

Facts about Flavonoids¹

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What Are Flavonoids?

Flavonoids are organic compounds that occur naturally in plants. More than five thousand flavonoid compounds exist in nature, but those found in foods fall into six major categories: flavonols, anthocyanidins, isoflavones, flavan-3-ols, flavones, and flavonones (Erdman et al. 2007). The compounds in these categories are of interest because of their potential health benefits.

Flavonols (FLAY-vo-nols)

Flavonols are the most commonly known and widespread flavonoids found in food (Erdman et al. 2007). Recent studies have shown that eating foods high in flavonols may reduce the risk for heart disease (Peterson et al. 2012). Flavonols can be found in small amounts in a variety of fruits and vegetables, although some foods are better sources than others. Some of the best-known sources of flavonols are listed in the table below (Bhagwat, Haytowitz, and Holden 2013).

Table 1. Flavonol content*

Food Source	Flavonols (mg/serving)
Kale, 1 cup	62
Onions, raw, 1 cup	42
Broccoli, raw, 1 cup	10
Apple, with skin, 1 small (4 oz.)	6
mg = milligrams; oz = ounces	
*Source: USDA Database for the Flavonoid Content of Selected Foods Release 3.1	



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Anthocyanidins (AN-tho-sigh-an-ah-dins)

Anthocyanidins are the compounds that give many fruits and vegetables their red, blue, or purple color. They are thought to protect the body from free radicals. Free radicals are unstable molecules that damage healthy cells. An imbalance between free radicals and the body's ability to protect itself against these damaging particles results in oxidative stress. Anthocyanidins act as strong antioxidants by neutralizing free radicals (Erdman et al. 2007). This reduces the oxidative stress on the body and cellular damage. For more information on antioxidants, see the EDIS publication [Facts about Antioxidants](#).

The anthocyanidin content of fruits and vegetables is highest in the fresh/raw form of these foods. For example, cranberries have a very high anthocyanidin content, but cranberry sauce and cranberry juice or cocktail contain

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very low amounts. This is mainly because the heat used in cooking and processing greatly reduces the flavonoid content of foods. Also, the production of fruit juice usually involves steps aimed at removing flavonoids in order to avoid discoloration (Manach et al. 2004). The best-known sources of anthocyanidins are listed below (Bhagwat et al. 2013).

Table 2. Anthocyanidin content*

Food Source	Anthocyanidins (mg/serving)
Blueberries, fresh, 1 cup	242
Sweet cherries, fresh, 1 cup	110
Cranberries, fresh, 1 cup	101
Red cabbage, raw, 1 cup	65
mg = milligrams	
*Source: USDA Database for the Flavonoid Content of Selected Foods Release 3.1	



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Isoflavones (I-so-FLAY-vones)

Isoflavones are found mostly in soybeans and other soy products such as soy milk and tofu (Bhagwat, Haytowitz, and Holden 2008). Several studies have reported that isoflavones reduce LDL (“bad”) cholesterol levels and may reduce the risk for heart disease, bone disease (osteoporosis), and certain cancers (Kucuk, Lampe, and Messina 2006). The isoflavone contents of some popular foods are listed below (Bhagwat et al. 2008).

Table 3. Isoflavone content*

Food Source	Isoflavones (mg/serving)
Soynuts (dry roasted mature soybeans), 1/2 cup	69
Tofu, fried, 4 oz.	39
Edamame (cooked green soybeans), 1 cup	28
Soy milk, original or vanilla flavor, 1 cup	26
mg = milligrams; oz = ounces	
*Source: USDA Database for the Isoflavone Content of Selected Foods Release 2.0	

Flavan-3-ols (FLAY-vahn-three-ols)

Similar to anthocyanidins, flavan-3-ols are known for having strong antioxidant power and are thought to promote heart health (Engler and Engler 2006). The best-known sources for flavan-3-ols are listed below (Bhagwat et al. 2013).

Table 4. Flavan-3-ols content*

Food Source	Flavan-3-ols (mg/serving)
Black tea, brewed, 1 cup	273
Blueberries, fresh, 1 cup	38
Dark chocolate, 1 oz.	30
Red wine (Cabernet Sauvignon), 5 oz. glass	27
mg = milligrams; oz = ounces	
*Source: USDA Database for the Flavonoid Content of Selected Foods Release 3.1	



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While black tea, red wine, and dark chocolate all contain compounds that may be heart-healthy, they should be consumed in moderation. For example, due to the caffeine content of tea, drinking more than five cups of black tea per day may cause unwanted side effects. These effects may include headaches, vomiting, and diarrhea (MedlinePlus 2012).

Consuming too much wine also can have negative effects, due to wine’s alcohol content. The 2010 US Dietary Guidelines for Americans recommend that if alcohol is consumed, it should be in moderation, which is defined as one glass per day for women and two glasses per day for men. Women who are pregnant and people with certain chronic diseases, such as liver disease or pancreatitis, are advised to avoid alcohol (USDA and DHHS 2010).

Dark chocolate, while rich in flavonoids, is high in fat and calories. To get the most from chocolate while avoiding excess energy intake, limit yourself to small, bite-size pieces

of chocolate, and choose dark chocolate as opposed to milk chocolate.

Flavones and Flavanones

Although flavones and flavanones have been identified as types of flavonoids, more research needs to be done regarding their potential health benefits. Several studies have suggested that flavones, found mainly in green herbs like parsley and many citrus fruits, may protect against heart disease (Yochum et al. 1999; Hertog et al. 1993; Hirvonen et al. 2001). However, a study conducted in Finland showed no effect of flavanones on heart disease risk (Knekt et al. 2002), so the health effects of flavanones are still unclear.

Take-Home Message

Studies suggest that a diet containing foods high in flavonoids may reduce the risk of heart disease and certain cancers. However, more research must be done before specific intake recommendations can be made. To reap the potential benefits of flavonoids, choose fruits and vegetables known to be good sources of flavonoids and follow the US Dietary Guidelines for Americans, which recommend eating at least 2.5 cups of vegetables and fruits per day (USDA and DHHS 2010). An easy way to accomplish this is by aiming to make half of your plate fruits and vegetables (USDA and CNPP 2011).

References

- Bhagwat, S., Haytowitz, D. B., & Holden, J. M. (2008). *USDA Database for the Isoflavone Content of Selected Foods Release 2.0*. Beltsville, Maryland: U.S. Department of Agriculture.
- Bhagwat, S., Haytowitz, D. B., & Holden, J. M. (2013). *USDA database for the flavonoid content of selected foods Release 3.1*. Beltsville, Maryland: U.S. Department of Agriculture.
- Buijsse B, Weikert C, Drogan D, Bergmann M, & Boeing H. (2010). Chocolate consumption in relation to blood pressure and risk of cardiovascular disease in German adults. *European Heart Journal*, 31, 1616–1623.
- Engler, M. B., & Engler, M. M. (2006). The emerging role of flavonoid-rich cocoa and chocolate in cardiovascular health and disease. *Nutrition Reviews*, 64, 109-118.
- Erdman, J. W., Balentine, D., Arab, L., Beecher, G., Dwyer, J.T., Folts, J., Harnly, J., Hollman, P., Keen, C.L., Mazza, G., Messina, M., Scalbert, A., Vita, J., Williamson, G., & Burrowes, J. (2007). Flavonoids and heart health: proceedings of the ILSI North America Flavonoids Workshop May 31-June 1, 2005, Washington DC. *Journal of Nutrition*, 137(3), 718S-737S.
- Hertog, M., Feskens, E., Hollman, P., & Katan, M. (1993). Dietary antioxidant flavonoids and risk of coronary heart disease: The Zutphen elderly study. *Lancet*, 342(8878), 1007-1011.
- Hirvonen, T., Pietinen, P., Virtanen, M., Ovaskainen, M., Häkkinen, S., Albanes, D., & Virtamo, J. (2001). Intake of flavonols and flavones and risk of coronary heart disease in male smokers. *Epidemiology*, 12(1), 62-67.
- Knekt, P., Kumpulainen, J., Jarvinen, R., Rissanen, H., Heliovaara, M., Reunanen, A., & Aromaa, A. (2002). Flavonoid intake and risk of chronic diseases. *American Journal of Clinical Nutrition*, 76, 560-8.
- Kucuk, O., Lampe, J. W., & Messina, M. (2006). An overview of the health effects of isoflavones with an emphasis on prostate cancer risk and prostate-specific antigen levels. *Journal of AOAC International*, 89, 1121. Retrieved from <http://go.galegroup.com/ps/i.do?id=GALE%7CA179978394&v=2.1&u=gain40375&it=r&p=AONE&sw=w>.
- Manach C., Scalbert A., Morand C., Remesy C., & Jimenez L. (2004). Polyphenols: Food sources and bioavailability. *American Journal of Clinical Nutrition*, 79, 727–747
- MedlinePlus (2012). Black Tea. Retrieved from <http://www.nlm.nih.gov/medlineplus/druginfo/natural/997.html>.
- Peterson, J. J., Dwyer, J. T., Jacques, P. F., & McCullough, M. L. (2012). Associations between flavonoids and cardiovascular disease incidence or mortality in European and US populations. *Nutrition Reviews*, 70, 491-508.
- US Department of Agriculture. Center for Nutrition Policy and Promotion (2012) *Make half your plate fruits and vegetables*. Retrieved from <http://www.choosemyplate.gov/downloads/FruitsAndVeggiesMiniPoster.pdf>.
- United States Dietary Guidelines Advisory Committee, United States Dept. o. A., United States Dept of Health and Human Services, & United States Office of Disease Prevention and Health Promotion. (2010). *Dietary guidelines for Americans*. Washington, D.C: U.S. Dept. of Health and Human Services: U.S. Dept. of Agriculture.

Yochum, L., Kushi, L., Meyer, K., & Folsom, A. (1999).
Dietary flavonoid intake and risk of cardiovascular disease
in postmenopausal women. *American Journal of Epidemiol-
ogy*, 149(10), 943.