
Amelanchier alnifolia

Scientific Name

Amelanchier alnifolia (Nutt.) Nutt. Ex M. Roem.

Synonyms

Amelanchier canadensis var. *alnifolia* (Nutt.) Torr. & A. Gray, *Amelanchier carrii* Rydb., *Amelanchier leptodendron* Lunell, *Amelanchier macrocarpa* Lunell, *Amelanchier sanguinea* var. *alnifolia* (Nutt.) P. Landry, *Aronia alnifolia* Nutt.

Family

Rosaceae

Common/English Names

Alder Leaf Shadbush, Mountain Juneberry, Pacific Serviceberry, Rocky Mountain Blueberry, Saskatoon, Saskatoon Berry, Saskatoon Serviceberry, Serviceberry, Sarvisberry, Shadbush, Juneberry, Western Serviceberry, Western Shadbush.

Vernacular Names

Canada: Hlighag, Saskatoon, Sgan Gam (Indigenous);

Czech: Muchovník Olšolistý;

Danish: Ellebladet Bærmispel;

Eastonian: Lepalehine Toompihlakas;

Finnish: Marjatuomipihlaja;

French: Amélanhier À Feuilles D'aulne;

German: Erlenblättrige Felsenbirne;

Icelandic: Hlíðaramall;

Norwegian: Tagglåhegg;

Swedish: Bärhäggmispel, Grovsågad Häggmispel, Sen Häggmispel, Västamerikansk Häggmispel.

Origin/Distribution

This species is native to North America from Alaska, Western Canada and western (southwards to North California, Utah and Colorado) and north central United States. In Canada, the species is found in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, North West Territories and Nunavut.

Agroecology

In its native range, it is found in thickets, woodland margins, banks of streams, canyons and hill-sides from plains to subalpine, from sea level to 3,000 m altitude. It is frost resistant to -20°C . It prefers a rich, well-drained loamy soil in but will grow in any sandy or clayey soil that is not water-logged or too dry. It is quite drought tolerant and is also salt tolerant. It thrives in a sunny position or semi-shade.

Edible Plant Parts and Uses

Ripe fruit is edible and is sweet with a hint of apple. The ripe fruit is eaten fresh out of hand or baked into pies, pastries, processed into preserves, jams, jellies, spreads or dried and used like raisins in cereals and snack food. The fruits are also made into cider, wine, beer, or tea. The Canadian indigenous people used the fruit in soups, stews, meat dishes, dried cakes and in a dried meat preparation called *pemmican* to which serviceberries are incorporated to impart flavour and to act as preservative. Saskatoon berry juice was used to marinate other foods such as black tree lichen or roots to sweeten them (Turner 1997). The advent of new and innovative methods of processing, freezing and packaging have greatly increased fruit uses and growers in Canada are promoting it as a superfruit like the berry fruits.

The leaves are used as a substitute for tea.

Botany

A deciduous, multi-stemmed shrub or small tree, mostly 1–5 m high with a fastigate crown and smooth ashy-gray bark. Twigs are slender, reddish-brown becoming glabrous during flowering. Leaves are alternate, simple, oval-obovate to nearly round, 2–5 cm long by 1.8–4 cm wide, pinnately-veined with a rounded to sub-acute apex, rounded bases, finely serrated margin, and born on 1–2 cm long petioles (Plate 1). Very young leaves are conduplicate in bud; less than half-expanded and unfolded, pubescent abaxially. Inflorescences in erect racemes with 4–20-flowers. Flower has a campanulate hypanthia, pubescent sepals erect or loosely spreading after flowering, 5 white broadly linear to oblong, 1–2 cm petals, 15–20 stamens, glabrous to pubescent ovary with 5 styles. Fruit a pome, globose to subglobose, 7–15 mm across, glabrous, wax-coated, maroon-purple, juicy and sweet (Plate 1).



Plate 1 Leaves and young developing fruits

Nutritive/Medicinal Properties

Saskatoon berries appear to be an excellent source of manganese, magnesium and iron and a relatively good source of calcium, potassium, copper, and carotene (Mazza 1982). Proximate nutrient value of raw Saskatoon berries per 100 g edible portion (dwb) was reported as: water 80 g, protein 9.7 g, fat 4.2 g, fibre 19 g, total sugars 11.4 g, Ca 0.44 g, P 0.16 g, Mg 0.2 mg, S 0.06 g, Fe 67.5 pp, NA 31.8 ppm, Mn 67.5 ppm, Cu 7.23 ppm, Zn 16.5 ppm, Ba 34.8 mg, Mo 0.38 mg, Al 74.5 mg, carotene 29.7 ppm (Mazza 1982). In a subsequent paper, Mazza (2005) reported the following nutrient composition in raw saskatoon berries per 100 g value, total dietary fibre 5.9 g, total sugars 11.4 g, Ca 42 mg, Fe 1 mg, Mn 1.4 mg, K 162 mg, Na 0.5 mg, vitamin C 3.6 mg, vitamin A 11 IU, vitamin E 1.1 mg, folate 4.6 µg, riboflavin 3.5 mg, pantothenic acid 0.3 mg, pyridoxine 0.03 mg and biotin 20 µg.

Total solids content in saskatoon berries ranged from 20% to 29.4% fresh weight with 15.9–23.4% sucrose and 8–12% reducing sugars (Mazza 1979, 1982). Wolfe and Wood (1972) found that the sugar content increased slowly as the fruit matured and then accelerated considerably before ripening. They found that fructose content decreased greatly (25%) after the fruit ripened while the glucose content remained

unaltered. Anthocyanins, total phenolics, sugars, sugars-acids ratios and anthocyanins-phenolics ratios in Saskatoon berries (*Amelanchier alnifolia*) increased with fruit ripening (Green and Mazza 1986). Titratable acidity and pH differed among cultivars but showed little change with fruit development. Anthocyanin contents ranged from 25.1 to 178.7 mg/100 g fruit, while total phenolics and soluble solids ranged from 0.17% to 0.52% and 9.6–18.7%, respectively. Significant correlation with anthocyanins was observed for total phenolics content, titratable acidity, pH and sugar-acid ratio. The results suggested that high contents of anthocyanins in Saskatoon berries were associated with high total phenolics and acids and low pH and sugar-acid ratios. The pH values of fruit ranged from 4.2 to 4.4 and titratable acidity values (% malic acid) from 0.36% to 0.49% (Mazza 1979; Green and Mazza 1986). The major acid in saskatoon berries was malic acid (Wolfe and Wood 1972) and the predominant aroma component was found to be benzaldehyde (Mazza and Hodgins 1985). The total anthocyanin content in fresh saskatoon berries was found to be 86–125 mg/100 g of fresh berries (Mazza 1982). The main anthocyanins identified were cyanidin 3-galactoside, (61% of the total anthocyanins) and cyanidin 3-glucoside (21%). Also detected were cyanidin 3-xyloside, chlorogenic acid and rutin. Hellström et al. (2007) found that saskatoon berries contained proanthocyanidins from dimers through heptamers and higher polymers. Saskatoon proanthocyanidins were generally of the procyanidin type, consisting mainly of epicatechin units linked by B-type bonds. Bakowska-Barczak et al. (2007) found saskatoon berries to have the following anthocyanidins: cyanidin, delphinidin, pelargonidin, petunidin, peonidin, and malvidin.

Ozga et al. (2007) characterised the following phenolic compounds in Saskatoon berries: cyanidin 3-O-galactoside, cyanidin 3-O-glucoside, cyanidin 3-O-arabinoside, and cyanidin 3-O-xyloside identified as the four major anthocyanins in mature fruit. The quercetin-derived flavonols, quercetin 3-O-glucoside, quercetin 3-O-galactoside, quercetin 3-O-arabinoside, quercetin 3-O-xyloside, quercetin 3-O-arabinoglucoside,

quercetin 3-O-robinobioside, and quercetin 3-O-rutinoside were also identified in mature fruit extracts. In addition, two chlorogenic acid isomers (hydroxycinnamates), 3-O-caffeoylquinic acid and 5-O-caffeoylquinic acid were detected. The total content of the anthocyanin-, flavanol-, and hydroxycinnamate-type phenolics detected in mature 'Smoky' saskatoon fruit was 140, 25, and 96 mg/100 g fresh weight, respectively.

Studies by Hosseinian and Beta (2007) showed Saskatoon berries and wild blueberries to have high potential value for fruit growers as well as the food and nutraceutical manufacturers because of their high anthocyanin contents. The total anthocyanin content of Manitoba fruits followed the order: Saskatoon berry and blueberry (high anthocyanin berries), raspberry and chokecherry (medium anthocyanin berries), strawberry (low anthocyanin berries), and seabuckthorn (negligible anthocyanin berries). Saskatoon berry and wild blueberry presented a high content of total anthocyanins (562.4 and 558.3 mg/100 g, respectively). Saskatoon berry and wild blueberry contained higher amounts of delphinidin 3-glucoside (Dp-3-glc), malvidin 3-glucoside (Mv-3-glc), and malvidin 3-galactoside (Mv-3-gal). Dp-3-glc was 263.8 (mg/100 g) in Saskatoon berry and 84.4 (mg/100 g) in wild blueberry, whereas the corresponding values for Mv-3-glc in these berries were 47.4 and 139.6 (mg/100 g), respectively.

Lutein was found to be the predominant carotenoid in mature (purple) berries of 5 saskatoon cultivars ranging from a low value of about 300 to a high of 1,000 µg/100 g of fresh berries (Mazza and Cottrell 2008). The corresponding values for zeaxanthin were 60–120 µg/100 g of fresh berries. Levels of lutein, zeaxanthin and β-carotene were much higher in the green berries (48,000–146,000 µg/100 g, fresh weight (FW)) than in the more mature fruit. In mature fruit, the Smoky berries from Alberta had in general higher levels of lutein, zeaxanthin and β-carotene than the other varieties. Two cyanogenic glucosides, prunasin and amygdalin, was also detected in all saskatoon berries analyzed. In all varieties, the levels of the two glucosides were very low in the green stage and then essentially the same for the following maturity stages. In mature (purple)

berries the content of amygdalin ranged from 43 to 129 mg/kg of fresh berries, and the content of prunasin was 5–19 mg/kg FW. Prunasin a cyanogenic glycoside was also detected in twigs and leaves especially during flowering (Majak et al. 1981). Cooking or drying destroys the cyanogenic glycoside in the leaves (Kershaw 2000).

The seed oil content of 17 cultivars of Saskatoon berries was found to vary from 9.4% (cv. 'Pasture') to 18.7% (cv. 'Thiessen') (Bakowska-Barczak et al. 2009). The seed oils contained mainly linoleic acid in the range from 47.3% (cv. 'Success') to 60.1% (cv. 'Lee 3') and oleic acid in the range from 26.3% (cv. 'Lee 3') to 38.1% (cv. 'Success'). The total tocopherol content varied from 1,053 to 1,754 mg/kg of oil. α -tocopherol was the predominant vitamin E compound in all berry seed oils, accounting for 87% of total tocopherols. The major sterols were β -sitosterol, $\delta(5)$ -avenasterol, and campesterol. The sterols content in seed oil varied from 7,357 mg/kg of oil (cv. 'Success') to 15,771 mg/kg of oil (cv. 'Lee 3'). Thirteen triacylglycerols (TAG) were identified in the seed oils, among which LLL, LLO, LOO, LLP, LOP (L, linoleoyl; O, oleoyl; P, palmitoyl) represented 88% of the total TAG. TAG composition suggested good oxidative stability of the Saskatoon berry seed oil, which could be suitable for food and industrial applications. The authors also maintained that Saskatoon berry seed oil may serve as potential dietary source of tocopherols, sterols, and unsaturated fatty acids.

Antioxidant Activity

Two cultivars (Thiessen and Smoky) of Saskatoon berries were found to possess free radical scavenging activities in a concentration-dependent manner (Hu et al. 2005). Cultivar Thiessen exhibited higher activity compared to cv. Smoky due to its relatively abundant anthocyanin content. Total anthocyanin content significantly correlated to free radical scavenging activities. It was found that the free radical scavenging components, i.e., anthocyanin, occurred predominantly in the ethyl acetate and n-butanol extracted fractions,

suggesting that active components were more likely to occur in glycoside forms. HPLC subsequently confirmed the existence of cyanidin-3-O-galactoside and cyanidin-3-O-glucoside as leading anthocyanins in the Saskatoon berries. In addition, Saskatoon berries extracts from both cultivars inhibited peroxy-radical induced intracellular oxidation in a concentration-dependent fashion without affecting cell viability.

The polyphenol contents and antioxidant activities were assessed for 17 Saskatoon berry cultivars grown in Canada in fresh and stored fruits at -20°C for 9 months. Of 17 Saskatoon berry cultivars, the Nelson cultivar was the richest in total polyphenol, anthocyanin, and procyanidin contents (801, 382, and 278 mg/100g fresh weight, respectively) (Bakowska-Barczak and Kolodziejczyk 2008). This cultivar exhibited the highest antioxidant potential measured with DPPH and ABTS radicals (2.8 and 5.0 mM/100 g FW, respectively). Cultivar-dependent changes in polyphenol content were observed after freezer storage at -20°C for 9 months. In the Lee 2 cultivar, significant increases in anthocyanin and flavonol contents occurred, while in the Lee 3 and Martin cultivars considerable decreases were observed. During the freezer storage, the antioxidant activity remained unchanged except for the Smokey which showed to be the most sensitive cultivar during storage. The Nelson and Lee 2 were the most stable cultivars during storage.

In the lipid peroxidation inhibitory assay, the anthocyanin mixture at 10 ppm presented activity of 72% compared with 89, 87 and 98% for commercial anti-oxidants butylated hydroxyanisole, butylated hydroxytoluene, and tertbutylhydroxyquinone at 1.67, 2.2 and 1.67 ppm, respectively. At 10 ppm, compounds 1-3 inhibited lipid peroxidation by 70, 75 and 78%, respectively (Adhikari et al. 2005).

Antiinflammatory Activity

Bioactive anthocyanins found in the fruits of *Amelanchier alnifolia* included cyanidin 3-galactoside (1) 155 mg/100 g, cyanidin 3-glucoside

(2) 54 mg/100 g and cyanidin (3) (Adhikari et al. 2005). At 100 ppm, the anthocyanin mixture inhibited cyclo-oxygenase (COX)-1 and COX-2 enzymes at 66 and 67% respectively. Anthocyanins 1 and 2 and cyanidin (3) inhibited COX-1 enzyme 50.5, 45.62 and 96.36%, respectively, at 100 ppm, whereas COX-2 inhibition was the highest for cyanidin at 75%. Cyclo-oxygenase enzymes are involved in mechanisms of pain and inflammation.

Antiviral Activity

Methanolic extract *A. alnifolia* plant was found to be active at non-toxic concentration against enteric coronavirus (McCutcheon et al. 1995).

Antidiabetic Activity

Burns Kraft et al. (2008) found that nonpolar constituents including carotenoids, from 4 wild berry species including Saskatoon berries, were potent inhibitors of aldose reductase (an enzyme involved in the etiology of diabetic microvascular complications), whereas the polar constituents, mainly phenolic acids, anthocyanins, and proanthocyanidins, were hypoglycemic agents and strong inhibitors of IL-1 β and COX-2 gene expression. Berry samples also exhibited the ability to regulate lipid metabolism and energy expenditure in a manner consistent with improving metabolic syndrome. The results demonstrated that berries like Saskatoon traditionally consumed by tribal cultures contained a rich array of phytochemicals with the capacity to promote health and protect against chronic diseases, such as diabetes.

Traditional Medicinal Uses

Indigenous people in Canada used to juice for treating stomach ailments and as a laxative. Eye and ear-drops were made from ripe berries. The boiled bark is used as a disinfectant. The root infusion was used to prevent miscarriage after an

injury. Thompson people made a tea from the twigs and stem and administer it to women just after birth and as a bath. A potent tonic from the bark was given to women after delivery to hasten discharge of the placenta (Turner et al. 1990) Saskatoon berry juice was ingested to relieve stomach upset and boiled berry juice was used as ear drops (Kershaw 2000).

Other Uses

It can be used as a wind-break plant. Its wood is hard, strong, fine-grained and used for tool handles, canes, canoe crossbars, tipi stakes, tipi closure pins and small implements. The young stems are used to make rims, handles and used in basket making. The shoots and young stems were used to make basket rims and handles, arrows, combs, digging sticks, salmon spreaders and pipes. Saskatoon berries provide a purple dye.

Comments

Saskatoon berries can be propagated by seeds, layering or suckers.

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