

# Vitamin C in Some North Dakota Fruits and Plant Tissues

By  
Eleanor McGuigan<sup>1</sup>

The war emergency produced many dietary changes. One purpose of this study was to find new sources of ascorbic acid (Vitamin C) in North Dakota plants. Some of the plants studied are not common to the average diet but are readily available. So far as these are valuable as a source of Vitamin C and can be made palatable, they are a definite contribution to diets.

One purpose in jelly studies was to determine whether jelly, upon standing, retains its antiscorbutic properties. The jellies stood three months and then were tested again for Vitamin C potency. These jellies, being made from native products of the State, offer an economical source of ascorbic acid. Jelly, as such, cannot be used as a sole source of Vitamin C as the quantity consumed would necessarily be enormous in order to provide an adequate amount of the vitamin. However, it is very useful as a tasty addition to menus and furnishes a portion of the winter diet of the average family.

## Historical

Scurvy, a disease caused by a deficiency of Vitamin C, was described as much as 600 years ago. It occurred among the ancients during times of war, famine and pestilence. Long before any scientific research on the subject had been done, fresh vegetables were known to be a good remedy. In our own State, Prince Maximilian du Wied, a German naturalist, who spent the winter of 1833-34 at Fort Clark, was cured of a severe case by eating the tops of wild onion on recommendation of a negro cook from another post. Lemon juice was shown to be helpful in 1757. In recent times Vitamin C was isolated and found to be the active agent. This material is present in most fruits and fresh vegetables, but in varying quantities.

## Methods of Analysis

The analyses here reported were made by the method of Bessey (2), using the Evelyn photo-electric colorimeter with filter No. 520.

## Plants Used

Table 1 presents a list of plants tested. Most of the material was grown in the college gardens or was collected locally. Those used as "greens" were collected when the plants were young and the leaves and tenderest stems were used. Tables 2 and 3 show the amounts of ascorbic acid found.

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**Table I.—List of Plants Tested for Ascorbic Acid**

Common Name	Scientific Name
Buffalo Berry	<i>Shepherdia argentea</i>
Chard, Swiss	<i>Beta vulgaris</i>
Cherry, Choke	<i>Prunus virginiana</i>
Cherry, Pin	<i>Prunus pennsylvanica</i>
Cherry, Russian	<i>Prunus tomentosa</i>
Cherry, Sand	<i>Prunus pumila</i>
Crabapple (Dolgo)	<i>Malus baccata</i> X <i>pumila</i>
Cranberry, High-bush	<i>Viburnum trilobum</i>
Currant, Wild Black	<i>Ribes floridum</i>
Dock, Curled	<i>Rumex crispus</i>
Elderberry	<i>Sambucus canadensis</i>
Grape, Wild	<i>Vitis vulpina</i>
Hawthorn	<i>Crataegus mollis</i>
Lamb's-Quarters	<i>Chenopodium album</i>
Lamb's-Quarters	<i>Chenopodium strictum</i>
Lettuce, Prickly	<i>Lactuca scariola</i>
Monolepis	<i>Monolepis nuttalliana</i>
Mustard, Wild	<i>Brassica arvensis</i>
Nettle	<i>Urtica gracilis</i>
Plum, Wild	<i>Prunus americana</i>
Purslane	<i>Portulaca oleracea</i>
Rhubarb, Strawberry	<i>Rheum rhaponticum</i>
Rose, Wild	<i>Rosa arkansana</i>
Russian Thistle	<i>Salsola kali</i>
Sow Thistle, Common	<i>Sonchus oleraceus</i>
Sow Thistle, Spiny	<i>Sonchus asper</i>

**Table 2.—Milligrams of Ascorbic Acid Per 100 Grams of Fresh Plant Tissue**

No.	Date	Plant	Mg. ascorbic acid per 100-grams
1	June 11	Rhubarb (with peel) .....	5.7
2	June 11	Rhubarb (without peel) .....	5.8
3	June 18	Monolepis (whole plant) .....	53.1
4	June 21	Monolepis (tops of plant).....	52.1
5	June 29	Lamb's-Quarters (C. album-young plant).....	101.6
6	July 2	Lamb's-Quarters (C. album whole plant).....	59.4
7	July 13	Lamb's-Quarters (C. strictum young plant).....	98.6
8	July 2	Prickly Lettuce (leaves).....	49.4
9	July 2	Wild Mustard (young plant) .....	81.2
10	July 8	Common Sow Thistle (leaves).....	40.8
11	July 8	Spiny Sow Thistle (leaves).....	26.7
12	July 9	Swiss Chard (stems and leaves).....	39.0
13	July 12	Purslane (stems and leaves).....	26.7
14	July 22	Curled Dock (leaves) .....	42.0
15	July 22	Nettles (tender tops) .....	44.8
16	July 27	Russian Thistle (young plants) .....	47.7

Table 3.—Ascorbic Acid in Fruits and Jellies

Dates 1943	Common names	Dry Matter Percent	Mg. ascorbic acid per 100 grams	
			Fresh Tissue Basis	Dry Matter Basis
July 23	Pin cherry		12.8	
July 26	Pin cherry jelly		8.9	
Nov. 12	Pin cherry jelly		4.3	
July 29	Wild black currant		92.2	
Aug. 4	Sand cherry, with pits	21.65	3.3	15.2
Aug. 8	Sand cherry jelly		4.3	
Nov. 24	Sand cherry jelly		2.3	
Aug. 9	Choke cherry, with pits	30.44	4.3	14.1
Aug. 9	Choke cherry jelly		14.0	
Nov. 8	Choke cherry jelly		6.7	
Aug. 12	Russian cherry	20.04	52.6	262.5
Aug. 12	Russian cherry jelly		14.9	
Nov. 18	Russian cherry jelly		11.6	
Aug. 17	Russian cherry	19.31	14.3	74.1
Aug. 17	Russian cherry jelly		.2	
Nov. 26	Russian cherry jelly		.1	
Aug. 11	Buffalo berry	25.82	92.0	356.3
Aug. 11	Buffalo berry jelly		91.4	
Nov. 24	Buffalo berry jelly		13.0	
Aug. 27	Wild plum, with pits	28.08	9.2	32.7
Aug. 27	Wild plum jelly		4.3	
Dec. 2	Wild plum jelly		4.3	
Aug. 27	Dolgo crabapple	18.70	18.2	97.3
Aug. 27	Dolgo crabapple jelly		13.0	
Dec. 1	Dolgo crabapple jelly		4.8	
Sept. 3	Highbush cranberry	17.42	12.0	68.9
Sept. 14	Elderberry	21.10	41.0	194.3
Sept. 16	Ribes sp.	24.80	41.8	168.5
Sept. 16	Ribes sp. jelly		8.9	
Dec. 2	Ribes sp. jelly		8.9	
Sept. 17	Wild grape		9.6	
Sept. 17	Wild grape jelly		6.2	
Dec. 2	Wild grape jelly		4.5	
Sept. 21	Hawthorn apple		30.3	
Sept. 21	Hawthorn apple jelly		lost	
Dec. 1	Hawthorn apple jelly		15.9	

#### Notes on Green Plants

Swiss Chard (*Beta vulgaris*) is a well known vegetable. It is a beet in which the leaf stalk is greatly enlarged instead of the root. The entire leaves or only the stalks are cooked like asparagus. It is an all season vegetable and is very productive.

Curled Dock (*Rumex crispus*) is a coarse, perennial weed with large, oblong, curly, dark green leaves. The early leaves are excellent as greens but the older ones are too pungent.

Lamb's Quarters (*Chenopodium album*) is a common annual weed which has long been used by many people and could well be used more generally. The young plants, when 6 inches to a foot high can be used, or the leaves and young branches of older plants so far as tender.

To appreciate the value of this plant, comparison should be made with spinach and turnip greens as reported by the U. S. Department of Agriculture (3). Lamb's quarters compares favorably with turnip greens and has about one-third more ascorbic acid than spinach. The second species tested (*Chenopodium strictum*) is a similar plant which has become frequent in only recent years. It resembles the common species but is smaller and develops late in summer, so is less useful.

Prickly Lettuce (*Lactuca scariola*) is a common introduced annual weed. The leaves are rather thick and smooth and usually stand edgewise. When well developed, they are prickly along the edges and on the midrib of the lower side of the leaf, but the new leaves of young plants are tender and can be used along with other kinds.

Monolepis (*Monolepis nuttalliana*) is a native, winter annual. It is a tufted, spreading plant, rarely more than 6 inches high or the branches over a foot long. The leaves are smaller than those of lamb's quarters and quite fleshy. The plant compares well with spinach for quality, flavor and ascorbic acid content.

This plant has seemed of some special interest because it grows readily in soils which become dry. The seeds germinate naturally in the fall and the seedlings live over winter, beginning growth early in the spring. The season is short, for the plants early develop dense branch tips of small green flowers and the stems soon become tough. Another disadvantage is that the plant grows close to the ground and so is somewhat hard to pick and clean. In cooking, only the water remaining on the washed plants was used.

Wild Mustard (*Brassica arvensis*) is an all too familiar annual weed, but it produces literally tons of valuable food which is not used. Table 2 shows that it ranks higher in ascorbic acid than any of the other greens tested except lamb's quarters. Adding to this the fact that it is available in quantity, easily collected and handled, the value of the plant for this purpose is evident. It is palatable alone but perhaps most people will prefer the flavor produced by addition of lamb's quarters or other plants. The young plants can be used as soon as they are large enough to pick. The leaves remain in good condition for a long time and the stem tips up to the beginning of flowering are tender if growing conditions are favorable. (Tumbling Mustard (*Sisymbrium altissimum*) was not tested. I found it good in taste and texture.—O. A. Stevens)

Nettle (*Urtica gracilis*) is a common native perennial which is somewhat of a nuisance because the hairs of the leaves and stems produce an acute burning sensation when touched. The stems grow 4 to 6 feet high, often in dense masses around barnyards, in trees and sloughs. The tender tops are often mixed with other greens and Table 2 shows that they contain nearly as much ascorbic acid as spinach.

Purslane (*Portulaca oleracea*) is a troublesome, annual weed in gardens. Unlike most other plants, the seeds germinate in early

summer after the ground has become warm and dry. The plants are very fleshy, retain their moisture very tenaciously and thrive during warm, dry weather. The stems and leaves are never fibrous but are rather mucilaginous and the flavor perhaps less acceptable than that of other plants. Some people like it as a raw vegetable.

Russian Thistle (*Salsola kali*) is another well known annual weed. The young plants are tender and are nearly equal to spinach in ascorbic acid. These young plants consist largely of leaves, quite in contrast to the mature, spiny, leafless branches.

Common Sow Thistle (*Sonchus oleraceus*) is the least common of the three sow thistles in this State. The specific name "oleraceus", the same as applied to cabbage (*Brassica oleracea*) is Latin for pot herb, and was applied to these plants because of their use in Europe. This species is a hollow-stemmed, tender annual, which is quite persistent when established in neglected gardens and yards. It is fairly late in developing and could be a useful addition to the diet of greens.

Spiny Sow Thistle (*Sonchus asper*) is also an annual, rather more weedy than the preceding. The leaves are coarser and somewhat spiny. It seems less useful than the other species. (Perennial Sow Thistle (*Sonchus arvensis*) was not included in the list. One cooking test indicated that the texture was poor.—O. A. Stevens)

#### Notes on Fruits

Buffalo Berry (*Shepherdia argentea*) is a native shrub which is common in western North Dakota. The small, bright red fruits, which ripen in September, are much appreciated for jelly in a region where other wild fruit is scarce. The bushes are thorny and picking is difficult so that a destructive practice of cutting the plants has often been used. The yellow flowers appear the last of April. The plant is a worthwhile ornamental for dry regions. The showy flowers are on the staminate trees which bear no fruit. In planting where they are not native, both sexes must be grown to secure fruit. Table 3 shows that the ascorbic acid value of the fresh jelly is very high but soon decreases in storage. Similar results were secured by Knowles and Wilk (4).

Choke Cherry (*Prunus virginiana*) is a common shrub throughout the State. There is much variation in flavor and color of fruit and in time of ripening on different plants. The fruit persists well on the bush so the season is quite long. The plant is ornamental when in bloom and the fruit is eaten by many kinds of birds.

Pin Cherry (*Prunus pennsylvanica*) is rather rare in North Dakota, but eastward and northward it is one of the commonest shrubs along the forest edge. It is a slender branched shrub or quite tree-like in form. The fruits are rounded, bright red, sour, about one-fourth inch long and ripen in July. The ascorbic acid content was fairly high but the jelly bitter. The flavor, however, had improved after 3 months storage.

Russian Cherry (*Prunus tomentosa*) is a recent introduction from Asia. The plant is a shrub or small tree with dense, widely spreading branches. The leaves are broad and hairy. It bears white or rose-colored flowers in abundance and was first grown as an ornamental. The fruit is hardly half an inch long, bright red and sour. The ascorbic acid content was high in some tests but considerable variation was encountered. The jelly was attractive and fine flavored, one of the nicest of all the jellies in the list.

Sand Cherry (*Prunus pumila*) is found in some localities in North Dakota, usually in sandy soil. It is a small shrub, the branches often lying on the ground or somewhat upright to 3 feet high. The leaves are small, rather thick, hardly toothed. The fruits are dark red to black, rounded or oblong, about one-half inch or less in length. The flesh is dark red and somewhat astringent. The jelly was strong flavored. These fruits would seem to have their greatest use in combination with bland fruits. Some good hybrids between this and certain plums are in cultivation.

Crab Apple (*Malus baccata x pumila*). Crab apples are among the most widely used fruits for producing an amber, mild jelly. The Dolgo variety used here has a deep red-colored fruit and is regarded as an excellent sort.

High-bush Cranberry (*Viburnum trilobum*) is a native shrub, 3-8 feet high, growing in woods, especially in rather wet or swampy places. The leaves are broad and three-lobed. The white flowers are borne in large clusters. The Snowball bush, often grown as an ornamental, is similar in appearance. The fruits are bright red, about three-eighths of an inch long and each contains a flat, stony seed. They ripen late and remain on the bushes into winter. They have a strong acid taste and this together with their appearance has given them the name. The Indian name "Pembina" is preferred by many, partly because the plant is not at all a cranberry. The jelly was clear and attractive but too strong and bitter to be palatable, but the fruit was rather dry and all from one plant.

Wild Black Currant (*Ribes floridum*) is a native shrub which is widely distributed but rather limited to wooded or moist places. The fruits which turn pinkish and finally black are borne in abundance. They are rather tasteless when raw but the jelly had an excellent flavor. They were very high in ascorbic acid, about the same in our tests as buffalo berry.

(In July, 1946, I brought a ripe sample of Bristly Gooseberry (*Ribes setosum*) from Slope County. An analysis was delayed a few days on account of other work and difficulty experienced because of the high color of the material, but D. W. Bolin found 64.7 mg. ascorbic acid per 100 gms. of fresh material. This species is common in western North Dakota and was fruiting heavily at the time.—O. A. Stevens)

Elderberry (*Sambucus canadensis*) is a many-stemmed shrub which spreads by roots. The flowers are in large, flat clusters, the berries small and black. It is native to central and southern United States, but sometimes is grown here as an ornamental. The sample was too small for a jelly test.

Wild Grape (*Vitis vulpina*) is a tall climbing, woody vine, which is frequent along wooded stream banks. The jelly from this sample was syrupy and sticky, not desirable. (Grapes must be taken before becoming ripe for successful jelly.)

Hawthorn (*Crataegus mollis*) is rare in North Dakota but sometimes planted as an ornamental. It becomes a fair sized, spreading tree, has broad, downy leaves, stout thorns and apple-like blossoms. The fruits are one-half to three-quarters of an inch in diameter, mature about September 1 and remain firm. The jelly was clear, red, fine-flavored and was complimented by those sampling it. The fruit was high in ascorbic acid. (Another species of Hawthorn (*Crataegus rotundifolia*) is frequent, but the fruits are smaller, ripen earlier and do not remain firm.—O. A. Stevens). These plants are also known as red haw and thorn apple. The latter name is highly descriptive but unfortunately is also used for poisonous plants of the nightshade family (*Datura spp.*)

Wild Plum (*Prunus americana*) is a widely distributed native plant. It is a somewhat thorny, spreading shrub, sometimes becoming a small tree with a trunk diameter of 6 inches. Size and quality of fruit varies widely and many selections and crosses have been made from it. The jelly was syrupy and is best mixed with other fruits.

Rhubarb (*Rheum rhaponticum*) is a familiar garden plant, the fleshy leaf stalks of which are widely used for pie and sauce. The Strawberry variety is a small type with brightly colored stalks. The ascorbic acid content was low and apparently not higher in the bright colored skin than in the inner, fleshy part of the stalk.

### Summary

Wild plants have long been used for "greens" by many people and can be used much more generally. In the present study, determinations of ascorbic acid content were made on a dozen different kinds in order to learn more of their value in diets. Mustard and lamb's quarters are outstanding in this factor and also are very abundant and palatable. Several other plants, while less valuable on the whole, may be useful in modifying the flavor of a mixed product. Most of the determinations agree well with those found in New Mexico (1).

Jellies and jams are an important item in the home diet. The total amount of ascorbic acid supplied by these is not large, but a knowledge of it will be helpful in any studies of diets.

As one examines the tables of results of analysis, it becomes evident that in most instances the Vitamin C content of jelly is lower than that of the fresh product. Work in the U. S. Department of Agriculture (3) shows that storage lowers the vitamin content of foods in varying amounts due to length of time and temperature of storage. This fact must be remembered when Table 3 is examined.

No effort was made to have a clear jelly as that was not the purpose of the experiment. Variations in the method might make

them practical from an edible standpoint. Many fruits combined with other fruits, commercial pectins and varying amounts of sugar would produce jelly of a different flavor and texture.

Combinations of different fruits give a better flavored product and in no way destroy the vitamin content. A combination of Dolgo crab apple and high-bush cranberry gave an appetizing product. A grape and wild plum mixture gave good results.

The finest-flavored jellies were obtained from the buffalo berry, wild plum, Dolgo crab apple, wild black currant and hawthorn. The comparison must be made with similar products of known composition. This can be done by noting results reported in U.S.D.A. Circular No. 638 where one finds blackberries, blueberries, apples, grapes and plums (5). The ascorbic acid content of the native North Dakota products is relatively higher than the corresponding fruits (analyzed by the U.S.D.A.) there listed.

Much plant work now is aimed at increasing the vitamin content of diets. These native plants have great promise. The products are native species or hybrids easily grown in North Dakota. It would seem that these native plants and fruits have a future because of their high Vitamin C content. According to the investigations of the Division of Fruit and Vegetable Crops and Diseases, U. S. Department of Agriculture, we know that a variety, nutritionally superior by virtue of its genes, is proportionately superior even when grown under unfavorable conditions. These investigations on ascorbic acid content of North Dakota plants and fruits offer suggestions for better utilization of some readily available materials.

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Further suggestions on the use of native fruits may be found in Bulletin No. 281 of the North Dakota Agricultural Experiment Station by Yeager, Latzke, and Berrigan, "The native fruits of North Dakota and their use."

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