

VITAMINS C AND A IN BLUEBERRIES¹

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INTRODUCTION

Blueberries are very widely distributed in the United States, Canada, and Newfoundland. *Vaccinium corymbosum*, the high-bush, cultivated type, and *V. pennsylvanicum*, a low-bush, dwarf type, are the common species growing in northern New England, the Canadian Maritime Provinces, and Newfoundland. Several minor species are also of importance in some localities.

Blueberries ripen over a period of several months and keep remarkably well. Fresh blueberries are extensively used as food and are also canned and frozen, and after preservation are used commercially in the bakery, preserve, and jelly industries. Blueberries thus constitute an important item in the diet of large numbers of people over a wide territory.

As no reports on the vitamin content of blueberries had come to the writers' attention, animal feeding tests designed to evaluate this fruit for its vitamin C and A content were accordingly begun in the summer of 1931. The results of these tests are reported in this paper.

EXPERIMENTAL PROCEDURE

VITAMIN C IN BLUEBERRIES

The method of Sherman, La Mer, and Campbell³ was used, with the exception that the amounts fed were proportioned to weight of the guinea pigs, i.e., a 400-gram animal was fed four thirds as much as one weighing 300 g. The animals were all young and healthy, weighed between 280 and 325 g, and were kept in individual cages. The basal ration consisted of 58 percent equal parts of rolled oats and wheat bran, 30 percent of vitamin C free baked skim-milk powder, 10 percent butterfat, 1 percent each of cod-liver oil and salt. This basal ration and water were kept before the animals at all times.

Three guinea pigs normally were used at each feeding level. At the end of the feeding period all animals were chloroformed and carefully examined for lesions of scurvy. Negative controls died in from 26 to 33 days with an average Sherman scurvy score of 16.

Native western Massachusetts high-bush blueberries, *Vaccinium corymbosum*, were used in both 1931 and 1932 in the tests on fresh blueberries. Since the latter were available for only 85 and 80 days, respectively, in 1931 and 1932, the feeding tests were limited to this period.

Frozen native, high-bush blueberries, *Vaccinium corymbosum*, were from the same lot that was fed fresh in 1932. These were wrapped in cellophane, packed in 1-pound waxed-paper cartons, and frozen at Gloucester-

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² The writers are indebted to the Birdseye Laboratories, Gloucester, Mass., for freezing, storing, and shipping the frozen samples from Massachusetts that were used in 1932.

³ SHERMAN, H. C., LA MER, V. K., and CAMPBELL, H. L. THE QUANTITATIVE DETERMINATION OF THE ANTISCORBUTIC VITAMIN (VITAMIN C). Jour. Amer. Chem. Soc. 44: 165-172, illus. 1922.

ter in the Birdseye multiplate freezer at about -30° F. and stored at 0° for 5 to 8 months. Samples for vitamin assay were shipped weekly with solid carbon dioxide and were still solidly frozen upon arrival at the laboratory. The cartons were held at -0° until just before using.

The Maine blueberries were the low-bush species, probably *Vaccinium pennsylvanicum* and were quick frozen by the Birdseye method at Winslows Mills, Me., during August in 1931 and 1932. No sugar was added. The berries were wrapped in cellophane and packed in 1-pound paraffined-paper cartons. Supplies packed with solid carbon dioxide were sent to the laboratory weekly. The Newfoundland blueberries were also the low-bush type, probably *V. pennsylvanicum*, and were quick frozen by the Birdseye method at St. Johns. They were packaged, stored, and shipped similarly to the frozen blueberries from Maine.

Blueberries were canned in both 1931 and 1932. In 1931 both the native high-bush and the low-bush types were canned. The high-bush native blueberries were blanched for about 30 seconds in boiling water, filled into spring-clamp glass jars, processed in a water bath at 212° F. for 8 minutes, and sealed. The low-bush variety was treated in the same way, except that the jars were vacuum-sealed at a partial vacuum of 25 inches of mercury. These berries were grown on Cape Cod, whereas the high-bush berries were grown in Amherst. In 1932 the high-bush variety from Amherst was again canned. This time the fruit was not blanched but was filled directly into glass jars, covered with a previously boiled hot 10 percent sugar sirup, vacuum-sealed at a partial vacuum of 20 to 22 inches of mercury, and processed at 212° for 8 minutes. The cooled jars had partial vacuums of 15 to 18 inches of mercury.

In every case the guinea pigs ate the fresh, frozen, or canned blueberries. A few animals that disliked the fruit were discarded early in the experiment and new animals substituted for them.

VITAMIN A IN BLUEBERRIES

A preliminary test of the vitamin A content of Maine quick-frozen blueberries was run according to the Sherman and Burtis technic.⁴ Depleted rats were fed the vitamin A free diet supplemented by 1 and 3 g of blueberries, but no significant evidence of protection was secured at either level. Although too scanty data were obtained to render these results quantitative, the agreement is such that the conclusion that blueberries contain but a trace of vitamin A, less than 0.3 unit per gram, seems justified.

RESULTS

The results of the experiments on the vitamin C content of blueberries are reported in table 1.

Data on two successive crops of *Vaccinium corymbosum*, high-bush blueberries, show a minimum protective dose of 4 to 5 g. There is little or no loss due to quick freezing. The canning method may be of importance in the retention of vitamin C. For example, the unblanched vacuum-canned blueberries were far superior to the same variety which were canned a year earlier but which were blanched for 30 seconds in boiling water and sealed without vacuumization.

⁴ SHERMAN, H. C. and BURTIIS, M. P. FACTORS AFFECTING THE ACCURACY OF THE QUANTITATIVE DETERMINATION OF VITAMIN A. Jour. Biol. Chem. 78: 671-680. 1928.

TABLE 1.—Vitamin C in blueberries

Source and treatment of blueberries	Year	Animals	Quantity fed	Change in weight	Average survival period	Scurvy score	Remarks
		Number	Grams	Grams	Days		
Native, high-bush, fresh	1931	3	3	24	85	7	Moderate scurvy; experiment terminated in 85 days.
	1932	3	5	110	85	0	Do.
Native, high-bush, frozen	1932	2	3	40	80	3	Moderate scurvy; experiment terminated in 80 days.
	1932	2	5	349	80	0	Do.
Maine, low-bush, frozen	1932	3	7	346	90	0	
	1932	3	14	322	90	0	
Newfoundland, low-bush, frozen	1931	3	4	-120	33	11	Severe scurvy.
	1931	3	8	-109	65	8	
Native, high-bush, blanchéd, canned	1932	3	10	149	90	3	Slight scurvy.
	1932	3	14	156	90	1	Trace scurvy.
Native, low-bush, blanchéd, vacuum canned	1931	3	4	-143	37	12	Severe scurvy.
	1931	3	8	-115	43	11	Do.
Native, high-bush, not blanchéd, vacuum canned	1931	3	4	-117	43	11	Do.
	1931	3	6	-115	60	16	Do.
Negative control	1931	3	4	-65	39	16	Do.
	1931	3	8	-114	38	14	Do.
Negative control	1932	3	5	360	90	0	No scurvy.
	1932	3	10	311	90	0	Do.
Negative control	1932	3	0	-130	30	16	Severe scurvy.

Too few controlled canning tests were made to justify conclusions relative to the effect of canning methods, yet it is significant that one of the methods used did conserve the vitamin C.

Although the low-bush blueberries, *Vaccinium pennsylvanicum*, were not assayed in the fresh state, nevertheless, inasmuch as quick freezing followed by storage at 0° F. did not injure the vitamin C content of cranberries,⁵ strawberries,⁶ or the high-bush blueberries, the same process probably caused no loss in the low-bush species.

The results obtained in using the low-bush species indicate considerable variation, both seasonal and regional. The 1932 Maine crop apparently contained more vitamin C than did that of 1931, but even this species is but 25 to 35 percent as active as the high-bush species, the minimum protective portion being 15 to 16 g. There is apparent also a slight difference between the vitamin C potency of the low-bush blueberries grown in Maine and those grown in Newfoundland. The results indicate that the Newfoundland berries are but 75 to 85 percent as potent as the Maine berries.

Only one sample of low-bush blueberries was canned. At the 8-g level, the highest amount fed, very little protection from scurvy was obtained.

SUMMARY

Vaccinium corymbosum, the high-bush blueberry, is a good source of vitamin C. Quick freezing and certain methods of canning did not significantly injure the vitamin C content.

Vaccinium pennsylvanicum, the low-bush blueberry contains only 25 to 35 percent as much vitamin C as does *V. corymbosum*. Only a trace of vitamin A is present in *V. pennsylvanicum*.

⁵ FELLERS, C. R. NUTRITIVE VALUE OF CRANBERRIES. Amer. Jour. Pub. Health 23: 13-18. 1933.

⁶ ——— and MACK, M. J. Indus. and Engin. Chem. 25: ——— 1933. (In press.)

