

THE PURPLE REPORT



PurpleFuel

PACKED WITH ENDLESS POTENTIAL

What are Saskatoon Berries?

Saskatoon berry (*Amelanchier alnifolia*) is a rosaceous pome and a wild fruit of North American prairies. Historically, the fruit has been widely used by the native Indians in making pemmican. The fruit is identified by several other names, saskatoons, serviceberry, maycherry, juneberry, shadbush, shadblossom, pigeonberry, pebmina, sugar pear, Indian peer, lance wood, bill berry, Canadian medlar and rocky mountain blueberry. Saskatoons are cold-hardy plants that withstand a temperature as low as -60°C and have a lifespan of 30 to 50 years. In Canada, orchard cultivation of saskatoons began as far back as 1918. Many cultivars of saskatoons are commercially grown and that includes Bluff, Buffalo, Elizabeth, Forestburg, Honeywood, JB 30, Martin, Nelson, Northline, PAR 90, Parkhill, Pearson II, Pembina, Smoky, Success and Thiessen. An orchard with mature trees of 12-15 years old yields 6,000-8,600 kg/ha (St-Pierre, 2005).

A growing number of studies have demonstrated the health benefits of polyphenols including anticancer, antitumor, anti-inflammatory and anti-mutagenic effects and oxygen-radical scavenging to minimize lipoprotein oxidation (Le Marchand et al., 2000; Kong et al., 2008). This information boom on the positive health effects of blue-purple fruits has helped saskatoons entering into the ever-expanding functional food market. As Health Canada defines, "a functional food is similar in appearance to, or may be a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions". Thus, fruits that are significant sources of anthocyanins and polyphenols qualify as functional foods.

Polyphenols are a heterogeneous group of plant metabolites that includes thousands of natural chemicals. These chemical compounds show a huge diversity in molecular weights, chain lengths and isomeric structures. Within a plant species, considerable polyphenol diversity is observed due to the differences in genetics and environment. As a result, only a limited number of less complex plant polyphenols have been analyzed and reported (Cheynier, 2005). Even though saskatoons have been introduced as a commercial fruit decades ago, not much information is available on polyphenol diversity of saskatoons, as influenced by cultivar and locality (i.e. soil fertility, temperature, irrigation and pest and diseases) differences. This report was put together by the Saskatoon Berry Council of Canada to share the recent research on health attributes of saskatoons, and where possible provide comparative information from other berry fruits considered in the functional food market.



OUR HERITAGE



Then: Making pemmican by First Nations people



Now: Saskatoon berries are processed assuring food safety

Saskatoon berry (*Amelanchier alnifolia*) is a wild fruit of Canadian Prairies grown and enjoyed by the Aboriginal peoples for hundreds of years. The name Saskatoon is originated from the Cree word “Mis-sask-quah-too-mina”. The berries provided nourishment to both Aboriginal people and early settlers. The berries were eaten fresh, steamed, mashed or added into soups, stews and pemmican. The leaves and fruit were used to make tea. The concoctions made from barks were used for treatment of ailments.

Pemmican was a nutritious survival food of the North. First Nations people as well as the early settlers involved in the fur trade made pemmican. Strips of buffalo meat were hung and dried. Then meat was pounded with a stone and mixed with saskatoon berries and buffalo fat. Pemmican thus made was consumed after cooling and drying.

Saskatoon berry industry has grown tremendously over the last few years. Internationally, saskatoon berries are identified as a super fruit packed with nutrients and polyphenolic antioxidants.



SASKATOON BERRIES ARE...

SMOOTHIE
 MINERALS
 BREAKFAST
 OCHARDS
 NON GMO
 VEGAN
 GROWERS
 CANADA
 CLEAN
 PRIARIES
 BERRY
 ANTIOXIDANTS
 POLYPHENOLS
 NATURAL
 PIE FILLING
 PURPLE
 PUREE
 ANTHOCYANINS
 DIETARY FIBER
 POWDERS
 VITAMIN-E
 PHYTOSTEROLS
 UNSATURATED OIL
 JAM
 JELLY
 SNACK
 LOCAL
 JUICE
 POTASSIUM
 CONCENTRATE
 FROZEN
 HIGH QUALITY

"A functional food is similar in appearance to, or may be a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions"

Health Canada¹





PUNCH FOR NUTRIENTS

The Power of Purple: Nutrients in just 100g of dried berries

346 calories of energy

1.8g of fat

76g of carbohydrate

24g of dietary fiber

6g of protein

11mg of vitamin E

234mg of calcium

4mg of iron

113mg of magnesium

987mg of potassium

0.91mg of zinc



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Minerals and fiber are essential

- Calcium contributes to growth and maintenance of bones and functioning of muscles.
- Iron is necessary for oxygen transport system of blood.
- Sodium and potassium help maintaining the electrolyte balance.
- Some minerals serve as co-factors of enzymes.
- Dietary fiber improves bowel movement.



OIL AND PHYTOSTEROLS

Monounsaturated fatty acids	g/100g oil
16:1t-Hexadecenoic (<i>trans</i>)	0.266
16:1 Palmitoleic	0.319
17:1 Margaroleic	0.053
18:1 Oleic	22.648
20:1 Gadoleic	0.957
Total	24.243

Polyunsaturated fatty acids	g/100g oil
18:2 Linoleic (cis-cis) (<i>omega-6</i>)	52.738
18:2 Conjugated-Linoleic	0.159
18:3 a-Linolenic (cis-cis) (<i>omega-3</i>)	4.572
20:2 Eicosadienoic (cis-cis)	0.106
Total	57.575

Saturated fatty acids	g/100g oil
10:00 Capric	0.106
12:00 Lauric	0.213
14:0 Myristic	0.159
15:0 Pentadecanoic	0.106
16:0 Palmitic	11.164
17:0 Margaric	0.213
18:0 Stearic	1.914
20:0 Arachidic	1.648
22:00 Behenic	1.861
23:00 Tricosanoic	0.159
24:00 Lignoceric	0.638
Total	18.18

Plytosterols	mg/100g dried berries
Beta-sitosterol	43.30
Campesterol	13.60
Stigmasterol	14.30
Brassicasterol	<0.10
Beta-sitostanol	24.90
Delta-5-avenasterol	7.94
Delta-7-avenasterol	4.49
Delta-7, 25-stigmadienol	4.41
24-Methylene cholesterol	2.80
D7 stigmasterol	1.51
D7 campesterol	<0.10
Campestanol	<0.10
Clerosterol	<0.10

“Studies have shown that plant sterols mimic cholesterol in the small intestine and partly block cholesterol absorption. Therefore, regular consumption of a variety of foods containing plant sterols results in the lowering of LDL-cholesterol levels, while having no detrimental effect on HDL-cholesterol levels (often referred to as good cholesterol). This would benefit those who want to lower their blood cholesterol levels, i.e., especially those who have moderate to high blood cholesterol”
Health Canada²

Nearly 2% of the weight of the dried saskatoon berries is oil and 81% of that is mono- and poly-unsaturated fatty acids, which are healthy oils. Omega-3 and omega-6 oils contribute to 4% and 52% of the oil weight, respectively. One hundred grams of dried saskatoon berries carry about 117 mg of phytosterols. Beta-sitosterol and beta-sitostanol are the major phytosterols of saskatoon berries.



ANTIOXIDANTS FOR HEALTH

ORAC value is commonly used to measure the antioxidant capacity of foods. The total ORAC value of 1.0 g of dried saskatoon berries is about 2414 micro moles of Trolox Equivalent (TE). Trolox is a vitamin-E analogue and the standard used. Thus, 1.0 g of dried saskatoon berry powder show an antioxidant capacity similar to that of 2414 micromoles of Trolox.



Reactive oxygen species (ROS) are harmful biomolecules produced in the bodies of all animals as part of the normal metabolism. Super oxide, peroxy, singlet oxygen, hydroxyl, and peroxynitrite are some of these ROS molecules. When the body produces more ROS than what the enzymes can neutralize, pathologies begin.

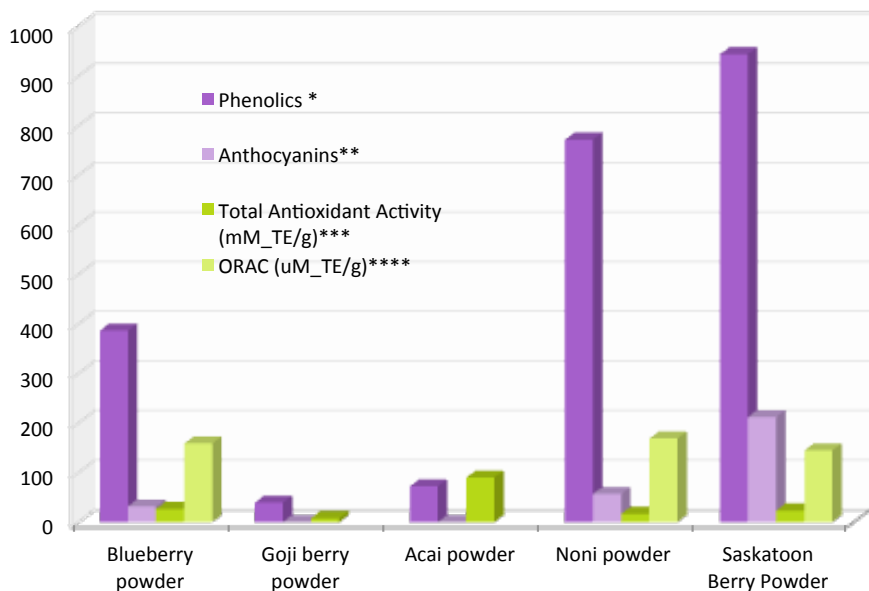
Antioxidants in the diet helps to decrease...

INFLAMMATION

THE RISK OF CANCER

CARDIOVASCULAR DISEASES

These berries pack a punch!



In laboratory experiments it has been shown that the polyphenol antioxidants found in plants are capable of mitigating the activity of ROS molecules. Some polyphenol compounds are better agents for neutralizing ROS molecules than others. Vitamin-E and zinc are valuable antioxidant compounds. Saskatoon berries are a good source of vitamin-E and also contain zinc. Information sources 3, 4, 5



POLYPHENOLS: NATURAL DEFENDERS

Polyphenols, including anthocyanins, contributes to the antioxidant capacity of saskatoon berries. Phenolic acids have proven health benefits when tested in animals. For example, caffeic acid and ellagic acid improve kidney function and glucose regulation of diabetic mice⁶. Caffeic acid and chlorogenic (caffeoylquinic) acid helped protection of the intestinal wall from oxidation induced damage⁷.

Proanthocyanidins are complex flavanol (polyphenol) compounds. They are present in saskatoon berries as complexes of two molecules (dimers), three molecules (trimers) and so on. These large molecules may protect the digestive system from oxidation damage when they are broken down (metabolised) by gut bacteria to produce small compounds with antioxidant activity⁹.



Phenolic compound	mg/100g fresh Saskatoon berry
<i>Flavonols</i>	
Kaemferol-glucoside & galactoside	0.31
Quercetin	0.16
Quercetin-3-glucoside	8.71
Quercetin-3-arabinoside	0.16
Quercetin-3-rutinoside	2.21
Quercetin-3-xyloside	2.43
Quercetin-galactoside	1.81
Quercetin-rhamnoside	1.29
<i>Flavan-3-ols</i>	
(-)-Epicatechin	0.45
<i>Phenolic acids</i>	
p-Hydroxybenzoid acid	0.01
Protocatechuic acid	0.59
Gallic acid	0.01
p-Coumaric acid	0.02
Caffeic acid	0.06
Ferulic acid	0.02
Coumaric acid glucoside	0.97
Caffeic acid glucoside	0.35
Shikimic acid	0.04
Ellagic acid	1.03
3-caffeoylquinic acid	3.20
4-caffeoylquinic acid	2.07
5-caffeoylquinic acid	16.3
<i>Proanthocyanidins</i>	
Monomers	3.18
Dimers	1.93
Trimers	1.67
Tetramers	1.46
Pentamers	1.24
Hexamers	1.07
Heptamers	0.44
Octoamers	0.28
Nonamers	0.25
Polymers	0.43



ANTHOCYANINS NATURALLY COLOURFUL

ANTHOCYANIN COMPARISON

See how other fruits match up to Saskatoon Berries

Anthocyanin type	Saskatoon berry	Wild Blueberry	Raspberry	Strawberry	Chokecherry	Seabuckthorn
Delphinidin-3-glucoside	●	●	●	●	●	●
Cyanidin-3-galactoside	—	—	●	●	●	●
Delphinidin-3-rutinoside	●	●	—	—	●	●
Delphinidin-3-galactoside	●	●	●	●	●	—
Cyanidin-3-glucoside	●	●	●	●	●	●
Cyanidin-3-rutinoside	●	—	●	—	●	●
Petunidin-3-glucoside	●	●	●	—	●	—
Petunidin-3-galactoside	●	●	●	—	●	—
Malvidin-3-glucoside	●	●	●	●	●	●
Pelargonidin-3-glucoside	—	●	●	●	●	—
Peonidin-3-glucoside	—	●	●	●	—	—
Peonidin-3-galactoside	●	●	●	●	●	●
Peonidin-3-arabinoside	●	●	●	—	●	●
Malvidin-3-galactoside	●	●	●	●	●	●
Malvidin-3-arabinoside	●	●	●	●	●	—
Total Anthocyanin (mg/100g dry weight)	562	558	365	97	177	0.84

Anthocyanins produce the red, purple and blue colours of fruit, flowers and leaves when bound to various other molecules. Anthocyanins, protect the plant from UV induced radiation damage and also from insects and plant pathogens.

Anthocyanins are polyphenol antioxidants. In fruits, anthocyanins may present with and without binding to sugar molecules. Anthocyanidin is a name for sugar-free anthocyanin. Delphinidin, cyanidin, petunidin, pelargonidin, peonidin and malvidin are anthocyanidins of saskatoon berries. Common sugars bound to anthocyanins of saskatoon berries are glucose, galactose, rutinose and arabinose.



IRRESISTIBLE FLAVOUR

TASTE THE PURPLE!

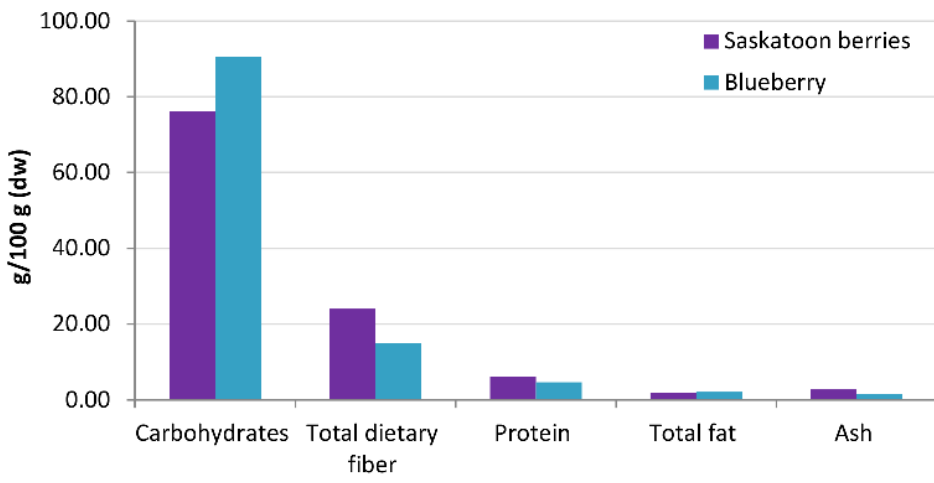
Fresh Saskatoon berries	Green	Green-Light Green	Green-Light Green-Pink	Light Green-Pink	Pink-Red	Red	Dark Red	Purple-Red	Dark Purple
pH	4.8	4.8	4.68	4.6	4.28	4.28	4.20	4.23	4.23
Titrateable acidity (mEq/100g)	2.8	3.2	3.3	3.5	4.0	4.5	5.0	3.8	3.5
Brix	4.0	5.0	8.0	8.0	10.0	12.0	14.0	14.5	16.0
Glucose (mg/g)	3.0	3.0	4.0	5.0	10.0	20.0	25.0	35.0	38.0
Fructose (mg/g)	5.0	5.0	5.0	6.0	15.0	20.0	28.0	33.0	37.0
Sucrose (mg/g)	1.5	2.0	1.75	1.25	1.0	1.25	1.0	1.25	0.4
Organic Acids									
Malate (mg/g)	3.0	2.7	2.5	2.8	3.3	3.5	3.3	3.1	2.8
Succinate (mg/g)	18.0	10.0	6.0	4.0	3.0	2.0	1.5	1.5	1.0
Citrate (mg/g)	0.5	0.6	0.5	0.32	0.3	0.2	0.3	0.25	0.25
Galactouronate (mg/g)	1.3	1.4	1.1	0.8	0.7	0.5	0.7	0.4	0.1

Malic acid (malate) and succinic acid (succinate) are the dominant organic acids contributing to the flavour of ripened saskatoon berries. Presence of close to equal amounts of glucose and fructose hinder the effect of acidity and develops a flavour unique to Saskatoon berries.

The growing saskatoon berries pass different stages of fruit development, which is characterized by the changes in chemical properties and more clearly by changes in fruit colour. The young fruit is dark green and small. The OBrix value (soluble solids) gradually increases as fruit grows through the stages, namely, dark green, green-light green, green-light green-pink, light green-pink, pink-red, red, dark red, purple-red and dark purple. A four fold increase in the anthocyanin content has been reported during the last three stages of saskatoon berry ripening; dark red, purple-red, and dark purple.

Pectin content of saskatoon berries, measured as galactouronic acid, gradually decrease as fruit ripens.

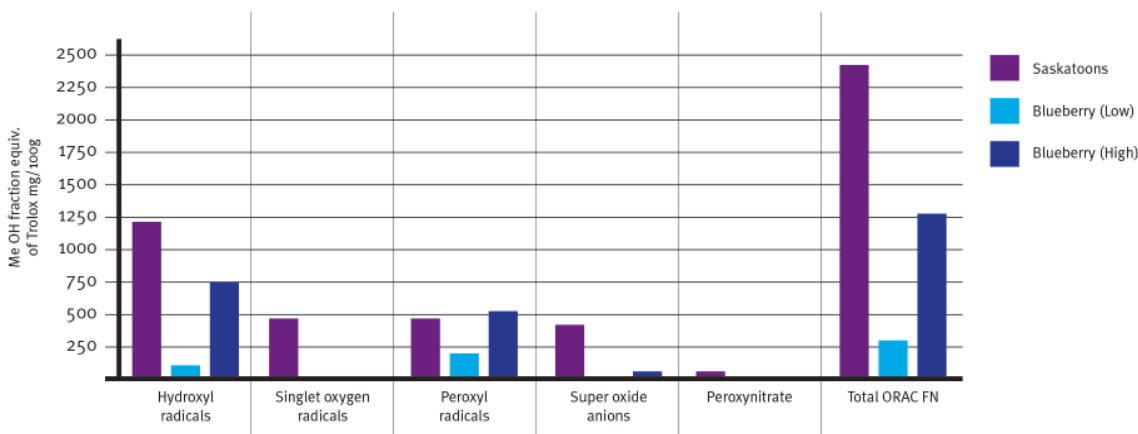
SASKATOON BERRY MATCH-UP



Comparison of proximate compositions of Saskatoons and blueberries (Blueberry data from the US Highbush Blueberry Council)

Saskatoons have more fiber (24 g/100 g dw) in the fruit than blueberries (15 g/ 100 g dw) (US Highbush Blueberry Council). As per the “Dietary Reference Intake” (DRI) tables of the Food and Nutrition Information Centre of USDA, a male adult between 14 to 50 years require 38 g of dietary fiber per day. The corresponding value for females is 25 g per day.

Antioxidant Levels



Comparison of antioxidant power of Saskatoons and blueberries (blueberry data from Wang et al., 2011).

Saskatoon Berries have high levels of antioxidants. Antioxidants are known to act as a protective guard to our immune system. Antioxidants help neutralize major free radicals in our bodies protecting against various diseases including diabetes, heart disease and cancer.

Antioxidants also defend against inflammatory illnesses and help reduce oxidative stress associated with aging.



OUR OBJECTIVE

Provide leadership in marketing of Saskatoon Berry health benefits, through promoting awareness and understanding of the health and nutritional benefits of berries as a collective whole that will, in the end, increase consumption of Saskatoon Berries. Positively position Saskatoon Berry nutrition and nutraceutical attributes. Promote and educate all stakeholders. Promote and provide Canada Brand tools for use by the membership.

WHO WE ARE

The Saskatoon Berry Council of Canada (SBCC) is a not for profit organization. We represent the Canadian Saskatoon Berry industry supporting the industry's growth locally and internationally.

Our membership produces 2.5 million pounds of saskatoon berries a year and adds about \$8.5 million to the Canadian economy.

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**Saskatoon Berry
Council of Canada**