

# Flavonoids in Foods

There are several subtypes of flavonoids, and their food sources vary.

## Flavanols and Flavan-3-ols

Of all the flavonoid subgroups, flavanols are the largest, with more than 6,000 types. They include kaempferol, quercetin, myricetin, and fisetin compounds.<sup>2</sup>

Flavanols are found in a number of fruits and vegetables, including kale, lettuce, tomatoes, apples, grapes, and berries. Onions, garlic, and scallions contain high amounts of a particular flavanol called [quercetin](#), a plant pigment. Other sources of quercetin include cocoa, green tea, and red wine.<sup>3</sup>

Flavanols are also referred to as flavan-3-ols and can be additionally found in fruits such as bananas, peaches, and pears.<sup>1</sup>

## Flavones

Flavones are the primary pigment in cream-colored flowers and co-pigments in blue flowers and are also widely found in the leaves and fruiting bodies of plants. They act as a shield against ultraviolet light (UVB) in plants.

Compounds in flavones include apigenin, luteolin, baicalein, and chrysin.<sup>4</sup> Food sources include parsley, thyme, celery, hot peppers, and green olives.

## Flavanones

Flavanones are found in all citrus fruits, such as oranges and lemons, and grapes. They include the compounds hesperidin, naringenin, [diosmin](#), and eriodictyol. Flavanones are linked to several health benefits because of their free radical-scavenging properties.<sup>1</sup>

## Isoflavones

Isoflavones or isoflavonoids are found in soybeans and other legumes. Some isoflavones have also been found in microbes. Isoflavones have the potential to fight many diseases. Isoflavones like

genistein and daidzein are commonly regarded to be phytoestrogens because of their estrogen activity in certain animals.<sup>1</sup>

## Anthocyanins

Anthocyanins are pigments in plants, flowers, and fruits. Cyanidin, delphinidin, malvidin, pelargonidin, and peonidin are the most common. They're found in the outer cell layers of fruits like cranberries, black currants, red grapes, merlot grapes, raspberries, strawberries, blueberries, bilberries, and blackberries.<sup>1</sup>

## What Do Flavonoids Do?

Flavonoids are known for their health benefits. They have properties that inhibit oxidation, reduce inflammation, prevent gene mutations, and oppose cancer development. They also help regulate cellular enzyme functions (proteins that stimulate chemical reactions in cells).

These properties have beneficial health effects on diseases ranging from lowering blood pressure to cancer prevention.

## Cardiovascular Benefits and Reduce Blood Pressure

Cardiovascular disease is considered the number one killer across the globe. High blood pressure increases the risk of heart disease.

[Polyphenols](#) and flavonoids found in a wide variety of plants, including fruits and vegetables, are reported to provide positive benefits in treating heart disease and [high blood pressure](#).

Because of their antioxidant properties, flavonoids can reduce oxidation in [low-density lipoprotein](#) (LDL—the "bad" cholesterol) and help improve [lipid profiles](#). This can lower the risk of cardiovascular disease.

Another positive effect is their capacity to aid in vasodilation (blood vessel dilation) and regulate the programmed cell death process in the [endothelium](#) (the inner lining of blood vessels).

Studies show that these effects are due to flavonoids' antioxidant properties, but recent research has shown multiple signaling pathways linked to them, suggesting more mechanisms are involved in flavonoids' effects.<sup>5</sup>

## Reduce Risk of Diabetes

[Diabetes mellitus](#) is recognized by increased levels of blood glucose or an increase in [insulin resistance](#). Consuming foods rich in flavonoids regulates carbohydrate digestion, insulin signaling and secretion, glucose uptake, and fat deposits.

Flavonoids target molecules that improve beta-cell proliferation (the cells in the pancreas that make insulin), promote insulin secretion, reduce apoptosis (programmed cell death), and improve [hyperglycemia](#) by regulating glucose metabolism in the liver.<sup>6</sup>

A study of 200,000 people assessed the link between dietary intake of flavonoids and its subclasses and type 2 diabetes. It confirmed that consuming more anthocyanins from apples, blueberries, and pears lowers the risk of diabetes.<sup>6</sup>

## Cancer Prevention

Studies show flavonoids wield anticancer activity and hunt free radicals that can damage large molecules, including DNA. Other anticancer activities include:<sup>3</sup>

- Obstructing enzymes involved in the metabolism of compounds including drugs, toxins, procarcinogens, and steroid hormones, which may prevent them from being transformed into carcinogenic chemicals, and may also lead to them being excreted by the body.
- DNA repair, or activation of pathways leading to apoptosis (programmed cell death) in case of irreversible DNA damage
- Hindering tumor invasion and angiogenesis (forming a blood supply for a tumor)
- Regulate cellular metabolism and prevent oxidative stress-related diseases

## Management of Chronic Pain and Inflammation

Studies show the therapeutic role of flavonoids in cardiovascular diseases, osteoarthritis, Parkinson's disease, colitis, cancer pain, arthritis, and neuropathic pain as powerful anti-inflammatory, analgesic (pain-relieving), and antioxidative molecules.

Flavonoids block many cellular regulatory proteins like cytokines and transcription factors (proteins involved in the process of converting, or transcribing, DNA into RNA). This results in a reduced cellular inflammatory response and less [chronic pain](#).<sup>7</sup>

## Treatment of Viral Infections

Flavonoids are recognized to be effective antivirals and can act at different stages of viral infection, specifically at the molecular level to hinder viral growth.

Flavonoids that impede viral activity can be further divided into the following sub-categories:<sup>8</sup>

- Flavonoids that bind to specific extracellular regions of the virus, such as viral proteins present on the protein shell of the virus.
- Flavonoids that stop attachment or entry of the virus into host cells; in some cases, flavonoids can bind to virions (the infective form of the virus outside a host cell), modify the virus's structure, and stall the process of viral uncoating.
- Flavonoids that can impede viral infections by interfering with host factors required for successful infection or regulating the immune system to reduce the viral load.

## Protect Against Cognitive Disease

Because of their anti-inflammatory properties and fighting free radicals, researchers believe that flavonoids may help the brain by providing protection to brain cells.<sup>9</sup>

Animal studies show that flavonoids block beta-amyloid plaque build-up in the brain, a sign of [Alzheimer's disease](#). In addition, flavonoids may increase blood flow to the brain, which provides dual benefits to both the cardiovascular system as well as the brain.<sup>9</sup>

Although human studies are in the early phases, findings seem positive. A study in *The American Journal of Clinical Nutrition* linked high consumption of flavonoids to a reduced risk of Alzheimer's disease and dementia.<sup>10</sup>

Using data from the Framingham Heart Study, researchers examined the dietary habits of nearly 3,000 people, average age 59, without any signs of dementia. Over a 20-year span, people who had the highest consumption of flavonoids (about 297 milligrams) had a reduced risk of developing Alzheimer's or dementia compared to those who ate about 123 milligrams.<sup>10</sup>

# Dosage and Treatment With Flavonoids

While it is best to get flavonoids from the diet in fresh fruits and vegetables, there are several dietary supplements that can be purchased at a local health food store or drug store. A major caveat is that each brand's flavonoid content may vary per dose.

The following list provides doses for each subcategory:<sup>3</sup>

- **Anthocyanins**: [Bilberry](#), [elderberry](#), black currant, blueberry, red grape, and mixed berry extracts are available as dietary supplements. No prescription is required in the United States. The anthocyanin content of these products may vary.
- **Flavan-3-ols**: Several tea extracts are available in the U.S. as dietary supplements. Green tea extracts are the most common. Some contain caffeine, while others are decaffeinated. Check the label or consult the manufacturer to determine the amounts of flavan-3-ols and caffeine to be consumed daily.
- **Flavanones**: Citrus bioflavonoid supplements may contain glycosides of hesperetin ([hesperidin](#)), naringenin (naringin), and eriodictyol (eriodictin). Hesperidin is also available in hesperidin-complex supplements, with daily doses from 500 milligrams (mg) to 2 grams (g).
- **Flavones**: Citrus fruit peels and tissues are rich in flavones. Although consumption of these flavones is low, they are found in citrus bioflavonoid complex supplements. Check the labels for recommended dose.
- **Flavonols**: The flavonols aglycone, quercetin, and its glycoside rutin are available as dietary supplements without a prescription in the U.S. Citrus bioflavonoid supplements may also contain quercetin or [rutin](#). Check the label for recommended dose.
- **Isoflavones**: A 50-milligram soy isoflavone supplement typically includes genistein (genistin; 25 milligrams), daidzein (daidzin; 19 milligrams), and glycitein (glycitin; about 6 milligrams). Smaller amounts of daidzein, genistein, and formononetin are also found in biochanin A-containing supplements (derived from red clover).

## Drug Interactions

It is important to discuss any supplements you wish to take with your healthcare professional. These compounds can interact with prescription and non-prescription medications, which may result in too little or too much effect of the drugs.

Certain flavonoids impede ATP-binding cassette (ABC) drug transporters including P-glycoprotein. Taking them as supplements or consuming very large amounts of them could increase the toxicity of drugs that are substrates of P-glycoprotein.<sup>3</sup> These drugs include calcium channel blockers, cyclosporin, digoxin, and erythromycin.

Many anthocyanins and anthocyanidins, as well as some flavones, isoflavones, flavonols, and flavanones, have been identified as inhibitors of BRCP-mediated transport. They may interact with drugs like anticancer agents, antibiotics, beta-blockers, and antiarthritics.

Also, certain flavonols, flavanones, flavones, and isoflavones, have been reported to inhibit multidrug resistance protein, which may affect MRP-mediated transport of many anticancer drugs.<sup>3</sup>

## Summary

Fruits, vegetables, grains, bark, roots, stems, flowers, tea, and wine are rich in flavonoids, which are known for their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties, along with their capacity to regulate key cellular enzyme function.

Their beneficial health effects may help reduce blood pressure, reduce the risk of diabetes, prevent tumor development, reduce inflammation, and protect against cognitive diseases. Before taking any flavanoids as supplements, talk to your doctor to avoid potential drug interactions.

## A Word From Verywell

Eating a diet rich in a variety of fruits and vegetables is a natural way to get the benefits of flavonoids. Look for colorful ones and branch out to try new ones. This can make your meals more interesting as well as bring health benefits.