

Comparative Absorption of Water-Soluble Vitamins from Five Dietary Supplements

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Nutrient bioavailability is an important characteristic of dietary supplements. Bioavailability is a measure of the extent to which nutrients in a supplement are absorbed by the body and delivered to the bloodstream. Many factors affect the absorption of a given nutrient from a given supplement (see *Discussion*), but in general, high bioavailability is desirable because absorption is a prerequisite for eventual activity and benefit. As such, quality supplements are designed with optimal nutrient bioavailability and absorption in mind.

Unfortunately, claims of high bioavailability are often misused in the dietary supplement industry. Some companies tout “revolutionary formulas” that promote “exceptional absorption,” but comparative data is rarely provided to substantiate such claims.

Moreover, such claims seldom draw a distinction between percent bioavailability and total absorption.

Consider the following example. Company A sells a multivitamin product containing vitamin C. Company A claims that this form of vitamin C is 80% bioavailable, meaning the average individual should absorb approximately 80% of the vitamin C in a given dose. Let us also assume that this product contains 100 mg of vitamin C (per dose). Based on these values, the average person should absorb a total of 80 mg of vitamin C from a dose of this product.

Alternatively, Company B also sells a multivitamin formula with vitamin C. However, they use a form of vitamin C that is only 50% bioavailable. But if the amount of vitamin C in a dose of Company B’s product is 500 mg, then the average person would absorb a to-

tal of 250 mg of vitamin C per dose – a significantly higher total absorption than Company A provides.

Clearly, total absorption is of greatest importance. Using the example above, if all other factors were equal (including price), Company B’s formula would be preferable, despite the fact that Company A used a “more bioavailable” form of vitamin C.

The purpose of this study was to compare the total absorption of several water-soluble vitamins as delivered by the following five multivitamin / multimineral formulas: the USANA Essentials (in tablet form), an encapsulated formula based on vegetable and fruit juice powders, a gel-based formula supplying nutrients in a soluble gum suspension, a phytonutrient formula delivered in caplet form, and a mass market “one-per-day” tablet.¹

Methods

This study followed a randomized crossover design involving ten (10) healthy subjects.

Regular intake of all dietary supplements was discontinued ten days prior to the start of the study. In addition, volunteers refrained from structured physical activity on each study day. Each subject took a full daily dose of each of the five products in random order on five separate days. The products were taken at the start of the day alongside a standard meal (plain bagel and cream cheese) after completing a 10-12 hour overnight fast. Blood samples were taken at baseline (prior to supplementation) and again at 1, 3, and 7 hours after supplementation. Subjects were fed the same standard meal for lunch, and they were allowed unlimited water over the course of the day. No additional food or beverages were allowed until after the final blood collection.

All blood samples were analyzed using standard methods for vitamin C, riboflavin, vitamin B6, and Plasma Antioxidant Reserve (PAR), a measure of overall antioxidant status.² Curves showing blood concentrations of these factors over the seven-hour study period were plotted, and the area under each curve (AUC) was calculated to provide a measure of total nutrient absorption. The average AUC was calculated across the 10 subjects for each nutrient as delivered by each product, and AUC differences between products were tested for statistical significance.

Results

The absolute absorption of the three water-soluble vitamins va-

ried markedly between products, but in all cases the USANA Essentials delivered highest levels of these nutrients to the bloodstream (Figures 1-3). AUC measurements showed that the Essentials delivered about 15% more vitamin C to the bloodstream than did the fruit and vegetable juice powder product (the second most effective formula with respect to vitamin C). Moreover, the Essentials delivered 3-4 times more vitamin C to the bloodstream than did the "one-per-day," gel-based, and phytonutrient formulas. Similar patterns were found in the results for riboflavin and vitamin B6, with the USANA Essentials generally outperforming competing products by 2-10 fold or more. With respect to PAR, all products boosted this measure of antioxidant status, but again the USANA Essentials outperformed other products by a factor of 1.5-3.0 (Figure 4).

In all cases but one, differences in absolute nutrient absorption between the USANA Essentials and other products were statistically significant ($p < 0.05$). The one exception was the difference between in PAR AUC between the USANA Essentials and the juice-based product ($p = 0.097$). We expect that a larger sample size would be required to achieve statistical significance for this measurement.

Discussion

As noted previously, many factors affect the total absorption of nutrients provided by dietary supplements, including the amount of a nutrient in a given formula, the nutrient form(s) used, the amounts of other

(competing) nutrients, the degree and speed with which the product disintegrates in the gut, whether or not the product is taken with a meal, the presence of factors that can enhance nutrient absorption, and more.

We believe that one of the most important factors underlying the differences found in this comparative study was dose, *i.e.* the presumed fact that a daily dose of the USANA Essentials contained higher amounts of vitamin C, riboflavin, vitamin B6, and total antioxidants than did the other products. We say "presumed fact" because two of the products did not provide complete label information on nutrient amounts. That said, several of these competing products claim that higher nutrient doses are not needed because their formulas are highly bioavailable. The results of this study call such claims into question.

The USANA Essentials clearly delivered higher amounts of the four tested nutrients to the bloodstream than did the four other products. We found nothing to suggest that nutrients provided in plant-based forms or exotic gel-based formulas possess superior bioavailability. Moreover, we found no evidence to suggest that these more exotic formulas provide superior nutrient bioavailability and absorption (percent and total) when compared to a relatively inexpensive, mass market "one-per-day" type product.

In conclusion, supplement users need to exercise caution when interpreting claims of high nutrient bioavailability. They need to demand evidence to support those claims, and they need to draw an important distinction

between percent bioavailability and total nutrient absorption. At the end of the day, it is the absolute levels of nutrients absorbed by the body that define the effectiveness of a product.

References and Notes

1. The term “one-per-day” is used in a generic sense. It does not refer to a specific product or brand.

2. Rabovsky A, Cuomo J, Eich N. Measurement of plasma antioxidant reserve after supplementation with various antioxidants in healthy subjects. 2006. Clin Chim Acta 371: 55-6.

Figure 1
Vitamin C Results

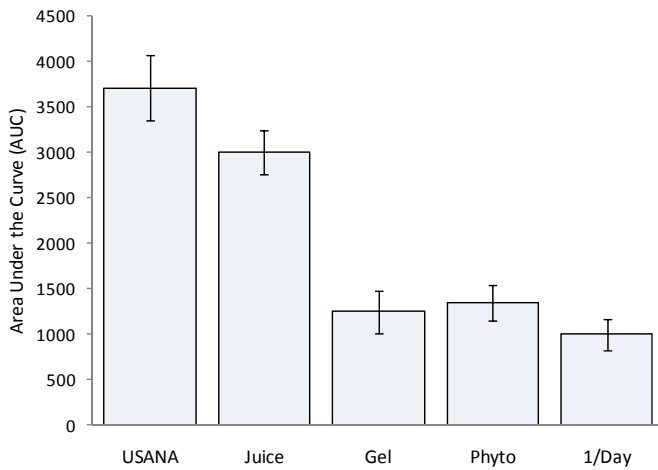


Figure 2
Riboflavin Results

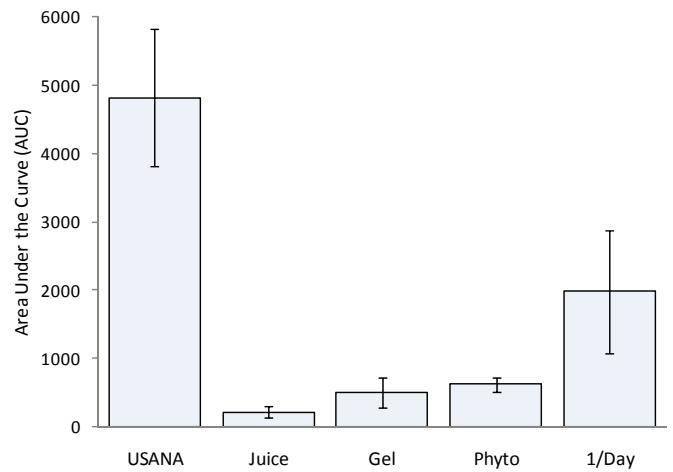


Figure 3
Vitamin B6 Results

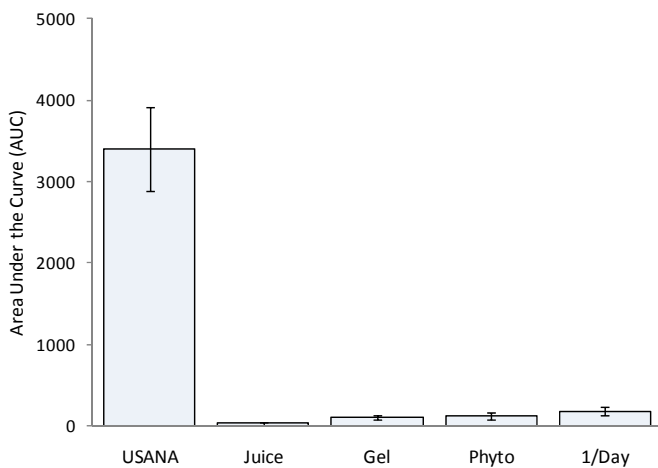


Figure 4
Plasma Antioxidant Reserve Results

