-analysis of interventional studies. *J Clin Med.* 2018;7(12):503. doi:10.3390/jcm7120503

Further Resources

30. Johnston CS, Bliss C, Knurick JR, Scholtz C. Rapid Eating Assessment for Participants [shortened version] scores are associated with Healthy Eating Index-2010 scores and other indices of diet quality in healthy adult omnivores and vegetarians. *Nutr J.* 2018;17(1):89. doi:10.1186/s12937-018-0399-x

31. Gans KM, Ross E, Barner CW, Wylie-Rosett J, McMurray J, Eaton C. REAP and WAVE: new tools to rapidly assess/discuss nutrition with patients. *J Nutr.* 2003;133(2):556S–562S. doi:10.1093/jn/133.2.556S

Appendix B: Recipes for Disease Prevention

By Aimee Novak, trained chef; Lucia Ramonet, MS, RDN, CNSC

CREATING HEALTHY RECIPES

Recipe ingredients or techniques can be altered to increase their nutritional value and align with recipes to support the management or prevention of various chronic diseases. Recipes can be modified to reduce sugar, salt, and fat. Alternative ingredients can be added or exchanged to increase fiber.

To improve recipes' nutritional value, you might want to consider swapping out white flour for whole-wheat flour. Doing so will add more fiber and essential nutrients to your dish, which can help with digestion and inflammation reduction. Furthermore, whole-wheat flour has a lower glycemic index, which can help regulate blood sugar levels and even lower the risk of diabetes.¹

Another option for improving the nutritional value of your dishes is to swap less-healthy **fats** for healthier options. Instead of using butter and trans fats, use healthier fats, such as fatty fish (e.g., sardines, salmon, tuna, mackerel), extra-virgin olive oil, avocado oil, walnuts, chia seeds, and flaxseeds. These fats have anti-inflammatory properties that can help improve cholesterol levels and reduce the risk of heart disease.²

To add a touch of sweetness to your dish without relying on refined sugar, consider using natural sweeteners such as honey or maple syrup. (NOTE: Honey should be avoided for infants younger than 12 months. It can contain spores of *Clostridium botulinum*, which can lead to infant botulism, a serious illness.) Honey and maple syrup contain vitamins, minerals, and antioxidants that provide additional health benefits. They also add a unique **flavor** to your dish that can enhance its overall taste. Additionally, excess consumption of added sugars can contribute to increased risk for chronic diseases such as type 2 diabetes, cardiovascular disease, and nonalcoholic fatty liver disease.³

Incorporating more vegetables or fruits into your dish is another great way to improve its nutritional value. Fruits and vegetables are rich in vitamins, minerals, and antioxidants, which can help prevent disease. Additionally, they can add beautiful color and texture to your dish.⁴

Finally, instead of relying on salt to add flavor to your dish, try using herbs and spices instead. Too much sodium can lead to high blood pressure, which increases the risk of heart disease. When modifying recipes, try to reduce the amount of sodium by using herbs, spices, and other seasonings instead of salt. Herbs and spices contain antioxidants and anti-inflammatory compounds that can improve overall health and reduce the risk of chronic diseases. Using these simple swaps, you can create a healthier version of your recipe without compromising taste or quality and enjoy delicious and nutritious meals that support your overall health and well-being.

Table B.1 provides a noninclusive overview of some recipe modifications for disease prevention.¹

Table B.1. Recipe Modifications for Disease Prevention

Intended outcome of modification	Modification options or techniques	Other information
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Adding fiber	<ul style="list-style-type: none">• Exchange up to one-half of all-purpose (white) flour for 100% whole-wheat flour.• Add whole oats, chopped fruits, or vegetables to baked dishes (e.g., muffins, breads).• Add beans to soups, casseroles, and other	Fruits and vegetables are rich in vitamins, minerals, and antioxidants, which can help prevent disease. ⁵
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	<p>dishes.</p> <ul style="list-style-type: none"> • Use brown rice instead of white rice. 	
<p>Reducing saturated (“bad”) fats</p>	<ul style="list-style-type: none"> • Exchange butter for olive or avocado oil. • Substitute applesauce for one-half of the butter in cookies or cakes. • Exchange lean ground turkey for ground beef. 	<p>Saturated fats are found in animal-based foods such as beef, pork, poultry; full-fat dairy products such as eggs, milk; and in palm and coconut oils.²</p>

<p>Increasing unsaturated (“good”) fats</p>	<p>Add walnuts, chia, or flax seeds to yogurt, breads, salads, and other dishes.</p>	<p>These fats have anti-inflammatory properties that can help improve cholesterol levels and reduce the risk of heart disease.²</p>
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<p>Managing sugar intake</p>	<ul style="list-style-type: none"> • Reduce the sugar in recipes by one-quarter to one-half. • Use natural sweeteners such as honey or maple syrup. <p>NOTE: Honey should be avoided for infants younger than 12 months.</p>	<ul style="list-style-type: none"> • Natural sweeteners can contain vitamins, minerals, and antioxidants but contain the same amount of glucose as crystal white sugar. • Excess consumption of added sugars can contribute to increased risk for chronic diseases such as type 2
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		diabetes, cardiovascular disease, and nonalcoholic fatty liver disease. ³
Reducing sodium	Incorporate more fresh herbs and spices for flavor instead of relying on salt.	Herbs and spices contain antioxidant and anti-inflammatory compounds that can improve overall health and reduce the risk of chronic diseases. ⁶

The following links provide more information on recipe modifications and ideas for cooking with nutritious ingredients.

Food Preparation and Recipe Modification

- [Food Preparation and Recipe Modification. Lifestyle Coach Facilitation Guide: Post-Core](#) (Centers for Disease Control and Prevention [CDC])
- [Modify a Recipe for Healthy Results](#) (Rutgers, The State University of New Jersey)

Food Fact Sheet

[Cooking With Nutritious Ingredients \[English\]](#) or
[Cocinando Con Ingredientes Nutritivos \[Spanish\]](#)
(US Food and Drug Administration [FDA])

RECIPE OPTIONS

The text and images of the following recipes are reprinted here in case links break. Recipes and images from the FDA; US Department of Health and Human Services; US Department of Agriculture; and National Heart, Lung, and Blood Institute (government agencies) are in the public domain. Recipes from AZ Health Zone are used with permission.

Units of Measure

- c = cup
- tbsp = tablespoon
- tsp = teaspoon
- lb = pound
- oz = ounce
- g = gram

- mg = milligram

Breakfast

Breakfast Parfait

Makes 4 servings.

Ingredients

- 2 c canned pineapple, chopped
- 1 c frozen berries, unsweetened and thawed
- 1 c yogurt, low-fat vanilla
- 1 banana, peeled and sliced
- $\frac{1}{3}$ c raisins



Figure B.1. This colorful parfait features 4 types of fruit: fresh, frozen, canned, and dried. Breakfast Parfait by the US Department of Agriculture is in the public domain.

Directions

1. Wash hands with soap and water.
2. Drain pineapple and berries well.
3. In glasses or bowls, layer pineapple, berries, yogurt,

banana, and raisins.

Nutrition Information

- Serving size: ¼ of recipe
- Total calories: 209
- Total fat: 1 g
- Saturated fat: 1 g
- Cholesterol: 3 mg
- Sodium: 44 mg
- Carbohydrates: 49 g
- Dietary fiber: 3 g
- Total sugars: 40 g
- Added sugars: 4 g
- Protein: 4 g

Source: [US Department of Agriculture's MyPlate.gov](https://www.myplate.gov)

Banana Oatmeal Pancakes With Lentils

Makes 10 pancakes.

Ingredients

- ¼ c dried red lentils
- 1 c old-fashioned oats
- 1 c all-purpose flour
- ¼ c brown sugar, packed
- 1 tsp cinnamon
- 2 tsp baking powder
- ½ tsp baking soda
- ¼ tsp salt
- ¾ c plain yogurt, low-fat
- ¾ c milk, low-fat
- ¼ c canola oil (or melted butter or cooking oil of choice)
- 2 large eggs
- 1 tsp vanilla
- 2 overripe bananas, mashed
- maple syrup (optional, to serve with pancakes)



Figure B.2. These pancakes bring whole grains, protein, and fiber to your breakfast table. [Banana Oatmeal Pancakes With Lentils](#) by the [US Department of Agriculture](#) is in the public domain.

Directions

1. Wash hands with soap and water.
2. In a small saucepan of boiling water, cook the lentils for 15 to 20 minutes, until soft. Drain well and set aside.
3. In a large bowl, stir together the oats, flour, brown sugar,

cinnamon, baking powder, baking soda, and salt.

4. In a smaller bowl, whisk together the yogurt, milk, oil, eggs, and vanilla. Add to the dry ingredients along with the mashed banana and lentils, and stir until just combined.
5. Set a heavy skillet over medium-high heat, add a drizzle of oil and wipe it around with a paper towel to coat the bottom of the pan.
6. Cook about one-half cup of batter at a time, spreading it out with the back of a spoon if needed (it will be thick). Cook for about 2 minutes or until bubbles begin to break through the surface and the bottom is golden. Keep the heat to medium; these will take longer to cook through than most pancakes, and you do not want to burn the bottoms.
7. Flip with a thin spatula and cook until they are golden on the other side and springy to the touch. Keep the pancakes warm on a rack set on a baking sheet in a 250 °F (121 °C) oven while you finish cooking the rest.
8. Serve drizzled with maple syrup, if desired.

Nutrition Information

- Serving Size: 1 pancake, one-tenth of recipe (116 g)
- Total calories: 218
- Total fat: 8 g
- Saturated fat: 1 g
- Cholesterol: 39 mg
- Sodium: 258 mg
- Carbohydrates: 31 g

- Dietary fiber: 3 g
- Total sugars: 11 g
- Added sugars: 5 g
- Protein: 7 g

Source: [US Department of Agriculture's MyPlate.gov](https://www.myplate.gov)

Avocado Breakfast Bruschetta

Makes 4 servings.

Ingredients

- 1 ripe avocado
- 2 medium tomatoes
- 1 green onion
- ½ c chopped fresh basil (plus 2 tbsp for garnish)
- 4 eggs (hard-boiled)
- 12 slices whole-wheat baguette bread
- ¼ c ricotta cheese (reduced-fat)
- Cracked black pepper to taste



Figure B.3. This twist on bruschetta features avocados, tomato, hard-boiled egg, and ricotta with basil atop toasted rustic whole-grain bread. You can serve it with an 8-ounce glass of fat-free milk. Avocado Breakfast Bruschetta by the US Department of Agriculture is in the public domain.

Directions

1. Dice avocado, tomatoes, and green onions.
2. Peel and chop hard-boiled eggs.

3. Reserving 2 tbsp basil for garnish, gently toss first 5 ingredients in a small bowl. Add pepper to taste.
4. Toast baguette slices and smear with ricotta cheese.
5. Top with avocado mix and garnish with chopped basil.

Nutrition Information

- Serving size: 3 slices
- Total calories: 340
- Total fat: 17 g
- Saturated fat: 4 g
- Cholesterol: 190 mg
- Sodium: 434 mg
- Carbohydrates: 32 g
- Dietary fiber: 9 g
- Total sugars: 6 g
- Added sugars: 1 g
- Protein: 17 g

Source: [US Department of Agriculture's MyPlate.gov](https://www.myplate.gov)

Bell Pepper and Vidalia Onion Strata With Fresh Salsa

Makes 4 servings.

Ingredients

- 1 Vidalia onion (divided)
- ½ red bell pepper (sliced vertically)
- ½ green bell pepper (sliced vertically)
- 1 tbsp olive oil
- 4 large eggs
- 4 egg whites
- ½ c fat-free (skim) milk
- ⅛ tsp ground black pepper
- Cooking spray
- 4 slices whole-grain bread (4-6 slices, dry or toasted, cubed)
- ½ c reduced-fat Italian blend cheese
- 10 cherry tomatoes (or 2 tomatoes)
- 1 garlic clove



Figure B.4. This baked dish can be assembled ahead of time, leaving the baking for the morning. You can serve it with an 8-ounce glass of fat-free milk and one-half cup of cantaloupe chunks. Bell Pepper and Vidalia Onion Strata With Fresh Salsa by the US Department of Agriculture is in the public domain.

Directions

1. Place rack in center of oven and preheat oven to 350 °F (~177 °C).
2. Cut Vidalia onion into slices vertically; reserve about one-quarter of onion. Heat oil in a 10-inch nonstick skillet.

Sauté onion and pepper slices for 5-8 minutes until tender and just starting to brown. Remove from heat.

3. Beat eggs, egg whites, milk, and pepper in large bowl, set aside.
4. Spray an 8- or 9-inch baking pan (square or round) with cooking spray.
5. Arrange bread cubes in bottom of pan. Sprinkle with shredded cheese.
6. Add sautéed vegetables and pour in egg mix.
7. Bake uncovered for 45 minutes, until set. Egg dishes should be cooked to 160 °F (71 °C).
8. While strata is baking, prepare salsa, by dicing and mixing cherry tomatoes, garlic, and remaining Vidalia onion.

Nutrition Information

- Total calories: 240
- Total fat: 9 g
- Saturated fat: 2 g
- Cholesterol: 189 mg
- Sodium: 371 mg
- Carbohydrates: 21 g
- Dietary fiber: 4 g
- Total sugars: 8 g
- Added sugars: 1 g
- Protein: 19 g

Source: [US Department of Agriculture's MyPlate.gov](https://www.myplate.gov)

Avocado Melon Breakfast Smoothie

Makes 2 servings.

Ingredients

- 1 large, ripe avocado
- 1 c honeydew melon chunks (about 1 slice)
- lime, juiced (1½ tsp lime juice)
- 1 c (8 oz) milk (fat free)
- 1 c fat-free yogurt (plain)
- ½ c 100% apple juice or white grape juice
- 1 tbsp honey



Figure B.5. This refreshing smoothie can be made a day ahead. It keeps well in the refrigerator up to 24 hours. You can serve it with 1 slice of toasted whole-wheat bread. Avocado Melon Breakfast Smoothie by the US Department of Agriculture is in the public domain.

Directions

1. Cut avocado in half, remove pit.
2. Scoop out flesh, place in blender.
3. Add remaining ingredients; blend well.
4. Serve cold.
5. Keeps well in refrigerator up to 24 hours. If made ahead, stir gently before pouring into glasses.

Nutrition Information

- Serving size: 1 c
- Total calories: 320
- Total fat: 11 g

- Saturated fat: 2 g
- Cholesterol: 5 mg
- Sodium: 170 mg
- Carbohydrates: 46 g
- Dietary fiber: 5 g
- Total sugars: 37 g
- Added sugars: 4 g
- Protein: 13 g

Source: [US Department of Agriculture's MyPlate.gov](https://www.myplate.gov)

Eggs With Nopales

Makes 4 servings.

Ingredients

- 1 medium bell pepper
- Nonstick cooking spray
- 1 c chopped onion
- ½ c chopped fresh nopales
- ½ c chopped tomato
- ½ tsp chili powder
- 6 egg whites
- 2 whole eggs
- ¼ tsp salt
- ¼ c reduced fat cheddar and Monterey Jack cheeses,



Figure B.6. Nopales are cactus paddles. Eggs With Nopales by AZ Health Zone is used with permission.

grated

- ½ c salsa

Directions

1. Wash your hands with soap and warm water. Wash fresh fruits and vegetables before preparing them. [Editors Note: Please read [Cleaning and Cooking Cactus Paddles or Nopales.](#)]
2. Place bell pepper in the oven and broil for a few minutes on each side to blacken skin. Place in a small paper bag and fold over the top; let stand for 5 minutes.
3. Rub off skin from the peppers. Cut open, remove seeds, and chop.
4. Spray a medium skillet with nonstick cooking spray.
5. Add onions and cook over medium heat for 10 minutes or until very soft.
6. Stir in bell pepper and nopales and cook for 5 minutes more.
7. Add tomato and chili powder and remove from heat.
8. In a medium bowl, beat egg whites, whole eggs, and salt. Add to skillet; stir and cook for 5 minutes or until eggs are cooked through.
9. Top with cheese and salsa. Serve immediately with warm tortillas.

Nutrition Information

- Serving size: 1 c
- Calories: 92
- Total fat: 3 g

- Saturated fat: 1 g
- Cholesterol: 6 mg
- Sodium: 300 mg
- Carbohydrates: 7 g
- Fiber: 2 g
- Total sugars: 53 g
- Protein: 10 g

Source: [AZ Health Zone](#)

Main Dishes

Quinoa-Stuffed Tomatoes

Makes 4 servings.

Ingredients

- 4 medium (2½ inches) tomatoes
- 1 tbsp red onions
- ½ ripe avocado
- 1 tbsp fresh parsley (or 1 tsp dried)
- 1 tbsp olive oil
- 1 c cooked mixed vegetables, such as peppers, corn, carrots, or peas
- 1 c quinoa, rinsed
- 1 c low-sodium chicken broth
- ¼ tsp ground black pepper



Figure B.7. Quinoa (pronounced KEEN-wah) is a grain native to South America. Quinoa-Stuffed Tomatoes by the US Department of Health and Human Services and National Heart, Lung, and Blood Institute is in the public domain.

Directions

1. Preheat oven to 350 °F (~177 °C).
2. Wash hands for at least 20 seconds with soap under running water.
3. Check tomatoes, red onions, and avocado for damage. Cut off bruises and spots.

4. Wash tomatoes, avocado, and parsley. Dry with a paper towel.
5. Peel and chop red onions. Chop parsley (if using fresh). Remove avocado peel, then dice avocado.
6. Cut off tops of tomatoes and hollow out the insides. (Save pulp for use in tomato soup or sauce, or salsa.) Set tomatoes aside.
7. Heat oil in a saucepan over medium-high heat. Add onions and cook until they begin to soften, about 1-2 minutes.
8. Add cooked vegetables, and heat through, about another 1-2 minutes.
9. Add quinoa, and cook gently until it smells good, about 2 minutes.
10. Add chicken broth and bring to a boil. Reduce the heat and cover the pan. Cook until the quinoa has absorbed all of the liquid and is fully cooked, about 7-10 minutes.
11. When the quinoa is cooked, remove the lid and fluff quinoa with a fork. Gently mix in the avocado, pepper, and parsley.
12. Carefully stuff about $\frac{3}{4}$ c of quinoa into each tomato.
13. Place tomatoes on a baking sheet, and bake for about 15-20 minutes or until tomatoes are hot throughout (tomatoes may be stuffed in advance and baked later).
14. Serve immediately.
15. Within 2 hours, divide leftovers into shallow, sealed containers and place in a refrigerator set to 40 °F (~4 °C) or below (as indicated by an appliance thermometer) or freeze at 0 °F (-18 °C) or below.

Nutrition Information

- Serving size: 1 tomato, $\frac{3}{4}$ c stuffing
- Calories: 299
- Total fat: 10 g
- Saturated fat: 1 g
- Sodium: 64 mg
- Total carbohydrate: 46 g
- Dietary fiber: 8 g
- Protein: 10 g

Source: [US Food and Drug Administration](#)

Grilled Tuna With Chickpea and Spanish Salad

Makes 4 servings.

Ingredients

- 1 tbsp olive or canola oil
- 1 tbsp garlic, minced (about 2-3 cloves)
- 2 tbsp lemon juice
- 1 tsp dried oregano
- 12 oz tuna steak, cut into 4 portions (3 oz each)

For salad:

- ½ bag (10 oz) leaf spinach
- 1 medium tomato
- ½ can (15½ oz) low-sodium chickpeas (or garbanzo beans)
- ⅛ tsp salt
- ⅛ tsp pepper
- 1 tbsp lemon juice

Directions

1. Preheat grill pan or oven broiler (with the rack 3 inches from heat source) on high temperature.
2. Wash hands for at least 20 seconds with soap under running water.
3. Combine oil, garlic, lemon juice, and oregano, and brush



Figure B.8. Tuna is delicious when grilled or broiled. Grilled Tuna With Chickpea and Spanish Salad by the US Department of Health and Human Services and National Heart, Lung, and Blood Institute is in the public domain.

over tuna steaks. Marinate for 5-10 minutes. Wash hands after handling raw tuna steaks.

4. Using clean cooking utensils and surfaces, wash and dry spinach. Remove any damaged areas from tomato, then wash and cut into wedges.
5. Wash the top of the can of chickpeas with soap and water before opening. Drain and rinse chickpeas.
6. Keeping produce separate from tuna, combine all salad ingredients. (Salad can be made up to 2 hours in advance and refrigerated.)
7. Grill or broil tuna on high heat for 3-4 minutes on each side until the flesh is opaque and separates easily with a fork (to a minimum internal temperature of 145 °F [63 °C]).
8. Serve 1 tuna steak over 1 c of mixed salad.
9. Within 2 hours, divide leftovers into shallow, sealed containers and place in a refrigerator set to 40 °F (~4 °C) or below (as indicated by an appliance thermometer) or freeze at 0 °F (-18 °C) or below.

Nutrition Information

- Serving size: 1 tuna steak, 1 c salad
- Calories: 282
- Total fat: 10 g
- Saturated fat: 2 g
- Sodium: 418 mg
- Carbohydrates: 15 g
- Protein: 31 g

Source: [US Food and Drug Administration](#)

Chicken and Mushroom Fricassee

Makes 4 servings.

Ingredients

- 1 carton (10 oz) white button mushrooms, quartered
- 1 c leek (see recipe for how to prepare)
- 1 c potatoes, peeled and diced
- 1 c celery, diced
- 1 c pearl onions
- 2 tbsp each fresh herbs (e.g., parsley and chives), minced, or 2 tsp dried
- 1 tbsp olive oil
- 3 c low-sodium chicken broth
- 1 lb skinless chicken legs or thighs (4 whole legs, split, or 8 thighs)
- 1 tbsp lemon juice
- 1 tbsp cornstarch
- 2 tbsp fat-free sour cream
- ½ tsp salt
- ¼ tsp ground black pepper



Figure B.9. Fat-free sour cream, vegetables, and herbs make this dish rich and hearty. [Chicken and Mushroom Fricassee](#) by the National Heart, Lung, and Blood Institute is in the public domain.

Directions

1. Preheat oven to 350 °F (~177 °C).
2. Wash hands for at least 20 seconds with soap under running water.
3. Check mushrooms, leeks, potatoes, celery, and pearl onions for damage. Cut off bruises and spots.
4. Wash mushrooms, leeks, potatoes, celery, pearl onions, and herbs (if using fresh). Dry with a paper towel.
5. Cut each mushroom into quarters. Cut leeks into quarters then slice into small squares. Peel and dice the potatoes. Dice the celery. Mince herbs.
6. Heat olive oil in a medium-sized, heavy bottom roasting or braising pan (a large sauté pan with a metal handle will work as well).
7. Add mushrooms to pan and cook until golden brown, about 3-5 minutes. Add leeks, potatoes, celery, and pearl onions, and continue to cook until the vegetables become soft, about 3-5 additional minutes.
8. Add chicken broth to the pan and bring to a boil. Add chicken legs to the pan, cover, and place in the heated oven for about 20 minutes or until the chicken legs are tender when pierced with a fork (check with a food thermometer that chicken has reached a safe minimum internal temperature of 165 °F [74 °C]).
9. Wash hands after touching raw chicken.
10. When chicken legs are tender, remove legs from the pan, return the pan to the stovetop, and bring the liquid to a boil. Add herbs and lemon juice.
11. In a bowl, mix the cornstarch with the sour cream, and add to the pan. Bring back to a boil and then remove from

the heat.

12. Season with salt and pepper, and pour 1 c of vegetables and sauce over chicken.
13. Within 2 hours, divide leftovers into shallow, sealed containers and place in a refrigerator set to 40 °F (–4 °C) or below (as indicated by an appliance thermometer) or freeze at 0 °F (–18 °C) or below.

Nutrition Information

- Serving size: 1 chicken leg, 1 c vegetables and sauce
- Calories: 242
- Total fat: 9 g
- Saturated fat: 2 g
- Sodium: 430 mg
- Total carbohydrates: 24 g
- Dietary fiber: 3 g
- Protein: 20 g

Source: [US Food and Drug Administration](#)

Avocado Chiltepin Dressing

Makes 14 servings.

Ingredients

- 1 large avocado, peeled and pitted
- ½ c Greek yogurt (or your favorite plain yogurt)
- 2 tbsp lime juice or the juice from 2 limes
- ⅛ tsp chiltepin pepper powder or red pepper flakes
- 1 tsp garlic powder or granulated garlic
- ½ tsp honey* (optional)
- 2-4½ tbsp water
- Salt and pepper, to taste



Figure B.10. Try this dressing on salads and other dishes. Avocado Chiltepin Dressing by AZ Health Zone is used with permission.

Directions

1. Wash hands with soap and warm water.
2. Rinse fruit before preparing.
3. Peel and pit avocado. If using juice of fresh limes, juice enough to give 2 tbsp.
4. Add avocado, yogurt, lime juice, chiltepin pepper powder or red pepper flakes, garlic, honey (if using), and 2 tbsp of water to a blender or food processor and puree until smooth. Add additional water to blender or food

processor and blend again to achieve desired thickness.

5. Season with salt and pepper, to taste.
6. Serve immediately or chill for later use.

*Honey should not be fed to infants younger than 1 year.

Nutrition Information

- Serving size: About 2 tbsp
- Calories: 30
- Total fat: 2.5 g
- Saturated fat: 0 g
- Cholesterol: 0 mg
- Sodium: 15 mg
- Carbohydrates: 2 g
- Fiber: 1 g
- Total sugars: 1 g
- Protein: 1 g

Source: [AZ Health Zone](#)

[7 more main dishes:](#) Grilled Chicken Basil, Moroccan Chicken with Eggplant-Zucchini Ragout, Miso-Marinated Short Ribs, Green Beans with Bacon and New Potatoes, Easy Chicken and Vegetable Stir-

Fry, Chicken Florentine Strata, Cantaloupe Gazpacho
(saferecipeguide.org)

Desserts

Pumpkin Pie

Makes 9 servings.

Ingredients for the pie crust:

- 1 c quick-cooking oats
- ¼ c whole-wheat flour
- ¼ c ground almonds
- 2 tbsp brown sugar
- ¼ tsp salt
- 3 tbsp vegetable oil
- 1 tbsp water



Figure B.11. This is an easy-to-prepare, food-safe version of a holiday classic. Pumpkin Pie by the US Food and Drug Administration is in the public domain.

Ingredients for the pie filling:

- ¼ c packed brown sugar
- ½ tsp ground cinnamon
- ¼ tsp ground nutmeg

- ¼ tsp salt
- 1 egg
- 4 tsp vanilla
- 1 c canned pumpkin
- ⅔ c fat-free evaporated milk

Directions

1. Preheat oven to 425 °F (218 °C).
2. Wash hands for at least 20 seconds with soap under running water.
3. To make crust: mix oats, flour, almonds, sugar, and salt together in a small bowl.
4. In a separate bowl, fully mix the oil and water together with a fork or whisk.
5. Add the oil mixture to the dry ingredients and mix well. If needed, add a small amount of water to hold the dough together.
6. Work the dough into a disk shape. On a washed and lightly floured cooking surface, roll dough into a 12-inch circle.
7. Press into a 9-inch pie pan and bake for 8-10 minutes, or until light brown. Wash hands after handling raw dough.
8. Turn down oven to 350 °F (~177 °C).
9. To make filling, mix sugar, cinnamon, nutmeg, and salt together in a bowl.
10. Crack egg into a separate bowl and beat. Add to the filling mixture, then wash hands.
11. Add vanilla and mix.

12. Wash lid of canned pumpkin with soap and water before opening. Then, add pumpkin and milk, and stir to combine.
13. Pour into prepared pie shell. Bake for 45 minutes or until a knife inserted near the center comes out clean.
14. Within 2 hours, place leftovers in a sealed container or wrap them in plastic wrap or aluminum foil. Chill in a refrigerator set to 40 °F (~4 °C) or below (as indicated by an appliance thermometer) or freeze at 0 °F (-18 °C) or below.

Nutrition Information

- Serving size: 1 wedge
- Calories: 177
- Total fat: 8 g
- Saturated fat: 1 g
- Sodium: 153 mg

Source: [US Food and Drug Administration](#)

Apple Pie in a Glass

Makes 2 servings.

Ingredients

- 1 c 1% low-fat or fat-free milk
- 1 c fat-free vanilla yogurt
- 2 apples
- ½ tsp ground cinnamon
- Handful of ice cubes

Directions

1. Wash hands with warm water and soap. Wash fresh fruits before preparing.
2. Peel apple, cut up into cubes, and take out the seeds.
3. Add remaining ingredients and blend for 1 minute.
4. Serve immediately.

Nutrition Information

- Serving size: 1 glass
- Calories: 206
- Total fat: 0 g
- Saturated fat: 0 g
- Cholesterol: 4 mg
- Sodium: 124 mg



Figure B.12. This quick dessert is made with milk, yogurt, apples, and cinnamon. [Apple Pie in a Glass](#) by AZ Health Zone is used with permission.

- Carbohydrates: 44 g
- Fiber: 5 g
- Total sugars: 34 g
- Protein: 9 g

Source: [AZ Health Zone](#)

Zucchini Bars With Dried Fruit

NOTE: Shredded carrots can be substituted for the zucchini, but you might need to add a little more milk because zucchini contains more liquid than carrots do.

Makes 8 servings.

Ingredients

- 1½ c all-purpose flour
- 1 tsp baking powder
- ¼ tsp baking soda
- ¼ tsp salt
- ⅓ c butter or margarine, softened
- ⅓ c sugar
- 1 large egg
- ⅓ c low-fat or fat-free milk
- 1 tsp vanilla extract
- 1 c shredded zucchini



Figure B.13. Shredded zucchini is mixed with dried fruit, such as figs, prunes, dates, apples, or raisins. Zucchini Bars With Dried Fruit by AZ Health Zone is used with permission.

- 2 c (about 8 oz) finely chopped dried fruit, such as figs, prunes, dates, apples, or raisins

Directions

1. Wash hands with soap and warm water. Wash fresh vegetables before preparing.
2. Preheat oven to 375 °F (190.5 °C).
3. Lightly grease an 8-inch square baking pan.
4. Combine flour, baking powder, baking soda, and salt in a large bowl.
5. Add butter, sugar, egg, milk, and vanilla and beat until smooth.
6. Stir in zucchini and dried fruit.
7. Spread batter in prepared pan.
8. Bake about 25 minutes or until center springs back when lightly pressed.
9. Cool in pan.
10. Cut into 8 bars and serve.

Nutrition Information

- Serving size: 1 bar
- Calories: 273
- Total fat: 9 g
- Saturated fat: 2 g
- Cholesterol: 27 mg
- Sodium: 335 mg
- Carbohydrates: 46 g
- Fiber: 4 g

- Total sugars: 21 g
- Protein: 4 g

Source: [AZ Health Zone](#)

Chocolate Tofu Pudding

Makes 3 servings.

Ingredients

- 1 c or one 8 oz package of silken tofu
- ½ c semi-sweet chocolate chips
- 2 tbsp water
- 1 tsp vanilla
- ½ tsp cinnamon (optional)
- Salt, to taste

Directions

1. Wash hands with soap and warm water.
2. In a blender or food processor, blend tofu a few seconds at a time to start to break it up.
3. In a small microwave-safe bowl, combine chocolate chips and water. Microwave for 30 seconds or until the chocolate chips start to melt. Stir the mixture until combined.
4. Add half of the chocolate mixture to the blender or food



Figure B.14. Add your favorite fruit, nuts, or other toppings. [Chocolate Tofu Pudding](#) by [AZ Health Zone](#) is used with permission.

processor and blend together until combine, about 10-15 seconds.

5. Scrape down the sides of the blender or food processor and add all remaining ingredients. Blend to combined.
6. Pour pudding into a bowl or individual serving dishes and refrigerate for at least 4 hours.
7. Serve chilled. Add your favorite fruit, nuts, or other toppings.

Nutrition Information

- Serving size: Approximately ½ c
- Calories: 180
- Total fat: 10 g
- Saturated fat: 5 g
- Cholesterol: 0 mg
- Sodium: 55 mg
- Carbohydrates: 19 g
- Fiber: 2 g
- Total sugars: 15 g
- Protein: 4 g

Source: [AZ Health Zone](#)

Banana Pops

Makes 2 servings.

Ingredients

- 1 medium banana
- 1 tbsp peanut butter
- 2 tbsp chopped roasted peanuts (unsalted)



Figure B.15. Freeze these banana pops before serving for a cool, nutty treat. [Banana Pops by AZ Health Zone](#) is used with permission.

Directions

1. Wash hands with warm water and soap.
2. Peel banana and cut in half cross-wise.
3. Put a popsicle stick in the center of each half.
4. Spread banana halves with peanut butter.
5. Pour chopped peanuts onto a plate and roll banana halves in peanuts.
6. Wrap in plastic wrap or foil and freeze before serving.

Nutrition Information

- Serving size: ½ banana pop
- Calories: 153
- Total fat: 9 g
- Saturated fat: 1.5 g
- Cholesterol: 0 mg
- Sodium: 38 mg
- Carbohydrates: 17 g

- Fiber: 3 g
- Total sugars: 8 g
- Protein: 5 g

Source: [AZ Health Zone](#) (adapted from aboutpeanuts.com)

RECETAS EN ESPAÑOL

Platos Principales

Tomates Rellenos de Quinua

Sirve: 4 porciones

Ingredientes

- 4 tomates medianos (2½ pulgadas)
- 1 cucharada de cebollas rojas
- ½ aguacate maduro
- 1 cucharada de perejil fresco (o 1 cucharadita de seco)
- 1 cucharada de aceite de oliva
- 1 taza de verduras mixtas cocidas—como por ejemplo pimientos, maíz, zanahorias o guisantes
- 1 taza de quinua, lavada
- 1 taza de caldo de pollo bajo en sodio
- ¼ cucharadita de pimienta molida



Figura B.16. La quinua (pronunciada KEEN-wah) es un grano originario de América del Sur. Tomates Rellenos de Quinua del Departamento de Salud y Servicios Humanos de EE. UU. y del Instituto Nacional del Corazón, los Pulmones y la Sangre es de dominio público.

Instrucciones

1. Caliente el horno a 350 °F (~177 °C).
2. Lávese las manos por al menos 20 segundos con jabón bajo el chorro del grifo.
3. Examine los tomates, la cebolla roja y el aguacate por si tienen magulladuras. Remueva las magulladuras y las manchas.
4. Lave los tomates, el aguacate y el perejil. Séquelos con papel toalla.
5. Pele y corte las cebollas rojas. Pique el perejil (si es fresco). Quítele la cáscara al aguacate, luego córtelo en cubos.
6. Corte el extremo superior de los tomates y sáqueles la parte de adentro. (Guarde la pulpa para usarla en una sopa o salsa, o en un condimento.) Ponga los tomates a un lado.
7. Caliente el aceite en una cacerola a fuego medio alto. Agregue las cebollas y cocínelas hasta que empiecen a ablandarse, de 1-2 minutos.
8. Agregue las verduras cocidas y caliéntelas bien, de 1-2 minutos más.
9. Agregue la quinua y cocínela a fuego bajo hasta que huela bien, alrededor de 2 minutos.
10. Agregue el caldo de pollo y hiérvalo. Baje el fuego y tape la cacerola. Cocine la quinua hasta que absorba todo el líquido y esté bien cocida, de 7-10 minutos.
11. Cuando la quinua esté cocida, quite la tapa y mueva la quinua con un tenedor. Mezcle el aguacate, la pimienta y el perejil con la quinua con cuidado.
12. Llene cada tomate con $\frac{3}{4}$ taza de quinua con cuidado.
13. Coloque los tomates en una bandeja para hornear y

hornéelos alrededor de 15-20 minutos, o hasta que los tomates estén bien calientes (puede llenar los tomates de antemano y hornearlos luego).

14. Sírvalos inmediatamente.
15. Dentro de 2 horas, divida las sobras en recipientes poco profundos con tapa y póngalos en la nevera a una temperatura de 40 °F (~4 °C) o menos (según lo indique un termómetro de electrodomésticos) o en el congelador a 0 °F (-18 °C) o menos.

Información Nutricional

- Tamaño de la porción: $\frac{3}{4}$ taza de relleno
- Calorías: 299
- Grasa total: 10 g
- Grasa saturada: 1 g
- Sodio: 64 mg
- Total de carbohidratos: 46 g
- Fibra dietética: 8 g
- Proteína: 10 g

Origen: [Administración de Alimentos y Medicamentos de EE. UU.](#)

Atún a la Parrilla Con Ensalada de Garbanzos y Espinaca

Sirve: 4 porciones

Ingredientes

- 1 cucharada de aceite de oliva o canola
- 1 cucharada de ajo, picado en pedazos bien pequeños (de 2-3 dientes)
- 2 cucharadas de jugo de limón
- 1 cucharadita de orégano seco
- 12 onzas de filete de atún, cortado en 4 pedazo (3 onzas cada uno)



Figura B.17. El atún es delicioso cuando se asa a la parrilla o al horno. Atún a la Parrilla con Garbanzos y Ensalada de Espinacas del Departamento de Salud y Servicios Humanos de EE. UU. y del Instituto Nacional del Corazón, los Pulmones y la Sangre es de dominio público.

Para la ensalada:

- ½ bolsa (10 onzas) de espinaca
- 1 tomate mediano
- ½ lata (15½ onzas) de garbanzos bajos en sodio
- ⅛ cucharadita de sal
- ⅛ cucharadita de pimienta 1 cucharada de jugo de limón

Instrucciones

1. Caliente la plancha o el asador del horno (con la parilla a 3 pulgadas del fuego) a una temperatura alta.

2. Lávese las manos por al menos 20 segundos con jabón bajo el chorro del grifo.
3. Mezcle el aceite, el ajo, el jugo de limón y el orégano, y aplique la mezcla sobre los filetes de atún con una brocha para cocinar. Marínelos de 5-10 minutos. Lávese las manos luego de tocar los filetes de atún crudos.
4. Lave y seque la espinaca en superficies y con utensilios de cocina limpios. Corte las áreas del tomate con magulladuras, lávelo y córtelo en rodajas.
5. Lave el tope de la lata de garbanzos con agua y jabón antes de abrirla. Bote el líquido y enjuague los garbanzos.
6. Mezcle todos los ingredientes de la ensalada, y manténgalos separados del atún. (Puede hacer la ensalada 2 horas antes y refrigerarla.)
7. Ponga el atún en la plancha o en el asador del horno a fuego alto de 3-4 minutos en cada lado hasta que la carne esté opaca y se separe fácilmente con un tenedor (a una temperatura mínima interna de 145 °F [63 °C]).
8. Sirva 1 filete de atún sobre 1 taza de ensalada mixta.
9. Dentro de un margen de 2 horas, divida las sobras en recipientes poco profundos con tapa y póngalos en la nevera a una temperatura de 40 °F (~4 °C) o menos (según lo indique un termómetro de electrodomésticos) o en el congelador a 0 °F (-18 °C) o menos.

Información Nutricional

- Tamaño de la porción: 1 filete de atún, 1 taza de ensalada
- Calorías: 282
- Grasa total: 10 g
- Grasa saturada: 2 g

- Sodio: 418 mg
- Total de carbohidratos: 15 g
- Fibra dietética: 5 g
- Proteína: 31 g

Origen: [Administración de Alimentos y Medicamentos de EE. UU.](#)

Fricasé de Pollo Con Setas

Sirve: 4 porciones

Ingredientes

- 1 paquete (10 onzas) de champiñones comunes
- 1 taza de puerro
- 1 taza de papas
- 1 taza de apio
- 1 taza de cebollas perla
- 2 cucharadas de dos hierbas frescas (por ejemplo, perejil y cebollines) o 2 cucharaditas de hierbas secas
- 1 cucharada de aceite de oliva
- 3 tazas de caldo de pollo bajo en sodio
- 1 libra de patas enteras o caderas de pollo sin piel (4



Figura B.18. La crema agria sin grasa, las verduras y las hierbas hacen que este plato sea rico y abundante.

Fricasé de Pollo Con Setas del Instituto Nacional del Corazón, los Pulmones y la Sangre y disponible en el dominio público.

patas enteras, separadas, ó 8 caderas)

- 1 cucharada de jugo de limón
- 1 cucharada de maicena
- 2 cucharadas de crema agria sin grasa
- ½ cucharadita de sal
- ¼ cucharadita de pimienta molida

Instrucciones

1. Caliente el horno a 350 °F (~177 °C).
2. Lávese las manos por al menos 20 segundos con jabón bajo el chorro del grifo.
3. Examine los champiñones, el puerro, las papas, el apio y las cebollas perla por si tienen magulladuras. Remueva las magulladuras y las manchas.
4. Lave los champiñones, el puerro, las papas, el apio, las cebollas perla y las hierbas (si son frescas). Séquelas con papel toalla.
5. Corte cada champiñón en cuatro pedazos. Corte el puerro en cuatro pedazos y luego en cuadrados pequeños. Pele y corte las papas en cubos. Corte el apio. Pique las hierbas.
6. Caliente el aceite de oliva en un sartén mediano de fondo grueso para asar o guisar (un sartén grande para saltear con mango de metal también funciona).
7. Agregue los champiñones al sartén y cocínelos hasta que estén marrón dorado, de 3–5 minutos. Agregue el puerro, las papas, el apio y las cebollas perla, y continúe cocinándolos hasta que las verduras estén blandas, de 3–5 minutos más.
8. Agregue el caldo de pollo al sartén y hiérvalo. Agregue las

patas de pollo enteras al sartén, tapelo y métalo en el horno alrededor de 20 minutos o hasta que las patas de pollo estén tiernas al pincharlas con un tenedor (verifique con el termómetro de alimentos que el pollo ha alcanzado una temperatura interna de 165 °F [74 °C]).

9. Lávese las manos luego de tocar el pollo crudo.
10. Cuando las patas de pollo estén tiernas, saque las patas del sartén, ponga el sartén en la estufa nuevamente y hierva el líquido. Agregue las hierbas y el jugo de limón.
11. En un bol, mezcle la maicena con la crema agria y agréguelas al sartén. Vuelva a hervir el líquido y luego quítelo del fuego.
12. Condimente con sal y pimienta, y eche 1 taza de verduras y salsa encima del pollo.
13. Dentro de 2 horas, divida las sobras en recipientes poco profundos con tapa y póngalos en la nevera a una temperatura de 40 °F (-4 °C) o menos (según lo indique un termómetro de electrodomésticos) o en el congelador a 0 °F (-18 °C) o menos.

Información Nutricional

- Tamaño de la porción: 1 pata entera de pollo, 1 taza de verduras y salsa
- Calorías: 242
- Grasa total: 9 g
- Grasa saturada: 2 g
- Sodio: 430 mg
- Total de carbohidratos: 24 g
- Fibra dietética: 3 g

- Proteína: 20 g

Origen: [Administración de Alimentos y Medicamentos de EE. UU.](#)

Postres

Tarta de Calabaza

Sirve: 9 porciones

Ingredientes para la costra de la tarta:

- 1 taza de avena de cocción rápida
- ¼ taza de harina integral
- ¼ taza de harina de almendras
- 2 cucharadas de azúcar negra
- ¼ cucharadita de sal
- 3 cucharadas de aceite vegetal
- 1 cucharada de agua



Figura B.19. Esta es una versión fácil de preparar y segura para los alimentos de un clásico navideño. Tarta de Calabaza de la Administración de Alimentos y Medicamentos de EE. UU es de dominio público.

Ingredientes para el relleno de la tarta:

- ¼ taza bien llena de azúcar negra
- ½ cucharadita de canela en polvo
- ¼ cucharadita de nuez moscada en polvo
- ¼ cucharadita de sal

- 1 huevo
- 4 cucharaditas de vainilla
- 1 taza de calabaza enlatada
- 2/3 taza de leche evaporada sin grasa

Instrucciones

1. Caliente el horno a 425 °F (218 °C).
2. Lávese las manos por al menos 20 segundos con jabón bajo el chorro del grifo.
3. Para hacer la costra: mezcle la avena, la harina integral, la harina de almendras, el azúcar y la sal en un bol pequeño.
4. En otro bol, mezcle bien el aceite y el agua con un tenedor o un batidor.
5. Agregue la mezcla de aceite a los ingredientes secos y mézclelos bien. De ser necesario, añada un poco de agua para que la masa se mantenga unida.
6. Forme un disco con la masa. Esparza un poco de harina en una superficie limpia de la cocina y estire la masa con un rodillo hasta que forme un círculo de 12 pulgadas.
7. Ponga la masa en un molde para hornear de 9 pulgadas y hornéela de 8-10 minutos, o hasta que esté marrón claro. Lávese las manos después de tocar la masa cruda.
8. Baje el horno a 350 °F (~177 °C).
9. Para hacer el relleno, en un bol mezcle el azúcar, la canela, la nuez moscada y la sal.
10. En otro bol eche un huevo y bátalo. Agréguelo a la mezcla del relleno, luego lávese las manos.
11. Agregue la vainilla y mézclela.
12. Lave la tapa de la calabaza enlatada con agua y jabón

antes de abrirla. Luego, agregue la calabaza y la leche, y mézclelas.

13. Eche el relleno en la costra de la tarta. Hornéelo 45 minutos o hasta que inserte un cuchillo cerca del centro y salga limpio.
14. Dentro de 2 horas, ponga las sobras en un recipiente con tapa o envuélvalas en papel plástico o de aluminio para alimentos. Métalas en la nevera a una temperatura de 40 °F (~4 °C) o menos (según lo indique un termómetro de electrodomésticos) o en el congelador a 0 °F (-18 °C) o menos.

Información Nutricional

- Tamaño de la porción: 1 pedazo
- Calorías: 177
- Grasa total: 8 g
- Grasa saturada: 1 g
- Sodio: 153 mg

Origen: [Administración de Alimentos y Medicamentos de EE. UU](#)

RECIPES MODIFICATION

- [Planning Meals | Healthy Weight, Nutrition, and Physical Activity](#) (CDC)
- [Cutting Calories | Healthy Weight, Nutrition, and Physical Activity](#) (CDC)
- [My Food and Beverage Diary](#) (CDC)
- [A Harvest of Recipes With USDA Foods](#) (US Department of Agriculture)

- [Healthy Eating](#) (National Heart, Blood, and Lung Institute)
- [Delicious Heart Healthy Latino Recipes \[English and Spanish\]](#) (National Heart, Lung, and Blood Institute)
- [Recipes, Cookbooks, and Cooking Videos](#) (U.S. Department of Veterans Affairs)

RECOMMENDED RESOURCE

- [Brief History of Indigenous Flavors in Arizona](#)

REFERENCES

1. Harvard T. H. Chan School of Public Health. Whole grains. *The Nutrition Source*. January 24, 2014. Accessed December 20, 2024. <https://nutritionsource.hsph.harvard.edu/what-should-you-eat/whole-grains>
2. American Heart Association. Dietary fats. Accessed April 13, 2023. <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/dietary-fats>
3. Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009;120(11):1011–1020. doi:10.1161/CIRCULATIONAHA.109.192627
4. Harvard T. H. Chan School of Public Health. Vegetables and fruits. *The Nutrition Source*. September 18, 2012. Accessed December 20, 2024.

[you-eat/vegetables-and-fruits](#)

5. Arizona Office of Tourism. Native cuisine in Arizona: Arizona restaurants with indigenous dishes and ingredients. Visit Arizona. Accessed December 20, 2024. <https://www.visitarizona.com/like-a-local/native-cuisine-in-arizona>
6. Yashin A, Yashin Y, Xia X, Nemzer B. Antioxidant activity of spices and their impact on human health: a review. *Antioxidants (Basel)*. 2017;6(3):70. doi:10.3390/antiox6030070

Glossary Terms

"local" food

Foods produced and sold within a certain distance or geographic boundary to consumers. Source: [US Department of Agriculture](#)

ableism

Discrimination or prejudice against individuals with disabilities. Source: [Merriam-Webster Online Dictionary](#)

Adequate Intake (AI)

A recommended average daily intake level for a nutrient when there is not enough scientific evidence to establish an RDA. Source: [National Institutes of Health](#)

adipokines

Protein hormones secreted by adipose tissue related to low-grade inflammation and different pathologies. Source: [PubMed](#)

adiposity

The quality or state of being fat; obesity. Source: [Merriam-Webster Online Dictionary](#)

African Diaspora

Refers to the descendants of the native West and Central

Africans enslaved and shipped to the Americas via the Atlantic slave trade between the 16th and 19th centuries, with large populations in the United States, Brazil, and Haiti.

akutaq

Eskimo ice cream made from whipped fat from animals and wild berries. Source: [Smithsonian Magazine](#)

albumin

Water-soluble proteins that occur in blood plasma or serum, muscle, the whites of eggs, milk, and other animal substances, and in plant tissues and fluids. Source: [Merriam-Webster Online Dictionary](#)

alkaloids

Any of numerous usually colorless, complex, and bitter organic bases (such as caffeine) containing nitrogen and usually oxygen that occur especially in seed plants. Source: [Merriam-Webster Online Dictionary](#)

amino acids

The building blocks of protein. Each has an amine group at 1 end, an acid group at the other, and a distinctive side chain. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

amylase

An enzyme that breaks down amylose (a form of starch). Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

apoptosis

A genetically directed process of cell self-destruction. It is a normal physiological process eliminating DNA-damaged, superfluous, or unwanted cells, and when halted (as by gene mutation) may result in uncontrolled cell growth and tumor formation. Source: [Merriam-Webster Online Dictionary](#)

asset mapping

A process of identifying and compiling a list of assets ("anything that can be used to improve the quality of community life") and organizing this information in a format, usually visually, that can be used to make improvements. Source: [Community Tool Box](#)

atherosclerosis

The buildup of fats, cholesterol, and other substances (plaque) in and on the artery walls; the plaque can burst, leading to a blood clot.

biases

Unfairly supporting or opposing a particular person or thing because of allowing personal opinions to influence your judgment. Source: [Cambridge Dictionary](#)

bile

An emulsifier made by the liver from cholesterol, stored in the gallbladder, and released into the small intestine when needed. Bile does not digest fat but emulsifies it so that enzymes may contact it and begin digesting fatty acids. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

bioactive compounds

A type of chemical found in small amounts in plants and certain foods (e.g., fruits, vegetables, nuts, oils, whole grains). Bioactive compounds have actions in the body that may promote good health. Source: [National Cancer Institute](#)

bioactive molecules

A type of chemical found in small amounts in plants and certain foods (e.g., fruits, vegetables, nuts, oils, whole grains) that may promote good health. They are being studied in the prevention of cancer, heart disease, and other diseases. Also

known as "bioactive compounds." Source: [National Cancer Institute](#)

bioavailability

The proportion of the nutrient that is digested, absorbed, and metabolized through normal pathways. Source: [The Journal of Nutrition](#)

bok choy

A Chinese cabbage forming an open head with long white stalks and green leaves. Source: [Merriam-Webster Online Dictionary](#)

botanicals

Plants or plant parts valued for their medicinal or therapeutic properties, flavor, and/or scent. Source: [National Institutes of Health](#)

breadfruit

A round, starchy, usually seedless fruit that resembles bread in color and texture when baked. Source: [Merriam-Webster Online Dictionary](#)

callaloo

A green leaflike spinach, blended with coconut milk, spices, chilies, sometimes with okra and red meat, then topped with crab.

calories

The unit used to measure the energy in foods is a kilocalorie; it is the amount of heat energy necessary to raise the temperature of a kilogram (a liter) of water 1 degree Celsius. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

carbohydrates

Compounds composed of single or multiple sugars. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

carcinogen

A substance or agent causing cancer. Source: [Merriam-Webster Online Dictionary](#)

carotenoids

A yellow, red, or orange substance found mostly in plants, including carrots, sweet potatoes, dark green leafy vegetables, and many fruits, grains, and oils. A type of antioxidant; some carotenoids are changed into vitamin A in the body and some are being studied in the prevention of cancer. Source: [National Cancer Institute](#)

ceviche

A dish made of raw fish marinated in lime or lemon juice, often with oil, onions, peppers, and seasonings. Sometimes served as a snack or appetizer. Source: [Merriam-Webster Online Dictionary](#)

Clinical Pearl

A key learning that can be applied to clinical practice. Source: [PubMed](#)

collective impact

A commitment of various partners from different sectors to a common agenda that will bring about positive social change or solve a specific social problem. Source: [Stanford Social Innovation Review](#)

colonialism

Domination of a people or area by a foreign state or nation : the practice of extending and maintaining a nation's political

and economic control over another people or area. Source: [Merriam-Webster Online Dictionary](#)

commensality

The practice of sharing food and eating together in a social group such as a family.

community engagement

The process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people. Source: *Principles of Community Engagement, 2nd Edition*

community gardens

Collaborative projects on shared open spaces where participants share in the maintenance and products of the garden. Source: [US Department of Agriculture](#)

community needs assessment

A process to collect information to identify community gaps or needs that impact health and wellness as well as identify the strengths or community assets that can be used to build solutions to the issues considered a priority to the community. Source: [Community Tool Box](#)

community or shared-use kitchen

A licensed commercial space that provides a pathway for food entrepreneurs—ranging from chefs, caterers, food truck operators, and bakers, to value-added producers and packaged food and beverage makers—to launch and grow their businesses. Source: [The Food Corridor](#)

community-supported agriculture (CSA)

A system in which a farm is supported by local consumers who purchase prepaid shares in the farm's output, which they

receive periodically throughout the growing season. Source: [Merriam-Webster Online Dictionary](#)

comorbidities

More than 1 medical condition present at the same time in a patient, which often leads to poorer health outcomes. Source: [National Library of Medicine](#)

complex carbohydrates

Long chains of sugar units arranged to form starch or fiber; also called polysaccharides. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

conditionally essential amino acids

Amino acids that must be obtained in the diet in certain situations when more are needed than the body can synthesize. Source: [Nutrition Science and Everyday Application, 2nd Edition](#)

confirmation bias

The tendency to gather evidence that confirms preexisting expectations, typically by emphasizing or pursuing supporting evidence while dismissing or failing to seek contradictory evidence. Source: [American Psychological Association Dictionary of Psychology](#)

congee

In Chinese cooking, it is a broth or porridge made from rice. Source: [Merriam-Webster Online Dictionary](#)

convenience stores

Small stores that sell mainly food and are usually open until late at night. Source: [Collins Dictionary](#)

coping skill

A method a person uses to deal with a stressful situation. It

may help a person face a situation, take action, and be flexible and persistent in solving problems. Source: [National Cancer Institute](#)

corner stores

Small stores, usually on the corner of a street, that sell mainly food and household goods. Source: [Collins Dictionary](#)

COU COU

Fish that is steamed and cooked with onions, lime juice, spices, and vegetables, and served on a bed of polenta-like cornmeal; or fried and served with a spicy sauce and flying fish. Source: [Taste Atlas](#)

COVID-19

A mild to severe respiratory illness that is caused by SARS-CoV-2 virus and characterized by fever, cough, loss of taste or smell, and shortness of breath. It may progress to pneumonia and respiratory failure. Source: [Merriam-Webster Online Dictionary](#)

crispers

A closed container in a refrigerator intended to prevent loss of moisture from fresh produce. Source: [Merriam-Webster Online Dictionary](#)

cross contamination

The inadvertent transfer of bacteria or other contaminants from 1 surface, substance, etc., to another, especially because of unsanitary handling procedures. Source: [Merriam-Webster Online Dictionary](#)

cruciferous

A member of the family of vegetables that includes broccoli, Brussels sprouts, cabbage, cauliflower, collard greens, kale, and turnips. These vegetables contain substances that may

protect against cancer. Also called Brassica vegetable. Source: [National Cancer Institute](#)

cultural awareness

Someone's understanding of the differences between themselves and people from other countries or other backgrounds, especially differences in attitudes and values. Source: [Collins Dictionary](#)

cultural competency

The ability to understand and appreciate cultural beliefs and values of other cultures and to work, communicate, and interact with others of different cultural backgrounds while being aware of one's own cultural beliefs. Source: [National Prevention Information Network](#)

cultural foods

Foods that represent the traditions, beliefs, geographic region, ethnic group, religious body, or cross-cultural community. Source: [Healthline](#)

cultural foodways

The eating habits and culinary practices of a people, region, or historical period. Source: [Michigan State University Cooperative Extension](#)

cultural humility

A dynamic and lifelong process focusing on self-reflections and personal critique, acknowledging one's own biases. Source: [University of Oregon Division of Equity and Inclusion](#)

culturally appropriate

Sensitivity to other cultures; refers to the awareness of how other ethnic, racial, and/or linguistic groups differ from one's own. Source: [Encyclopedia.com](#)

cyanocobalmin

Also known as vitamin B12. It is necessary for a number of processes in the body, including DNA and RNA production, and carbohydrate, fat, and protein metabolism. Source: [National Cancer Institute](#)

Daily Value (DV)

One value for each nutrient, selected for the labels of dietary supplements and food. It is often, but not always, similar to one's RDA or AI for that nutrient. Source: [National Institutes of Health](#)

dalma

Lentil stew with vegetables. Source: [Wikipedia](#)

deficiencies

Inadequate nutrient intake or absorption that can lead to specific health problems or diseases.

dental caries

A common chronic infectious disease resulting from tooth-adherent bacteria that metabolize sugars to produce acid, which, over time, demineralizes tooth structure. Source: [National Library of Medicine](#)

dental fluorosis

A common disorder characterized by hypomineralization of tooth enamel caused by the excessive ingestion of fluoride during tooth development. Source: [National Library of Medicine](#)

dichotomous thinking

The tendency to think in terms of polar opposites—that is, in terms of the best and worst. Also referred to as "black-and-white thinking" or "all-or-none thinking." Sources: [APA](#)

[Dictionary of Psychology](#) and [Encyclopedia of Personality and Individual Differences](#)

diet culture

Often describes a set of societal beliefs pertaining to food and body image, primarily focused on losing weight, an endorsement of thinness as a high moral standard, and the alteration of food consumption. Source: [Wikipedia](#)

dietary acculturation

When individuals adopt eating patterns of a host country. Source: [Journal of the Academy of Nutrition and Dietetics](#)

Dietary Reference Intakes (DRIs)

A set of scientifically developed reference values for nutrients. Source: [US Department of Health and Human Services](#)

dietary supplement

A product consumed in addition to a regular diet to supplement the intake of certain nutrients, available in various forms, such as pills, capsules, powders, and liquids. Source: [US Food and Drug Administration](#)

direct marketing

The sale of agricultural goods and products from the farm straight to the consumer, without intervening distributors or retailers. Source: [University of California Agriculture and Natural Resources](#)

disordered eating

Food and diet-related behaviors that don't meet diagnostic criteria for recognized eating disorders but still negatively affect someone's physical, mental, or emotional health. Source: [PubMed](#)

dumplings

A small piece of dough enclosing a typically savory filling (e.g., meat, seafood) and cooked usually by boiling, steaming, or pan-frying. Source: [Merriam-Webster Online Dictionary](#)

eating disorder

Any of several psychological disorders (e.g., anorexia nervosa, binge eating disorder, bulimia) characterized by serious disturbances of eating behavior. Source: [PubMed](#)

eicosanoids

Biologically active compounds that regulate body functions. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

electrolyte

Any of the ions (as of sodium or calcium) that in biological fluid regulate or affect most metabolic processes (such as the flow of nutrients into and waste products out of cells). Source: [Merriam-Webster Online Dictionary](#)

emotional eating

Eating in response to any human emotion, negative or positive. Also known as "stress eating." Source: [Wikipedia](#)

emulsifier

A substance with both water-soluble and fat-soluble portions that promotes the mixing of oils and fats in a watery solution. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

energy-yielding nutrients

The nutrients the body can use for energy: carbohydrate, protein, and fat. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

enzyme

Proteins that facilitate chemical reactions without being

changed in the process; protein catalysts. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

EPA and DHA

Eicosatetraenoic acid (EPA) and docosahexaenoic acid (DHA); omega-3 fatty acids made from linolenic acid in the tissues of fish. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

essential amino acids

Amino acids the body cannot make, so must be obtained from the diet. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

essential fatty acids

Required by humans and other animals for normal physiological function that cannot be synthesized by the body. Source: [Wikipedia](#)

Estimated Average Requirement (EAR)

The average daily intake of a nutrient estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group. Source: [National Institutes of Health](#)

farm to hospital

A supply chain relationship between a hospital or health-care facility and local farms that supplies fresh, locally produced food.

farm to school

The process of increasing student access to healthy foods, providing nutrition education, and supporting local producers. Source: [National Center for Appropriate Technology](#)

farm-to-institution programs

These programs connect local and regional farms with public and private institutions to purchase foods from local producers

for use in their cafeterias, catering services, classrooms, meal service, and institutional restaurants or markets. Source: [US Department of Agriculture](#)

farmers markets

Typically temporary retail establishments held outdoors, where farmers sell their produce at a specified place and time directly to customers. Source: [National Center for Appropriate Technology](#)

fat-soluble vitamins

Vitamins that dissolve in fat and can be stored in the body's fatty tissues, including vitamins A, D, E, and K. Source: [Human Nutrition](#)

fats

A group of compounds composed of oxygen, hydrogen, and carbon atoms that supply the body with energy. Source: [Merriam-Webster Online Dictionary](#)

fibers

The indigestible parts of plant foods. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

flavonoids

A type of phytochemical or plant chemical that creates vibrant colors of fruit, vegetables, and flowers that have a variety of health benefits, such as providing antioxidants, anti-inflammatory, and anti-cancer properties and reduce risk of chronic diseases and improve cognitive functioning. Source: [PubMed](#)

flavor

The blend of taste and smell sensations evoked by a substance in the mouth. Source: [Merriam-Webster Online Dictionary](#)

food banks

Organizations (usually nonprofits) that collect donated food and distribute it to people in need via a number of systems, including food pantries. Source: [Feeding America](#)

food demonstration

An interaction between a presenter and an audience that involves education about specific foods and/or recipes while using those same ingredients and/or recipes. Source: [AZ Health Zone Food Demonstration Guide](#)

food deserts

Areas in which high-quality fresh food is challenging to purchase due to lack of proximity to a large grocery store. Source: [Congressional Research Service](#)

food environment

The physical, social, economic, cultural, and political factors that impact the accessibility, availability, and adequacy of food within a community or region. Source: [Intuitive Eating: A Revolutionary Anti-Diet Approach, 4th Edition](#)

food equity

The concept that people should have equal access to and the ability to grow and consume nutritious, affordable, and culturally significant foods. Source: [University at Buffalo Community of Excellence in Global Health Equity](#)

food hubs

Centrally located facilities with a business management structure facilitating the aggregation, storage, processing, distribution, and/or marketing of locally/regionally produced food products. Source: [US Department of Agriculture](#)

food pantries

A distribution center where hungry families can receive food.

Source: [Feeding America](#)

food security

The state of having reliable access to sufficient quantities of affordable, nutritious food. Source: [Oxford English Dictionary](#)

food shed

The geographical area between where food is produced and where that food is consumed. Source: [Michigan State University Extension](#)

food sovereignty

The right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. Source: [US Food Sovereignty Alliance](#)

food systems

Complex networks that include all the inputs and outputs associated with agricultural and food production and consumption. Source: [US Department of Agriculture](#)

foodborne

Caused by food contaminated with pathogenic microorganisms or toxic substances. Source: [Merriam-Webster Online Dictionary](#)

free radicals

Highly reactive chemicals that have the potential to harm cells. They are formed naturally in the body but they can be hazardous at high concentrations and damage all major components of cells, including DNA, proteins, and cell membranes. Source: [National Cancer Institute](#)

Fruit and Vegetable Prescription Program

A medical treatment or preventative service for eligible patients due to diet-related health risks or conditions, food insecurity, or other documented challenges in access to nutritious foods, and are referred by a health-care provider or health insurance plan. Source: [National Produce Prescription Collaborative](#)

gleaning

The act of collecting excess fresh foods from farms, gardens, farmers markets, grocers, restaurants, state/county fairs, or any other sources in order to provide it to those in need. Source: [US Department of Agriculture *Let's Glean!*](#)

glucose

A single sugar used in plant and animal tissues for energy. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

glycogen

A highly branched polysaccharide that is made and held in liver and muscle tissues as a storage form of glucose. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

grocery stores

Stores or marketplaces where groceries (food, beverages, and common household goods) are sold. Source: [Allrecipes](#)

H2 blockers

Medications that work by reducing the amount of stomach acid secreted by glands in the lining of your stomach. H2 blockers are commonly used to relieve symptoms of acid reflux, or gastroesophageal reflux disease. This is a condition where food liquid moves up from the stomach into the esophagus. Source: [MedlinePlus](#)

health disparities

Differences in which disadvantaged social groups such as the poor, racial/ethnic minorities, women, and other groups who have persistently experienced social disadvantage or discrimination systemically experience worse health or greater health risks than more advantaged social groups. Source: [Centers for Disease Control and Prevention](#)

health equity

The state in which everyone has a fair and just opportunity to attain their highest level of health. Achieving this requires focused and ongoing societal efforts to address historical and contemporary injustices; overcome economic, social, and other obstacles to health and health care; and eliminate preventable health disparities. Source: [Centers for Disease Control and Prevention](#)

healthifying

Altering a recipe (e.g., swapping out ingredients, changing amounts) to make it more healthful.

hemoglobin

Any numerous iron-containing respiratory pigments of various organisms. Source: [Merriam-Webster Online Dictionary](#)

highly processed or ultra-processed foods

These contain multiple ingredients created via industrial processing, such as hydrogenated oils, high-fructose corn syrup, emulsifiers, artificial colors, and protein isolates. Examples include veggie burgers, infant formula, oat and almond milk, packaged bread, breakfast cereals, frozen meals and pizzas, chicken nuggets, hot dogs, chocolate, ice cream, cookies, and cakes. Source: [Food and Agriculture Organization of the United Nations](#)

historical trauma

Multigenerational trauma experienced by a specific cultural, racial, or ethnic group. Source: [Administration for Children & Families](#)

hormones

Chemical messengers secreted by a variety of glands in response to altered conditions in the body that travel to 1 or more specific target tissues or organs, where it elicits a specific response to maintain homeostasis. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

hydrolyzes

Undergoes the process of hydrolysis (a chemical process of decomposition involving the splitting of a bond and the addition of the hydrogen cation and the hydroxide anion of water). Source: [Merriam-Webster Online Dictionary](#)

insulin

A hormone secreted by special cells in the pancreas in response to elevated blood glucose concentration. Insulin controls the transport of glucose from the bloodstream into the muscle and fat cells. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

interpersonal relationships

A social association, connection, or affiliation between 2 or more people. Source: [Wikipedia](#)

isoflavones

Phytoestrogens produced mainly by plants of the legume family, especially soybeans, potentially useful in lowering cholesterol and in treating some cancers and menopausal symptoms. Source: [Dictionary.com](#)

kalua pork

Shredded meat from a pig cooked in an imu (underground oven pit) using traditional Hawaiian methods (covered with plant or banana leaves and steamed). Source: [Wikipedia](#)

ketones

Acids your body makes when it's using fat instead of glucose for energy. Too many ketones can make your blood acidic and toxic. Source: [Cleveland Clinic](#)

ketosis

An elevation of ketone levels in the body. Source: [Merriam-Webster Online Dictionary](#)

kosher

Selling or serving food ritually fit according to Jewish law. Source: [Merriam-Webster Online Dictionary](#)

lau lau

Meat and fish (e.g., pork, salmon) wrapped in leaves (e.g., taro, ti) and baked or steamed. Source: [Merriam-Webster Online Dictionary](#)

lipase

Enzymes that hydrolyze lipids. *Gastric lipase* is a fat-digesting enzyme secreted from the cells of the stomach. *Pancreatic lipase* is a fat-digesting enzyme secreted from the pancreas. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

low-access regions

Defined as being far from a supermarket, supercenter, or large grocery store. Source: [Food Access Research Atlas](#)

Machher Jhol

Curried fish gravy made with spices (turmeric, cardamom) served with rice. Source: [Wikipedia](#)

macronutrients

Nutrients your body needs in large amounts to function optimally, such as carbohydrates, protein, and fat. Source: [WebMD](#)

microbiome

The collection of all microbes, such as bacteria, fungi, viruses, and their genes, that naturally live on our bodies and inside us. Source: [National Institute of Environmental Health Sciences](#)

microbiota

A wide variety of bacteria, viruses, fungi, and other microorganisms present in a singular environment, such as the human digestive tract. Source: [MedicalNewsToday](#)

micronutrients

Vitamins, minerals, and trace elements required in small quantities. They support various bodily functions and are essential for growth and development.

millet

A varied group of small-seeded grasses, widely grown around the world as cereal crops or grains. Source: [Wikipedia](#)

minerals

Inorganic substances that are essential for the body's proper functioning, including elements such as calcium, iron, zinc, and magnesium.

mise en place

A French term that translates to "everything in place." Refers to organizing and arranging ingredients before cooking. Source: [Food for Fifty, 14th Edition](#)

mobile markets

Markets that travel to customers, such as a refrigerated van

that brings fresh produce to a neighborhood to sell to its residents. Source: [Health Care Without Harm](#)

monounsaturated fatty acid

Contains 1 point of unsaturation. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

mooncakes

Small pastries filled with sweet or savory ingredients; traditionally associated with Mid-Autumn Festival and moon watching. Source: [Merriam-Webster Online Dictionary](#)

muktuk

The skin and fat of whale, cut into small pieces and eaten as food by Inuit people. Source: [Cambridge Advanced Learner's Dictionary & Thesaurus](#)

MyPlate

Developed and published by the U.S. Department of Agriculture's Center for Nutrition Policy and Promotion, this contemporary nutrition guide aligns with the Dietary Guidelines for Americans. Source: [US Department of Agriculture](#)

neurodivergent

Refers to people whose ways of thinking, learning, and behaving fall outside of what is considered "neurotypical" or "normal."

nonessential amino acids

Amino acids the body can make. Source: [Understanding Normal and Clinical Nutrition, 12th Edition](#)

nopales

The edible fleshy pads of the nopal cactus, used as a staple in Mexican cuisine.

nourishing foods

Foods that provide a person, animal, or plant with the nutrition that is necessary for life, growth, and good health. Source: [Collins Dictionary](#)

nutrition assistance programs

Programs that provide assistance to access or purchase food for certain individuals and groups; programs include the Supplemental Nutrition Assistance Program, the National School Lunch Program, and more. Source: [US Department of Agriculture's Nutrition.gov](#)

nutrition degradation

The process by which essential nutrients in food (e.g., vitamins, minerals, macronutrients) deteriorate over time due to various factors (e.g., heat, light, air, moisture, enzymatic reactions), resulting in a reduction of their nutritional value and bioavailability.

nutrition security

Having consistent and equitable access to healthy, safe, affordable foods essential to optimal health and well-being. Source: [US Department of Agriculture's National Institute of Food and Agriculture](#)

nutrition-sensitive conditions

A disease and/or a medical or health condition that can be influenced by nutrition and diet.

odorants

Substances that have an odor, scent, or fragrance. Source: [Merriam-Webster Online Dictionary](#)

oils

Lipids that are liquid at room temperature. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

olfactory mucosa

The mucus-secreting membrane in the upper nasal cavity that contains cells responsible for initiating the sense of smell.

Source: [Encyclopedia of Neuroscience, 2009](#)

omega-3

A polyunsaturated fatty acid with its endmost double bond 3 carbons from the end of the carbon chain. Linolenic acid is an example. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

omega-3 fatty acids

One class of polyunsaturated fatty acids with 3 double bonds. They're present in foods such as flaxseed, walnuts, and fatty fish used to make eicosanoids and are associated with decreasing inflammation. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

omega-6

A polyunsaturated fatty acid with its endmost double bond six carbons from the end of the carbon chain. Linoleic acid is an example. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

online shopping

A form of electronic commerce that allows consumers to directly buy goods or services from a seller over the Internet.

Source: [Wikipedia](#)

oral cavity

The part of the mouth behind the gums and teeth that is bounded above by the hard and soft palates and below by the tongue and by the mucous membrane connecting it with the inner part of the mandible (lower jaw). Source: [Merriam-Webster Online Dictionary](#)

organosulfur compounds

Organic molecules that contain sulfur and are associated with the pungent odors characteristic of allium vegetables such as garlic and onions. They are also abundant in cruciferous vegetables such as broccoli and cabbage. Source: *Epigenetics of Cancer Prevention, Vol. 8*

pandanus

A tropical plant also known as screw pine, bearing edible fruit. Source: *Britannica*

pemmican

A concentrated food used by North American Indians and consisting of lean meat dried, pounded fine, and mixed with melted fat. Source: *Merriam-Webster Online Dictionary*

pepsin

A gastric enzyme that hydrolyzes protein. Pepsin is secreted in an inactive form, pepsinogen, which is activated by hydrochloric acid in the stomach. Source: *Understanding Normal and Clinical Nutrition, 12th Edition*

peptidase

A digestive enzyme that hydrolyzes peptide bonds. Tripeptidases cleave tripeptides; dipeptidases cleave dipeptides. Source: *Understanding Normal and Clinical Nutrition, 12th Edition*

perishable foods

Foods likely to spoil, decay, or become unsafe to consume if not kept refrigerated at 40 °F or below, or frozen at 0 °F or below. Source: *US Department of Agriculture*

phenolic diterpenes

A type of polyphenol, including carnosic acid, carnosol, and

12-O-methyl carnosic acid. Source: [Journal of Agriculture and Food Chemistry](#)

phospholipids

One of 3 main classes of dietary lipids. These lipids are present in all cell membranes. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

phytonutrients

Compounds produced by plants that provide health benefits to the body. Also called phytochemicals or antioxidants. Source: [US Department of Agriculture's National Agriculture Library](#)

plantains

a tropical fruit similar to a banana with green skin. Larger in size than bananas, they have a thicker skin. Plantains are also starchier and lower in sugar than bananas. Source: [Merriam-Webster Online Dictionary](#)

poi

A Hawaiian food prepared from the cooked corms of taro that are mashed with water to the consistency of a paste or thick liquid and often allowed to ferment. Source: [Merriam-Webster Online Dictionary](#)

polyphenols

Beneficial plant compounds with antioxidant properties that may help keep you healthy and protect against various diseases. Source: [Healthline](#)

polyunsaturated fatty acid

Contains 2 or more points of unsaturation. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

Prepare-Engage-Respond

A model to follow when counseling individuals about dietary modification.

prickly pear fruit

The pulpy, pear- or egg-shaped, edible, yellow to purplish-red fruit of a prickly pear cactus. Source: [Merriam-Webster Online Dictionary](#)

probiotics

Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host. Source: [National Institutes of Health](#)

processed

Food that's changed from its natural state (cut, washed, heated, pasteurized, canned, cooked, frozen, dried, dehydrated, mixed, or packaged). It also can include food that has added preservatives, nutrients, flavors, salts, sugars, or fats. Source: [WebMD](#)

processed foods

Minimally processed foods with added processed culinary ingredients, such as canned vegetables, tomato sauce in a jar, cheese, fresh bread, bacon, canned beans, and tofu. Source: [Food and Agriculture Organization of the United Nations](#)

proteases

Enzymes that hydrolyze protein. Source: *Understanding Normal and Clinical Nutrition, 12th Edition*

pulses

The edible seeds of various crops (e.g., peas, beans, lentils) of the legume family. Source: [Merriam-Webster Online Dictionary](#)

Recommended Dietary Allowance (RDA)

The average daily intake of a nutrient that is sufficient to meet the requirements of most healthy individuals in a particular life stage and gender group. Source: [National Institutes of Health](#)

resveratrol

A substance found in the skins of grapes and in certain other plants, fruits, and seeds. It is a type of antioxidant and a type of polyphenol. It is being studied in the prevention of cancer and heart disease. Source: [National Cancer Institute](#)

saguaro cactus fruit

The reddish edible fruit from a tall, treelike cactus that grows in the desert Southwest United States and Mexico. Source: [Merriam-Webster Online Dictionary](#)

sanitizing

To reduce or eliminate pathogenic agents (such as bacteria) on the surfaces of something; to make something sanitary (as by cleaning or disinfecting). Source: [Merriam-Webster Online Dictionary](#)

satiety

The feeling of fullness and satisfaction that occurs after a meal. Source: *Understanding Normal and Clinical Nutrition, 12th Edition*

saturated fats

Fats found in animal-based foods such as beef, pork, poultry, full-fat dairy products, eggs, and tropical oils. Because they are typically solid at room temperature, they are sometimes called "solid fats." Source: [American Heart Association](#)

saturated fatty acid

Carries the maximum possible number of hydrogen atoms (having no points of unsaturation). Source: *Nutrition Concepts and Controversies, 15th Edition*

seed-to-table programs

Programs that teach how to grow, prepare, and eat produce, while learning about the environment and nutrition. Source: [The Edible Schoolyard Project](#)

seitan

A form of wheat gluten with a firm, chewy texture and a bland flavor. Source: [On Cooking: A Textbook of Culinary Fundamentals, 6th Edition](#)

shelf-stable foods

Foods that can be safely stored at room temperature or “on the shelf.” Source: [US Department of Agriculture](#)

simple carbohydrates

Sugars, including both single sugar units and linked pairs of sugar units. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

sinusitis

An inflammation of the sinus (a cavity in the substance of a bone of the skull that usually communicates with the nostrils and contains air). Source: [Merriam-Webster Online Dictionary](#)

smoke point

The temperature at which fat begins to break down and smoke. Source: [On Cooking: A Textbook of Culinary Fundamentals, 6th Edition](#)

social determinants of health (SDOH)

The conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. Source: [World Health Organization](#)

social norms

The perceived informal, mostly unwritten, rules that define

acceptable and appropriate actions within a given group or community, thus guiding human behavior. Source: [UNICEF](#)

social-ecological model

A way of thinking that “understands health to be affected by the interaction between the individual, the group/community, and the physical, social, and political environments.” These nested levels organize many factors that affect health to help communities “develop approaches to disease prevention and health promotion that include action at [these] levels.” Source: *Principles of Community Engagement, 2nd Edition*

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

A program that provides federal grants to states for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, and to infants and children up to age 5 who are found to be at nutritional risk. Source: [US Department of Agriculture](#)

Standard American Diet

The dietary pattern of many people in the United States. It typically includes high intakes of saturated fats and refined carbohydrates and low intakes of plant-based foods. Evidence links this with various chronic diseases. Also known as the Western diet. Source: [MedicalNewsToday](#)

stanols/phytosterols

Plant-derived compounds that are structurally related to cholesterol. They reduce serum cholesterol by interfering with intestinal absorption and facilitate biliary excretion of cholesterol in the feces. Source: [The Association of UK Dietitians](#)

staple

A food that is regularly consumed, usually in large quantities such that they contribute importantly to the energy needs of a population. Source: *Encyclopedia of Human Nutrition, 3rd Edition*

starches

Plant polysaccharides composed of glucose. Source: *Nutrition Concepts and Controversies, 15th Edition*

sterols

One of the 3 main classes of dietary lipids. Sterols have a structure similar to that of cholesterol. Source: *Nutrition Concepts and Controversies, 15th Edition*

stilbenes

A small class of plant phenolics synthesized in plant root, leaves, or fruit, such as resveratrol in grapes.

sugars

Simple carbohydrates; that is, molecules of either single sugar units or pairs of those sugar units bonded together. Source: *Nutrition Concepts and Controversies, 15th Edition*

Supplemental Nutrition Assistance Program (SNAP)

A government program that provides food benefits to low-income families to supplement their grocery budget so they can afford nutritious food. Source: [SNAP](#)

supply chain

A local food supply chain represents all processes involved in the movement of local foods from the farm to the consumer, including marketing, markets, distribution, aggregation, processing, packaging, purchasing, preparation, resource recovery, and waste disposal. Source: [NC State Extension](#)

systemic racism

Policies and practices that exist throughout a whole society or organization and that result in and support a continued unfair advantage to some people and unfair or harmful treatment of others based on race. Source: [Cambridge Advanced Learner's Dictionary & Thesaurus](#)

tamales

Cornmeal dough rolled with ground meat or beans seasoned usually with chili, wrapped usually in corn husks, and steamed. Source: [Merriam-Webster Online Dictionary](#)

tannins

Naturally occurring chemical compounds, known as polyphenols, that are found in clarifying wine and beer and in medicine.

teaspoon

A unit of measure, especially in cookery, equal to $\frac{1}{6}$ fluid ounce or $\frac{1}{3}$ tablespoon (5 milliliters). Source: [Merriam-Webster Online Dictionary](#)

tempeh

Fermented whole soybeans mixed with a grain such as rice or millet that has a chewy consistency and a yeasty, nutty flavor. Source: *On Cooking: A Textbook of Culinary Fundamentals, 6th Edition*

terpenes

Terpenes are naturally occurring chemical compounds found in plants and some animals. They're responsible for the aromas, flavors, and even colors associated with various types of vegetation. Source: [Healthline](#)

three sisters

Corn, squash, and beans grown and/or prepared together.

Source: [US Department of Agriculture's National Agricultural Library](#)

time/temperature control for safety (TCS)

Some foods grow bacteria more easily and quickly than others so they require certain time and temperature controls to be kept safe. Source: [StateFoodSafety](#)

Tolerable Upper Intake Level (UL)

The highest level of daily nutrient intake that is unlikely to cause adverse health effects in almost all individuals. Source: [Scientific Committee on Food](#)

trace elements

Minerals that are required by the body in very small amounts. Examples include iron, zinc, copper, selenium, and iodine.

triglycerides

One of 3 main classes of dietary lipids and the chief form of fat in foods and the human body. A triglyceride is made up of 3 units of fatty acids and 1 unit of glycerol. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

type 2 diabetes mellitus (T2DM)

A chronic condition in which the body does not produce enough insulin or the body resists the effects of insulin, causing elevated blood glucose levels. Source: [National Institute of Diabetes and Digestive and Kidney Diseases](#)

umami

The taste sensation that is produced by several amino acids and nucleotides (such as glutamate and aspartate) and has a rich or meaty flavor characteristic of cheese, cooked meat, mushrooms, soy, and ripe tomatoes. Source: [Merriam-Webster Online Dictionary](#)

unsaturated fatty acid

Lacks some hydrogen atoms and has 1 or more points of unsaturation. Source: [Nutrition Concepts and Controversies, 15th Edition](#)

urban agriculture

Includes the cultivation, processing, and distribution of agricultural products (food or nonfood) in urban and suburban areas. Source: [US Department of Agriculture's National Agricultural Library](#)

value-added

In agriculture, this entails changing a raw agricultural product into something new through cooking, packaging, processing, cooling, drying, extracting, or any other type of process that differentiates the product from the original raw commodity. Source: [National Center for Appropriate Technology](#)

vitamins

Essential micronutrients, broadly categorized into water-soluble or fat-soluble vitamins.

water-soluble vitamins

Vitamins that dissolve in water and are not stored in the body for long periods. These include vitamin C and B-complex vitamins. Source: [Human Nutrition](#)

Westernized beliefs

The adoption of the practices and culture of Western Europe by societies and countries in other parts of the world, whether through compulsion or influence. Source: [Britannica](#)

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Versioning History

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.01. If the edits involve substantial updates, the version number increases to the next full number.

The files posted by this book always reflect the most recent version.

Version	Date	Change	Notes
1.01	12/23/24	Book published	
1.02	12/23/24	updated spelling of co-author Aimee Novak's name in Chapter 1	
1.03	1/7/25	updated author list	
1.04	1/9/25	updated peer reviewer Monica K. Esquivel's title in contributor list	

1.05	1/21/25	updated author and contributor list	
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