Spotlight on Dietary Supplements and Functional Foods

THINK About It

1. When choosing food, what health benefits do you consider beyond basic nutrition?
2. What do you know about the safety of high doses of nutrient supplements?
3. Would you ask your physician before taking an herbal supplement?
4. If a friend told you about a new herbal extract that is guaranteed to tone muscles, would you try it?

LEARNING Objectives

1. Describe how dietary supplements are regulated in the food supply.
2. Discuss the potential benefits and harmful effects of dietary supplements and herbal supplements.
3. List individuals for whom dietary supplements would be considered appropriate.
4. Discuss functional foods and give three to five examples including the food source and potential benefit.
5. Define phytochemicals.

isoflavones Plant chemicals that include genistein and daidzein and may have positive effects against cancer and heart disease. Also called *phytoestrogens*.

dietary supplements Products taken by mouth in tablet, capsule, powder, gelcap, or other nonfood form that contain one or more of the following: vitamins, minerals, amino acids, herbs, enzymes, metabolites, or concentrates.

complementary and alternative medicine (CAM) A broad range of healing philosophies, approaches, and therapies that include treatments and healthcare practices not taught widely in medical schools, not generally used in hospitals, and not usually reimbursed by medical insurance companies.

megadoses Doses of a nutrient that are 10 or more times the recommended amount.

When she feels down, Jana takes the herbal St. John's wort to give her a lift. Whenever she has the option, Sherina chooses calcium-fortified foods. Carlos swears by creatine in his muscle-building regimen. Jason tries a new energy bar with added ginkgo biloba, hoping it will improve his memory. Others in search of better health turn to massage therapy, meditation, organic diets, homeopathy, acupuncture, and many other practices.

Any trip to the grocery store will tell you that a new era in product development is here—one in which food products are more often touted for what they contain (e.g., soy **isoflavones**, vitamins and minerals, herbal ingredients) than for what they lack (e.g., fat, cholesterol). Beverages, energy bars, food products and teas marketed with special health benefits sit side by side on the shelf with traditional foods. The market for **dietary supplements**—which are much more than the simple vitamins and minerals our parents knew—continues to grow.

This spotlight looks at dietary supplements, functional foods, and the role of nutrition in **complementary and alternative medicine (CAM)**. We will discuss not only the claims made for products and therapies in terms of current scientific knowledge, but also the regulatory and safety issues. Making decisions about nutrition and health requires both consumers and professionals to stay informed and consult reliable sources before trying a new product or embarking on a new health regimen.

Courtesy of Jesse Geraci.

Figure SF.1 **Increasing popularity of dietary supplements.** Two-thirds of adult Americans regularly purchase dietary supplements.

Dietary Supplements: Vitamins and Minerals

Dietary supplements come in various forms—vitamins, minerals, amino acids, herbs, glandular extracts, enzymes, and many others. The marketplace includes a wide variety of products claiming to do everything from enhancing immune function to improving mood. Dietary supplement use is common in the United States among adults, with over half the population using at least one, the most common of which are multivitamin/mineral dietary supplements.[1,2] **Table SF.1** lists many popular supplements, claims, and important cautions. Despite the enticing claims made for many non-nutrient supplements, scientific evidence of efficacy and long-term safety often is lacking.

"Should I take a vitamin (or mineral) supplement?" Apparently many people already have answered that question for themselves: (See **Figure SF.1**.) Multivitamin/mineral supplements and other single vitamin or mineral supplements are popular and are taken by a substantial percentage of Americans.[3] In this spotlight, we will look at two levels of vitamin and mineral supplementation: (1) moderate doses that are in the range of the Daily Values (DVs) or levels you might eat in a nutrient-rich diet and (2) **megadoses**, or high levels that are typically multiples of the DVs and much greater amounts than diet alone could supply.

Position Statement: Academy of Nutrition and Dietetics

Nutrient Supplementation

It is the position of the Academy of Nutrition and Dietetics that the best nutrition-based strategy for promoting optimal health and reducing the risk of chronic disease is to wisely choose a wide variety of foods. Additional nutrients from supplements can help some people meet their nutrition needs as specified by science-based nutrition standards such as the Dietary Reference Intakes.

Source: Reproduced from Marra MV, Boyar AP. Position of the American Dietetic Association: Nutrient supplementation. *J Am Diet Assoc*. 2009;109(12):2073–2085.

Moderate Supplementation

Healthcare practitioners often recommend moderate nutrient supplementation for people with elevated nutrient needs and for people who may not always eat a well-balanced diet.[4] **Table SF.2** lists some examples of people for whom nutritional supplementation may be recommended.

In addition to those listed in Table SF.2, other groups may also be vulnerable to nutrient inadequacies, such as individuals who are food insecure, are alcohol/drug dependent, or have altered nutritional needs due to an illness or medication use. Many people take nutrient supplements to ensure

Table SF.1 Examples of Commonly Used Dietary Supplements and Their Claims

Supplement	Claimed Benefit	What Does the Science Say?
Beta-carotene	Prevents cancer and heart disease, boosts immunity, improves eye health	Diets rich in beta-carotene–containing fruits and vegetables reduce heart disease and cancer risk. Supplements have not been shown to be beneficial. Taking supplements may increase lung cancer risk in smokers. In combination with vitamin C, vitamin E, and zinc, may slow progression of age-related macular degeneration.
Chromium picolinate	Builds muscle, helps with blood glucose control in diabetes, promotes weight loss, reduces cholesterol	No solid evidence that chromium picolinate supplements perform as claimed or benefit healthy people. Some evidence that supplements may harm cells.
Coenzyme Q_{10}	Prevents heart disease, improves health of people with heart disease and hypertension, cure-all	May have value in preexisting heart disease, but benefits for healthy people are unproved.
Cranberry	Prevents and treats urinary tract infections (UTIs)	There is some evidence that cranberry can help to *prevent* urinary tract infections; however, the evidence is not definitive, and more research is needed. Cranberry has not been shown to be effective as a *treatment* for an existing urinary tract infection.
Creatine	Increases muscle strength and size, improves athletic performance	May enhance power and strength for some athletes, but is ineffective for casual exercisers and distance athletes.
Echinacea	Protects against and cures colds, boosts immunity	Study results are mixed on whether echinacea can *prevent* or effectively *treat* upper respiratory tract infections such as the common cold. Other studies have shown that echinacea may be beneficial in treating upper respiratory infections.
Ephedra	Weight control, herbal "high," decongestant	Ephedra raises heart rate and blood pressure, causes gastrointestinal problems, and is dangerous for people with diabetes, hypertension, or heart disease. According to the Food and Drug Administration (FDA) there is little evidence of ephedra's effectiveness, except for short-term weight loss—and the increased risk of heart problems and stroke outweighs any benefits. The FDA has prohibited sales of ephedra-containing supplements.
Feverfew	Prevents migraines	Some evidence of reduced severity and frequency of migraines, but high dropout rates in studies. Study results are mixed and there is not enough evidence available to assess whether feverfew is beneficial for other uses.
Flaxseed and flaxseed oil	Laxative; lowers cholesterol levels, prevents cancer	Studies of flaxseed preparations to lower cholesterol levels show mixed results. Some studies suggest that alpha-linolenic acid found in flaxseed and flaxseed oil may benefit people with heart disease. Flaxseed might reduce the risk of certain cancers; however, research does not yet support a recommendation for this use.
Garlic	Lowers blood pressure and blood cholesterol, reduces cancer risk	There is some evidence that garlic reduces cholesterol and blood pressure. Dietary garlic may reduce cancer risk; however, results are conflicting.

(*continues*)

Table SF.1 **Examples of Commonly Used Dietary Supplements and Their Claims (*continued*)**

Supplement	Claimed Benefit	What Does the Science Say?
Ginkgo biloba	Improves blood flow and circulatory disorders; prevents or cures absentmindedness, memory loss, dementia	Studies on ginkgo biloba found it to be ineffective in lowering the overall incidence of dementia and Alzheimer's disease in older adults, improving memory, slowing cognitive decline, lowering blood pressure, or reducing the incidence of hypertension; there is conflicting evidence on the efficacy of ginkgo for tinnitus.
Ginseng	Improves athletic performance, fights fatigue, helps control blood glucose in people with diabetes, reduces cancer risk	There is no evidence that ginseng has any beneficial effects. Many products on the market contain no ginseng.
Glucosamine and chondroitin sulfate	Relieve arthritis pain, slow progression of arthritis	Some evidence of reduced pain and improved symptoms, although more studies are needed. Does not reverse arthritis. Variable amounts in products.
Kava	Promotes relaxation and relieves anxiety	The FDA has issued a warning that using kava supplements has been linked to a risk of severe liver damage. Banned in Switzerland, Germany, and Canada.
Melatonin	Promotes sleep, counters jet lag, improves sex life, prevents migraine	May be effective for jet lag; studies are contradictory relative to sleep. No evidence for anti-aging or sex-drive claims. No data on long-term safety.
Milk thistle	Reduces liver damage in alcoholic liver disease, promotes general liver health	Previous studies suggested that milk thistle may benefit the liver by protecting and promoting the growth of liver cells, fighting oxidation, and inhibiting inflammation. However, results from small clinical trials of milk thistle for liver diseases have been mixed or found no benefit.
Saw palmetto	Shrinks prostate, reduces symptoms of benign prostatic hyperplasia, prevents prostate cancer	Several small studies suggest that saw palmetto may be effective for treating benign prostatic hyperplasia (BPH) symptoms. However, a 2011 National Center for Complementary and Alternative Medicine (NCCAM) co-funded study saw palmetto did not reduce the urinary symptoms associated with BPH more than placebo; a review of the research concluded that saw palmetto has not been shown to be more effective than placebo for this use.
St. John's wort	Alleviates depression, promotes emotional well-being	Some studies of St. John's wort have reported benefits for depression; however, others have not. St John's wort has not been found to be any more effective than a placebo in treating depression.
Valerian	Enhances sleep, reduces stress and anxiety	Valerian may be helpful for insomnia. Results are inconclusive to date; much more research is needed.

Source: National Institutes of Health, National Center for Complementary and Alternative Medicine. Herbs at a glance. http://nccam.nih.gov/health/herbsataglance.htm. Accessed August 9, 2014; National Institutes of Health, Office of Dietary Supplements. Dietary supplement fact sheets. http://ods.od.nih.gov/factsheets/list-all. Accessed August 10, 2014.

Table SF.2 **People for Whom Nutrition Supplementation May Be Recommended**

Women of childbearing age who may become pregnant as well as pregnant and breastfeeding women: Taking supplemental folic acid prior to and during pregnancy can reduce the incidence of birth defects. During pregnancy, it's hard to meet the increased needs for iron and other nutrients through diet alone. Morning sickness makes it even harder. When a woman breastfeeds, some of her nutrient needs are even higher than they were in pregnancy.

Women with heavy menstrual bleeding: Women with high iron losses may need a supplement, but they should not take high doses of iron without a doctor's recommendation. Lab tests can show whether a woman gets enough blood-building nutrients or whether she needs supplements.

Children: A supplement can help balance the diets of picky eaters or children on a food jag (eating only a few specific foods), and it can ease parental worries. Children who do not consume the recommended amounts of vitamin D–fortified milk may need supplemental vitamin D.

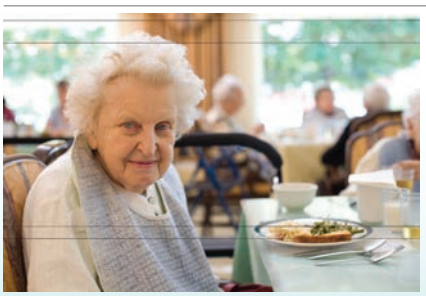
Infants: If their access to sunlight is restricted, infants may need supplemental vitamin D. Doctors also may prescribe fluoride in areas where water is not fluoridated.

(*continues*)

Table SF.2 **People for Whom Nutrition Supplementation May Be Recommended (*continued*)**

People with severe food restrictions, either self-imposed or prescribed: Supplements may help people on a strict weight-loss diet, those who have eating disorders, those who have mental illnesses, and those who limit their eating because of social or emotional situations.

Strict vegetarians who abstain from animal foods and dairy products: People who don't eat meat or dairy products may need supplemental vitamin B_{12}, vitamin D, and perhaps calcium, zinc, iron, and other minerals.



Older adults: Because inadequate stomach acid (which is needed for normal absorption of vitamin B_{12}) is common among older people, older adults may need extra vitamin B_{12}. When older adults have limited exposure to the sun and their diets lack dairy products, they should take supplements of vitamin D, calcium, and possibly other nutrients to help maintain bone health.

they meet their nutritional needs. However, taking supplements to "fix" a poor diet is not a perfect solution. According to the Academy of Nutrition and Dietetics, "focusing on variety, moderation, and proportionality in the context of a healthy lifestyle, rather than targeting specific nutrients or foods, can help reduce consumer confusion and prevent unnecessary reliance on supplements."[5] Foods provide not only nutrients, but also fiber and other health-promoting phytochemicals. For the most healthful benefits, whenever possible, meet your nutritional needs with food.

Many supplements contain multiple vitamins and minerals. If you are one of those who should take multivitamin/mineral supplements, look for brands that contain at least 20 vitamins and minerals, each no more than 100 percent of its Daily Value unless otherwise instructed by your doctor. (See **Figure SF.2**) Although most products have appropriate nutrient levels, some formulas are irrational and unbalanced, with less than 10 percent of the Daily Value of some nutrients and more than 1,000 percent of others.

Key Concepts Vitamin and mineral supplements are popular; however, it is better to obtain nutrients from food. Some conditions and circumstances make it difficult to meet nutritional needs through food alone or to consume enough food to accommodate increases in nutrient needs. Multivitamin/mineral supplements should be well balanced, with doses no greater than about 100 percent of the Daily Value of each nutrient.

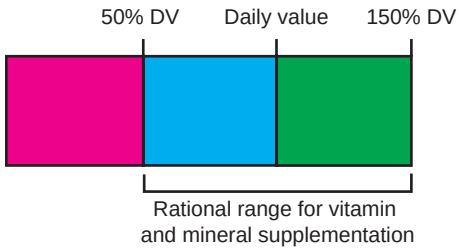


Figure SF.2 **Moderate supplementation.** Healthcare practitioners often recommend moderate nutrient supplementation for people with elevated nutrient needs and for people who have consistently poor diets.

Megadoses in Conventional Medical Management

High doses of vitamins and minerals have become so much a part of treating certain illnesses that when physicians prescribe these nutrients, many see themselves as following "standard medical practice" rather than as "practicing nutrition." Here are some situations in which physicians may prescribe a vitamin or mineral at megadose levels:

- When a medication dramatically depletes or destroys the stores or blocks the functions of vitamins or minerals, megadosing can overcome these effects. For example, folic acid and vitamin B_6 are used during long-term treatment with some tuberculosis drugs.
- People with **malabsorption syndromes** such as cystic fibrosis often take large nutrient doses to compensate for nutritive losses and to override intestinal barriers to absorption.
- Megadoses of vitamin B_{12} can overcome the malabsorption seen in pernicious anemia, a condition in which a key substance needed for vitamin B_{12} absorption is lacking.

A vitamin at megadose levels can have *pharmacological activity*—that is, it acts as a drug. Nicotinic acid (niacin) is a good example. At usual levels (around 10 or 20 milligrams), it functions as a vitamin, but at levels 50 or 100 times higher it acts as a drug to lower blood lipid levels. Niacin has been used since the 1950s as a lipid-altering drug for low-density lipoprotein (LDL) cholesterol and is currently an effective agent available for raising high-density lipoprotein (HDL) cholesterol.[6] Like any drug, though, it can have serious side effects.[7]

Megadosing Beyond Conventional Medicine: Orthomolecular Nutrition

In 1968, Linus Pauling, the best-known advocate of megadosing, coined the term **orthomolecular medicine**. To him, *orthomolecular* meant achieving the optimal nutrient levels in the body.[8] Few nutritionists argue with the

Position Statement: American Heart Association

Vitamin and Mineral Supplements

The American Heart Association recommends that healthy people get adequate nutrients by eating a variety of foods in moderation, rather than by taking supplements.

"The Dietary Recommended Intakes (DRIs) published by the Institute of Medicine are the best available estimates of safe and adequate dietary intakes," says the AHA. "There aren't sufficient data to suggest that healthy people benefit by taking certain vitamin or mineral supplements in excess of the DRIs." Moreover, "vitamin or mineral supplements aren't a substitute for a balanced, nutritious diet that limits excess calories, saturated fat, trans fat, sodium, and dietary cholesterol. This dietary approach has been shown to reduce coronary heart disease risk in both healthy people and those with coronary disease."

Source: Reproduced with permission, www.heart.org, © 2011 American Heart Association, Inc. Vitamin and mineral supplements. http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/Vitamin-and-Mineral-Supplements_UCM_306033_Article.jsp. Accessed April 8, 2014.

malabsorption syndromes Conditions that result in imperfect, inadequate, or otherwise disordered gastrointestinal absorption.

orthomolecular medicine The preventive or therapeutic use of high-dose vitamins to treat disease.

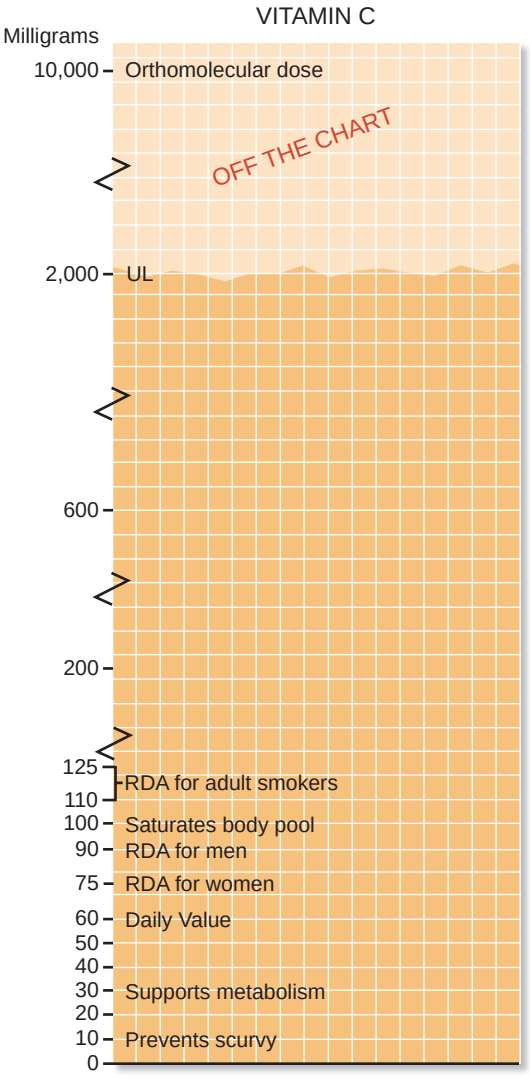


Figure SF.3 **Vitamin C megadoses.** Megadoses of vitamin C are much higher intakes than currently recommended.

importance of optimum nutrition. In fact, some nutritionists share Pauling's concerns that the typical diet is too refined to provide adequate nutrients and that intake equal to RDA values may not be high enough to achieve optimal body levels.

Most nutritionists would argue, however, with the high doses Pauling recommended to attain those optimal body levels and with the therapeutic value he and his followers attributed to those doses. Most notably, Pauling suggested in the early 1970s that an optimal daily intake of vitamin C was 2,000 milligrams—more than 30 times the current Daily Value. (See **Figure SF.3**.) Some advocates of vitamin C recommend even higher doses, relying on intravenous administration to avoid causing diarrhea. Dr. Pauling claimed megadoses of vitamin C prevented or cured the common cold. Although many researchers have attempted to confirm this theory, studies do not support the idea that vitamin C prevents colds. A few studies found that colds were slightly less severe or less frequent in those who took high doses of vitamin C, but most studies found no beneficial effect.[9]

Drawbacks of Megadoses

Megadose vitamins and minerals remain popular, but when taken without recommendation or prescription from a qualified health professional they can cause problems. Because high doses of a nutrient can act as a drug, with a drug's risk of adverse side effects, people who choose to take megadoses should always check first with their doctors.

Excesses of some nutrients can create deficits of other nutrients. High doses of supplemental minerals, especially calcium, iron, zinc, and copper, can interfere with absorption of the others.[10] If you use high doses of the fat-soluble vitamin A, it is easy to reach toxic levels. Even megadoses of water-soluble vitamins can be problematic; for example, nerve damage can result from vitamin B_6 at 50 to 100 times the DV. **Figure SF.4** lists some more examples of medical side effects that can occur from megadose supplementation. It is good practice to review the DRI tables for tolerable upper intake levels (UL) before taking any vitamin and mineral supplement.

Key Concepts High doses (megadoses) of vitamins or minerals turn nutrients into drugs—chemicals with pharmacological activity. Although there may be medical reasons for prescribing high-dose supplements, they should be taken under a physician's supervision. Many claims for high-dose supplements are not supported by clinical studies.

Supplement	Side Effects and Complications
Iron	Constipation
Vitamin C	Diarrhea
Folic acid	Breakthrough seizures for those on anti-seizure medication
Vitamin K	Disrupts balance of blood-clotting medication
Vitamin E	Bleeding problems during surgery
Antioxidant supplements	Counteract some chemotherapy and radiation treatments

Figure SF.4 **Dietary supplement megadoses.** Megadoses of vitamins and minerals can cause medical side effects and complications.

Dietary Supplements: Natural Health Products

Supplementation with herbal and other "natural" products is a popular form of complementary medicine. (See **Figure SF.5**) The 1990s saw a dramatic rise in the popularity of dietary supplements—a trend that continues into the 2000s. Currently in the United States, more than 150 million people use dietary supplements, accounting for $32 billion in annual sales.[11] Health Canada estimates that 71 percent of Canadians have consumed natural health products: herbs, vitamins and minerals, and homeopathic products.[12] **Herbal therapy (phytotherapy)** is nothing new, however. Most cultures have long traditions of using plants (and some animal products) to treat illness or sustain health. For centuries there were no other medicines. Even now, most of the world's people depend primarily on plants for medications; in some remote areas, modern medicines are just not obtainable.

Figure SF.5 Use of herbal supplements has grown significantly in recent years.

Traditional herbalists know their patients and individualize their herbal remedies accordingly. Those who turn to the mass market for herbal supplements rarely receive such attention and are likely to be confused by nutrition and health-related claims that surround foods and supplements.

In the Western world, the feeling that "natural" is better than "chemical" or "synthetic" has launched the market for "natural" foods to a $12.9 billion industry, with "all natural" becoming the second most common claim to be found on new food labels in 2008.[13] Consumers interpret claims such as "100% natural" to mean the product is more wholesome, nutritious, and healthy.

herbal therapy (phytotherapy) The therapeutic use of herbs and other plants to promote health and treat disease. Also called *phytotherapy*.

Quick Bite

Culinary Herbs Are Not Medicinal Herbs—Or Are They?

Herbs used in cooking are called *culinary herbs* to distinguish them from medicinal herbs. But culinary herbs are also rich in phytochemicals. Some examples are beta-carotene in paprika, the antioxidants in rosemary, the mild antibiotic allicin in garlic, and the mild antiviral curcumin in turmeric.

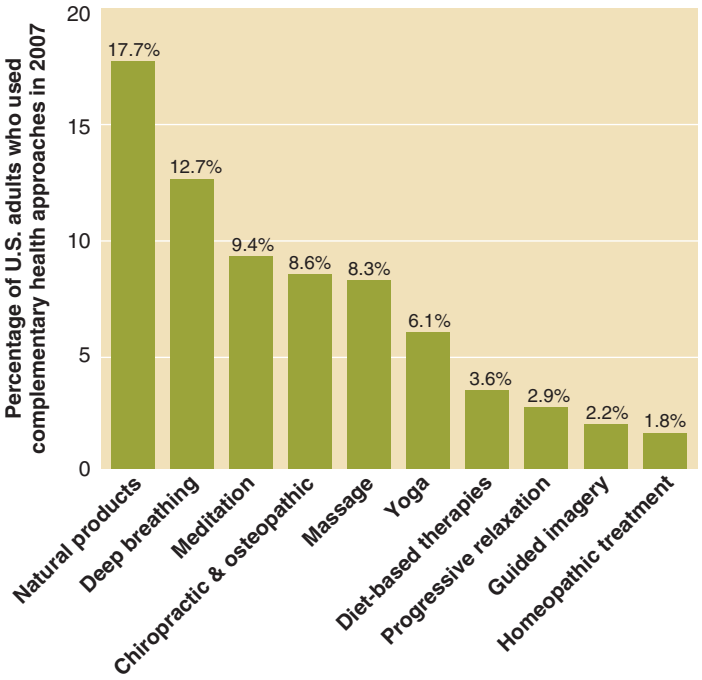
Helpful Herbs, Harmful Herbs

Until recently, most research on herbs was published in obscure or foreign-language journals that were hard to locate or read. Traditional herbal medical practices are difficult to study in a controlled manner because they use plants to make teas or soups, a far cry from the purified extracts and herbal blends sold in a supermarket. Nevertheless, for some herbs, researchers have enough data to plan carefully controlled studies.

In 1998, Congress established the **National Center for Complementary and Alternative Medicine (NCCAM)** at the **National Institutes of Health (NIH)** to stimulate, develop, and support research on complementary and alternative medicine (CAM) for the benefit of the public. The NCCAM is an advocate for quality science, rigorous and relevant research, and encouraging objective inquiry into which CAM practices work, which do not, and why. The mission of the NCCAM "is to define, through rigorous scientific investigation, the usefulness and safety of complementary health approaches and their roles in improving health care."[14] (For more information about how to define CAM, see the FYI feature "Where Does Nutrition Fit?") According to the NCCAM, natural products are the most common type used in a complementary approach, as shown in **Figure SF.6**. Over 17 percent of American adults have used a nonvitamin/nonmineral natural product in the past year; fish oil/omega-3s were the most commonly used natural product.[14] Some natural products have been studied in large, scientific trials, and although there are indications that some may be helpful, many have failed to show anticipated effects (Table SF.1). The suggested benefits of other herbs are based not on scientific study but on years of informal observation: Mint helps indigestion; ginger helps nausea and motion sickness; lemon perks appetite; chamomile helps insomnia. More research is still needed about the effects of

National Institutes of Health (NIH) A Department of Health and Human Services agency composed of 27 separate institutes and centers with a mission to advance knowledge and improve human health.

National Center for Complementary and Alternative Medicine (NCCAM) An NIH organization established to stimulate, develop, and support objective scientific research on complementary and alternative medicine for the benefit of the public.



Reproduced from National Institutes of Health, National Center for Complementary and Alternative Medicine (NCCAM). Complementary, alternative, or integrative health: What's in a name? http://nccam.nih.gov/health/whatiscam#vision. Accessed April 9, 2014.

Figure SF.6 **Ten most common complementary health approaches among adults.**

these products in the human body and about their safety and potential interactions with medicines and with other natural products.

If you're considering using an herb, remember this important rule of thumb: Any herb that is strong enough to help you can be strong enough to hurt you. Like any medicine, herbs can have side effects, and herbs can be contraindicated. Herbs can interfere with standard medicines. They can affect the way the body processes both over-the-counter and prescription medications, causing the medications to not work the way they should, and therefore can make people with underlying health problems quite sick.[15] Herbal products and supplements may not be safe if you have certain health problems or take certain medications.

Some herbs and herbalist treatments are downright dangerous. (See **Table SF.3**.) Some hazardous therapies even use lead or arsenic, known poisons. St. John's wort, ginseng, ginkgo biloba, garlic, grapefruit juice, hawthorn, saw palmetto, danshen, echinacea, yohimbe, licorice, and black cohosh are examples of common herbal remedies known to be potentially dangerous for people taking medications for cardiovascular disease.[16] Other herbs, such as ephedra (ma huang), chaparral, and comfrey, have also been shown to be dangerous.

Quality control is a big issue in herbal medicines. In 2007, the FDA issued final regulations requiring current good manufacturing practices (cGMPs) for the manufacturing, packaging, labeling, and storage of dietary

Quick Bite

Office of Dietary Supplements

The Office of Dietary Supplements (ODS) is a Congressionally mandated office in the National Institutes of Health (NIH). The mission of the ODS is to strengthen knowledge and understanding of dietary supplements by evaluating scientific information, stimulating and supporting research, disseminating research results, and educating the public to foster an enhanced quality of life and health for the U.S. population.

Table SF.3 **Potential Adverse Effects of Selected Herbs**

Herb	Adverse Effects
Chamomile (tea)	Allergic reaction
Echinacea	Allergic reaction; gastrointestinal side effects
Ephedra	Stroke, heart attack, sudden death, seizures
Ginkgo biloba	Headache, nausea, gastrointestinal upset, diarrhea, dizziness, allergic skin reactions, increased bleeding risk
Ginseng	Headaches, insomnia, diarrhea, itching, nervousness
Kava	Liver damage including hepatitis and liver failure, abnormal muscle spasm or involuntary muscle movements
Licorice	Headaches; fluid retention; increased blood pressure; electrolyte imbalance; weakness, paralysis, and occasionally brain damage; absence of a menstrual period in women, decreased sexual interest and function in men
Senna	Laxative dependency, diarrhea, cramps, electrolyte disturbances
St. John's wort	Adverse interactions with many medications, increased sensitivity to light, gastrointestinal symptoms, headaches, dizziness, anxiety, dry mouth, fatigue, sexual dysfunction
Valerian	Drowsiness; withdrawal symptoms if abruptly discontinued

Source: Medline Plus. Herbs and supplements. http://www.nlm.nih.gov/medlineplus/druginfo/herb_All.html. Accessed April 9, 2014.

supplements. Under the regulations, manufacturers are required to evaluate the identity, purity, strength, and composition of their products and ensure proper labeling.[17]

Other Dietary Supplements

The supplement market used to include only vitamins, minerals, and a handful of other products, such as brewer's yeast and sea salt. Today there are hundreds more products, with new ones continuously popping up. Although some are useful, many are of dubious benefit.

Supplement categories, for example, now include protein powders, amino acids, carotenoids, **bioflavonoids**, digestive aids, fatty acid formulas and special fats, lecithin and phospholipids, probiotics, products from sharks and other sea animals, algae, metabolites such as coenzyme Q_{10} and **nucleic acids**, glandular extracts, garlic products, and fibers such as guar gum. Supplement producers also blend these products with herbs and nutrients, resulting in the countless array of individual and combination supplements sold today. In many cases, labeling and advertising claims extend beyond current knowledge about these products.

bioflavonoids Naturally occurring plant chemicals, especially from citrus fruits, that reduce the permeability and fragility of capillaries.

nucleic acids A family of more than 25,000 molecules found in chromosomes, nucleoli, mitochondria, and the cytoplasm of cells.

Key Concepts Herbal products are among the many dietary supplements available today. Herbal medicine has a long history in many cultures. Although there is anecdotal support for the use of many herbal products, there is little scientific evidence to back it up. The FDA has set standards for production and sale of herbal supplements. It is important to remember that any herb that is strong enough to help you can also be strong enough to hurt you. Before taking any supplements, it's a good idea to consult your healthcare practitioner.

Dietary Supplements in the Marketplace

Although some dietary supplements have drug-like actions (e.g., reducing cholesterol levels), government agencies regulate supplements differently from drugs. Manufacturers are allowed to make a wide variety of claims for product effects without having to provide scientific evidence to support those claims. The freedoms of speech and press prevail; in practical terms, almost anything goes. Promotional books, magazine articles, CDs and DVDs, lectures, staged interviews, and web pages—all are protected by the First Amendment, and their authors have the freedom to inform or to deceive. It's up to the listener or reader to distinguish fact from fiction. (See **Figure SF.7**.)

The FTC and Supplement Advertising

The Federal Trade Commission (FTC) in the U.S. Department of Commerce is responsible for ensuring that advertisements and commercials are truthful and do not mislead. The agency depends on and encourages self-monitoring by the supplement industry. In pursuing companies that skirt the regulations, the FTC gives priority to cases that put people's health and safety at serious risk or that affect sick and vulnerable consumers.

The FDA and Supplement Regulation

The Food and Drug Administration has primary responsibility for regulating labeling and content of dietary supplements under the Federal Food, Drug, and Cosmetic Act, as amended by the 1994 **Dietary Supplement Health and Education Act (DSHEA)**.[18] How do you know a product is a "dietary supplement"? Simple. The law defines *dietary supplements*, in part, as products that are taken by mouth that contain a "dietary ingredient."[19] Dietary supplements include vitamins, minerals, herbs or botanicals, and amino acids as well as other substances such as enzymes, organ tissues, metabolites, extracts, or concentrates, used to supplement the diet.

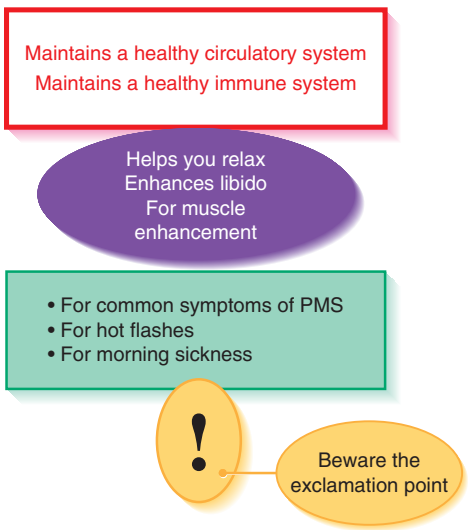


Figure SF.7 **Dietary supplement label claims.** Although claims such as these appear on dietary supplement labels, they do not have to be approved by the FDA. All should be viewed with skepticism.

Dietary Supplement Health and Education Act (DSHEA) Legislation that regulates dietary supplements.

Quick Bite

Pronouncing the Acronym

The Dietary Supplement Health and Education Act of 1994 is better known by its acronym DSHEA, pronounced "da-shay."

Dietary supplements are *not* drugs. A drug is intended to diagnose, cure, mitigate, treat, or prevent disease. Before marketing, drugs must undergo extensive studies of effectiveness, safety, interactions with other substances, and dosing. The FDA gives formal premarket approval to a drug and monitors its safety after the drug is on the market. If a drug is subsequently shown to be dangerous, the FDA can act quickly to have it removed from the market. None of this is true for dietary supplements. The current law only gives the FDA limited authority over supplements, making it difficult for the government to remove unsafe supplements from the marketplace. The FDA does not evaluate the safety and effectiveness of supplements before they hit the marketplace. There are some in Congress who want to improve the law by requiring supplement makers to put safer products on the shelves and label products more clearly.[20] The objective is to ensure that consumers can tell the difference between dietary supplements that are safe and those that have potentially serious side effects or drug interactions.

Supplement Labels

Supplement Facts panel Content label that must appear on all dietary supplements.

Like food labels, supplement labels have mandatory and optional information. All labels on dietary supplements must include ingredient information and a **Supplement Facts panel**.[21] You'll notice in **Figure SF.8** that the format is similar to the Nutrition Facts panel on food labels. Supplements that contain *proprietary blends*—products or techniques exclusive to the manufacturer—are not required to list specific amounts of each ingredient.[22]

Supplement labels, like food labels, may contain health claims, structure/function claims, and nutrient content claims. (See **Figure SF.9**.) Qualified health claims may also apply to dietary supplements.

Manufacturers can use structure/function claims without FDA authorization and can base their claims on their own review and interpretation of the scientific literature. Structure/function claims are easy to spot because they are accompanied by the disclaimer "This statement has not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease."[23] A dietary supplement with a label claiming to cure or treat a specific condition is considered an unapproved drug.[24]

Canadian Regulations

Beginning January 1, 2004, all natural health products sold in Canada have been subject to Health Canada's Natural Health Products Regulations.[25] By definition, natural health products include vitamins, minerals, herbal remedies, and homeopathic medicines. Health Canada has developed a product approval system whereby each product must meet the requirements of the Natural Health Products Regulations to acquire a license and be legally sold in Canada. Authorization requires evidence of safety and efficacy. The regulations also include provisions for on-site licensing, good manufacturing practices, labeling and packaging requirements, and adverse reaction reporting. The Canadian regulations go further than DSHEA in terms of assuring the safety and efficacy of supplements.

Key Concepts Dietary supplements are neither foods nor drugs, and the government regulates their manufacture and sale differently than it does for foods, additives, and drugs. The FTC and FDA monitor advertising and labeling of dietary supplements. A Supplement Facts panel is now required on labels. Canada's regulations for natural health products require premarket approval and product licensing.

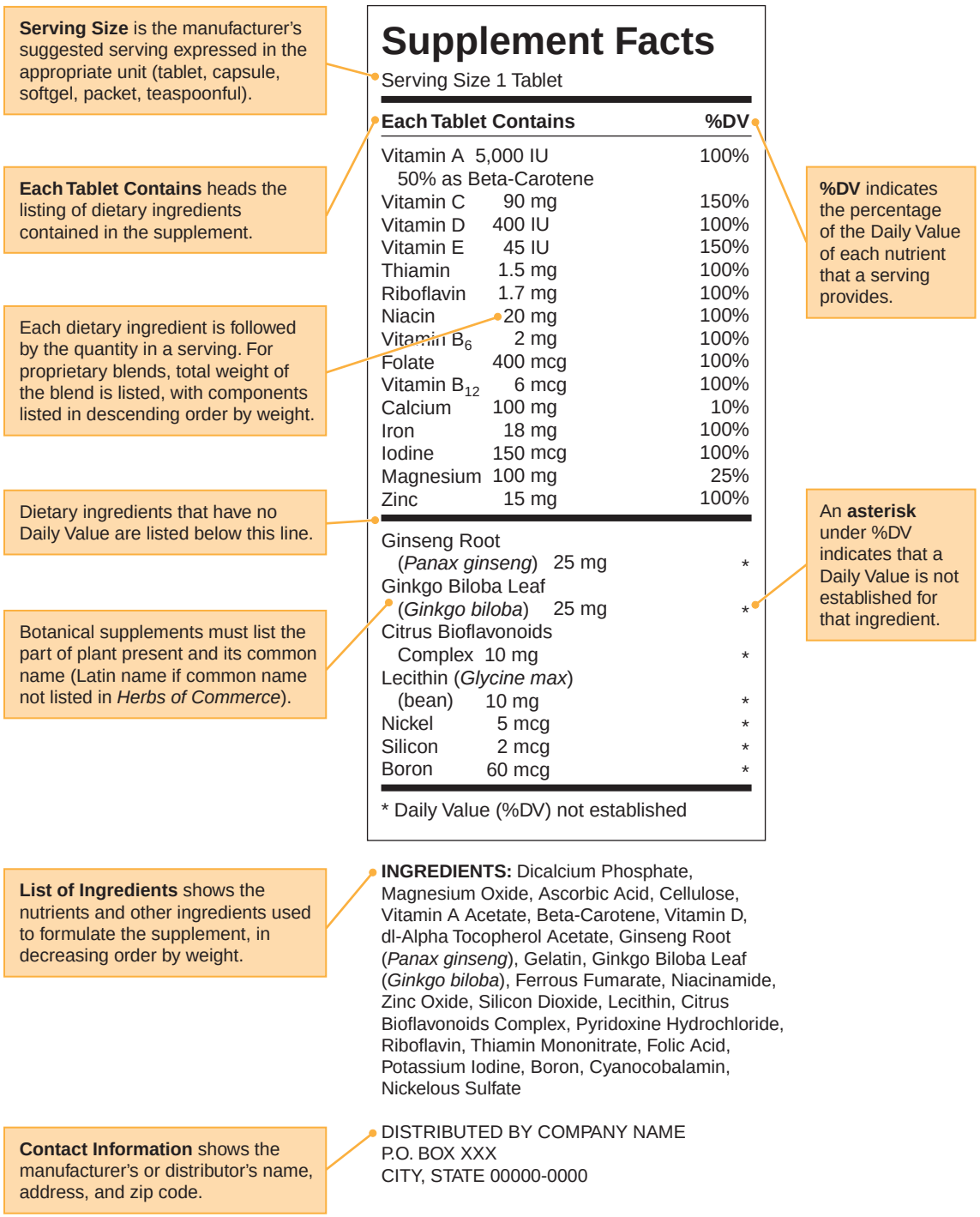
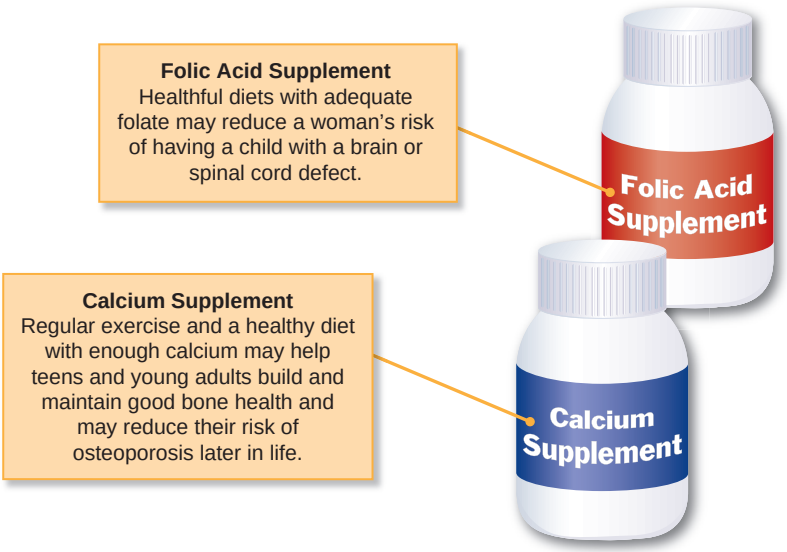


Figure SF.8 **Supplement Facts panel.** Similar to the Nutrition Facts panel on food labels, the Supplement Facts panel required on dietary supplement labels shows the product composition.



Data from U.S. Food and Drug Administration.

Figure SF.9 **Health claims for supplements.** Calcium and folic acid supplements may carry health claims similar to these model statements.

bioavailability A measure of the extent to which a nutrient becomes available to the body after ingestion and thus is available to the tissues.

U.S. Pharmacopeia (USP) Established in 1820, the USP is a nonprofit healthcare organization that sets quality standards for a range of healthcare products.

Choosing Dietary Supplements

Knowledge of nutrition science is your most valuable tool for evaluating a supplement. Read each label and judge each implied claim in light of what you know. For tips on choosing supplements, see the FYI feature "Shopping for Supplements." Ask the following questions:

- *Is the quantity enough to have an effect or is it trivial?* What will happen if you take more than you need?
- *Is the product new to you?* Learn about it from the many reliable resources available. Evaluate the product in light of scientific research.
- *Can the supplement cross the intestine and travel to its presumed site of action in the body?* There are little data on the absorption and **bioavailability** of herbal preparations and other types of non-nutrient supplements.
- *Can this supplement interact with any prescription or over-the-counter medications?* Some combinations of supplements or using some supplements together with either prescription or OTC medications could produce potentially harmful adverse effects.
- *Does the product promise too much?* A product touted to control high blood cholesterol, hangnails, psoriasis, and insomnia is unlikely to do much of anything.
- *Who is selling the product?* Alternative practitioners, dietitians, and even physicians sometimes sell the supplements they recommend—which is a possible conflict of interest that could compromise their objectivity. The Academy of Nutrition and Dietetics has issued guidelines for practitioners' recommendations and sales of supplements.[26]

Even the best-intentioned, most carefully considered supplement can prove ineffective or even risky. A good indicator of quality is the voluntary **U.S. Pharmacopeia (USP)** verification mark (see **Figure SF.10**), which verifies that the product meets the U.S. Pharmacopeia's standards for product purity, accuracy of ingredient labeling, and proper manufacturing practices.[27]

Reprinted with permission from The United States Pharmacopeial Convention, 12601 Twinbrook Parkway, Rockville, Maryland 20852.

Figure SF.10 **U.S. Pharmacopeia verification mark.** Dietary supplements can earn the USP-Verified mark through a comprehensive testing and evaluation process.

Shopping for Supplements

Thinking about buying a dietary supplement? Before you do, ask yourself, "Why do I need this supplement?" and "Is it suitable for me?" Think about your typical diet and what it may be lacking. Remember, the word *supplement* means just that—a product meant to supplement your food. A well-chosen supplement can be beneficial under some circumstances, especially if your diet is limited. However, if you're healthy and eat a good balance of healthful foods, supplements probably won't help you much.

It's a good idea to let your doctor know your supplement plans. Some supplements are contraindicated during pregnancy or lactation; others should not be used with certain chronic illnesses. Supplements sometimes interfere with the action of medicines. Some slow blood clotting, which is a concern if surgery is planned.

To a great extent, you will need to rely on your own understanding of diet and nutrition to make your selection. And, you must rely on the supplement manufacturer for the product's safety, its purity and cleanliness, and the label's accuracy. If you are concerned about potential side effects or contraindications, you will probably need to contact the manufacturer or distributor.

Choose Quality

In 2010, the FDA finalized guidelines for current good manufacturing practices by supplement manufacturers.[1] Additionally, you should also use tip-offs to judge a quality company—the kind you would expect to have good quality control procedures and to manufacture, store, and transport products safely and carefully.

A quality company will not promise miracles on its website, in catalogues, in commercials or advertisements, or in in-store promotions. A quality company will not manipulate statistics or distort research findings in an attempt to mislead you. And a quality company will take care with its labels, print materials, and Web information.

Confirm Supplement Ingredients

Use resources that analyze and confirm supplement content, dose, and purity. ConsumerLab.com is one such service. Pharmaceutical researchers also report findings on supplement label accuracy; a search on PubMed can lead you to this information.

Look for the U.S. Pharmacopeia (USP) logo (USP verification mark) on supplement labels. The mark certifies that the USP has found the ingredients consistent with those stated on the label; that the supplement has been manufactured in a safe, sanitary, controlled facility; and that the product dissolves or disintegrates to release nutrients in the body. However, the USP does not test the supplement's efficacy.

Choose Freshness

Finding the freshest supplement is often easier if you shop in a retail store. Choose a store where turnover is likely to be quick, and check expiration dates. Supplements should be displayed away from direct sunlight, bright lights, or nearby heat sources, because heat ages many supplements.

Expect Accountability

How easily can you obtain information about the product? Look for a phone number on the label so you can call with questions or to report side effects. On websites, look for a domestic address and phone number, in addition to an email contact. Does a knowledgeable company representative respond to your questions, or is the only person available one who reads a scripted response?

If you're shopping online but are uncertain whether the supplement is right for you, check the Web retailer's return policy. A Web retailer that also has a brick-and-mortar outlet near your locale may be preferable.

1 Food and Drug Administration. Guidance for industry: Current good manufacturing practice in manufacturing, packaging, labeling, or holding operations for dietary supplements; small entity compliance guide. December 2010. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/DietarySupplements/ucm238182.htm. Accessed April 11, 2014.

Be a Safe and Informed Consumer

When buying supplements, follow this advice from the Food and Drug Administration:

- Let your healthcare professional advise you on sorting reliable information from questionable information.
- Contact the manufacturer for information about the product you intend to use.
- Be aware that some supplement ingredients, including nutrients and plant components, can be toxic. Also, some ingredients and products can be harmful when consumed in high amounts, when taken for a long time, or when used in combination with certain other drugs, substances, or foods.
- Do not self-diagnose any health condition. Work with healthcare professionals to determine how best to achieve optimal health.
- Do not substitute a dietary supplement for a prescription medicine or therapy, or for the variety of foods important to a healthful diet.
- Do not assume that the term *natural* in relation to a product ensures that the product is wholesome or safe.
- Be wary of hype and headlines. Sound health advice is generally based on research over time, not a single study.
- Learn to spot false claims. If something sounds too good to be true, it probably is.

Source: Food and Drug Administration. FDA 101: Dietary supplements. http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm050803.htm. Accessed April 11, 2014.

The USP verification mark helps assure consumers, healthcare professionals, and supplement retailers that a product has passed USP's rigorous program and does the following:

- Contains the ingredients declared on the product label
- Contains the amount or strength of ingredients declared on the product label
- Meets requirements for limits on potential contaminants
- Has been manufactured properly by complying with USP and FDA standards for current good manufacturing practices (cGMPs)

Fraudulent Products

Some health advocates consider the burgeoning market of dietary supplements an unwelcome return to the "snake oil" era of the late nineteenth and early twentieth centuries, when "magic" potions and cures were sold door to door and at county fairs and markets. Most manufacturers work hard to ensure the quality of their products, yet some supplements on the market are nothing more than a mixture of ineffective ingredients.

The FDA has found nearly 300 fraudulent products that contain hidden or deceptively labeled ingredients.[28] Most frequently recalled products with potentially harmful ingredients are those that are promoted for weight loss, sexual enhancement, and bodybuilding. When considering the use of dietary supplements, do your homework—make sure the product is safe and effective. It's always a good idea to ask your healthcare professional for help in distinguishing between reliable and questionable information.

Key Concepts When considering a dietary supplement, it is important to consider the product and its claims carefully. Be aware that some products may promise more than they can deliver. A good indicator of quality is the USP verification mark, but this does not guarantee that a product will fulfill its claims.

Functional Foods

What do garlic, tomato sauce, tofu, and oatmeal all have in common? They aren't in the same food group, nor do they have the same nutrient composition. Instead, all of these foods could be considered "functional foods." Although there is not yet a legal definition for the term, a **functional food** is widely considered to be a food or food component that provides a health benefit beyond basic nutrition.[29] Garlic contains sulfur compounds that may reduce heart disease risk, and tomato sauce is rich in **lycopene**, a compound that may reduce prostate cancer risk. The soy protein in tofu and the fiber in oatmeal can help reduce the risk of heart disease. (See **Figure SF.11**.) The functional food industry has grown rapidly since its birth in Japan in the late 1980s. In the United States, the functional food market is projected to grow approximately 5 percent yearly, with annual sales expected to reach over $150 billion by 2015.[30,31]

Phytochemicals Make Foods Functional

Many functional foods get their health-promoting properties from naturally occurring compounds that are not considered nutrients but are called **phytochemicals**. Although the word *phytochemical* may sound intimidating, its meaning is simple: "plant chemical." A vitamin is a food substance essential for life. Phytochemicals, in contrast, are substances in plants that may affect health, even though they are not essential for life. Phytochemicals are complex chemicals that vary from plant to plant. They include pigments, antioxidants, and thousands of other compounds, many of which have been associated with protection from heart disease, vision loss, hypertension, cancer, and

Quick Bite

Jell-O and Your Nails

You may have heard that taking gelatin can make your nails stronger. Not true. Fingernails get their strength from sulfur in amino acids. Gelatin has no sulfur-containing amino acids.

functional food A food that may provide a health benefit beyond basic nutrition.

lycopene One of a family of plant chemicals, the carotenoids. Others in this big family include alpha-carotene and beta-carotene.

phytochemicals Substances in plants that may possess health-protective effects, even though they are not essential for life.

Figure SF.11 **Soy is rich in phytochemicals.** Soybeans contain phytochemicals called isoflavones. High intake of soy products such as tofu is linked to a lower incidence of heart disease and cancer.

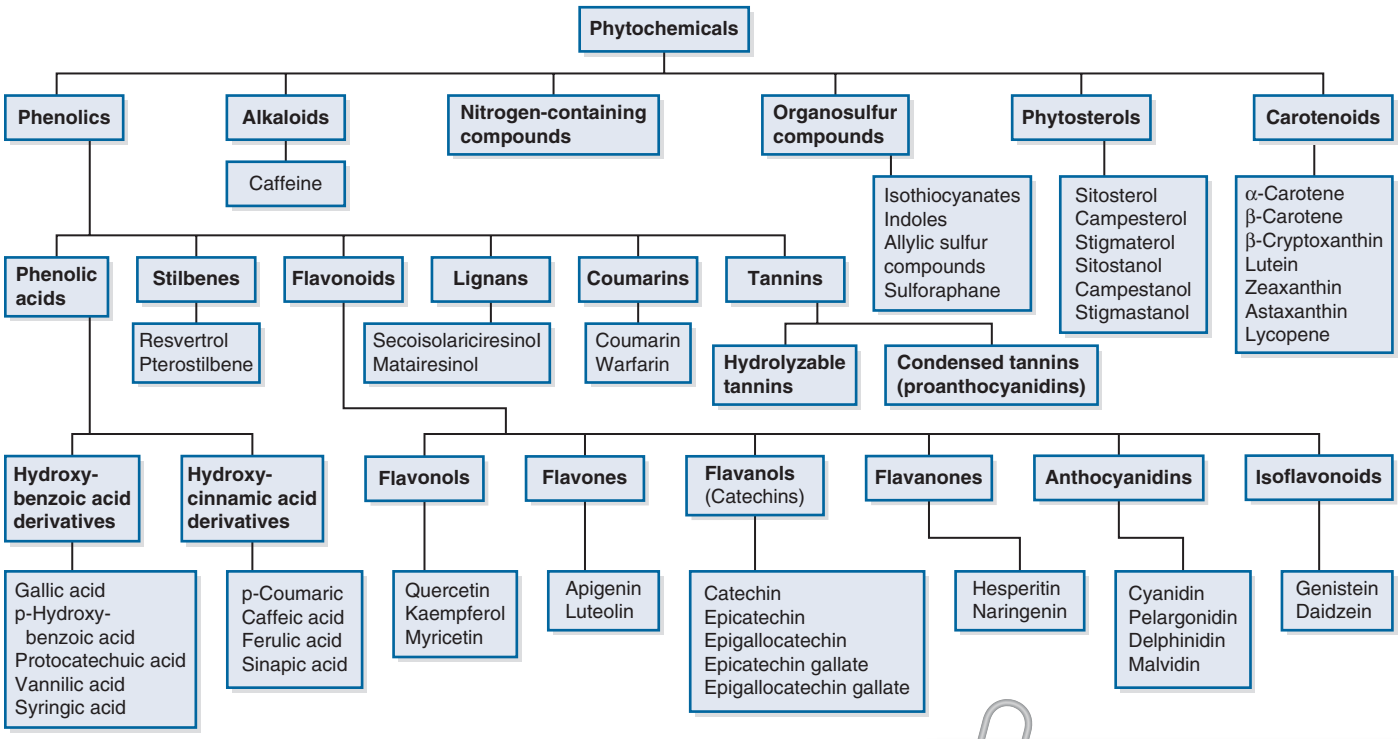


Figure SF.12

diabetes. The flow chart in **Figure SF.12** shows the classifications of the most well-known dietary phytochemicals that affect human health. **Table SF.4** lists many examples of phytochemicals and their potential benefits.

Plants contain phytochemicals in abundance because these substances are of benefit to the plant itself. For example, an orange has at least 170 distinct phytochemicals. Individually and together, these compounds help plants resist the attacks of bacteria and fungi, the ravages of free radicals, and high levels of ultraviolet light from the sun. When we eat these plants, the phytochemicals end up in our tissues and provide many of the same protections that benefit plants.

Phytochemicals are part of the reason why the *Dietary Guidelines for Americans* recommends that we increase our consumption of fruits and vegetables each day and eat a variety of vegetables, especially dark-green, red, and orange vegetables and beans and peas.[32] The emphasis also can literally be seen in the MyPlate food plan, which encourages you to make half your plate fruits and vegetables.[33] Fruits and vegetables are naturally low in fat and calories and tend to be rich in fiber, potassium, and vitamins. In addition, studies show that groups of people who consume more fruits and vegetables tend to have lower rates of common chronic diseases.

Benefits of Phytochemicals

What are some of the specific benefits of phytochemicals? People who eat tomatoes and processed tomato products take in lycopene, which is associated with a decreased risk of chronic diseases, such as cancer and cardiovascular diseases.[34] Scientists believe that the large consumption of soy products in Asian countries contributes to lower rates of colon, prostate, uterus, and breast cancers.[35] Depending on the source of the isoflavones, the kind of cancer, and the study population, the outcomes of these studies are occasionally conflicting.[36] The foods and herbs with the highest anticancer activity include garlic, soybeans, cabbage, ginger, and licorice as well as the family of vegetables that includes celery, carrots, and parsley.

Position Statements: Academy of Nutrition and Dietetics

Functional Foods

It is the position of the Academy of Nutrition and Dietetics to recognize that although all foods provide some level of physiological function, the term *functional foods* is defined as whole foods along with fortified, enriched, or enhanced foods that have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels based on significant standards of evidence. The Academy supports Food and Drug Administration–approved health claims on food labels when based on rigorous scientific substantiation.

Source: Position of the Academy of Nutrition and Dietetics: Functional foods. *J Acad Nutr Diet*. 2013;113:1096–1103.

Quick Bite

Functional Food Decisions

Are you a health-conscious consumer who seeks out functional foods? A 2009 survey found that 53 percent of consumers surveyed "strongly" agreed that functional foods offer health benefits. The top functional foods named by consumers included fruits and vegetables, fish and seafood, dairy, meat and poultry, herbs/spices, fiber, tea/green tea, nuts, whole grains, water, cereal, and oat products. The top three food components people look for when choosing foods and beverages for themselves and their children are fiber, whole grains, and protein.

Table SF.4 Examples of Functional Components

Class/Components and Sources[a]	Potential Benefit	Tips for Including Healthful Components in the Diet
Carotenoids		
Beta-carotene Sources: Carrots, pumpkin, sweet potato, cantaloupe	Neutralizes free radicals that may damage cells; bolsters cellular antioxidant defenses; can be made into vitamin A in the body	For beta-carotene–rich french fries, try sweet potatoes coated lightly with olive oil or fat-free cooking spray, and add spices to taste (e.g., pepper, rosemary, thyme).
Lutein, zeaxanthin Sources: Kale, collards, spinach, corn, eggs, citrus	May contribute to maintenance of healthy vision	For a simple way to enjoy kale, purchase a prewashed and destemmed ready-to-eat bag. Toss lightly with olive or peanut oil and salt, and then roast for 10–12 minutes at 425 degrees.
Lycopene Sources: Tomatoes and processed tomato products, watermelon, red/pink grapefruit	May contribute to maintenance of prostate health	Try adding 1 cup tomato sauce to sautéed zucchini for a colorful side dish.
Dietary (Functional and Total) Fiber		
Insoluble fiber Sources: Wheat bran, corn bran, fruit skins	May contribute to maintenance of a healthy digestive tract; may reduce the risk of some types of cancer	Try adding a little dry wheat bran when making smoothies or muffins to bulk up the fiber content; this may help keep you full longer.
Beta-glucan[b] Sources: Oat bran, oatmeal, oat flour, barley, rye	May reduce risk of coronary heart disease (CHD)	Instant oatmeal packets are easily stored in your backpack or desk drawer to have on hand when you missed breakfast or need a hearty afternoon snack.
Soluble fiber[b] Sources: Psyllium seed husk, peas, beans, apples, citrus fruit	May reduce risk of CHD and some types of cancer	Try adding canned beans (black, pinto, or garbanzo) to a quesadilla or an omelet, or enjoy them cold in a mixed green salad.
Whole grains[b] Sources: Cereal grains, whole wheat bread, oatmeal, brown rice	May reduce risk of CHD and some types of cancer; may contribute to maintenance of healthy blood glucose levels	Did you know that air-popped popcorn is a great low-fat source of whole grains? Try spicing up your popcorn with garlic powder and cinnamon or rosemary and parmesan cheese.
Fatty Acids		
Monounsaturated fatty acids (MUFAs)[b] Sources: Tree nuts, olive oil, canola oil	May reduce risk of CHD	For a quick and healthy on-the-go snack with heart-healthy fats make snack bags of mixed nuts (e.g., almonds, pecans). Throw in some dried fruit for an antioxidant boost.
Polyunsaturated fatty acids (PUFAs): omega-3 fatty acids, ALA Sources: Walnuts, flax	May contribute to maintenance of heart health; may contribute to maintenance of mental and visual function	When cooking, try substituting a tablespoon of flaxseed oil in a recipe that calls for canola or olive oil, once or twice a week. Add ground flax to baked products, smoothies, yogurt, and hot cereal.
PUFAs: omega-3 fatty acids, DHA/EPA[b] Sources: Salmon, tuna, and other fish oils	May reduce risk of CHD; may contribute to maintenance of mental and visual function	Salmon or tuna that is canned in water or in a shelf-stable pouch can make easy and affordable meals.
Conjugated linoleic acid (CLA) Sources: Beef and lamb; some cheese	May contribute to maintenance of desirable body composition and healthy immune function	Try something fun and healthy at your next cookout by preparing kebabs for the grill by alternating beef and vegetables.
Flavonoids		
Anthocyanins: cyanidin, delphinidin, malvidin Sources: Berries, cherries, red grapes	Bolsters cellular antioxidant defenses; may contribute to maintenance of brain function	For a cold treat, try frozen berries. They are also tasty additions to any yogurt and can help to cool and flavor your oatmeal in the morning.

Class/Components and Sources[a]	Potential Benefit	Tips for Including Healthful Components in the Diet
Flavanols: catechins, epicatechins, epigallocatechin, procyanidins Sources: Tea, cocoa, chocolate, apples, grapes	May contribute to maintenance of heart health	Go ahead and indulge in an occasional piece of chocolate.
Flavanones: hesperetin, naringenin Sources: Citrus fruits	Neutralize free radicals, which may damage cells; bolster cellular antioxidant defenses	Squeeze half an orange and half a lemon into a small dish; add olive or flax oil and dashes of salt, pepper, and basil for a perfectly refreshing salad dressing.
Flavonols: quercetin, kaempferol, isorhamnetin, myricetin Sources: Onions, apples, tea, broccoli	Neutralize free radicals, which may damage cells; bolster cellular antioxidant defenses	Caramelized onions make a sweet and tasty garnish to many main dishes. Sautee onions over low heat in oil until a deep gold color; add on top of prepared steak, chicken, fish or whole grain.
Proanthocyanidins Sources: Cranberries, cocoa, apples, strawberries, grapes, wine, peanuts, cinnamon	May contribute to maintenance of urinary tract health and heart health	Grab an apple or bunch of grapes for a snack—what could be easier than that?
Isothiocyanates		
Sulforaphane Sources: Cauliflower, broccoli, broccoli sprouts, cabbage, kale, horseradish	May enhance detoxification of undesirable compounds; bolsters cellular antioxidant defenses	Keep frozen broccoli and cauliflower on hand for an easy dinner side dish.
Phenolic Acids		
Caffeic acid, ferulic acid Sources: Apples, pears, citrus fruits, some vegetables, coffee	May bolster cellular antioxidant defenses; may contribute to maintenance of healthy vision and heart health	Love your morning coffee? Good news—coffee is a powerful source of antioxidants.
Plant Stanols/Sterols		
Free stanols/sterols[b] Sources: Corn, soy, wheat, fortified foods and beverages	May reduce risk of CHD	Get your free stanols/sterols from fortified foods such as bread containing whole-wheat flour, low-fat yogurt, and some cereals.
Stanol/sterol esters[b] Sources: Stanol ester dietary supplements, fortified foods and beverages, including table spreads	May reduce risk of CHD	Many table spreads (butter or margarine alternatives) are now fortified with stanol and/or sterol esters. Check labels for other commercial products now commonly fortified with stanols and sterols including orange juices, yogurt beverages, chocolate, and granola bars.
Polyols		
Sugar alcohols[b]: xylitol, sorbitol, mannitol, lactitol Sources: Some chewing gums and diet candies	May reduce risk of dental caries	Reduce your risk for dental caries and curb your appetite by chewing gum containing xylitol after eating.
Prebiotics		
Inulin, fructo-oligosaccharides (FOS), polydextrose Sources: Whole grains, onions, some fruits, garlic, honey, leeks, fortified foods and beverages	May improve gastrointestinal health; may improve calcium absorption	You can get prebiotics by simply adding honey to some of your routine meals. Try honey in your oatmeal or yogurt, or use in place of sugar as a sweetener.
Probiotics		
Yeast, *Lactobacilli*, *Bifidobacteria*, and other specific strains of beneficial bacteria Sources: Certain yogurts and other cultured dairy and nondairy products	May improve gastrointestinal health and systemic immunity; benefits are strain-specific	For an easy way to add probiotics into your diet choose from a variety of flavored yogurts with probiotics.

(*continues*)

Table SF.4 Examples of Functional Components (*continued*)

Class/Components and Sources[a]	Potential Benefit	Tips for Including Healthful Components in the Diet
Phytoestrogens		
Isoflavones: daidzein, genistein Sources: Soybeans and soy-based foods	May contribute to maintenance of bone health, healthy brain, and immune function; for women, may contribute to maintenance of menopausal health	Get your isoflavones by getting soft, silken tofu and adding it to the cheese sauce mixture used to make lasagna.
Lignans Sources: Flax, rye, some vegetables	May contribute to maintenance of heart health and healthy immune function	Add ground flaxseeds to a smoothie or a recipe for baked goods to pack a lignan punch!
Soy Protein		
Soy protein Sources: Soybeans and soy-based foods	May reduce risk of CHD	Soybeans are also called edamame. Look for edamame in the frozen section to easily prepare as a healthy snack or party sampler. Edamame that has been cooked and removed from the pod adds great flavor and extra protein to any salad.
Sulfides/Thiols		
Diallyl disulfide, allyl methyl trisulfide Sources: Garlic, onions, leeks, scallions	May enhance detoxification of undesirable compounds; may contribute to maintenance of heart health and healthy immune function	Scallions, or green onions, are milder than traditional onions and are commonly added at the last minute to salads or cooked sauces as a garnish. Leeks can also be an easy substitute, but are more commonly used in soups.
Dithiolethiones Sources: Cruciferous vegetables	May enhance detoxification of undesirable compounds; may contribute to maintenance of healthy immune function	Varieties of cabbage, bok choy, Brussels sprouts, kale, and wasabi are also sources of dithiolethiones. Bok choy is great in any stir-fry or raw in a salad with Asian dressing.

[a] Examples are not an all-inclusive list.
[b] FDA-approved health claim established for component.
Source: Modified from the International Food Information Council Foundation, Functional Foods, July 2011, http://www.foodinsight.org/Content/3842/Final%20Functional%20Foods%20Backgrounder.pdf.

© Photodisc.

Figure SF.13 **Grapes, red wine, and heart disease.** Grapes and red wine contain phytochemicals that appear to reduce the risk of heart disease. Studies show that moderate consumption of alcohol independently reduces heart disease risk.

How do phytochemicals work to prevent chronic disease? A number of phytochemicals, including those from soybeans and from the cabbage family, are able to modify estrogen metabolism or block the effect of estrogen on cell growth. Such compounds are known as **phytoestrogens**. Other phytochemicals neutralize **free radicals**. Free radicals (active oxidants) are continually produced in our cells and over time can result in damage to DNA and important cell structures. Eventually, this damage can promote both cancer and cell aging. Many different plant chemicals, such as the pigments in grapes and red wine (see **Figure SF.13**), are able to neutralize or reduce concentrations of free radicals, thus protecting us against the development of both cancer and heart disease. Phytochemicals in fruits and vegetables have a number of other potential benefits. Lutein and zeaxanthin are carotenoids (plant pigments) found in dark-green leafy vegetables, corn, and egg yolks. Increased consumption of these compounds is associated with a lower incidence and slower progression of age-related macular degeneration, the leading cause of blindness in older people.[37,38]

Adding Phytochemicals to Your Diet

Before you reach for your next slice of bread, it is worth remembering that refined wheat, the source of white flour, has lost more than 99 percent of its

phytochemical content. Because phytochemicals are so beneficial, why can't we just purify the important ones and add them to our diet as supplements, the way we put vitamins back into white flour after processing? The short answer is that we don't know enough about how phytochemicals function. There are numerous known and still unidentified bioactive compounds in foods, such as phytochemicals, that have potential health benefits; however, the precise role, requirement, interactions, and toxicity levels of many of these substances remain unclear. Furthermore, whole foods might contain additional nutritional substances that have not yet been elucidated and their health benefits might not be maintained when components are isolated and consumed as supplements or fortification ingredients.[39] Thus, appropriate food choices, rather than supplements, should be the foundation for achieving nutritional adequacy.

Many phytochemicals appear to act synergistically, both fighting free radicals and blocking the negative effects of hormones. Yet there is no doubt that consumption of plant foods containing multiple antioxidants is strongly associated with health benefits. The weight of evidence and experience strongly favors finding a place for more fruits and vegetables in the diet. (See **Figure SF.14**.) The new MyPlate graphic and the Fruits & Veggies—More Matters logo both encourage fruit and vegetable consumption. In addition, MyPlate's advice to "Make at least half your grains whole grains" helps promote intake of disease-fighting phytochemicals naturally found in whole grains. Changing your diet to include more functional foods and fewer empty calories needn't be painful. Sometimes you can have your pizza and eat it too. Next time, ask for your pizza loaded with vegetables. Whole-wheat crust would be a plus. The combination of lycopene from tomato sauce, quercetin from onions, and carotenoids and glucarates from colored peppers can turn your pizza into a phytochemical cornucopia.

phytoestrogens Compounds that have weak estrogen activity in the body.

free radicals Short-lived, highly reactive chemicals often derived from oxygen-containing compounds, which can have detrimental effects on cells, especially DNA and cell membranes.

Foods Enhanced with Functional Ingredients

Another type of functional food is one that gets its health-promoting properties from what has been added during processing. Calcium-fortified orange juice, breakfast cereals fortified with folic acid, yogurt with live active cultures, and margarines with added plant sterol and plant stanol esters are examples. Health properties come from added nutrients, bacteria, fiber, or other substances. Some are foods and beverages that contain added herbal compounds, such as those sold in pill form as dietary supplements. The result is a wide variety of products making an often confusing array of label statements and health claims. There are instances where functional foods do not deliver the health benefit they claim; consumers should be skeptical of products that sound too good to be true.

Regulatory Issues for Functional Foods

Food labeling is required for most prepared foods, such as breads, cereals, canned and frozen foods, snacks, desserts, drinks, and so on. Nutrition labeling for raw produce such as fruits and vegetables and fish is voluntary. The FDA refers to these products as *conventional* foods. The terms *functional foods* and *nutraceuticals* are widely used in the marketplace and media. Such foods are regulated by the FDA under the authority of the Federal Food, Drug, and Cosmetic Act, even though they are not specifically defined by law.[40] Although this may sound a little confusing, a *food* is a product that we eat or drink as well as all the components of that product. This definition distinguishes a food from a *drug*, which is a substance intended to diagnose, cure, mitigate, treat, or prevent disease. Foods also are distinct from *dietary supplements*, which are products intended to supplement the diet but that do not represent themselves as a conventional food, meal, or diet.

fruits & veggies more matters®

Courtesy of FruitsandVeggiesMatter.gov.

Figure SF.14 **The National Fruit and Vegetable Program.** This program encourages Americans to increase their consumption of fruits and vegetables for better health. It is a public–private partnership, consisting of government agencies, nonprofit groups, and industry. For more information, visit www.fruitsandveggiesmorematters.gov.

Quick Bite

Early Food Laws

In 1202, King John of England proclaimed the first English food law, the Assize of Bread, which prohibited adulteration of bread with such ingredients as ground peas or beans.

Quick Bite

Old Concept, New Frontier

Functional foods are a new frontier of nutrition and food science, but the idea has been around for centuries. Hippocrates, the father of modern medicine, proclaimed, "Let food be your medicine, and medicine be your food."

Although some manufacturers have tried to market functional products as dietary supplements rather than foods to take advantage of broader allowances for label claims, the FDA's position is that products that are conventional foods and beverages are subject to the regulations for food and not for dietary supplements. A substance added to a food for health benefits must still conform to FDA regulations for food.

Additives in Functional Foods

Using additives to create functional foods raises questions of how much should be used and how much is safe. In addition, although there are guidelines for the use of vitamins and minerals in the fortification of food and for the use of approved food additives, not much is known about what happens to many novel ingredients, such as botanical extracts, when they are put into a food. Tea beverages with enhanced antioxidant content and yogurt with added prebiotic or probiotics, for example, are common examples of additives in functional foods with intended health benefits.

Any food containing an unapproved food additive is considered adulterated and cannot legally be marketed in the United States.

Key Concepts Functional foods provide health benefits beyond basic nutrition. Phytochemicals are "plant chemicals" that include thousands of compounds, pigments, and natural antioxidants, many of which are associated with protection from heart disease, hypertension, cancer, and diabetes. Just like conventional foods, functional foods are subject to FDA regulations for claims and safety.

Health Claims for Functional Foods

As consumer choices continue to expand and the abundance of functional foods and supplements increases, products that make exaggerated health claims will continue to mislead consumers about their benefits. Although many foods and products have legitimate functional benefits, many people put their money and hopes for good health into unneeded functional foods and supplement products that make misleading health claims with little or no scientific evidence of effectiveness.[41] To avoid wasting money on unnecessary products, be an informed consumer (see the FYI feature "Shopping for Supplements"). When a functional food meets the appropriate FDA guidelines, it may make a nutrient content claim or health claim on the label. For example, tofu containing at least 6.25 grams of soy protein per serving may make a health claim about the role of soy protein in reducing the risk of heart disease. Oatmeal with an adequate amount of beta-glucan fiber can highlight its benefit in reducing the risk of heart disease. Another health claim applies to a functional food created through the addition of plant sterol or plant stanol esters to a vegetable-oil–based spread. The Benecol and Take Control product lines (spreads and salad dressings) contain these plant esters, which have been shown to reduce cholesterol levels when consumed daily in adequate amounts.[42] (See **Figure SF.15**.)

Figure SF.15 **Some functional foods can make health claims.** Manufacturers have obtained approval from the FDA to make health claims for these margarine products.

Structure/Function Claims for Functional Foods

Structure/function claims on conventional or functional foods must be based on the food's nutritive value. An example is orange juice with added vitamin C, vitamin E, and zinc to "support your natural defenses." However, structure/function claims are not as stringently regulated by the FDA as health claims. So, at present, many manufacturers are making claims about

non-nutrients in foods and their effects on body structure or function. For example, a cereal with added St. John's wort and kava extract is "accented with herbs to support emotional and mental balance," and a bottled tea is "infused with mind-enhancing ginkgo biloba and Panax ginseng." Consumers should beware; many companies continue to deliberately confuse consumers by exaggerating the health effects or ingredients of their products, despite the FDA sending warning letters to food manufacturers about misleading labeling.[43]

Key Concepts Under FDA guidelines, a functional food's label may have a nutrient content claim, health claim, or structure/function claim. A structure/function claim promotes a substance's effect on the structure or function of the body. For foods, the claimed effect must be based on the food's "nutritive value." Currently, many manufacturers make structure/function claims about non-nutrients in foods.

Strategies for Functional Food Use

So, should you run out and fill your shopping cart with functional foods? Which ones would you buy? The best course of action is to stick with what scientists have agreed upon so far. First, fruits and vegetables promote health and reduce disease risk through a whole host of natural phytochemicals. Use the list of foods and phytochemicals in Table SF.4 to enhance your shopping list with nature's functional foods. Second, consider nutrient-fortified products when a particular nutrient is lacking in your diet and you either don't like or can't eat good food sources of that nutrient. For example, if you are allergic to milk and dairy products, consider calcium-fortified orange juice as a nutritious way to get the calcium you need. Third, *read, read, read* about functional foods, and be skeptical when you evaluate what's on the Internet. **Table SF.5** lists some questions to ask when assessing the credibility of websites. For more tips on how to evaluate health information on the Internet, visit the Office of Dietary Supplements website.[44] Do your homework by looking at scientific articles—your instructor can help you find and interpret studies of functional food components. Finally, be critical of advertising and hype—if it sounds too good to be true, it probably is!

Quick Bite

Mayonnaise Protects Against Strokes

Is this claim science or snake oil? Studies show that foods rich in vitamin E help protect against heart disease and stroke. In one study of stroke reduction in postmenopausal women, mayonnaise was the most concentrated food source of vitamin E. But to claim that mayonnaise prevents strokes is unwarranted and overstates the evidence.

Table SF.5 Questions to Ask to Assess the Credibility of Websites

Checking Out a Health Website: Five Quick Questions

Many online health resources are useful, but others may present information that is inaccurate or misleading, so it's important to find sources you can trust and to know how to evaluate their content.

If you're visiting a health website for the first time, these five quick questions can help you decide whether the site is a helpful resource.

Who? Who runs the website? Can you trust them?
What? What does the site say? Do its claims seem too good to be true?
When? When was the information posted or reviewed? Is it up-to-date?
Where? Where did the information come from? Is it based on scientific research?
Why? Why does the site exist? Is it selling something?

Source: NIH National Center for Complementary and Alternative Medicine. Finding and evaluating online resources on complementary health approaches. http://nccam.nih.gov/health/webresources#ask. Accessed April 12, 2014.

Quick Bite

The Yin and Yang of Food

The early theory of yin and yang had its genesis during the Yin and Zhou dynasties in China (1766 B.C.E.–256 B.C.E.). The yin force is passive, downward flowing, and cold. Conversely, the yang force is aggressive, upward rising, and hot. The concept of balance and harmony between these life forces is the basis upon which food and herbs are used as medicine. In traditional Chinese healing methods, disease is viewed as the result of an imbalance of these energies in the body. To balance these energies, according to this view, your diet should balance yin foods and yang foods. Yin (cold) foods include milk, honey, fruit, and vegetables; yang (hot) foods include beef, poultry, seafood, eggs, and cheese. Foods are also classified as sweet (earth), bitter (fire), sour (wood), pungent (metal), and salty (water). Each class supposedly has specific effects on different parts of the body.

Defining Complementary and Alternative Medicine: How Does Nutrition Fit?

Complementary and alternative medicines (CAMs) are therapies and treatments outside the medical mainstream. Historically, they tended to be based mainly or solely on observation or anecdotal evidence rather than controlled research. According to the National Center for Complementary and Alternative Medicine, "Defining CAM is difficult because the field is very broad, constantly changing, and hard to define because it means different things to different people."[1]

The term *alternative* suggests practices that replace conventional ones. *Complementary* implies practices that are used *in addition to* conventional ones. A practice that combines both conventional and CAM treatments for which there is evidence of safety and effectiveness is referred to as *integrative*. For example, using only herbs and megavitamins to treat AIDS would be alternative, whereas using herbs to combat diarrhea caused by conventional AIDS medications and taking supplements to replace lost vitamins would be complementary. Many people find the terms *complementary* and *integrative* more acceptable than *alternative*, although all these terms often are used interchangeably. CAM includes a broad range of healing therapies and philosophies. Several among them involve nutrition, including special diet therapies, phytotherapy (herbalism), orthomolecular medicine, and other biologic interventions.

Almost 40 percent of adults and 12 percent of children in the United States use some form of CAM therapy.[2] Commonly used CAM therapies include a variety of natural products and diet-based therapies, as well as mind–body practices such as deep breathing exercises, prayer, and relaxation techniques such as guided imagery, meditation, spinal manipulation (chiropractic care), Tai chi and yoga, acupuncture, massage therapy, and movement therapies. People seek out CAM for numerous reasons, including fear of aging, personal beliefs, and distrust of institutional medicine.

Where Does Nutrition Fit?

A number of alternative therapies involve nutrition, and sometimes the line between standard and alternative nutrition is not clear. A variety of health conditions, such as diabetes, gastrointestinal disorders, and kidney disease, require special diets. Alternative nutrition practices include diets to prevent and treat diseases not shown to be diet-related. (See **Figure 1**.) What often makes these practices "alternative" is the limited nature of the diet, the lack of rigorous scientific evidence showing effectiveness, and the divergence from science-based healthy eating patterns such as the DASH diet or MyPlate. Other practices outside the nutritional mainstream have gained recent popularity, such as reliance on only raw foods and the extensive use of herbal and botanical supplements as well as megadoses of vitamin/mineral supplements, which we have already discussed. Most nutritionists consider vegetarianism a routine variation of a normal diet, particularly if the vegetarian's motivation is religious or philosophical, the result of a concern for animals, or an aversion to animal products. When a meat eater goes vegetarian in an attempt to prevent or cure disease, that's alternative. The **macrobiotic diet** is another well-known alternative diet. The original version of this primarily vegetarian diet progressed in 10 increasingly restrictive stages, with the "highest level" consisting of little more than brown rice and water. The diet has since evolved into a simpler one-level regimen that emphasizes the consumption of fresh, nonprocessed food, as well as foods that are low in fat, whole grains, and vegetables, and restricts the intake of fluids. The composition of a macrobiotic diet may be changed depending on a person's health status and is associated with a person's lifestyle and spiritual philosophy.[3]

Food Restrictions and Food Prescriptions

Societies throughout the world commonly use dietary changes to treat or prevent illness. The specifics vary from place to place, however, which suggests that they are based on cultural factors rather than science.

In recent years, we have seen yeast-free diets, dairy-free diets, sugar-free diets, white-flour-free diets, cleansing diets, both low-carbohydrate and high-carbohydrate diets, both low-red-meat and high-red-meat diets, caffeine-free diets, salicylate-free diets, and more. People with subjective symptoms such as headaches, fatigue, or back pain have been instructed to avoid irrational lists of "allergenic foods" based on "blood screening." We've also seen illogical instructions on how to combine foods or what foods not to combine. For weight loss, we've had grapefruit diets, hard-boiled-egg diets, cottage-cheese diets, water diets, high-fat diets, low-fat diets, and blue-foods-only diets; the list goes on and on.

Many types of diets can be described as alternative. Their origins and claims vary, and their proponents often cannot show that they improve health; some alternative diets can actually be harmful by restricting foods and thereby lowering the body's intake of necessary nutrients. Such fad diets come and go. Most often they are not based on science and eventually fail to interest people when they don't work. Those few that prove effective and have a scientific basis become *integrated* into conventional nutrition and diet therapy. (See **Figure 2**.)

1. National Institutes of Health, National Center for Complementary and Alternative Medicine. Op cit.
2. Ibid.
3. Lerman RH. The macrobiotic diet in chronic disease. *Nutr Clin Pract*. 2010; 25(6):621–626.

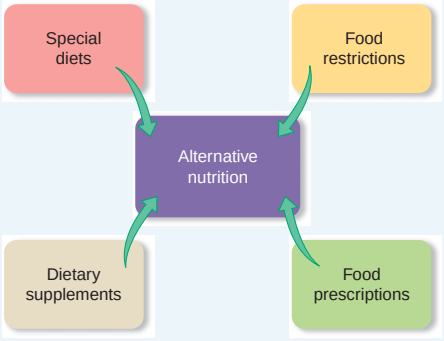


Figure 1 **Alternative nutrition practices.** Although many mainstream medical practices may involve special dietary regimens, alternative nutrition practices often are overly restrictive, depart from established dietary guidelines, and lack rigorous scientific evidence.

macrobiotic diet A highly restrictive dietary approach applied as a therapy for risk factors or chronic disease in general.

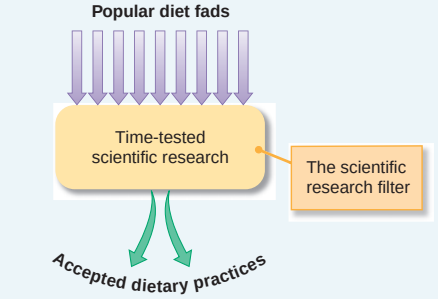


Figure 2 **Many apply but few are chosen.** Dietary practices with a scientific basis and proven efficacy are incorporated into conventional nutrition and diet therapy.

If you picked up a multivitamin/mineral container from your drugstore shelf, would you know how to read the label? Look at this Supplement Facts panel from a basic multivitamin/mineral supplement. Here are some questions that you might have:

1. If you were a 20-year-old woman who knew she wasn't consuming enough calcium, would this supplement allow you to get your recommended intake?
2. If 25 percent of the vitamin A in this supplement comes from beta-carotene, where does the rest come from?
3. What trend do you see in the amounts of B vitamins?
4. What trend do you see in the amounts of bone minerals?
5. What trend do you see in the amounts of antioxidant vitamins?

Supplement Facts
Daily Multivitamin/Mineral Dietary Supplement

USP USP has tested and verified ingredients, potency, and manufacturing process. USP sets official standards for Dietary Supplements. For more information, go to www.uspverified.org.

Serving Size 1 tablet

Each Tablet Contains	%DV
Vitamin A 10,000 I.U. 25% as beta-carotene	200%
Vitamin C 120 mg	200%
Vitamin D 400 IU	100%
Vitamin E 60 IU	200%
Vitamin K 25 mcg	31%
Thiamin (vit. B_1) 1.5 mg	100%
Riboflavin (vit. B_2) 1.7 mg	100%
Niacin 20 mg	100%
Vitamin B_6 2 mg	100%
Folate (folic acid) 400 mcg	100%
Vitamin B_{12} 6 mcg	100%
Biotin 30 mcg	10%
Pantothenic acid 10 mg	100%
Calcium 162 mg	16%
Iron 9 mg	50%
Phosphorus 109 mg	11%
* Daily Value (%DV) not established	

Each Tablet Contains	
Iodine 150 mcg	100%
Magnesium 100 mg	25%
Zinc 22.5 mg	150%
Selenium 45 mcg	64%
Copper 3 mg	150%
Manganese 2.5 mg	125%
Chromium 100 mcg	83%
Molybdenum 25 mcg	33%
Chloride 36.3 mg	1%
Sodium less than 5 mg	less than 1%
Potassium 40 mg	1%
Nickel 5 mcg	*
Tin 10 mcg	*
Silicon 2 mg	*
Vanadium 10 mcg	*
Boron 150 mcg	*

Reprinted with permission from The United States Pharmacopeial Convention, 12601 Twinbrook Parkway, Rockville, Maryland 20852.

Answers to Questions

1. No. This supplement provides only 162 milligrams, and the Adequate Intake (AI) for a 20-year-old woman is 1,000 milligrams. You may need a calcium supplement if you can't eat enough calcium-rich foods.
2. The other 7,500 IU of vitamin A is most likely retinol in the form of retinyl acetate or retinyl palmitate; check the list of ingredients.
3. With the exception of biotin, this supplement provides 100 percent of the Daily Value (100%DV) for the B vitamins. The 30 micrograms of biotin provides 100 percent of the current AI.
4. This supplement contains very low percentages of the Daily Values for calcium, magnesium, and phosphorus (16 percent, 11 percent, and 25 percent, respectively). Adding more of these minerals would make the pill huge and impossible to swallow. A nutritious diet should provide the rest of these minerals.
5. This supplement contains 200 percent of the Daily Value for each of the antioxidant vitamins A, C, and E.

Learning Portfolio

Key Terms

	page		page
bioavailability	290	**malabsorption syndromes**	283
bioflavonoids	287	**megadoses**	278
complementary and alternative medicine (CAM)	278	**National Center for Complementary and Alternative Medicine (NCCAM)**	285
Dietary Supplement Health and Education Act (DSHEA)	287	**National Institutes of Health (NIH)**	285
dietary supplements	278	**nucleic acids**	287
free radicals	297	**orthomolecular medicine**	283
functional food	292	**phytochemicals**	292
herbal therapy (phytotherapy)	285	**phytoestrogens**	297
isoflavones	278	**Supplement Facts panel**	288
lycopene	292	**U.S. Pharmacopeia (USP)**	290
macrobiotic diet	300		

Study Points

- Dietary supplements encompass vitamins, minerals, herbal products, amino acids, glandular extracts, enzymes, and many other products.
- Vitamin and mineral supplements may be warranted in certain circumstances, although the preferred mode of obtaining adequate nutrition is through foods.
- Megadose vitamin or mineral therapy has not been proved effective in the treatment of cancer, colds, or heart disease. Moreover, such megadoses act more like drugs than nutrients in the body and should be approached with caution.
- Herbal medicine is a traditional form of healing in many cultures. Some herbal medicines have shown enough promise to warrant large-scale clinical studies involving supplements. However, herbal products can have side effects and can interfere with prescription medications.
- Dietary supplements are regulated according to the provisions of the Dietary Supplement Health and Education Act of 1994 (DSHEA). Unlike drugs and additives, dietary supplements do not need premarket approval.
- Claims for dietary supplements can include health claims, structure/function claims, and nutrient content claims.
- Dietary supplements must have a Supplement Facts panel on the label.
- Consumers should carefully evaluate claims and evidence for dietary supplements and consult their physician before taking a supplement.
- A functional food is considered to be a food that may provide a health benefit beyond basic nutrition.
- Phytochemicals are plant chemicals responsible for the health-promoting properties of many functional foods.
- Consumption of plant foods containing multiple antioxidants is strongly associated with health benefits. Scientific evidence strongly supports eating at least five servings of fruits and vegetables daily and emphasizing whole grains.
- Complementary and alternative medicine (CAM) comprises practices outside the medical mainstream that are becoming increasingly popular. CAM includes a broad range of therapies, many of which include nutrition. People seek them for a variety of reasons, including environmental concerns and a fear of aging.

Study Questions

1. How do you know a product is a dietary supplement?
2. If a dietary supplement product label contains the words "High in vitamin E," what type of claim is it making? What other claims can a supplement make?
3. What things should someone do before purchasing supplements?
4. What are phytochemicals, and how do they benefit plants and humans?
5. Name three chronic diseases that consuming functional foods may help prevent.
6. What are some of the possible complications involved in using herbal medicines?
7. What role does nutrition have in complementary and alternative medicine?

Try This

Finding Functional Beverages

This exercise will familiarize you with the many beverages that contain functional ingredients now available to consumers. Take a trip to your grocery store and spend some time in the beverage aisles. You may want to check out the chilled juice section in addition to the bottled teas and juice beverages. Pick out about 10 different products that have either a nutrient or herbal compound added and try to identify how many have nutrient content claims, health claims, and structure/function claims. Note the prices of

these products. How does their nutritional content compare to a 100-percent fruit juice like orange juice? How does it compare to soda?

Take a Walk on the "Web Side"

This exercise will familiarize you with various websites that promote and sell supplements. Do an Internet search with keywords affiliated with supplements. Try *vitamins*, *minerals*, *supplements*, *herbs*, and even some specific terms like *chromium picolinate* and *ginseng*. On the websites you visit, how is the nutrition information presented? Do the supplement's benefits sound too good to be true? See if you can spot a fraud. Use the information in the "Fraudulent Products" section of this chapter to identify the accuracy of the product information you find.

References

1 Gahche J, Bailey R, Burt V, et al. Dietary supplement use among U.S. adults has increased since NHANES III (1988–1994). NCHS Data Brief No. 61. April 2011. http://www.cdc.gov/nchs/data/databriefs/db61.pdf. Accessed April 9, 2014.

2 Bailey RL, Gahche JJ, Miller PE, Thomas PR, Dwyer JT. Why U.S. adults use dietary supplements. *JAMA Intern Med*. 2013;173(5):355–361. doi: 10.1001/jamainternmed.2013.2299.

3 Position of the Academy of Nutrition and Dietetics: Nutrient supplementation. *J Am Diet Assoc*. 2009;109:2073–2085.

4 Ibid.

5 Position of the Academy of Nutrition and Dietetics: Functional foods. *J Acad Nutr Diet*. 2013;113:1096–1103.

6 Hochholzer W, Berg DD, Giugliano RP. The facts behind niacin. *Ther Adv Cardiovasc Dis*. 2011;5(5):227–240. doi: 10.1177/1753944711419197. Epub September 5, 2011.

7 *Physicians' Desk Reference* 2011. 65th ed Montvale NJ: Thompson Healthcare; 2010.

8 Pauling L. Orthomolecular psychiatry. Varying the concentrations of substances normally present in the human body may control mental disease. *Science*. 1968;160(3825):265–271.

9 Institute of Medicine, Food, and Nutrition Board. *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids*. Washington, DC: National Academies Press; 2000.

10 Institute of Medicine, Food, and Nutrition Board. *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc*. Washington, DC: National Academies Press; 2001.

11 Council for Responsible Nutrition. Dietary supplements: Safe, beneficial, and regulated. http://www.crnusa.org/CRNRegQandA.html. Accessed April 9, 2014.

12 Health Canada. About natural health products. http://www.hc-sc.gc.ca/dhp-mps/prodnatur/about-apropos/cons-eng.php. Accessed April 9, 2014.

13 Silverglade B, Ringel Heller I. Food labeling chaos. The case for reform. 2010. Center for Science in the Public Interest. http://cspinet.org/new/pdf/food_labeling_chaos_report.pdf. Accessed April 9, 2014.

14 National Institutes of Health, National Center for Complementary and Alternative Medicine (NCCAM). Complementary, alternative, or integrative health: What's in a name? http://nccam.nih.gov/health/whatiscam#vision. Accessed April 9, 2014.

15 Kennedy DA, Seely D. Clinically based evidence of drug–herb interactions: A systematic review. *Expert Opin Drug Saf*. 2010;9(1):79–124.

16 Tachjian A, Maria V, Jahangir A. Use of herbal products and potential interactions in patients with cardiovascular diseases. *J Am Coll Cardiol*. 2010;55(6):515–525.

17 U.S. Food and Drug Administration. FDA issues dietary supplements final rule. FDA press release. June 22, 2007. http://www.fda.gov/newsevents/newsroom/pressannouncements/2007/ucm108938.htm. Accessed April 9, 2014.

18 U.S. Food and Drug Administration. Regulatory information. Dietary Supplement Health and Education Act of 1994. http://www.fda.gov/RegulatoryInformation/Legislation/FederalFoodDrugandCosmeticActFDCAct/SignificantAmendmentstotheFDCAct/ucm148003.htm. Accessed April 11, 2014.

19 U.S. Food and Drug Administration. FDA 101: Dietary supplements. http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm050803.htm. Accessed April 11, 2014.

20 S. 1425: Dietary Supplement Labeling Act of 2013. https://www.govtrack.us/congress/bills/113/s1425. Accessed April 11, 2014.

21 U.S. Food and Drug Administration. Dietary supplement labeling guide. Guidance for industry. http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/dietarysupplements/ucm2006823.htm. Accessed April 11, 2014.

22 National Institutes of Health, Office of Dietary Supplements. Dietary supplements. Background information. http://ods.od.nih.gov/factsheets/DietarySupplements-HealthProfessional/. Accessed August 8, 2014.

23 U.S. Department of Health and Human Services. FDA structure/function claims. Dietary supplements and functional foods. http://www.fda.gov/Food/IngredientsPackagingLabeling/LabelingNutrition/ucm2006881.htm. Accessed April 11, 2014.

24 U.S. Food and Drug Administration. Dietary supplements. http://www.fda.gov/Food/Dietarysupplements/default.htm. Accessed April 11, 2014.

25 Health Canada. Drugs and health products. About natural health product regulation in Canada. http://www.hc-sc.gc.ca/dhp-mps/prodnatur/about-apropos/index-eng.php. Accessed April 11, 2014.

26 Academy of Nutrition and Dietetics. Guidelines regarding the recommendation and sale of dietary supplements. http://www.eatright.org/About/Content.aspx?id=8145. Accessed April 11, 2014.

27 U.S. Pharmacopeial Convention. Home page. http://www.usp.org. Accessed June 23, 2011.

28 U.S. Food and Drug Administration. Beware of fraudulent "dietary supplements." http://www.fda.gov/forconsumers/consumerupdates/ucm246744.htm. Accessed April 11, 2014.

29 Position of the Academy of Nutrition and Dietetics: Functional foods. Op cit.

30 Starling S. U.S. functional foods market to grow 21 per cent by 2015. August 23, 2010. http://www.nutraingredients-usa.com/Markets/US-functional-foods-market-to-grow-21-per-cent-by-2015. Accessed April 11, 2014.

31 Report Linker. Functional food industry Market research and statistics. http://reportlinker.com/ci02036/Functional-Food.html. Accessed April 12, 2014.

32 U.S. Department of Agriculture, U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th ed. Washington, DC: U.S. Government Printing Office; December 2010.

33 U.S. Department of Agriculture. MyPlate. http://www.choosemyplate.gov. Accessed April 11, 2014.

34 Mordente A, Guantario B, Meucci E, et al. Lycopene and cardiovascular diseases: An update. *Curr Med Chem*. 2011;18(8):1146–1163.

35 Andres S, Abraham K, Appel KE, Lampen A. Risks and benefits of dietary isoflavones for cancer. *Crit Rev Toxicol*. 2011;41(6):463–506.

36 Ibid.

37 Wong IY, Koo SC, Chan CW. Prevention of age-related macular degeneration. *Int Ophthalmol*. 2011;31(1):73–82.

38 Olson JH, Erie JC, Bakri SJ. Nutritional supplementation and age-related macular degeneration. *Semin Ophthalmol*. 2011;26(3):131–136.

39 Position of the Academy of Nutrition and Dietetics. Op cit.

40 U.S. Food and Drug Administration. Labeling and nutrition: Food labeling and nutrition overview. http://www.fda.gov/food/ingredientspackaginglabeling/labelingnutrition/default.htm . Accessed April 11, 2014.

41 Position of the Academy of Nutrition and Dietetics. Op cit.

42 U.S. Food and Drug Administration. Guidance for industry: A food labeling guide. Appendix C: Health claims. http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/labelingnutrition/ucm064919.htm. Accessed April 12, 2014.

43 Silverglade B, Ringel Heller I. Op cit.

44 National Institutes of Health, Office on Dietary Supplements. Health information. How to evaluate health information on the Internet: Questions and answers. http://ods.od.nih.gov/Health_Information/How_To_Evaluate_Health_Information_on_the_Internet_Questions_and_Answers.aspx. Accessed April 12, 2014.