Rubus ursinus × *idaeus* 'Boysenberry'

Scientific Name

***Rubus ursinus* × *idaeus* 'Boysenberry' sensu Wada and Ou (2002).**

Synonyms

Rubus loganobaccus × *baileyanus* Britt sensu McGhie et al. (2006), Barnett et al. (2007), *Rubus loganobaccus* cv boysenberry sensu Kiyoko (2005), *Rubus ursinus* var *loganobaccus* cv Boysenberry.

Family

Rosaceae

Common/English Name

Boysenberry

Vernacular Names

Dutch: Boysenbes;
Finnish: Boysenbeere, Boysenbes;
French: Baie De Boysen, Mûre De Boysen, Ronce De Boysen;
German: Boysenbeer, Brombeere;
Slovašcina: Medvedja Robida;
Slovenia: Medvedja Robida;
Swedish: Boysenbär, Boysenbeere, Boysenbes.

Origin/Distribution

Boysenberry is named after by the originator, Rudolf Boysen, a Swedish immigrant and horticulturist who developed the crop during the Great Depression in the Napa Valley region of California. Boysenberry enjoyed commercial success under the growing guidance and development of farmer and berry "expert" Walter Knott of Knott's Berry Farm. The Boysenberry's popularity is the single most reason for making Knott's Berry Farm so famous. Today, Boysenberry is grown as trailing vines throughout the Western Coast of the United States and they have been naturalized in Northern New Zealand, where the fruit is grown for commercial export. Over 60% of the world's Boysenberry production comes from New Zealand. Boysenberry is also grown in Australia.

The exact parentage of boysenberry is obscure. It is thought to be a cross between a European raspberry (*Rubus idaeus*), a common Blackberry (*Rubus fruticosus*), and loganberry (*Rubus* × *loganobaccus*). Scientists surmised, based on analyses of genes, plants and fruits, that Boysenberry, resulted from a cross of Loganberry with an Eastern dewberry.

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Agroecology

Boysenberry is a cool climate crop. It grows in full sun to partial shade and does best in a well-drained, moist, loamy soil rich in organic matter from pH 6–7.5. It is usually grown on a support or trellis and needs to be protected from cold weather and strong winds. The vines need to be untied from the trellis and laid flat before a freeze. The canes also should be covered with at least a foot of loose hay or straw.

Plate 1 Prolific boysenberry vine

Edible Plant Parts and Uses

Boysenberry may be eaten fresh, in fruit salads, with ice-cream, in drinks, milk shakes or use alone with creams, in trifles, and to top fruit tarts. It can be frozen and similarly used. It can be used in jams, preserves, pies, cheesecake, muffins, cobblers, bars, pancakes and syrups, or even made into wine. Boysenberry is also used to infuse light spirits and muddle into cocktails.

Botany

A long trailing or climbing shrub usually grown on trellis to 6–7 m long. Primo canes are terete with soft, short prickles. Leaves imparinately compound with 3 shortly-stalked broadly ovate leaves with obtuse to acute to acuminate apices, serrated margins, adaxial surface darker green, abaxial surface pale green, pubescent or glabrous, with or without short prickles on the mid-vein and petioles (Plates 1, 2 and 3). Stipules narrow, free from petiole or fused at the base. Flowers 2–3 cm across, produce in short racemes or cymes on floricanes with 5 reflexed sepals, 5 mostly white spreading petals, numerous short stamens and few to many carpels on an elongated receptacle. Fruit about 3 cm long and from 2 to 3 cm in width, an aggregate of numerous succulent drupelets, each containing a single seed. Colour green changing to straw-yellow, amber, orange-red, red, reddish black, to glossy purplish-black (Plates 1, 2 and 3) as they ripen.

Plate 2 Close-up of boysenberry and leaves

Nutritive/Medicinal Properties

The nutrient value of frozen Boysenberries per 100 g edible portion was reported as follows (USDA 2011): water 85.90 g, energy 50 kcal (209 kJ), protein 1.10 g, total lipid (fat) 0.26 g,

Plate 3 Ripening boysenberries

ash 0.54 g, carbohydrate 12.19 g, total dietary fibre 5.3 g, total sugars 6.89 g, Ca 27 mg, Fe 0.85 mg, Mg 16 mg, P 27 mg, K 139 mg, Na 1 mg, Zn 0.22 mg, Cu 0.080 mg, Mn 0.547 mg, Se 0.2 μg, vitamin C 3.1 mg, thiamin 0.053 mg, riboflavin 0.037 mg, niacin 0.767 mg, pantothenic acid 0.250 mg, vitamin B-6 0.056 mg, total folate 63 μg, total choline 10.2 mg, vitamin A 3 μg RAE, vitamin A 67 IU, β-carotene 40 μg, lutein + zeaxanthin 118 μg, vitamin E (α-tocopherol) 0.87 mg, vitamin K (phylloquinone) 7.8 μg, total saturated fatty acids 0.009 g, 16:0 (palmitic) 0.006 g, 18:0 (stearic) 0.001 g, total monounsaturated fatty acids 0.025 g, 18:1 undifferentiated (oleic) 0.023 g, 20:1 (gadoleic) 0.002 g, total polyunsaturated fatty acids 0.148 g, 18:2 undifferentiated (linoleic) 0.098 g and 18:3 undifferentiated (linolenic) 0.050 g. Studies using labelled glucose-1-C14 showed that glucose was converted to the galacturonic acid and the arabinose moieties of pectin without cleavage of the carbon chain in boysenberry fruit (Seegmiller et al. 1955).

The major anthocyanins in Boysenberries were shown to be cyanidin 3-mono-glucoside and cyanidin 3-diglucoside (Luh et al. 1965). Also present were smaller amounts of cyanidin 3-rhamnoglucoside and cyanidin 3-rhamnoglucosido-5-glucoside. The major anthocyanins of Boysenberry fruit, (*Rubus loganobaccus* x *Rubus baileyanus* Britt), were isolated and elucidated as cyanidin-3-[2-(glucosyl)glucoside] and cyanidin-3-[2-(glucosyl)-6-(rhamnosyl)glucoside] (McGhie et al. 2006).

Compositional analysis revealed that polyphenolic extracts prepared from the waste seeds and commercial juice of Boysenberry contained six polyphenolic classes: flavanol monomers, proanthocyanidins, anthocyanins, ellagic acid, ellagitannins, and flavonol glycosides (Furuuchi et al. 2011). Ellagitannins were the most abundant polyphenols in both extracts. Proanthocyanidins were present as short oligomers consisting of dimeric and trimeric procyanidins and propelargonidins, with the most abundant component being procyanidin B4 in both extracts. The seeds contained a 72-fold higher amount of proanthocyanidins than the juice. These results indicated Boysenberry fruits contained short oligomeric proanthocyanidins along with flavanol monomers and the seeds represented a good source of short oligomeric proanthocyanidins.

Cold-pressed marionberry, boysenberry, red raspberry, and blueberry seed oils were found to contain significant levels of α-linolenic acid ranging from 19.6 to 32.4 g per 100 g of oil, along with a low ratio of n-6/n-3 fatty acids (1.64–3.99) (Parry et al. 2005). The total carotenoid content ranged from 12.5 to 30.0 μmol per kg oil. Zeaxanthin was the major carotenoid compound in all tested berry seed oils, along with β-carotene, lutein, and cryptoxanthin. Total tocopherol was 260.6–2276.9 μmol per kg oil, including α-, γ-, and δ-tocopherols. Seeds from all five caneberry species: red raspberry, black raspberry, Boysenberry, Marion blackberry, and evergreen blackberry were found to have 6–7% protein and 11–18% oil (Bushman et al. 2004). The oils contained 53–63% linoleic acid, 15–31% linolenic acid, and 3–8% saturated fatty acids. Antioxidant capacities were detected both for whole seeds and for cold-pressed oils but did not correlate to total phenolics or tocopherols. Ellagitannins and free ellagic acid were the main phenolics detected in all five caneberry species and were approximately threefold more abundant in the blackberries and the boysenberry than in the raspberries.

Antioxidant Activity

Results of studies by Wada and Ou (2002) indicated that caneberries [evergreen blackberries (*Rubus laciniatus*), marionberries (*Rubus ursinus*), Boysenberries (*Rubus ursinus x idaeus*), red raspberries (*Rubus idaeus*), and black raspberries (*Rubus occidentalis*)] were high in antioxidant activity and were rich sources of anthocyanins and phenolics. All cane berries had high ORAC (oxygen radical absorbance capacity) activity ranging from 24 to 77.2 μmol of Trolox equivalent/g of fresh berries. Anthocyanin content ranged from 0.65 to 5.89 mg/g, and phenolics ranged from 4.95 to 9.8 mg/g. All berries had high levels of ellagic acid (47–90 mg/g). The oxygen radical absorbance capacity (ORAC) for Boysenberries (42.2 μmol of TE/g) was higher than that seen in either red raspberries or blackberries. Total phenolics in Boysenberry was 5.99 mg/g fresh weight based on gallic acid standard and total anthocyanin content based upon cyanidin 3-glucoside was 1.31 mg/g. Percent contribution of individual anthocyanins to total anthocyanins in boysenberry comprised cyanidin 3-(6′-p-coumaryl) glucoside-5-glucoside 56.27% which coeluted with cyanidin 3,5-diglucoside (minor amount), and cyanidin 3-glucoside 43.73%. Ellagic acid 70 mg/100 g was present primarily as the free form in Boysenberries, thus, there was little change in concentration after hydrolysis. Boysenberry (*Rubus loganobaccus* cv boysenberry), a hybrid cross between a loganberry and a blackberry had been reported to have potential to be an innovative functional ingredient (Kiyoko 2005). Its antioxidant activity was attributed to its anthocyanins with the major components identified as cyanidin-3-O-sophoroside, cyanidin-3-O-glucosylrutinoside and cyanidin-3-O-glucoside. Boysenberry also contained ellagic acid and folate.

Results of studies showed that Boysenberry (*Rubus loganobaccus* x *baileyanus* Britt) fruit extract functioned as an in-vivo antioxidant and raised the antioxidant status of plasma while decreasing some biomarkers of oxidative damage, but the effect was highly modified by basal diet (Barnett et al. 2007). When Boysenberry extract was added to the rat's basal diet containing fish and soybean oils, there was little change in DNA (8-oxo-2′-deoxyguanosine) excretion in urine, oxidative damage to proteins decreased, and plasma malondialdehyde either increased or decreased depending on the basal diet. The results provided further evidence of complex interactions among dietary antioxidants, background nutritional status as determined by diet, and the biochemical nature of the compartments in which antioxidants function.

Oxidative stability index (OSI) values were 20.07, 20.30, and 44.76 h for the marionberry, red raspberry, and Boysenberry seed oils, respectively (Parry et al. 2005). The highest TPC (total phenolic content) of 2.0 mg gallic acid equivalents per gram of oil was observed in the red raspberry seed oil, while the strongest oxygen radical absorbance capacity was in boysenberry seed oil extract (77.9 μmol Trolox equivalents per g oil). All tested berry seed oils directly reacted with and quenched DPPH radicals in a dose- and time-dependent manner. The data suggested that the cold-pressed berry seed oils may serve as potential dietary sources of tocopherols, carotenoids, and natural antioxidants.

Hepatoprotective Activity

Boysenberry anthocyanin was found to have heptoprotective activity. Increases in plasma aspartate aminotrasferase and alanine aminotrasferase, which were all induced by the injection of GalN in rats, were relieved by the intake of boysenberry anthocyanins, suggesting boysenberry anthocyanins to be a food component available to prevent liver injury (Igarashi et al. 2004). Seven polyphenols were isolated from leaves of New Zealand Boysenberry and elucidated as quercetin 3-O-glucuronide, quercetin 3-O-glucoside, quercetin 3-O-arabinoside, kaempferol 3-O-glucuronide, kaempferol 3-O-arabinoside, kaempferol 3-O-(6″-O-p-coumaroyl)-glucoside, and ellagic acid (Kubomura et al. 2006). Increases in plasma aspartate aminotrasferase and alanine aminotrasferase activities in mice, induced with liver injury by the injection of carbon tetrachloride, were suppressed by oral administration of the polyphenol fraction prepared from the leaves, and ellagic acid was found to be its effective component. Thus polyphenol fraction contained in boysenberry leaves may be effective in suppressing liver injury.

Antidiabetic Activity

Increases in the concentration of plasma thiobarbituric acid reactive substances (TBARS), and in the liver 8-hydroxy deoxyguanosine (8-OH dG)/deoxyguanosine (dG) ratio and also in the liver reduced glutathione/oxidized glutathione ratio (GSH/GSSG) ratio, which were all observed in streptozotocin-induced diabetic rats, were restored or tended to be restored to the level of the control rats when a diet with Boysenberry anthocyanins was given to the diabetic animals (Sugimoto et al. 2003). The susceptibility of the liver homogenate of the diabetic rats to the oxidation by AAPH (2,2′-azobis(2-amidinopropane) dihydrochloride) was relieved when boysenberry anthocyanins was fed to them. These results suggested that Boysenberry anthocyanins was effective in protecting the development of in-vivo oxidation involved with diabetes.

Neuroprotective Activity

Results of studies suggested that the putative toxic effects of Abeta or DA (dopamine) might be reduced by high antioxidant fruit extracts such as Boysenberry, cranberry, black currant, strawberry, dried plums, and grapes (Joseph et al. 2004). The fruit extracts antagonized Abeta- or DA-induced deficits in Ca2+ flux in M1-transfected COS-7 cells. The extracts showed differential levels of recovery protection in comparisons to the non-supplemented controls that was dependent upon whether DA or Abeta was used as the pretreatment. Interestingly, assessments of DA-induced decrements in viability revealed that all of the extracts had some protective effects. In-vitro-studies showed that SH-SY5Y human neuroblastoma cells were protected against H2O2-induced toxicity by the anthocyanins and phenolic fractions of boysenberries and blackcurrants (Ghosh et al. 2006). The concurrent addition of either fractions of these berries with H2O2 significantly inhibited the increase in intracellular reactive oxygen species production. Studies demonstrated that extracts of Boysenberry and blackcurrant showed significant protective effect and restored the calcium buffering ability of transfected COS-7 cells cells that had been subjected to oxidative stress induced by dopamine and the amyloid β25–35 (Ghosh et al. 2007). Blackcurrant polyphenolics showed slightly higher protective effect against dopamine, whereas Boysenberry polyphenolics had a higher effect against the amyloid β25–35. In viability studies, all extracts showed significant protective effects against dopamine and amyloid β25–35-induced cytotoxicity. Four major anthocyanins, cyanidin glucoside, cyanidin rutinoside, cyanidin sophoroside and cyaniding glucorutinoside were detected in the Boysenberry anthocyanin. The total anthocyanin and phenolic concentrations in the boysenberry extracts 261 and 241 mg/g respectively. The results provided evidence to suggest that the deleterious neurotoxic effect of compounds such as dopamine or Aβ on neurons can be reduced by polyphenolic fractions of Boysenberry and blackcurrant. In further studies, long-term consumption of both the Boysenberry and blackcurrant drinks was found to elevate the plasma total antioxidant capacity of the study of elderly participants suggesting that Boysenberry and blackcurrant may help protect against oxidative stress-related health conditions and degenerative diseases (McGhie et al. 2007). Plasma malondialdehyde decreased in both the Boysenberry and blackcurrant treatments although the decrease was not statistically significant. Measures of oxidative stress for protein oxidation and lipid peroxidation improved for the berryfruit treatments during the study but were not statistically different from the placebo.

Bioavailability Studies

McGhie et al. (2003) investigated the bioabsorption of 15 anthocyanins with structures containing different aglycons and conjugated sugars extracted from blueberry, Boysenberry, black raspberry, and blackcurrant in both humans and rats. They detected intact and unmetabolized anthocyanins in urine of rats and humans following dosing for all molecular structures investigated, thus demonstrating anthocyanins with diverse molecular structure and from different dietary sources were bioavailable at diet relevant dosage rates. In addition, the relative concentrations of anthocyanins detected in urine following dosing varied, indicating that differences in bioavailability were due to variations in chemical structure. Their results suggested that the nature of the sugar conjugate and the phenolic aglycon to be both important determinants of anthocyanin absorption and excretion in rats and humans.

Other Uses

Oxi-fend® Boysenberry Extract is an antioxidant rich extract of Boysenberries from New Zealand where over 60% of the world's Boysenberries are grown (New Zealand Extract Ltd 2011). Oxifend® Plus is a powerful antioxidant formula blended from the extracts of four New Zealand superfruits: Grapes, Boysenberries, Blackcurrants, Kiwifruit.

Comments

Boysenberry is propagated from stem cuttings, or from seeds, stooling, mound layering and tip layering.

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