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### Pharmacokinetics of Poly C versus Ascorbic Acid

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#### Introduction

Vitamin C, also known as ascorbic acid, is an essential nutrient for humans. It plays several roles in the body: as a cofactor or co-substrate for several enzyme systems—including three involved in collagen biosynthesis—as an electron donor or reducing agent for many biochemical reactions, and as a general antioxidant in protecting cells and tissues against free-radical damage (1). Acute vitamin C deficiencies result in scurvy. Because of its essential role in human nutrition, vitamin C is a common and often high-dose constituent of nutritional supplements. As such, many chemical forms of the compound have been developed, in part as a means of improving product performance and as a way to differentiate one supplement brand from another. USANA's proprietary vitamin C blend, Poly C, is a mixture of calcium, potassium, magnesium, and zinc ascorbates. This blend was developed to promote bioavailability and to help reduce the stomach upset that often accompanies high doses of pure ascorbic acid. The clinical study reported here was undertaken to compare the pharmacokinetics of Poly C versus ascorbic acid, and to substantiate claims of improved bioavailability.

#### Methods

This study was a double blind, prospective pharmacokinetic study involving 19 healthy volunteers. Subjects were randomly assigned to the two treatment groups, nine to the Poly C group, and ten to the ascorbic acid group. Subjects reported at 7:30 a.m. on the test day for their first blood draw. Immediately following the draw, they were given either 1,200 mg of vitamin C as Poly C or 1,200 mg of pure ascorbic acid. Subjects reported to the lab again for blood draws at 1, 2, 3, 4, 7, and 10 hours following supplementation. In the interim, they were given low-vitamin C meals and snacks. Treatments were run in parallel. Following the last blood collection, samples were processed and analyzed for plasma vitamin C content by HPLC, using an internal standard and an electrochemical detector. Results were tabulated, and differences between treatments were assessed using a Profile Repeated

Measures Analysis, performed by an independent statistician. Analyses were conducted on three sets of variables: raw plasma concentration of ascorbic acid, percent increase (from baseline) in plasma ascorbic acid, and percent increase in plasma ascorbic acid per kilogram of body weight. Differences associated with a "p" value <0.05 were considered statistically significant.

#### Results

Results showed that Poly C, USANA's proprietary blend of four mineral ascorbates, delivered more vitamin C to the bloodstream than did an equivalent dose of pure ascorbic acid (Figure 1). Plasma vitamin C concentrations were consistently higher in the Poly C group than in the ascorbic acid group across the 10-hour study period. Differences were most pronounced 2 - 4 hours after supplementation. During this time, vitamin C levels in the Poly C group averaged 10–15% higher than in the ascorbic acid group. Similarly, increases in plasma vitamin C per kilogram of body weight were 8% higher in the Poly C group than in the ascorbic acid group (results not shown). This difference was statistically significant ( $p < 0.01$ ) and, as before, was largest during the period two–four hours after treatment. When percent increases in plasma ascorbic acid were not normalized for body weight, differences between groups were not statistically significant.

#### Conclusion

This study showed that Poly C delivers more vitamin C to the bloodstream than does pure ascorbic acid. Subjects who were given the equivalent of 1,200 mg of ascorbic acid as Poly C had significantly higher concentrations of plasma ascorbic acid over a 10-hour period than did subjects given 1,200 mg of pure ascorbic acid. Differences were most prominent two–four hours after supplementation. We conclude that, from the standpoint of bioavailability, Poly C is superior to pure ascorbic acid as a supplemental source of vitamin C.

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**References**

(1) Levine M, et al. 1996. Vitamin C. pp. 146-159 In Ziegler EE and LJ Filer (eds). Present Knowledge in Nutrition. ILSI Press, Washington, D.C.

**Figure 1.**

Plasma concentrations of vitamin C ( $\mu\text{M}$ ) following supplementation with Poly C versus pure ascorbic acid. In both cases, the equivalent of 1,200 mg of vitamin C were administered.

