An expanding body of research suggests that beans promote health and reduce risks for, or improve outcomes of, various disorders, including cardiovascular disease, diabetes, and other diseases. For these reasons, many dietary recommendations include beans. Plus, beans are good to excellent sources of protein, fiber, folate, potassium, magnesium, iron, copper, and manganese yet also are cholesterol- and fat-free. Nutr Today. 2008;43(5):201–209

Scientific research linking health, nutrition, and longevity to the affordable and widely available dry bean continues to emerge. Beans are inexpensive sources of high-quality protein. Today, however, beans are also in the news because of their potential to lower cholesterol, reduce the risks of heart disease, relieve constipation, improve gastrointestinal integrity, and stabilize blood sugar.

An Ancient Food

Because they are easy to plant, grow, and store, beans are among the oldest cultivated and most widely used foods in the world. They also are relatively inexpensive to produce, are portable, and have a long storage life. Their low cost and high nutritional value have contributed to their global popularity. Historically, beans have served as a food staple for at least 10,000 years, and some food historians double that figure.

Today, beans continue to serve as food staples in China, India, the Middle East, and the Americas. Several varieties may have arrived in North America with the pilgrims on the Mayflower, but many others were native plants. Domesticated about 7,000 years ago in what is now Peru and Southern Mexico, several varieties of beans were already flourishing by the time the Portuguese and Spaniards arrived in the New World.

What Is a Bean?

The terms dry beans and legumes often are used interchangeably in the United States. In other parts of the world, including Canada, beans often are called pulses. Distinguishable by their seed-bearing pods, legumes are a family of plants characterized by 2 classes: oilseeds, such as soybeans and peanuts, and grain legumes, including dry beans, lima beans, cowpeas, fava beans, chickpeas (garbanzo beans), lentils, and dry peas. Of the estimated 16,000 legume varieties, more than 100 are cultivated commonly worldwide. Rooted from the Latin word pul, or ancient bean porridge, dry beans, peas, and lentils all qualify as pulses, but the term excludes green beans, green peas, soybeans, and peanuts. (For the purpose of this article, “beans” refers to dry edible beans but excludes soybeans and all “garden-type” fresh-bean varieties—green, string, wax, etc.)

Legume. A family of plants with seed-bearing pods. These grain legumes include dry beans, lentils, dry peas, lima beans, and chickpeas.

Pulse. A term used in many countries to refer to crops harvested solely for their grain, including dry beans, peas, and lentils but excluding green beans, green peas, soybeans, and peanuts.

Fruit, Vegetable, Meat Alternative

Beans are an inexpensive and flavorful source of protein, fiber, carbohydrates, and micronutrients, which often are lacking in American diets. In MyPyramid, beans are listed in 2 different food groups: vegetables, and meat and beans. From a strictly botanical standpoint, beans are the fruits of bean plants; however, they function in the diet as a vegetable and as a nonmeat protein source, as well as an excellent source of fiber. Still, many consumers view beans erroneously as a starch, like rice or pasta (see Sidebar A).
Nutrients and Other Beneficial Constituents in Beans

Beans have a nutritional profile that suits all ages, providing cholesterol-free protein, fiber, magnesium, potassium, B vitamins, resistant starch, and the more recently discovered phytonutrients. Their nutrient profile fits with the dietary needs of growing children and teenagers as well as adults. Protein is critical for growth and development in children and adolescents, and beans cooked until tender are an easy-to-chew protein source and an appealing finger food for young children.

Children who eat beans have significantly greater intakes of fiber, magnesium, and potassium than do those who do not eat beans. Bean eaters between the ages of 12 and 19 years also weigh significantly less and have smaller waist measurements compared with non-bean eaters. For adults who want to moderate their fat and cholesterol intakes, beans are a healthful alternative to meat. Several studies show that beans may help lower blood cholesterol. Furthermore, soluble fiber and resistant starches in beans may help suppress appetite and manage blood sugar. Compared with other sources of carbohydrates, beans exhibit a low glycemic index (GI) and produce a relatively flat blood-glucose response. For example, the GI of kidney beans is 23, and chickpeas is 42. Long-grain, boiled white rice, however, produces a GI of 61, and a baked potato has a GI of 85.

The glycemic load (GL) is another related indicator of a food’s effect on blood glucose. Whereas GI is based on the effect of a standard 50-g amount of a food on blood sugar, GL accounts for carbohydrate quality and quantity. Calculations are based on a typical single serving of the food. For a half-cup standard serving of kidney beans, the GL is 6, and for chickpeas, the GL is 9. The same size serving of rice exhibits a GL of 22 and of baked potato, a GL of 26.

Beans contain health-promoting oligosaccharides (short-chain sugar polymers) and another functional carbohydrate, resistant starch. Food starches are classified as either glycemic or resistant. Glycemic starches break down into glucose and then are absorbed into the bloodstream. Resistant starches, however, cannot be broken down by enzymes in the body and, because they cannot be absorbed, pass to the large intestine for fermentation by intestinal bacteria. Similar to the actions of dietary fiber, resistant starch helps decrease intestinal transit time and increase fecal bulk.

Beans contain several important minerals. One-half cup of beans supplies 10% or more of the daily values for potassium, magnesium, and iron. (See illustration in Sidebar B on the 12 key nutrients in beans.) Cooked dry beans are very low in sodium, and rinsing canned beans reduces sodium content by approximately 40%. Beans also offer even higher antioxidant contents than some wines and many vegetables do.

A. Survey

Beans are really fruits but look more like vegetables, not starches. Despite the fact that the American Cancer Society, the Centers for Disease Control and Prevention, the US Dietary Guidelines, and nutritionists classify beans as vegetables, a recent survey found that only 43% of consumers think of beans as a vegetable.

B. 12 Key Nutrients in Beans

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<th>Navy</th>
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Nutrition information is based on nutrient profiles for baby lima beans, black beans, black-eye peas, cranberry beans, garbanzo beans, Great Northern beans, navy beans, pinto beans, red kidney beans.

Beans and Good Health

Food and Nutrition

12 Key Nutrients in Beans

Despite myriad differences in shapes, sizes, colors, textures and flavors, beans are surprisingly similar in nutrient composition. While beans are naturally low in calories, sodium and sugar, very low in fat and are cholesterol-free, they are also good to excellent sources of several key nutrients.

The Dietary Guidelines Advisory Committee Report determined that calcium, magnesium, iron and fiber are likely to fall short of nutritional goals if the recommended 3 cups of legumes, such as beans, a week are not included in the diet (USDA, 2004).

One-half cup of cooked beans provides the following Daily Value (DV):

- Folate: 23% to 45%
- Fiber: 24% to 36%
- Manganese: 19% to 26%
- Protein: 14% to 16%
- Magnesium: 10% to 15%
- Copper: 8% to 15%
- Iron: 11%
- Potassium: 10%
- Selenium: 8%
- Carbohydrates: 8%
- Zinc: 6% to 8%
- Calcium: 2% to 6%

Caldium is important for building bones in children and adolescents and for preventing bone-throwing.

Carbohydrates, including complex carbohydrates (starches), are an important source of energy and beans contain a resistant starch, which may play a role in weight management.

Fiber includes both soluble fiber for lowering cholesterol, regulating blood sugar and maintaining bacterial balance in the intestinal tract, and insoluble fiber, for relieving constipation.

Folate is important for women of child-bearing age to reduce the risk of a group of birth defects known as neural tube defects, in which the spinal cord doesn’t develop properly. Folate may also play a role in preventing or slowing some of the cognitive decline that occurs with age.

Iron functions primarily as a carrier of oxygen in the blood and is particularly important for children and adolescents, as well as women of child-bearing age. For vegetarians, beans provide a much-needed source of iron.

Magnesium is key for building bone, regulating blood sugar, promoting normal blood pressure and keeping the heart rhythm steady.

Selenium regulates thyroid function, synthesizing DNA, preventing oxidative damage to cells, boosting immunity and reducing inflammation.

Zinc is responsible for stimulating the activity of approximately 100 enzymes that are needed for biochemical reactions in the body to take place. It plays an important role in the immune system, wound healing, DNA synthesis, and maintaining the sense of taste and smell.

Cooked dry beans are very low in sodium. Rinsing canned beans reduces sodium content even more, by approximately 40%.13

However, beans do vary nutritionally, especially with differences between and among types of dry beans and their bioactive food components (BAFCs).16 BAFCs are “dietary constituents that elicit physiological effects beyond those associated with essential human nutrition.”17 In animal studies, different types of beans exhibited varying effects on the occurrence of induced breast and colon cancers among rats.18 Processing beans also alters their BAFC, reducing BAFC up to 80% or more, as compared with unprocessed seed.

Beans and Health
An expanding body of research suggests that beans promote good health and reduce risk for, or improve outcomes of, several diseases. Thus, beans are included in many dietary recommendation frameworks, including the Dietary Guidelines for Americans (DG) 2005, MyPyramid, Dietary Approaches to Stop Hypertension (DASH), American Heart Association, American Cancer Society, and Produce for Better Health Foundation (see Sidebar C).

C. Beans: Current Guidance From Health Authorities Encourage More
Health organizations have incorporated messages about beans into their recommendations for healthful eating, including guidelines specifically designed to help prevent heart disease and cancer.63,64 6

In 1997, the World Cancer Research Fund/American Institute for Cancer Research issued its report entitled “Food, Nutrition, and the Prevention of Cancer: A Global Perspective,” which recommended that everyone should choose a predominately plant-based diet rich in a variety of vegetables and fruits. Specifically, the report singled out legumes such as beans as important in the diet.65

The Dietary Guidelines for Americans 2005 emphasizes the importance of beans in a healthful diet and recommends an adult intake of 3 cups of legumes, such as beans, each week.61 This quantity is more than 3 times the average amount that adult Americans currently consume.36

The Dietary Guidelines for Americans 2005 and MyPyramid identify beans as part of both the meat and beans group and the vegetable group.4,61 Beans, good sources of protein, can serve as a meat substitute (one-half cup of cooked dry or canned beans = 2 oz of lean meat) or as a vegetable (one-half cup = 1 serving).

Also, in 2005, bean processors began adding an official dietary guidance message to their food labels: “Diets including beans may reduce your risk of heart disease and certain cancers.” A dietary guidance message is not a health claim; rather, it is a statement that generally encourages consumers to eat more healthfully and to make better food choices that promote good health. The only other official guidance statement currently in the marketplace is a more general one for fruits and vegetables, which also includes beans.

“Fruits & Veggies: More Matters” is an advertising campaign that promotes the consumption of fruits and vegetables, including beans as a vegetable, to encourage eating more of them to improve the health of Americans.66

The American Cancer Society’s 2006 Guidelines on Nutrition and Physical Activity for Cancer Prevention recommends choosing fish, poultry, and beans as alternatives to beef, pork, and lamb and stresses the healthfulness of vegetables.64

For the prevention of cardiovascular disease, the American Heart Association recommends 4 to 5 servings a week of nuts, seeds, and legumes, such as beans.63

Longevity
Several studies have shown that people who eat a Mediterranean-style diet, rich in plant foods, including beans, have lower risks of heart disease and some cancers.19,20

A cross-cultural study of the dietary intakes of 785 subjects, aged 70 years and older, in Japan, Sweden, Greece, and Australia revealed that of all the dietary factors analyzed, legume consumption had the most consistent and statistically significant association with reduced mortality risk. Every 20-g increase in daily intake of legumes produced a 7% to 8% reduction in risk of death. Even after controlling for age, sex, and smoking, the link to beans was still statistically significant. No other food or food group affected survival across cultures—not olive oil, nor fish, nor other fruits and vegetables.21

Reducing Cancer Risk
Several specific bean constituents offer possible roles in reducing cancer risk: saponins, inositol, resistant starch, and fiber. Saponins, a class of phytoneutrants found in beans, may help reduce the risk of lung and blood
Beans are an abundant source of inositol, specifically inositol hexaphosphate, an antioxidant compound that can help prevent cancer and control the growth, progression, and spread of tumors in animals. Inositol hexaphosphate has not yet been studied for its effectiveness in human beings. One animal study showed that mice consuming diets consisting of 20% black beans experienced a reduced incidence of DNA damage, which may be linked to cancers, but human studies are not yet available.

A strong correlation exists between high intakes of resistant starch, present in beans, and lower risks of colorectal cancer. The fiber and resistant starch in beans increase the production of short-chain fatty acids, such as acetate, propionate, and butyrate, as a result of fermentation by intestinal bacteria of the undigested carbohydrates. (Studies suggest that butyrate may help slow the growth of colon tumor cells.) However, in another recent study, bean consumption had no effect on total short-chain fatty acid production, and propionic and butyric acid production actually was lower. Eating beans also did not affect gut bacterial populations, except for Escherichia coli, which also was lower.

Hyperinsulinemia also may be a factor in increasing cancer risk. Several population studies, for example, have found that consuming a diet consisting of low-GL foods, such as beans, is associated with a reduced risk of colorectal cancer.

For the past 3 decades, epidemiologic data connecting beans and reduced risk of various cancers have been suggestive, and here is a summary of the findings, which may provide the foundation for smaller controlled studies as well as for larger clinical intervention trials. A study of African American, white, Japanese, and Chinese men showed that those people with the highest intake of legumes, such as beans, were significantly less likely to have prostate cancer. Even when soy foods were excluded from the analysis, risk was still significantly reduced.

A recent analysis of more than 183,000 subjects enrolled in the Hawaii–Los Angeles Multiethnic Cohort Study revealed that a high intake of legumes, including beans, was associated with a significantly lower risk of pancreatic cancer among overweight and obese subjects.

The National Institutes of Health (NIH)–funded Polyp Prevention Trial, a multicenter, randomized clinical trial of more than 2,000 men and women, was designed to determine the effects of a high-fiber, high-fruit, high-vegetable, low-fat diet on the recurrence of adenomatous polyps (colon cancer precursor lesions) in the large bowel. Researchers found a much lower risk (65% lower) of advanced adenoma recurrence in people who increased their intake of beans the most (an almost 4-fold increase) during a 4-year period. This NIH study was the first research to examine the effects of beans on adenomas in a Western population. Other studies have examined legumes as a group without focusing on dried beans specifically. The average bean intake for the study’s intervention group was about one-quarter cup a day, still much higher than the current bean intake in the United States, which is less than a cup a week. If these effects stand up in more definitive studies, more recommendations for increased dry bean consumption may follow.

Promoting Cardiovascular Health

Several components of beans decrease cardiovascular disease: soluble fiber, phytosterols, magnesium, potassium, copper, and folate. Consuming enough fruits and vegetables (including beans) rich in potassium and magnesium is a critical component of the DASH Diet approach to controlling hypertension. As part of the long-term, 4,000-person Coronary Artery Risk Development in Young Adults (CARDIA) Study, researchers found that greater consumption of legumes was linked to a lower incidence of hypertension.

Less well documented are the effects of copper, highly available in beans, which may help reduce the risk of cardiovascular disease by lowering blood pressure and cholesterol levels. Folate, too, may help reduce the risk of cardiovascular disease and stroke. Researchers analyzed data from the National Health and Nutrition Examination Survey (NHANES) Epidemiologic Follow-up Study and found that those who consumed the most folate (average intake, 405 µg/d) exhibited 21% lower risk of stroke and 14% lower risk of cardiovascular disease than did individuals who consumed the least folate (99 µg/d average intake). One-half cup of beans alone provides as much as 45% of the daily value for folate.

The soluble fiber in beans (about 6–9 g per half-cup cooked beans) helps lower blood cholesterol by binding bile acids and preventing cholesterol reabsorption. Animal studies show that the resistant starch in beans also may help lower blood cholesterol.

Researchers have suggested that a diet that replaces some refined carbohydrates with protein sources low in saturated fat, such as beans, may help reduce the cardiovascular disease risks. The Mediterranean dietary pattern, which includes beans, also reduces cardiovascular disease risk and mortality. A study of 9,632 men and women involved in the first NHANES Epidemiologic Follow-up Study who were free of cardiovascular disease at baseline and were tracked for 19 years, on average, revealed similar effects of bean consumption. People who ate legumes, including beans, at least 4 times a week during that
long period showed a 22% lower risk of coronary heart disease as compared with those who ate beans less than once a week. A 10-year longitudinal study of Costa Ricans revealed that people who ate just one-third cup of black beans a day were 38% less likely to experience myocardial infarction, compared with people who ate beans less than once a month. Because many other factors may have differed between these populations, more definitive studies are needed to draw firmer conclusions.

For 20 years, researchers have known that diets supplemented with dry beans lower serum cholesterol by as much as 19% and low-density lipoprotein (LDL) cholesterol by 24%, almost identical to the cholesterol-lowering effect of oat bran. Nearly 2 decades later, a meta-analysis of 11 clinical trials revealed that legumes (including beans, but excluding soybeans) may have a significant, beneficial effect on several important risk factors for cardiovascular disease, including total cholesterol, LDL-cholesterol, high-density lipoprotein cholesterol, and triglycerides. Beans are part of the University of Ontario's "portfolio diet" that emphasizes cholesterol-lowering foods—fruits and vegetables, soy protein, almonds, plant-sterol–enriched margarine, and foods high in soluble fiber, such as oats and barley. This diet can be as effective as prescription statin drugs for lowering serum LDL-cholesterol levels.

Various kinds of beans differ in their disease-fighting abilities. In a study undertaken to determine the effects of daily consumption of beans on risk factors for coronary heart disease and diabetes, adults with abnormal insulin sensitivity consumed either a half cup of pinto beans, black-eye peas, or carrots (placebo) daily. As the 8-week study progressed, a significant effect was evident. Reduced total and LDL blood cholesterol resulted with pinto beans, but not with black-eye peas or carrots. Pinto bean consumption, in fact, lowered cholesterol more than oatmeal did. In a related study, vegetarian baked beans, even with their added fat and sugar, lowered serum cholesterol in hypercholesterolemic adults.

Weight Management?

In NHANES, those men and women who regularly consumed beans had a 22% lower risk of obesity when compared with non–bean eaters. In Canada, women who followed eating plans resembling the Mediterranean diet pattern, which included a higher consumption of legumes, such as beans, significantly reduced their waist measurements.

Various types of carbohydrates found in beans are likely contributors to healthier weight status. Eating foods with a high GI or GL may stimulate appetite sooner after a meal than if low-GI or -GL foods, such as beans, are consumed. At least 15 studies have shown that participants experienced lower satiety, increased hunger, or higher food intake after consumption of high-GI compared with low-GI meals. The impact of low-GI meals on satiety and food intake may be especially effective in people who are overweight or obese. Beans may also function by slowing digestion, prolonging the feeling of fullness, and reducing hunger, in part, because of their effect on hormonal responses to a meal.

Soluble fiber, including that found in beans, may also help promote satiety, but study results, to date, have not yielded a definitive, significant relationship. In addition, more generally, although satiety is one factor related to weight regulation, researchers continue to debate whether soluble fiber or resistant starch aids with weight loss.

Unlike most other vegetables, beans contain significant amounts of protein, and research shows that protein may be more satiating than fat. In several studies, subjects consuming higher protein diets reported less hunger on reduced-calorie diets.

Controlling Blood Sugar

Beans may reduce the risk of developing type 2 diabetes and improve diabetes control. Over the years, several dietary-intervention studies have shown that increasing dietary intakes of legumes, including beans, as well as whole grain foods and other vegetables, positively affects blood glucose management and insulin sensitivity. For example, in one study, the glycemic responses to 5 kinds of beans were tested and compared with the glycemic response to bread. Although glycemic responses to different beans varied, all were significantly lower than the response to bread.

Flatulence

People believe that beans cause significant gas and bloating. However, the same bean components that cause gas—oligosaccharides and fiber—also are responsible for some of beans' health-promoting properties, including stimulating healthy gut flora. Recent research provides new insights into human beings' ability to adapt to bean consumption with reduced flatulence occurring over time.
Beans also may help alleviate other health disorders. In a prospective study of more than 32,000 men, the intake of legumes, including beans, was also linked to lowering risk of benign prostatic hyperplasia (noncancerous enlargement of the prostate gland). 39

On a totally different health front, additional research is underway to study the efficacy of a bean-based food to improve growth and development and to slow the progression of AIDS in a group of HIV-positive children in Botswana. 60

At the study's implementation, most children displayed clear signs of both acute and chronic malnutrition. Nutritional intervention with a bean/micronutrient-fortified sorghum porridge improved growth and development when compared with a sorghum-only porridge (a familiar food in the region) that was micronutrient fortified but contained no bean ingredient. The protein quality of the bean-protein–enriched product was equal to that of a similar soy-based product used in similar nutrition-intervention relief work. Preliminary data have revealed that nutritional intervention reduced the prevalence of growth stunting by half and the prevalence of underweight by 22%. 61

Tips for Health Professionals

Most current guidelines for health and disease prevention, such as the DG 2005, offer recommendations to eat legumes daily, and most mention beans specifically. 63 As an update to the 2000 version of the DG, the 2005 edition places more emphasis on subgroups of nutrient-dense fruits and vegetables, such as dark green vegetables, orange vegetables, legumes (including dry beans), and starchy vegetables. 85 In fact, the 2000-calorie eating plan calls for 3 cups of cooked dry beans per week (nearly a half cup per day).

Barriers to bean consumption include lack of knowledge about preparing and serving beans, as well as outdated perceptions about gas and bloating. Health professionals can help consumers increase their bean intake from the current average of less than a cup a week to the recommended 3 cups a week for adults by emphasizing these factors:

1. The flavor and convenience of beans in a health-promoting diet—consumers need specific tips for bean preparation.
2. The reduction of gastrointestinal signs and symptoms over time, when beans are consumed regularly—consumers need guidance for gradually increasing bean intake, much like dietary advice for raising overall fiber intake.

D. Resources

For additional information on the link between beans and good health and for practical information about cooking and consuming beans, visit the following websites:

- www.beansforhealth.com
- www.health.gov/dietaryguidelines
- www.mypyramid.gov
- www.5aday.gov
- www.morematters.com

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