



## Blueberries – Superstar

Cardiovascular system, high blood pressure, eye disease (retina), diabetes, nervous system, cognitive functions, muscles

In terms of U.S. fruit consumption, blueberries rank only second to strawberries in popularity of berries. Blueberries are not only popular, but also repeatedly ranked in the U.S. diet as having one of the highest antioxidant capacities among all fruits, vegetables, spices and seasonings. Antioxidants are essential to optimizing health by helping to combat the free radicals that can damage cellular structures as well as DNA. We recommend enjoying raw blueberries — rather than relying upon blueberries incorporated into baked desserts — because, like other fruits, raw blueberries provide you with the best flavor and the greatest nutritional benefits.

As one of the few fruits native to North America, blueberries have been enjoyed by Native Americans for hundreds of years. They have also enjoyed great popularity around the world in cuisines from Asia to the Mediterranean. For more on the Healthiest Way of Preparing Blueberries, see below.

### What's New and Beneficial About Blueberries

- After many years of research on blueberry antioxidants and their potential benefits for the nervous system and for brain health, there is exciting new evidence that blueberries can improve memory. In a study involving older adults (with an average age of 76 years), 12 weeks of daily blueberry consumption was enough to improve scores on two different tests of cognitive function including memory. While participants in the study consumed blueberries in the form of juice, three-quarters of a pound of blueberries were used to make each cup of juice. As participants consumed between 2 to 2-1/2 cups each day, the participants actually received a very plentiful amount of berries. The authors of this study were encouraged by the results and suggested that blueberries might turn out to be beneficial not only for improvement of memory, but for slowing down or postponing the onset of other cognitive problems frequently associated with aging.
- New studies make it clear that we can freeze blueberries without doing damage to their delicate anthocyanin antioxidants. There's no question about the delicate nature of many antioxidant nutrients found in blueberries. These antioxidants include many different types of anthocyanins, the colorful pigments that give many foods their wonderful shades of blue, purple, and red. After freezing blueberries at temperatures of 0°F (-17°C) or lower for periods of time between 3-6 months, researchers have discovered no significant lowering of overall antioxidant capacity or anthocyanin concentrations. Anthocyanins studied have included malvidins, delphinidins, pelargonidins, cyanidins, and peonidins. These findings are great news for anyone who grows, buys, or picks fresh berries in season and wants to enjoy them year round. They are also great news for anyone

who has restricted access to fresh blueberries but can find them in the freezer section of the market.

- Berries in general are considered low in terms of their glycemic index (GI). GI is a common way of identifying the potential impact of a food on our blood sugar level once we've consumed and digested that food. In general, foods with a GI of 50 or below are considered "low" in terms of their glycemic index value. When compared to other berries, blueberries are not particularly low in terms of their GI. Studies show the GI for blueberries as falling somewhere in the range of 40-53, with berries like blackberries, raspberries, and strawberries repeatedly scoring closer to 30 than to 40. However, a recent study that included blueberries as a low-GI fruit has found that blueberries, along with other berries, clearly have a favorable impact on blood sugar regulation in persons already diagnosed with type 2 diabetes. Participants in the study who consumed at least 3 servings of low-GI fruits per day (including blueberries) saw significant improvement in their regulation of blood sugar over a three-month period of time. (Their blood levels of glycosylated hemoglobin, or HgA1C were used as the standard of measurement in this study.) It's great to see blueberries providing these clear health benefits for blood sugar regulation!
- If you want to maximize your antioxidant benefits from blueberries, go organic! A recent study has directly compared the total antioxidant capacity of organically grown versus non-organically grown highbush blueberries (*Vaccinium corymbosum* L., var. Bluecrop) and found some very impressive results for the organically grown berries. Organically grown blueberries turned out to have significantly higher concentrations of total phenol antioxidants and total anthocyanin antioxidants than conventionally grown blueberries, as well as significantly higher total antioxidant capacity. Numerous specific antioxidant anthocyanins were measured in the study, including delphinidins, malvidins, and petunidins. The antioxidant flavonoid quercetin was also measured.

## WHFoods Recommendations

In our Healthiest Way of Eating Plan, we encourage the consumption of 5-10 servings of fruits-plus-vegetables (combined) each day. We believe that the balance between fruits and vegetables can vary from day to day, depending upon personal health factors, personal taste preferences, and optimal combining of foods in recipes as well as meals.

We recognize that our recommendation calls for a more generous amount of fruits and vegetables than the amount recommended by the Centers for Disease Control (CDC) at the U.S. Department of Health and Human Services (DHHS). The CDC recommends between 1.5-2.5 cups of fruit and 2.5-4.0 cups of vegetables per day, as well as a target goal of at least 5 fruit-plus-vegetable servings (combined) per day. We recommend that you set your fruit goals higher than these CDC amounts.

Based on the scientific research, we believe it's going to take closer to 3 fruit servings per day (consisting of one cup's worth of fruit per serving, or 3 cups total per day) to provide you with optimum health benefits. With respect to berries in particular, we recommend

that you include berries at least 3-4 times per week within your fruit servings. In several of our sample meal plans, we include berries on a daily basis! It would definitely not be a mistake for you to include a serving of berries in your daily meal plan! With respect to blueberries in particular, you might be surprised about the number of blueberries that can fit into a single cup. The average weight for a small, lowbush blueberry (also sometimes called a "wild blueberry") can be close to 1-2 grams, meaning that a weighted cup's worth of wild blueberries will contain 100-150 berries!

## Nutrients in Blueberries 1.00 cup (148.00 grams)

Nutrient%Daily Value

vitamin K35.7%

manganese25%

vitamin C23.9%

fiber14.2%

Calories (84)4%

This chart graphically details the %DV that a serving of Blueberries provides for each of the nutrients of which it is a good, very good, or excellent source according to our Food Rating System. Additional information about the amount of these nutrients provided by Blueberries can be found in the [Food Rating System Chart](#). A link that takes you to the In-Depth Nutritional Profile for Blueberries, featuring information over 80 nutrients, can be found under the Food Rating System Chart.

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Health Benefits

In the popular press, blueberries have reached superstar status in terms of their unique health benefits. While we prefer to think of all 130 World's Healthiest Foods as rightful superstars, we can understand many of the special accolades being given to this wonderful berry. Most health research on blueberries involves their phytonutrient content. Anthocyanins - the colorful antioxidant pigments that give many foods their wonderful shades of blue, purple, and red - are usually the first phytonutrients to be mentioned in descriptions of blueberries and their amazing health-supportive properties. While it is true anthocyanins are pretty spectacular when it comes to blueberries and their support of our body systems, there are actually a wide variety of health support phytonutrients found in blueberries. Here is list that spotlights some of the better studied of these blueberry phytonutrients:

## BLUEBERRY PHYTONUTRIENTS

- Anthocyanins
  - malvidins
  - delphinidins
  - pelargonidins
  - cyanidins
  - peonidins
- Hydroxycinnamic acids
  - caffeic acids
  - ferulic acids
  - coumaric acids
- Hydroxybenzoic acids
  - coumaric acids
- Hydroxybenzoic acids
  - gallic acids
  - procatechuic acids
- Flavonols
  - kaempferol
  - quercetin
  - myricetin
- Other phenol-related phytonutrients
  - pterostilbene
  - resveratrol

Virtually all of the above-named phytonutrients function both as antioxidants and as anti-inflammatory compounds in the body, and they are responsible for many of the well-documented health benefits we get from regular consumption of blueberries.

## Whole Body Antioxidant Support

Given the wide variety of antioxidant nutrients present in blueberries, it is not surprising to find research studies showing improved antioxidant defenses in body systems that need special protection from oxidative stress, like the cardiovascular system. But what is

surprising about the blueberry research is its whole body relevance. It is not only the cardiovascular system that has been shown to have strengthened antioxidant status following consumption of blueberries. It is virtually every body system studied to date! For example, there is new evidence that damage to muscles following overly taxing exercise can be reduced through consumption of blueberries. There is also evidence that protection of the nervous system from oxidative stress can be accomplished by regular consumption of blueberries. These antioxidant-based protective effects have been shown in older adults at risk of neurodegenerative diseases, as well as in younger healthy adults and middle-aged obese adults. Antioxidant protection of the blood sugar regulatory system has also been demonstrated in blueberry intake studies, as has antioxidant protection of the digestive tract (especially with respect to the colon and its risk of cancer). It's this whole body antioxidant support that helps blueberries stand out as an amazing antioxidant fruit.

### Cardiovascular Benefits

Blueberry support of antioxidant defenses has been especially well documented with respect to the cardiovascular system. It's the many different pathways for cardio support that are so striking in the blueberry research. In repeated studies of blood composition, blueberry intake (usually in the amount of 1-2 cups per day and over the course of 1-3 months) has been shown to improve blood fat balances, including reduction in total cholesterol, raising of HDL cholesterol, and lowering of triglycerides. At the same time, blueberry intake has been shown to help protect the blood components (like LDL cholesterol) from oxygen damage that could lead to eventual clogging of the blood vessels. Protection has also been shown for the cells lining the blood vessel walls. Connected with this antioxidant protection of blood vessel structures and blood fats is an improved overall antioxidant capacity in the blood itself. Interestingly, the ability of blueberries to increase plasma antioxidant capacity seems to continue as blueberry intake goes up above everyday levels. For example, some studies have shown better total antioxidant capacity when 3 or more cups of blueberries were consumed per day as compared to a daily intake of 1-2 cups.

Recent research has added yet another factor to our understanding of blueberries and cardioprotection. That factor involves an enzyme called nitric oxide synthase (NOS). Most studies on NOS have focused on a form of NOS called inducible NOS, or iNOS. Excess formation of iNOS is generally associated with increased risk of inflammation. However, there is a second form of NOS called endogenous NOS, or eNOS. Increased activity of eNOS is usually associated with *better* balance in cardiovascular function. Recent studies have shown that daily blueberry intake can result in increased eNOS activity, and this result is viewed as helping to explain some of the unique health benefits of blueberries for the cardiovascular system.

It would be wrong to end a discussion of blueberries and cardiovascular health without talking about blood pressure. In both men and women, and in study participants of many different ages, routine blueberry intake has been shown to support healthy blood pressure. In individuals with high blood pressure, blueberry intake has significantly reduced both

systolic and diastolic blood pressures . In individuals with health blood pressure, blueberry intake has been shown to help maintain these healthy pressures.

### Cognitive Benefits

One of the most exciting new areas of research on blueberries is the area of cognitive benefits. In one study involving older adults (with an average age of 76 years), 12 weeks of daily blueberry consumption was enough to improve scores on two different tests of cognitive function including memory. While participants in the study consumed blueberries in the form of juice, three-quarters of a pound of blueberries were used to make each cup of juice. As participants consumed between 2 and 2-1/2 cups per day, they actually received a very plentiful amount of berries. The authors of this study were encouraged by the results and suggested that blueberries might turn out to be beneficial not only for improvement of memory, but for slowing down or postponing the onset of other cognitive problems frequently associated with aging.

Lab and animal research studies on blueberry intake suggest that a large part of this cognitive protection is most likely due to nerve cell protection from oxygen damage by blueberries' vast array of antioxidant nutrients. Nerve cells have a naturally high risk of oxygen damage and they require special antioxidant protection at all times in life. Their ability to send information throughout the body depends on the presence of balanced oxygen metabolism, and that balance cannot be achieved without ample intake of antioxidant nutrients. By lowering the risk of oxidative stress in our nerve cells, blueberries help us maintain smoothly working nerve cells and healthy cognitive function.

### Blood Sugar Benefits

Persons diagnosed with type 2 diabetes, metabolic syndrome, and insulin resistance have a special challenge with respect to blood sugar balance. In many cases, persons diagnosed with obesity also have special challenge maintaining a balanced blood sugar level. It's simply more difficult for these individuals to keep their blood sugar levels from spiking too high (or sometimes also from dropping down too low). Research on blood sugar balance and blueberry intake has been conducted on individuals who have been diagnosed with type 2 diabetes, metabolic syndrome, or insulin resistance, and the results of this research have been consistent. They have shown that blueberries (along with other berries) have a favorable impact on blood sugar regulation in persons already diagnosed with blood sugar problems.

When compared to other berries, blueberries are not particularly low in terms of their glycemic index (GI) value. Studies show the GI for blueberries falling somewhere in the range of 40-53, with berries like blackberries, raspberries, and strawberries repeatedly scoring closer to 30 than to 40. However, recent studies have shown that blueberries definitely function as a low-GI fruit in terms of their blood sugar impact. In one study on individuals diagnosed with type 2 diabetes, study participants who consumed at last 3 servings of low-GI fruits per day (including blueberries) saw significant improvement in

their regulation of blood sugar over a three-month period of time. Their blood levels of glycosylated hemoglobin, or HgA1C were used as the standard of measurement in this study.

The blood sugar benefits of blueberries should not be surprising. Even at 40-53 in terms of glycemic index, blueberries typically fall into the "low-GI" category of foods (usually defined as any food with a GI of 50 or below). They also provide a very good amount of fiber (nearly 4 grams per cup). Most low-GI foods with strong fiber content are foods we can count on to be helpful in blood sugar regulation.

### Eye Health

The retina of the eye is a unique place in our body and it is also a place that is at higher than normal risk of oxidative stress. Foods unique in phytonutrient antioxidants are often investigated for their ability to help protect the retina from oxygen damage, and blueberries are no exception! In preliminary studies on laboratory animals, the anthocyanins in blueberry protected the retina from unwanted oxygen damage. Interestingly, they have also been determined to help protect the retina from damage from sunlight. Like the area of cancer protection, we look forward to future research on human eye health and the potential for blueberry intake to help protect the human eye from damage by sunlight and oxidative stress.

### Anti-cancer Benefits

While almost exclusively coming in the form of laboratory studies on human cells or laboratory animal studies, an increasing percentage of the blueberry research is being focused on anti-cancer benefits. Types of cancer already studied with respect to blueberry intake include breast cancer, colon cancer, esophageal cancer, and cancers of the small intestine. We look forward to the results of large-scale human studies on the potential ability of blueberry intake to lower risk of these cancer types.

### Description

With flavors that range from mildly sweet (cultivated) to tart and tangy (wild), blueberries are nutritional stars bursting with nutrition and flavor while being very low in calories.

Blueberries are the fruits of a shrub that belong to the heath (*Ericaceae*) family whose other members include the cranberry and bilberry as well as the azalea, mountain laurel, and rhododendron. Blueberries grow in clusters and range in size from that of a small pea to a marble. They are deep in color, ranging from blue to maroon to purple-black, and feature a white-gray waxy "bloom" that covers the berry's surface and serves as a protective coat. The skin surrounds a semi-transparent flesh that encases tiny seeds. Blueberries are at their best from May through October when they are in season.

From a botanical perspective, all blueberries belong not only to the *Ericaceae* family of plants but also to the *Vaccinium* genus. Within this *Vaccinium* genus, however, are three very interesting groups of blueberries!

- **Highbush Blueberries:** These species are the most commonly cultivated forms of blueberries and the type we see most often in the grocery store. Included here are northern and southern highbush, which can grow as high as 12 feet in height in their native (uncultivated) state but when cultivated usually stay within a range of 4-7 feet. Highbush blueberries are also the kind you're most likely to find available for purchase at your local garden stores and plant nurseries. Cultivated highbush blueberries have often been hybridized to produce larger size berries, which U.S. consumers seem to prefer.
- **Lowbush Blueberries:** These species are commonly referred to as "wild blueberries." In their native state, they typically grow less than 2 feet in height and often stay even lower, at 8-12 inches from the ground. Lowbush species produce berries of a smaller size than highbush and even though they can be found growing wild in many parts of the U.S. are not commonly found in supermarkets.
- **Rabbiteye Blueberries:** These species are native to the southern U.S. and can grow up to 20 feet in height in their native state. They are less frequently cultivated than highbush blueberries, but when cultivated, the plant usually grows to heights of 4-10 feet.

All types of blueberries described above have found their way into agricultural practices around the world and are part of cuisines from Asia to the Mediterranean. Some varieties were originally transported to Europe and Asia from North America, but native varieties of blueberries can be found on all three continents.

## History

Blueberries hold a special place in the foods of North America, since more species of blueberries are native to North America than any other continent. While lowbush berries are native to other parts of the world — including Europe, the Mediterranean and Asia — highbush berries were originally found almost exclusively in North America. To this day, the United States cultivates and supplies over half of all blueberries on a global basis. (The next largest percentage of world production — about 30% — also belongs to a North American country, Canada.) Among the 275 million pounds of blueberries grown in the U.S. (out of 550 million pounds grown worldwide), Maine, Michigan, New Jersey, Oregon, and North Carolina are states most heavily involved in blueberry farming. Because of its special interest in lowbush blueberries, the state of Maine is actually the largest lowbush blueberry producer in the world.

Cultivation of blueberries was widespread among the Native American tribes throughout North America. European colonists learned about blueberries thanks to these Native American traditions and brought blueberry species back to Europe. Yet commercial cultivation of blueberries in Europe has been a relatively recent phenomenon limited to



the 20th and 21st centuries. Thanks to increasing cultivation in the Southern Hemisphere — including South American countries such as Chile, Argentina, and Uruguay as well South Africa, New Zealand and Australia — fresh blueberries are now enjoyed throughout the year on many of the world's continents.

One interesting current trend in history of blueberries has been their dramatically increased consumption within the U.S. In 1997, the average U.S. adult consumed about 13 ounces of blueberries per year. Ten years later, in 2007, that amount nearly doubled and reached an average level of 22 ounces. This increasing consumption of blueberries within the U.S. has led to cultivation of blueberries on almost 100,000 acres of land in the U.S., and has moved blueberries to second place as the most commonly eaten berry in the U.S. (second only to strawberry).

### How to Select and Store

Choose blueberries that are firm and have a lively, uniform hue colored with a whitish bloom. Shake the container, noticing whether the berries have the tendency to move freely; if they do not, this may indicate that they are soft and damaged or moldy. Avoid berries that appear dull in color or are soft and watery in texture. They should be free from moisture since the presence of water will cause the berries to decay. When purchasing frozen berries, shake the bag gently to ensure that the berries move freely and are not clumped together, which may suggest that they have been thawed and refrozen. Blueberries that are cultivated in the United States are available from May through October while imported berries may be found at other times of the year.

Before storing remove any crushed or moldy berries to prevent the rest from spoiling. Don't wash berries until right before eating as washing will remove the bloom that protects the berries' skins from degradation. Store ripe blueberries in a covered container in the refrigerator where they will keep for up to 3 days. If kept out at room temperature for more than a day, the berries may spoil.

Ripe berries can also be frozen, although this will slightly change their texture and flavor. Before freezing, wash, drain and remove any damaged berries. To better ensure uniform texture upon thawing, spread the berries out on a cookie sheet or baking pan, place in the freezer until frozen, then put the berries in a plastic bag for storage in the freezer.

Recent research has shown that fresh blueberries can be frozen without damaging their delicate anthocyanin antioxidants. There's no question about the delicate nature of many antioxidant nutrients found in blueberries. These antioxidants include many different types of anthocyanins, the colorful pigments that give many foods their wonderful shades of blue, purple, and red. After freezing blueberries at temperatures of 0°F (-17°C) or lower for periods of time between 3-6 months, researchers have discovered no significant lowering of overall antioxidant capacity or anthocyanin concentrations. Anthocyanins studied have included malvidins, delphinidins, pelargonidins, cyanidins, and peonidins. These findings should encourage you to consider freezing your blueberries if you have an

abundant seasonal supply but restricted access to fresh berries during other parts of the year.

### Tips for Preparing and Cooking

#### Tips for Preparing Blueberries

Fresh berries are very fragile and should be washed briefly and carefully and then gently patted dry if they are not organic. Wash berries just prior to use to not prematurely remove the protective bloom that resides on the skin's surface. If you know the source of either wild or organic berries try not to wash them at all.

When using frozen berries in recipes that do not require cooking, thaw well and drain prior to using.

Blueberries retain their maximum amount of nutrients and their maximum taste when they are enjoyed fresh and not prepared in a cooked recipe. That is because their nutrients - including vitamins, antioxidants, and enzymes - undergo damage when exposed to temperatures (350°F/175°C and higher) used in baking.