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File: ■ Black Chokeberry (*Aronia melanocarpa*, Rosaceae)
■ Chronic Disease

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RE: Review of Black Chokeberry—Bioactivities of Phenolic-rich Fruit May Contribute to Prevention of Chronic Diseases

Jurikova T, Mlcek J, Skrovankova S, et al. Fruits of black chokeberry *Aronia melanocarpa* in the prevention of chronic diseases. *Molecules*. June 7, 2017;22(6):944. doi: 10.3390/molecules22060944.

Bioactive plant-derived compounds, especially phenolics with high antioxidant activity, are increasingly shown to be beneficial in preventing and treating chronic diseases. Black chokeberry (*Aronia melanocarpa*, Rosaceae) fruit has high levels of antioxidants, especially anthocyanins in the form of cyanidin derivatives. Black chokeberry fruit also contains other beneficial compounds such as vitamins C and E, carotenoids, pectins, and organic acids, as well as essential minerals (potassium, calcium, and magnesium).

Black chokeberry is native to eastern North America, from the Great Lakes to New England and higher altitudes of the Appalachians. Its fruits were used by Native Americans to treat colds. Introduced to Russia in the early 1900s, black chokeberry soon spread throughout the country, and in the early 20th century was introduced to other European nations, especially in Eastern Europe and Scandinavia. Several cultivars with larger and sweeter fruit have been developed in Northern and Eastern Europe, of which two, "Viking" and "Nero," are available in the United States. A high tannin level and astringent taste limit black chokeberry's popularity as a fresh fruit. It is widely used as a food colorant and flavoring; in teas (infusions), juices, jams, purees, etc.; and as a source of compounds for nutritional supplements. Its pomace is rich in bioactives.

The authors summarize black chokeberry fruit's composition and the bioavailability, antioxidant properties, and health-promoting benefits of its compounds in relation to chronic diseases. They do not describe search methods for the information presented.

Polyphenols are the major bioactive compounds of black chokeberry. These dietary antioxidants can scavenge free radicals, a cause of oxidative stress, which causes chronic inflammation and thereby increases the risk of diseases including atherosclerosis, cancer, and neurodegenerative conditions. Black chokeberry fruit's total phenolic (TP) content is in the range of 690-2560 mg gallic acid equivalents (GAE) per 100 g fresh weight. This is higher than for many better-known berry crops, including blueberry (*Vaccinium* spp., Ericaceae), red raspberry (*Rubus idaeus*, Rosaceae), red currant (*Ribes rubrum*, Grossulariaceae), strawberry (*Fragaria* × *ananassa*, Rosaceae), "blackberry" (*Rubus fruticosus*; also a generic common name for an edible fruit produced

by many *Rubus* spp.), and cranberry (*V. macrocarpon*), and comparable to the TP content of bilberry (*V. myrtillus*) and hawthorn (*Crataegus monogyna*, Rosaceae) fruit. As in other phenolic-producing plants, black chokeberry's TP content and levels of specific phenolic compounds vary with cultivar and genotype, growth conditions, maturity at harvest, extraction and/or processing methods, and storage. The highest levels of phenolic compounds are found in the "Hugist" cultivar; the lowest, in "Aron." Average concentration of phenolics in pomace is about five times that in black chokeberry juice. The most important phenolic compounds in black chokeberry fruits are phenolic acids, especially hydroxycinnamic acids, and flavonoids, including flavanols (epicatechin), flavonols (mainly quercetin glycosides), anthocyanins, and proanthocyanidins. While intestinal absorption of black chokeberry polyphenols is very poor, metabolization into other compounds allows for their beneficial effects. Quantities and proportions of individual phenolics vary among cultivars and plant parts, and are affected by extraction/processing and storage methods. The relative antioxidant activities of different extracts and products are detailed. Compared with black chokeberry cultivars "Viking" and "Aron," purple chokeberry (*Aronia* × *prunifolia*) dried berries had higher antioxidant activity. It is noted that black chokeberry's lipophilic antioxidant capacity is quite low. Its hydrophilic antioxidant capacity, along with black currant (*Ribes nigrum*) and elderberry (*Sambucus* spp., Adoxaceae), is among the highest of berry fruits.

Black chokeberry exerts anti-inflammatory, antiatherosclerotic, hypotensive, anticoagulant, antithrombotic, and antiplatelet activities, making it especially valuable for cardiovascular health. It also has immunomodulatory, antiviral, and antibacterial effects. Black chokeberry extract decreases the expression of genes for cholesterol synthesis, uptake, and efflux dose-dependently in humans. It is known for its gastroprotective effects, especially against peptic ulcer, and for its antidiabetic effects, improving fasting glucose and lipid profiles. Anthocyanins may help prevent obesity and, by inhibiting α-glucosidase and α-amylase activities, reduce postprandial hyperglycemia. *Aronia* spp. extracts benefit risk factors related to insulin resistance, modulating multiple associated pathways. Black chokeberry anthocyanins can normalize carbohydrate metabolism. The anticancer effects of black chokeberry also operate through numerous pathways and mechanisms, including induction of detoxication enzymes, induction of cell cycle arrest apoptosis, and changes in cellular signaling. In vitro, it retards or halts the growth of human breast, leukemia, colon, and cervical cancer lines. Black chokeberry may reduce oxidative stress in patients with cancer before and after surgery. Different extracts and polyphenolic compounds may affect different cancer cell lines more or less strongly. Overall, black chokeberry, like other less-utilized berry crops, offers many positive benefits for prevention and treatment of chronic diseases. While some human trials are mentioned, more research is clearly warranted.

—Mariann Garner-Wizard

Referenced article can be accessed at www.mdpi.com/1420-3049/22/6/944/pdf.