

## Human Supplementation with Different Forms of Vitamin C

J.A. Vinson, 1986.

### Background

Chemically all forms of Vitamin C are identical - ascorbic acid. However, the bioflavonoids, proteins and carbohydrates present in citrus fruits may affect the bioavailability of the ascorbic acid. A previous study with guinea pigs in our laboratory has shown that Renatured Vitamin C in Citrus Fruit Media was more absorbed than ascorbic acid alone in short and long term experiments. Also, a single dose human study proved that the Citrus Fruit Media was more absorbed than ascorbic acid alone.

### Protocol

Ten subjects (three females and seven males, age 18-44) volunteered for this study with informed consent. They were asked to abstain from high vitamin C containing foods for the duration of the study. Each subject appeared in the morning after an overnight fast for the baseline analysis. Plasma and red blood cells were collected from a finger-prick sampling and the samples stored at -20°C following protein precipitation with 7% perchloric acid. Sorbitol was measured with a standard enzyme technique and ascorbate was measured fluorimetrically, then each subject took 500 mg daily of ascorbate, either as 500 mg tablets or as Renatured Vitamin C in Citrus Fruit Media which contains 25 % ascorbate. The latter was measured by volume. The supplementation period lasted two weeks when subjects then were sampled fasting. A ten day washout period followed and a baseline sampling then proceeded a second two week supplementation period and finger-prick sampling.

The results were compared statistically by means of a paired students' *t*-test.

Supplement	Change	
	Plasma Ascorbate	Red Blood Cell Ascorbate
Ascorbic Acid	+ 46.8 ± 24.0%	+ 35.5 ± 19.4%
Citrus Fruit Media	+ 72.3 ± 57.0%	+ 61.9 ± 29.4%

\* The Citrus Fruit Media produced a significantly greater change than Ascorbic Acid ( $p < 0.05$ ).

**Table 2:** Net twenty four urinary excretion of ascorbate after oral ingestion of 500 mg of synthetic ascorbic acid alone or in a citrus extract to ascorbate-saturated subjects.

Subject	Urinary Ascorbate (mg)	
	Ascorbic Acid	Citrus Extract
1	8.0	26.4
2	73.4	157.7
3	49.6	189.9
4	102.1	172.1
5	36.8	43.2
6	108.4	262.1
Mean ± SD	63 ± 38.9	141.9 ± 90.5 *

\*  $p < 0.05$  by a paired *t*-test.

**Table 3:** Net mean twenty four urine excretion of ascorbate in 12 human subjects after oral ingestion of 500 mg of the form of synthetic ascorbic acid alone or in citrus extract.

Subjects	Ascorbic Acid	Urinary Ascorbate (mg)	
		Citrus Extract	p*
Males (n = 6)	181 ± 89	72 ± 35	< 0.05
Females (n = 6)	93 ± 32	71 ± 29	N.S.
All Subjects	135 ± 79	72 ± 31	< 0.05

Significance of difference between synthetic ascorbic acid and citrus extract by a paired *t*-test.

### **Discussion**

Following the washout period, all ascorbate concentrations fell to baseline levels. In plasma and red blood cells, all ascorbate concentrations were changed by both supplements. The range of increase for plasma ascorbate was 22.2 to 96.7% for the ascorbic acid and 27.2 to 153.7% for the Citrus Fruit Media. The range of increase for red blood cell ascorbate was 17.2 to 83.0% for the ascorbic acid and 19.7 to 115.3% for the Citrus Fruit Media. Compared to ascorbic acid, the Citrus Fruit Media produced 54.5% greater change in plasma ascorbate and a 74.4% greater change in red blood cell ascorbate, the difference between the two supplements was significant ( $p < 0.05$ ).