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# Blueberries Storage and Processing

**US Highbush Blueberry Council**

## Cultivated blueberries

(*V. corymbosum* and *V. ashei*)

are grown

commercially in

the United States,

Canada,

South America,

Australia,

New Zealand,

Northern and

Eastern Europe.

North America's blueberry

producers serve

domestic and

export markets.

The United States and Canada

combined are the

largest world

producers.

Studies on the effect of storage on blueberries show positive relationships for antioxidant activity and anthocyanin content.

**Lee J, Wrolstad RE. Extraction of anthocyanins and polyphenolics from blueberry processing waste. J Food Sci. 2004; 69:564-573.**

This study looked at various methods of extracting anthocyanins and polyphenolics from blueberry juice-processing wastes. The authors found that combinations of heat, SO<sub>2</sub> and citric acid increased anthocyanin and polyphenolic extraction from blueberries and blueberry skin.

Processing enzymes were not as effective in extracting anthocyanins and polyphenolics from whole berries but were useful in extracting from skin. Blueberry skins were higher in anthocyanins, polyphenolics and antioxidant activity compared to the flesh or seed fraction.

**Zheng Y, Wang CY, Wang SY, Zheng W. Effect of high-oxygen atmospheres on blueberry phenolics, anthocyanins, and antioxidant capacity. Journal of Agricultural and Food Chemistry, 2003, 51:7162-7169.**

This paper looked at the influence of high oxygen concentrations on total phenolic, total anthocyanin, phenolic compounds and oxygen radical absorbance capacity (ORAC) in highbush blueberries. They found that fruit treated with 60, 80 or 100% O<sub>2</sub> at 5 °C had significantly less decay rate and higher ORAC, phenolic and anthocyanin content after 5 weeks of storage as compared with 40% O<sub>2</sub> treatment or air control.

**Connor AM, Luby JJ, Hancock JF, Berkheimer S, Hanson EJ. "Changes in fruit antioxidant activity among blueberry cultivars during cold-temperature storage," Journal of Agricultural and Food Chemistry, 2002, 50:893-898.**

Antioxidant activity, total phenolic content, anthocyanin content, titratable acid concentration, soluble solids, firmness and percentage of bruised berries were determined for nine blueberry cultivars at harvest and at various postharvest intervals after storage at 5°C. None of the cultivars demonstrated a decrease from its antioxidant activity value at harvest during storage. Antioxidant activity correlated strongly with total phenolics and anthocyanin content which were also stable during cold storage. One cultivar (Elliott) that was harvested immature, demonstrated an increase in antioxidant activity, total phenolic and anthocyanin content in the first three weeks of storage.

**Skrede G, Wrolstad RE, Durst RW. Changes in anthocyanins and polyphenolics during juice processing of highbush blueberries (*Vaccinium corymbosum* L.). J Food Sci. 2000; 65:357-364.**

This study looked at changes in blueberry anthocyanins and polyphenolics during processing into juice and concentrate. The authors found that only 32% of the anthocyanins were recovered in the single-strength juice with 18% left in the press-cake residue. There was also loss of flavonols, procyanidin and chlorogenic acid with recoveries of 35%, 43% and 53%, respectively. These losses occurred during milling and depectinization and are attributed to polyphenol oxidase.

Losses of anthocyanins and polyphenolics were relatively low when pasteurized single-strength juice was concentrated.

**Kalt W, Forney CF, Martin A, Prior RL. "Antioxidant capacity, vitamin C, phenolics, and anthocyanins after fresh storage of small fruits," Journal of Agricultural and Food Chemistry, 1999, 47:4638-4644.**

Highbush blueberries and other berries were stored at 0, 10, 20, and 30°C for up to eight days to determine the effects of storage temperature on whole fruit antioxidant capacity and total phenolic, anthocyanin, and ascorbate content. Only anthocyanins were significantly affected by storage time and temperature. There was a significant increase in anthocyanin content after eight days at 20°C.

**US Highbush Blueberry Council**

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**Blueberry Formats to Meet Manufacturer Needs** (For USHBC suppliers list go to <http://www.blueberry.org/suppliers.htm>)

Product	Process	Typical Packaging	Characteristic/ Application	Storage
<b>FRESH</b>				
Fresh	Fresh blueberries > packaged	Consumer packs: plastic clam shells, cello packs; Cartons: 2-1/2 lb, 5 lb (2.3 kg), 10 lb (4.5 kg), 20 lb.	Available almost year round.	32° to 34°F (-0.6° to 1°C) 90-95% relative humidity
<b>FROZEN</b>				
IQF (Individually Quick Frozen)	*>Fresh blueberries>individually quick frozen> packaged.	Consumer packs: poly bags. Bulk: Poly lined corrugated cartons 10-50 lb (4.5 - 22.7 kg), poly-lined metal drums: 270 lb (122.5 kg)	Individual fresh fruit identity. Any formulation where fruit identity is important.	0° to -10°F (-18° to -23°C)
Straight Pack or Block Frozen	*>Fresh Blueberries> packaged> flash frozen.	Poly-lined corrugated cartons: 30-50 lb (13.6 - 22.7 kg); poly-lined metal drums: 350 lb (158.8 kg)	High amount of fruit in a box, base ingredient for toppings, syrups fillings and soups.	0° to -10°F (-18° to -23°C)
<b>DRIED</b>				
Dehydrated	*>Fresh or frozen blueberries > air dehydrated to around 11-18 % moisture > further processed to dried fruit specs: i.e. oil coated, diced etc.	Poly-lined corrugated boxes: 5, 10, 25 lb.	Moisture: 11-18 % Water Activity: 0.5-0.6	Shelf stable in a cool, dry place.
Dehydrated Infused	*>Fresh or frozen blueberries are infused with a syrup>dehydrated to 11-18% moisture> further processed to dried fruit specs: eg. oil coated, diced	Poly-lined corrugated boxes 5, 10, 25 lb.	Moisture: 11-18 % Water Activity: 0.5-0.6	Shelf stable in a cool, dry place.
Freeze Dried	*>Fresh or frozen blueberries > flash frozen > moisture removed in vacuum chamber > sealed in moisture proof bags.	Poly lined corrugated boxes (10 lb) and other custom sizes.	Moisture (unsweetened):0-2 % Moisture (sweetened): 9-14%	Stable at room temperature 3 mo., after that store at 40°F.
Osmotically Pre-served	*>Fresh or frozen blueberries >placed in vacuum chamber>undergo slow natural infusion process with syrup solution and stabilizers> carefully dried to preserve color and flavor	Poly lined corrugated boxes (25 lb) and other custom sizes.	Moisture: 40% maximum Water Activity: 0.5 – 0.87	Shelf stable in cool, dry place. Best used within 10 months.
Drum Dried/Powders	*>Fresh or frozen blueberries or purée > drum dried > ground into powder or flakes to specifications	Poly lined corrugated boxes (10 lb) and other custom sizes.	Moisture Content: 3-5% Various screen sizes and granule consistency available.	Stable at room temp. for 3 months, after that store at 40°F.
<b>LIQUID</b>				
Single Strength Purée	*>Fresh blueberries> crushed>finished> pasteurized or cold filled in containers> frozen.	Plastic pails: 28, 30 lb (12.7, 13.6 kg) Poly lined corrugated cartons: 25, 30 lb (12.7, 13.6 kg); Poly lined metal drums: 55 gal (208 l) 400 lb. (181 kg)	Brix: 8.0 -13.0 pH: 2.8 -3.5 >Used in, sauces, flavorings and fillings.	0° to -10°F (-18° to -23°C)
Purée Concentrate	*>Fresh blueberries> crushed > heat/enzyme treated> vacuum concentrated > pasteurized > packaged > frozen.	Plastic pails: 4, 6 gal (15.1, 22.7 l) 28, 30, 60 lb (12.7, 13.6, 27.2 kg) Poly-lined metal drums	Brix Ranges: 20,37, 40 pH: 2.8 - 3.4 >Juices, sauces, blends.	0° to -10°F (-18° to -23°C)
Single Strength Juice	*>Fresh berries > crushed > pressed > filtered > pasteurized > packaged > frozen	Plastic pails: 5,6 gal (18.9, 22.7 l) 28,30,60 lb (12.7,13.6, 27.2 kg) Poly-lined metal drums	Brix: 8.0 - 12.0 pH: 2.8 - 3.4 >All natural fruit juices.	0° to -10°F (-18° to -23°C)
Juice Concentrate	*>Fresh blueberries > crushed > heat/enzyme treated > vacuum concentrated > packaged > frozen.	Plastic pails: 5,6 gal (18.9, 22.7 l) 50,66 lb (22.7, 29.9 kg) Poly-lined metal drums/	Brix: 45.0, 65.0 pH: 2.1 - 2.7 >Fruit juices and sauce flavor.	0° to -10°F (-18° to -23°C)
<b>OTHER FORMATS</b>				
Canned (Packed in Syrup) (Packed in Water)	*>Fresh or frozen blueberries > placed in cans > light or heavy syrup added > sealed > heated. Fresh or frozen blueberries> placed in cans>water added >sealed>heated.	Cans: #2, #2-1/2, #10, other sizes.	Various levels of fruit content depending on supplier and application.	Shelf stable in a cool, dry place.
Bakery fruit fillings	*>Fresh or frozen blueberries and/or other forms > sweetener and starch/gum based slurry added > heated > packaged to specifications. (differs from supplier to supplier)	Plastic and foil pouches, 5 gal plastic pails (18.9 l) and 55 gal drums (208.2 l).	Various levels of fruit content depending upon supplier and end use	Shelf stable in a cool, dry place.
Essence	+ >volatile flavor components distilled off from juice and concentrate process > packaged.	Plastic pails: 5, 6 gal (18.9, 22.7 l) and other sizes.	Intensive blueberry flavor found in no artificial flavoring.	Tightly closed container at 40°F (4°C) or lower
Other	Real fruit bits and chips are formulated out of a blend of purée and other ingredients.	10 lb boxes and other custom sizes.	Fruit Content: 30-40 % >Baking/snack applications.	Shelf stable in a cool, dry place.