Ascorbic Acid Effect on Plasma Amino Acids

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Many patients seen at The Center are diagnosed with nutrition problems. After the appropriate laboratory tests, any nutrition problem such as a deficiency or imbalance, are treated with diet and oral or intravenous supplementation. Some of the treatment protocols include high dose vitamin C. This can be administered via the oral and/or intravenous route. In reviewing the literature, several authors had shown that high levels of plasma ascorbic acid (mean=2.36 ± 0.42 mg/dL) significantly increased isoleucine, leucine, aspartic acid, and taurine, while significantly decreasing arginine, glutamic acid glycine and serine when compared to controls (mean=0.087 ± 0.254 mg/dL).[1] Since the numbers reported in this study were small, 22 for the controls and 10 for the test group, we reviewed plasma ascorbic acid and amino acid data from 112 patients (36 males, 76 females) who were enrolled in a one year project at The Center. Ages ranged from 9 years to 52 years.

Free amino acids were measured by high performance liquid chromatography on a Water's Pico-Tag® amino analysis system (Waters Associates, Division of Millipore, Maple Street, Milford, MA 01757)[2,3] with methionine sulfone as the internal standard. Plasma ascorbic acid levels were measured using the 2-6-dichlorophenol indophenol method. Subjects were divided into two groups, group one (22 males, 45 females) a control group with plasma ascorbic acid levels of 0.94 ± 0.27 mg/dL, and group two (14 males, 31 females) with plasma ascorbic acid levels of 2.11 ± 0.58 mg/dL.

Statistical analysis showed no decrease in any amino acid in either group. There was an increase ($p<0.05$) in lysine, methionine, arginine, taurine and tryptophan in group 2: age and gender had no effect on the results (**Table 1**, p. 165). Although statistically significant increases were demonstrated in five amino acids, the changes appeared to be so small to be of little physiological significance. Also, there was no significant difference in the sum of the essential amino acids (81.12 versus 83.45 μmol/dL) and total non-essential amino acids (131 versus 134 μmol/dL). Total for all amino acids was 212.12 μmol/dL for group one and 217.45 for group two. The data shows that if plasma ascorbic acid in any way influences amino acid levels, the effect is weak. The question to be answered is whether the effect shown was an *in vitro* technique error, or a true *in vivo* physiological effect.

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References

1. Tsao CS, Miyashita K: Effects of high intake of ascorbic acid on plasma levels of amino acids. *IRCS Med Sci*, 1984; 12: 1052-1053.
2. Manual for physiologic amino acids on the pico-tag system. *Water's Assoc,* Div. of Millipore, 1986; 3: 12-32.
3. Thomas H, Maugh H: New tool for amino acid analysis. *Science,* 1984; 225:42.

Table 1. Relationship between plasma ascorbic acid and plasma amino acids

	Controls	Test Group
	n=67 (22M, 45F)	n=45 (14 M, 31 F)
Age (yrs)	*51.4 ± 12.6	45.3 ± 16.2
Plasma ascorbic acid (mg/dL)	0.94 ± 0.27	2.11 ± 0.58
Plasma amino acid (umol/dL)		
Histidine	7.42 ± 1.90	7.76 ± 2.50
Isoleucine	6.00 ± 1.90	5.94 ± 1.77
Leucine	10.38 ± 2.90	10.46 ± 3.64
Lysine	15.81 ± 5.52	**16.95 ± 5.39
Methionine	2.62 ± 1.11	**2.66 ± 1.36
Phenylalanine	5.30 ± 1.38	5.60 ± 1.66
Threonine	11.81 ± 4.21	10.76 ± 3.81
Valine	20.54 ± 6.16	21.21 ± 6.72
Total essential amino acids	81.12	83.45
Tyrosine	5.92 ± 2.09	6.19 ± 2.45
Alanine	35.71±10.43	33.12 ± 9.94
Arginine	7.44 ± 2.33	**7.71 ± 2.33
Aspartic acid	0.35 ± 0.20	0.30 ± 0.23
Citrulline	3.64 ± 1.12	3.49 ± 1.55
Glutamic Acid	5.11 ± 2.51	5.29 ± 3.89
Glycine	22.93 ± 8.38	22.90 ± 7.35
Ornithine	6.25 ± 2.50	6.37 ± 2.92
Serine	9.03 ± 2.36	9.32 ± 3.25
Taurine	5.49 ± 1.94	**5.62 ± 2.06
Hydroxyproline	1.51 ± 1.08	1.36 ± 0.68
Asparagine	.35 ± .20	.30 ± .23
Glutamine	5.11 ±2.51	5.29±3.89
Proline	17.89 ± 7.14	16.89 ± 5.92
Cystine	4.07 ± 2.72	4.76 ± 2.96
Tryptophan	4.94 ± 1.40	5.36 ± 1.77
Phosphoserine	.37 ±.19	.44 ± .30
Total other non-essential amino acids	131	134
Total all amino acids	212.12	217.45

*mean ± 1.0 standard deviation
**$p < 0.05$