

A STUDY OF THE ASCORBIC ACID CONTENT OF THE DIET COMMONLY PRESCRIBED FOR PATIENTS WITH GASTRIC ULCERS¹

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The diet prescribed for patients suffering with gastric ulcer is one which must be followed over a period of months or years; therefore it is quite important that such a diet supply all of the essentials for good nutrition. A study of the literature reveals that, while special diet restrictions advised because of the presence of gastric ulcer have resulted in improvement of the ulcerous condition, these restrictions have in many cases resulted in definite deficiency states. It has long been recognized that the usual diets prescribed for gastric or duodenal ulcers are often deficient in ascorbic acid (7, 21). Cases have been reported (2, 5, 18, 22) of the development of scurvy in patients who followed such a diet. At present, moreover, it has been noted that early "prescorbutic" states in such cases are of frequent occurrence (1, 3, 8, 9, 10, 11, 13, 14, 15, 19). Further, the relationship of ascorbic acid to collagen formation (2, 3, 4) and consequently to wound healing (12), and to capillary fragility (6), may indicate that this vitamin is important in the healing of the ulcers although it is unlikely that ascorbic acid deficiency is a definite etiological factor in producing peptic ulcer in man (17, 19). Thus it would appear that the presence of a superimposed ascorbic acid deficiency state in patients with peptic ulcer would be extremely detrimental. Consequently this study was undertaken with two objects in view: first, to determine the ascorbic acid content of the ulcer diet as it was being served at the hospital; and second, to suggest a practical means of maintaining an adequate vitamin C intake in the diet of the ulcer patient.

PROCEDURE

The menu for the prescribed diet was written daily by the therapeutic dietitian and served from the floor diet kitchen in the usual manner. In general, the typical pattern of the diet was as follows:

BREAKFAST	LUNCH	SUPPER
Fruit	Protein Dish	Soup or Vegetable
Cereal with Cream and Sugar	Potato	Egg, Cottage Cheese
Egg	Vegetable	or Baked Potato
Toast with Butter	Toast with Butter	Toast with Butter
Milk	Dessert	Dessert
	Milk	Milk

At 10 A. M., 2 and 8 P. M., a glass of milk is given.

This diet is characterized by its bland and non-irritating foods. Any tender meats such as beef, lamb, chicken, ground or scraped beef, liver, tender fish or sweetbreads and cream or cottage cheese and eggs are given. Cereals as Farina, white or fine whole wheat bread, noodles, and rice are permitted. All coarse vegetables such as corn, green beans, peas, and lima beans are strained and other vegetables as potatoes, spinach, asparagus, carrots are given if well cooked. Orange, grapefruit, and tomato juices, soft stewed fruits, peaches, sieved pears, apricots,

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and prunes are allowed in addition to simple desserts as custard, junket, jello, ice cream, and sponge cake. Beverages such as milk and eggnog are used frequently, and weak coffee, cocoa, or chocolate milk are sometimes permitted. Each item of food was weighed as served and aliquot samples were collected. Analyses were made 15 to 20 minutes after each collection except for the supper meal, in which case metaphosphoric suspensions were made in the usual manner, placed in the refrigerator at 5° C., and the analyses completed the following morning.

The estimation of ascorbic acid was made by a modified Roe and Kuether method (20). This method gives directly a determination of the total ascorbic acid, and encounters no difficulties with pigmented food extracts.

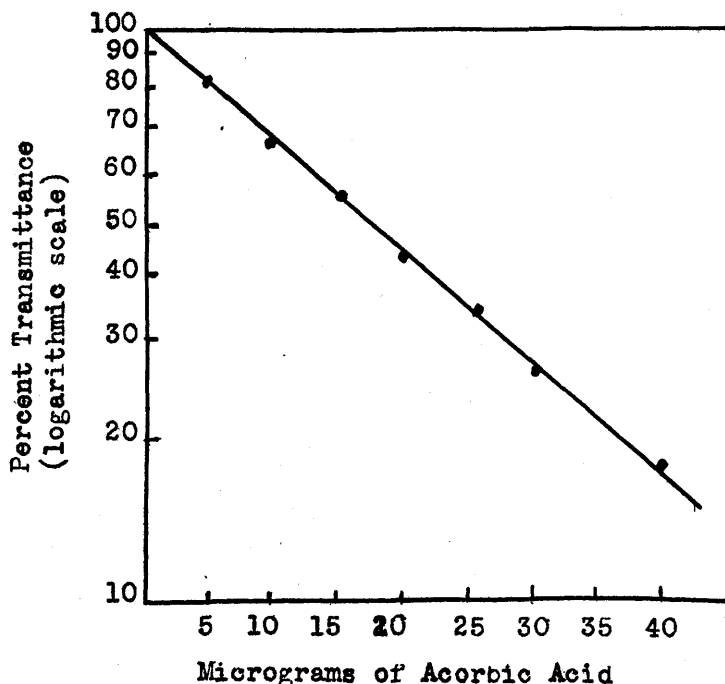


FIG. 1. Absorption Curve of 2, 4-dinitrophenylhydrazine Derivative of Ascorbic Acid Using Reagent Blank as Reference Solution.

One to ten grams of the sample (a weight which when diluted properly would contain 5 to 40 gammas of ascorbic acid per milliliter) were weighed into the bowl of the Waring Blendor. Fifty or one hundred milliliters of 1% metaphosphoric acid were then added and the sample mixed at high speed for approximately three minutes. The mixture was transferred to a volumetric flask (100 ml. or 200 ml.) and made up to volume with 8% trichloroacetic acid. For each 100 cc. of the diluted sample approximately one teaspoonful (1.5 gm.) of acid washed norite was added and the mixture shaken vigorously.

Five cubic centimeters of the norite filtrate were placed in each of two matched photoelectric colorimeter tubes. When a volume smaller than 5 cc. was used, the quantity was made up to 5 cc. with 4% trichloroacetic acid. One drop of 10% thiourea solution was added to each tube. One tube was held in reserve for a blank and to the other tube 2 cc. of 2, 4-dinitrophenylhydrazine was added. The latter tube was placed in a water bath at 37° C. The bath was well equipped by thermostat to maintain a constant temperature. The tube was kept immersed

in the water bath for exactly three hours. It was removed and placed in a beaker of ice water containing generous quantities of ice. The blank tube was placed in the water also. To each of these tubes while in the ice water bath, were added very slowly 5 cc. of 85% sulphuric acid. The sulphuric acid was added from a burette a drop at a time, a step which required about one minute. It is very important not to allow the temperature of the solution to be raised appreciably, as this brings about a charring of the sugars or other organic matter and thus a positive error would be introduced. Finally, 1 cc. of 2, 4-dinitrophenylhydrazine was added to the blank tube. Both tubes were shaken thoroughly under the ice water to obtain complete mixing and were then removed to a rack. After thirty minutes the tubes were wiped clean and dry and read in a Coleman 10 S spectrophotometer using light with a wave length of 510 μ since in preliminary work an absorption curve (Fig. 1) showed an absorption band at 510-520.

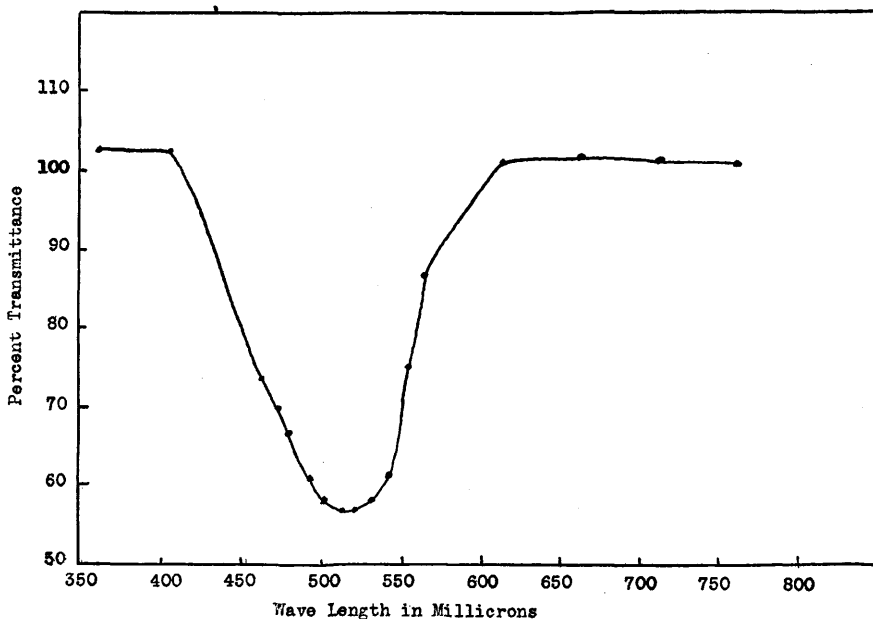


FIG. 2. Calibration Curve Made at 510 Millicrons.

A calibration curve was constructed using standard solutions of ascorbic acid varying from 5 to 40 gammas in 4% trichloroacetic acid. These solutions were treated with norite, filtered, and the determinations made in exactly the same way as described above. The readings of the known solutions were then plotted on semi-log paper, per cent transmittance against concentration (Fig. 2). Readings of the unknown solutions were determined, referred to the curve, and the ascorbic acid content computed.

In some cases simultaneous determinations on each item of food were made by a modified Tillman's (16) method; these results were found to agree closely with those obtained by the colorimetric method; however, in most cases, slightly higher results were obtained by the colorimetric method. This is to be expected since the colorimetric method gives an estimation of total ascorbic acid, while the method of Tillman determines only the reduced form. The vitamin C contents of individual foods as analyzed are recorded in Table I and the total ascorbic acid content of each day's diet for sixteen days are recorded in Table II.

TABLE I
VITAMIN C CONTENT OF FOODS ANALYZED

Food	Method of Preparation	Variety	No. of Times on Menu	Av. milligrams of Vitamin C per 100 grams
Apples.....	Steamed, unpeeled.....	Jonathan.....	1	3.1
	Sauce.....	Winesap.....	1	1.25
	Juice (commercially prepared).....	.....	1	0.00
Apricots.....	Juice (commercially canned).....	.....	2	0.00
Grapefruit.....	Juice (commercially canned).....	.....	1	32.5
Lemons.....	Lemonade (1 pt. of lemon juice to 1 gal. of water).. Pudding.....	California.....	2	7.80
		.....	1	0.00
Loganberries...	Juice (commercially canned).....	.....	1	0.00
Pears.....	Commercially canned.....	Bartlett.....	3	1.49
Oranges.....	Juice (prepared the night before, sealed and placed in refrigerator)..... Orangeade (approx. one-half orange juice and one-half water).....	Valencia.....	8	37.50
		Valencia.....	2	16.00
Asparagus.....	Steamed to warm (commercially canned).....	.....	3	18.70
	Puree (commercially canned, then warmed when served).....	.....	1	15.0
	Soup (homemade, one-third asparagus puree and two-thirds milk)....	.....	1	4.38
Beets.....	Fresh, steamed, small, whole.....	.....	2	2.40
	Whole, canned, steamed to warm.....	.....	2	3.10
Carrots.....	Puree (canned, warmed before served).....	.....	2	5.30
	Strips, (fresh, steamed, then buttered).....	.....	2	3.05
	Cubes, (fresh, steamed, buttered).....	.....	1	2.8
Green Beans...	Puree (commercially canned).....	.....	1	6.0
Peas.....	Puree (commercially canned, heated before serving).....	.....	2	5.75
	Soup (homemade, one-third pea puree, two-thirds milk).....	.....	2	2.95

TABLE I—(Continued)

Food	Method of Preparation	Variety	No. of Times on Menu	Av. milligrams of Vitamin C per 100 grams
Potato, Sweet..	Mashed.....	Nancy Hall.....	1	12.0
	Steamed, candied.....	Nancy Hall.....	1	19.5
Potato, White..	Steamed, unpeeled.....	Idaho.....	1	15.5
	Steamed, peeled, buttered.	Red Russets.....	1	13.0
	Baked.....	Idaho Russet.....	4	11.31
	Escalloped.....	Red Russets.....	1	10.0
	Mashed.....	Red Russets.....	2	9.1
	Mashed.....	Bliss Triumphs.....	1	8.1
	Creamed.....	Bliss Triumphs.....	1	6.7
	Baked, stuffed.....	Idaho.....	1	2.2
Spinach.....	Soup (homemade, one-third spinach puree and two-thirds milk).....		1	1.00
Squash.....	Mashed, frozen.....	Winter.....	2	7.29
Tomatoes.....	Juice (commercially canned)		4	11.25
	Soup (commercially canned)		1	3.55
	Soup (homemade, approx. two-thirds milk and one-third canned tomato puree).....		2	4.38
Cream.....	Pasteurized.....		5	0.30
Ice Cream.....	Commercial (vanilla).....		3	0.53
Liver.....	Baked.....	Beef.....	1	16.20
	Loaf (with mashed potato topping).....	Beef.....	1	7.00
Milk.....	Pasteurized.....		5	1.57

TABLE II
ASCORBIC ACID IN THE DIET OF STOMACH ULCER PATIENTS

Day	Total Ascorbic Acid	Total Ascorbic Acid less Orange, Grapefruit and Tomato Juices	Total Ascorbic Acid less Orange, Grapefruit and Tomato Juice, plus 3 ounces of Orange Juice
1	152	25	60
2	99	41	76
3	125	41	76
4	34	38	73
5	142	39	74
6	75	43	78
7	64	50	85
8	40	41	76
9	31	30	65
10	89	48	83
11	142	56	91
12	61	39	74
13	39	43	78
14	45	49	84
15	100	36	71
16	117	48	83

DISCUSSION

Examination of Table II reveals that four days fell in the 25-40 milligram range, four days fell in the 40-75 milligram group and eight days reached the level 75-100 milligrams, usually considered necessary for body saturation. Also it may be noted that with the omission of orange, grapefruit and tomato juice (Table II) all of the days fell below the 60 milligram level. On the other hand, the addition of three ounces of orange juice to each day's diet would adequately correct this condition.

CONCLUSIONS

The amount of ascorbic acid furnished by the fruits and vegetables used in the ulcer diet other than orange, grapefruit or tomato can be relied upon to contribute only a small part of the daily need. From the results obtained, it can be seen that the required standard of ascorbic acid necessary for body saturation (75-100 milligrams) cannot be assured in the routine ulcer diet without the daily use of more than three ounces of orange juice, or its equivalent in other citrus fruit juices.

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