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Vitamin C Requirement of Man. Prolonged Study of Daily Excretion and Plasma Concentration of Vitamin C.*

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The vitamin C requirement was determined on 2 male adults who were hospitalized during the study and fed diets containing constant minimal amounts of vitamin C. The 24-hour urinary excretion of vitamin C was determined daily and the plasma concentration 3 times a week. The determination of vitamin C in both plasma and urine was done by the indophenol titration method¹ in the first case and in the second case both by titration and by the photoelectric colorimeter.^{2, 3} The use of the photoelectric colorimeter reduces the error due to the small amount of non-vitamin C reducing substances present in the urine. On the diet fed, titration gave urine figures which were consistently higher by 10 mg per day. No significant differences were found in the plasma values.

The first case, L. R., age 57, height 72.5 in., weight 160 lb., was observed for a total of 110 days. In the first period of 19 days he received 50 mg of ascorbic acid daily; during the second period of 53 days he received 100 mg of ascorbic acid daily; during the third period of 22 days, 200 mg daily and during the fourth period of 16 days 350 mg daily. The ascorbic acid was given in divided doses of 50 mg each at regular intervals throughout the day. In the first period the daily excretion of vitamin C averaged 11 mg, the daily retention averaged 39 mg and the blood plasma concentration varied from 0.76 to 0.97 mg %, the average being 0.85 mg %. In the second period the daily excretion averaged 20 mg, the daily retention 80 mg, and the plasma vitamin C varied from 0.93 mg % to 1.22 mg %, the average being 1.12 mg %. In the third and fourth periods the vitamin C intake was increased to 200 mg and 350 mg respectively. The excretion increased but the amount retained did not go above an average of 91 mg daily. The plasma concentrations remained at the higher levels. Apparently the patient was retaining a maximal amount on an intake of 100 mg daily.

The second patient was 42 years of age, 66.5 in., weight 160 lbs.

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¹ Birch, T. W., Harris, L. J., and Ray, S. N., *Biochem. J.*, 1933, **27**, 590.

² Mindlin, R. L., and Butler, A. M., *J. Biol. Chem.*, 1938, **122**, 673.

³ Evelyn, K. A., Malloy, H. J., and Rosen, C., *J. Biol. Chem.*, 1938, **126**, 645.

The vitamin C studies were begun when the plasma concentration was 0.24 mg %. There was an interval of 2 months between periods II and III, during which time no observations were made. The patient was observed for a total of 179 days. In the first period of 6 days the patient was kept on diet alone, receiving no ascorbic acid; in the second period the patient received 100 mg of ascorbic acid daily for the 52 days. In the 3rd period of 8 days the patient was again kept on the diet alone; in the 4th period of 41 days he was given 50 mg of ascorbic acid daily; in period 5, 43 days, he received 75 mg of ascorbic acid; in period 6, 29 days, he was given 100 mg daily. The average daily excretion in period I was 6.4 mg; the plasma concentration was 0.24 mg %. In period II the average daily excretion was 6.0 mg daily; the retention was 94 mg daily; the plasma concentration rose to 1.06 mg %. A level of 1.00 mg % was reached in the plasma after 36 days. In the 3rd period of 8 days the plasma concentration fell from 0.56 to 0.27 mg %. In the 4th period of 41 days the daily excretion averaged 9.6 mg, the daily retention averaged 40 mg and the plasma concentration rose to 0.34 mg %, the average being 0.28 mg %. In the 5th period of 43 days the excretion averaged 7.9 mg, the retention averaged 68 mg daily and the plasma level rose to 0.75 mg %; the average for the last 20 days was 0.70 mg %. In the 6th period of 41 days the daily excretion averaged 10 mg; the daily retention was 90 mg. The plasma level rose to 1.43 mg % and was maintained at an average of 1.23 mg % for the last 17 days.

From these observations it seems that the optimum intake of vitamin C daily is 100 mg. At this intake the blood plasma concentration will be maintained at or above a level of 1 mg %. If a greater amount of vitamin C is fed it is excreted in the urine.

TABLE I.
Average Daily Excretion of Vitamin C in 2 Adults.

Period No. of Days	Ascorbic acid fed daily, mg	Avg daily excretion Vitamin C, mg \pm S.D.	Avg daily retention Vitamin C, mg	Plasma levels Vitamin C, mg %
Case I.				
I-19	50	11 \pm 4.6	39	0.85
II-53	100	20 \pm 2	80	1.12
III-22	200	109 \pm 20	91	1.14
IV-16	350	259 \pm 48	91	1.15
Case II.				
I- 6	none	6.4 \pm 3.9		0.24
II-52	100	6. \pm 4.4	40	0.20-1.06
III- 8	none	6.1 \pm 2.0		0.56-0.27
IV-41	50	10. \pm 5.2	40	0.28
V-43	75	7.9 \pm 3.6	68	0.30-0.73
VI-41	100	10. \pm 3.7	90	0.73-1.43