

THE ASCORBIC ACID CONTENT OF SOME
MARITIME PROVINCE FOODS

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ABSTRACT

Determinations of ascorbic acid, and in some cases of ascorbic acid plus dehydroascorbic acid, in potatoes from Maritime Province sources, cooked in various ways, of commercial tomato juice and canned tomatoes sold locally, of home canned tomatoes and of several varieties of Annapolis Valley apples are given. For the most part the values found are within previously determined normals for potato, tomato and apple.

Large numbers of determinations of the 1-ascorbic acid (Vitamin C) and dehydroascorbic acid content of foods by titration methods have been published in recent years. The studies reported here—abstracted from Senior Theses—were made to compare some locally grown fruits and vegetables with citrus fruits as a source of vitamin C, and to study the effect of various cooking processes on the vitamin.

METHOD

The method used in general was that described by Burrell and Ebright (1940). A twenty gram sample of the material to be analyzed was mixed with 15 ml. of 2N sulphuric acid and 15 ml. of 4 per cent metaphosphoric acid and the mixture was ground in a porcelain mortar with acid-washed sand if solid material was present. It was then made up to a standard volume, centrifuged, and aliquots of the clear liquid, measured with a small pipette, were titrated. In some cases, in order to determine also dehydroascorbic acid, which is physiologically active in the same way as 1-ascorbic acid, the material ground with the mixed acids was saturated with hydrogen sulphide to reduce dehydroascorbic acid to ascorbic acid, allowed to stand over night, and then washed with carbon dioxide for

half an hour to wash out all remaining hydrogen sulphide before centrifuging and titrating.

The titrations were made with 0.001 molar solution of the dye sodium 2, 6-dichlorobenzeneindophenol made up fresh at least once a week with 2 ml. of fifteenth molar phosphate buffer of pH 6.8 in 100 ml. of the solution, and standardized usually iodometrically (Menaker and Guerrant, 1938) against a 0.01 normal solution of thiosulphate the primary standard for which was the best grade of arsenic trioxide. The dye was standardized also in some cases against Merck's Cebione (pure 1-ascorbic acid) (Clayton and Folsom, 1940).

The titrations of the samples of the fruit or vegetable extracts were made at room temperature by adding the dye from a Folin 5 ml. burette to the sample contained in a 50 ml. Erlenmeyer flask until the pink color of the dye (in acid solution) persisted for a few seconds.

THE POTATO

Experiments by B. C. C.

The destructive action of the enzyme ascorbic acid oxidase on ascorbic acid starts as soon as the potato is dug, and continues until the enzyme is inactivated by heat. The destruction of the vitamin takes place most rapidly during the first few minutes of heating before the enzyme is destroyed. The method of cooking, therefore, has a great effect on the vitamin C content of the cooked potato.

In this study, medium sized, firm, well-shaped potatoes were chosen and a great deal of care was taken with their preparation, to insure the best possible results.

The baking was done in an electric oven at 400°F. for fifty minutes. The baked potatoes were allowed to stand in their skins for twenty minutes, and then portions of two potatoes were extracted separately as quickly as possible with the acid mixture. Three aliquots from each extract were titrated.

The boiling was done by dropping the whole potato into three cupfuls of vigorously boiling water and continuing to

boil for fifty minutes. The boiling with salt was done in the same way except that $\frac{1}{2}$ teaspoonful of salt was added. Potatoes were also boiled in halves with the other conditions unchanged. Vitamin C retention per gram was about half that for the whole potato. This is because a larger proportion of the vitamin passes into the water. Olliver (1936) found that by the time cooking is completed the vitamin is usually fairly evenly distributed throughout the solid and liquid.

The French fried potatoes were cut in eighths lengthwise, and fried in deep shortening for ten minutes, drained from fat on soft paper and sprinkled with salt.

The method of analysis was the same in all cases.

The results expressed in milligrams of ascorbic acid per 100 grams of the cooked potato are given in Table I.

TABLE I

	French		Boiled whole with Salt	Boiled whole without Salt
	Fried	Baked		
N. B. Green Mountain....	18.0	13.8	11.2	6.3
Cape Breton Pink Eye....	16.1	11.9	10.9	5.9
N. S. Green Mountain....	15.9	10.9	8.9	5.3
N. B. Sebago.....	15.3	8.2	8.2	5.2
N. B. Katahdn.....	14.0	8.2	8.0	5.0
N. S. Cobbler.....	13.2	8.0	7.4	4.3
N. S. Bliss Triumph.....	9.5	5.9	5.9	4.2

The analyses in Table I were made without reduction by hydrogen sulphide. Such reduction of the baked N. B. Green Mountain variety resulted in an increase in ascorbic acid amounting to 3 mg. per 100 grams.

It will be noticed that the order of ascorbic acid retention for the different methods of cooking is the same for each of the seven varieties.

The experiments were made in February and March. Storage reduces the vitamin C content of the potato. It is probable that the difference between the varieties was due largely to difference in storage conditions. The New Brunswick potatoes were grown from certified seed, were graded, were intended for use as seed and were obtained from a warehouse in Victoria County; N. B., shortly before analysis. The Cape Breton potatoes, also, were grown from certified seed and were

graded. The other Nova Scotia potatoes were grown from uncertified seed and were ungraded.

An attempt was made to determine the ascorbic acid content of the raw potato in the case of each variety. The order of ascorbic acid content found for the different varieties was the same when raw as when cooked. Inasmuch as it is difficult to break down the hard uncooked tissues by grinding with sand and the acid mixture in a porcelain mortar and prepare a uniform sample for analysis, the actual weights obtained are not listed here.

THE TOMATO

Experiments by M. F. McK. M.

Ascorbic acid determinations were made on five brands of tomato juice and one brand of canned tomatoes purchased in local stores, on tomatoes grown locally and canned in tins by a Women's Institute and in glass by members of a Household Economics class, and on raw tomatoes imported in February. The tomato juice and the commercially canned tomatoes originated in the Provinces of Ontario and Quebec. In the case of each brand, analyses were made on the contents of two or three newly opened cans, and the effects of heating, and in some cases of adding soda and heating, and of exposure to air, on the ascorbic acid content were investigated also.

The results with tomato juice are given in Table II, those with canned and raw tomatoes in Table III.

TABLE II

Milligrams of Ascorbic Acid per 100 grams of Tomato Juice

		Newly Opened	Heated in Pyrex	Exposed to Air
Brand A.	1st. can	19.1	14.6	
	2nd. "	17.2	...	10.9 (after 1½ hrs.)
Brand B.	1st. "	21.1	...	
	2nd. "	19.8	20.7	
Brand C.	1st. "	14.7	...	11.3 (after 2 days)
	2nd. "	26.6	...	
Brand D.	1st. "	14.5	18.1	
	2nd. "	17.8	...	
Brand E.	1st. "	13.3	14.9	
	2nd. "	14.7	...	13.6 (after 1½ hrs.)

TABLE III
 Milligrams of Ascorbic Acid per 100 grams of Tomatoes

	Newly Opened	Heated in Pyrex	Heated with Soda	Exposed to Air
Commercially canned...	17.0	17.1	16.6	
Home canned in glass...	22.1	22.1	14.7 (2 days)
“ “ “ tins....	4.5 (1 week)
“ “ “ tins....	15.5	21.	19.2	
Raw imported tomatoes.	23.1	

DISCUSSION OF RESULTS

The proportion of ascorbic acid in the canned tomatoes and tomato juice was found to be in general a third or a quarter of that in fresh citrus fruit juice which is usually found to contain between 50 and 65 mg. per 100 ml. The loss of ascorbic acid on exposure to air is due to oxidation. Loss by oxidation on heating might be expected, especially when the acidity is reduced by the addition of soda, but the reverse effect, found in about half the experiments, has been observed frequently by others. McHenry and Graham (1935) suggested in explanation “that a part of the ascorbic acid in the tissue is bound to some other substance and that this combination is split by hydrolysis.” Our glass packed tomatoes were particularly high in ascorbic acid, but extensive studies by Lueck and Pilcher (1941) have shown “that vitamin C was retained in higher degree in the product packed in tin containers than in the identical tomato juice packed in glass bottles.” This is attributed to the reducing conditions maintained by the tin plate.

THE APPLE

Experiments by M. E. M.

The apples used were grown in the Annapolis Valley. They were all obtained from the same warehouse shortly before analyses. The work was done between the 25th of February and the 24th of March.

Radial sections of the raw apples, excluding the inedible parts but including the peel, were taken for analyses. The

rest of the method of analyses was the same as that for the cooked potatoes.

The results in milligrams of ascorbic acid per 100 grams of apple are as follows: Golden Russett, 14.5; Ben Davis, 13.4; Red Spy, 11.9; Baldwin, 10.9; Gano, 8.6; Greening, 5.8; apple sauce from Ben Davis apples which had been soaked over night in 2½ per cent salt solution to exhaust respiratory oxygen, 7; apple sauce from the same apples without the treatment with salt water, 3.7.

Analyses, with hydrogen sulphide reduction, of several brands of canned apple juice, showed that almost all of the ascorbic acid had been irreversibly oxidized.

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