

# BIOAVAILABILITY OF USANA® ESSENTIALS™ VERSUS FOUR SELECT COMPETITOR PRODUCTS

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## INTRODUCTION

In the supplement industry, products can be rated based on the number of nutrients provided at an efficacious level and the bioavailability of said nutrients. Bioavailability is defined as the degree and rate at which a substance is absorbed into a living system or is made available at the site of physiological activity. What good does it do to take a supplement if it is not effective due either to low amounts of nutrients or poor bioavailability? A simple way to examine the quality of a health supplement is to examine its bioavailability—a superior nutraceutical has superior bioavailability.

Some supplement companies make considerable claims about the bioavailability of their supplements, claiming that they are more efficiently absorbed. A few companies go even further and state that their “novel delivery systems” allow their products to be more bioavailable despite having low concentrations of select nutrients. Other companies suggest that the nutrients they use in their products are “natural” or “food-derived” and, therefore, are more bioavailable than conventional formulations. The purpose of this study was to assess whether blood levels of select key nutrients could reach similar levels after supplementation with 5 diverse dietary supplements.

Four products were analyzed relative to USANA's Essentials™ vitamin, mineral, and antioxidant supplement: 1) a plant-sourced vitamin/mineral supplement utilizing minerals obtained through hydroponic cultivation; 2) a food-based supplement consisting of dehydrated fruits and vegetables; 3) a leading single daily vitamin/mineral tablet containing up to the recommended daily allowance (RDA) of select vitamins and minerals; 4) a gel-based vitamin/mineral supplement containing up to the RDA levels of vitamins and minerals.

## MATERIALS AND METHODS

### Study Design

This study was a crossover study that consisted of 10 healthy adult volunteers (8 males, 2 females), ranging in age from 26–50. One supplement was evaluated each week for a total of 5 weeks. Each product was given as directed to include the manufacturer's recommended daily dose in a single intake. On each study day, subjects were required to complete an overnight fast, donate a baseline venous blood sample, and take the randomly assigned dietary supplement. Additional blood samples were collected 1, 3, and 7 hours later. A standardized breakfast and lunch consisting of a bagel with 20 g of cream cheese was given to subjects at baseline and again after the 3-hour blood draw. Participants were also asked to abstain from physical activity the day of their study appointment.

### Nutrient Analyses

Ascorbic acid, riboflavin, vitamin B6, and plasma antioxidant reserve (PAR) were measured at each time point to obtain an absorption curve for each product/nutrient.

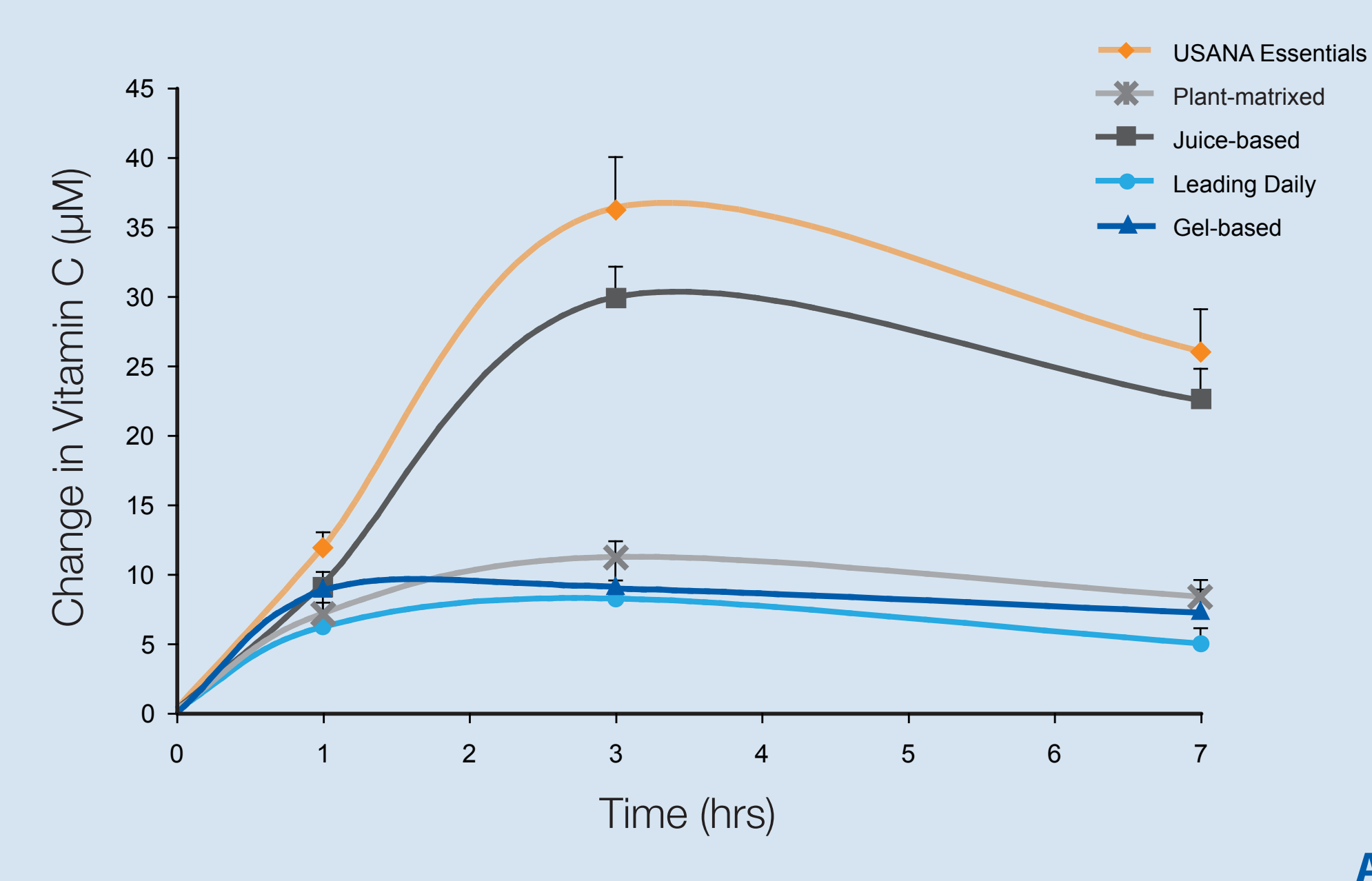
### Serum Vitamin C

Serum samples were analyzed for ascorbic acid via HPLC according to the CDC's Laboratory Procedure Manual for vitamin C. Briefly, samples were mixed 1:1 with 10% (w/v) metaphosphoric acid (MPA), centrifuged at 10,000 x g for 10 minutes, and the resulting supernatant diluted 1:5 in MPA. Analyte concentrations were determined relative to authentic samples.

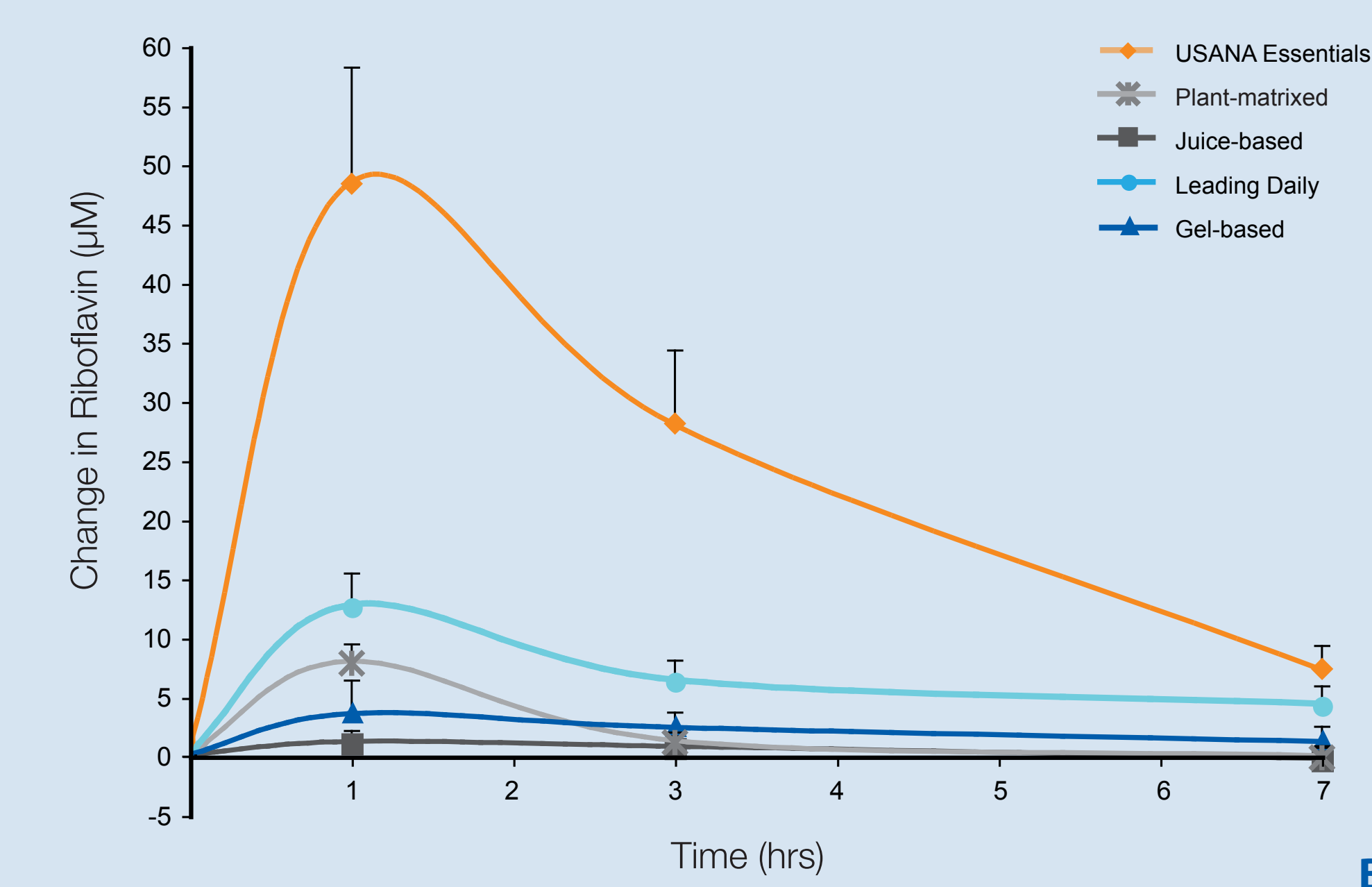
### Plasma Riboflavin and Vitamin B6

Serum samples were diluted with an equal volume of 10% (w/v) MPA. Samples were centrifuged for 10 minutes at 10,000 x g. The resulting supernatant was analyzed for riboflavin and vitamin B6 content via liquid chromatography – mass spectrometry (LC-MS).

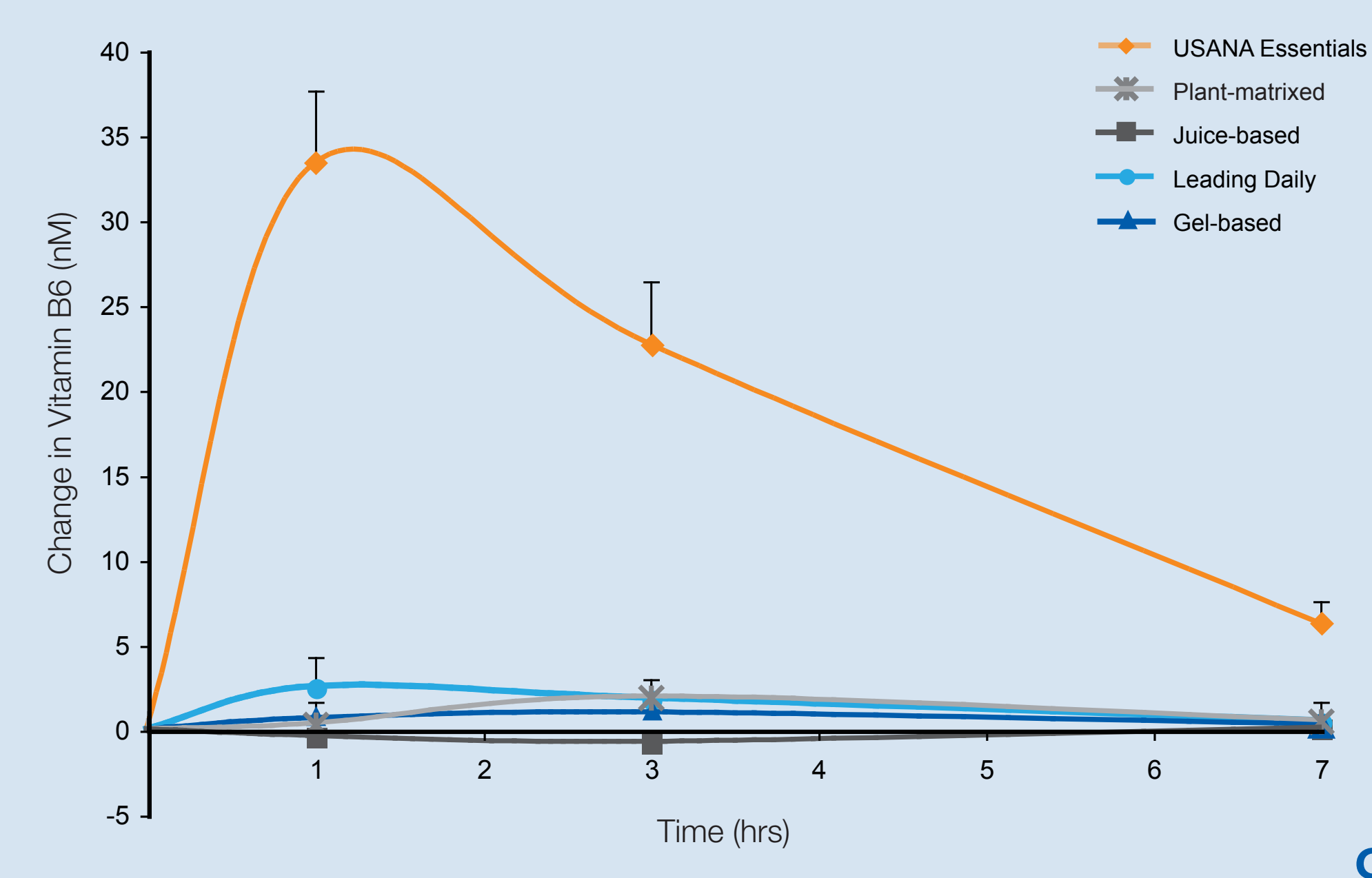
### USANA® Essentials Increases Vitamin C in Serum More Than Other Products†



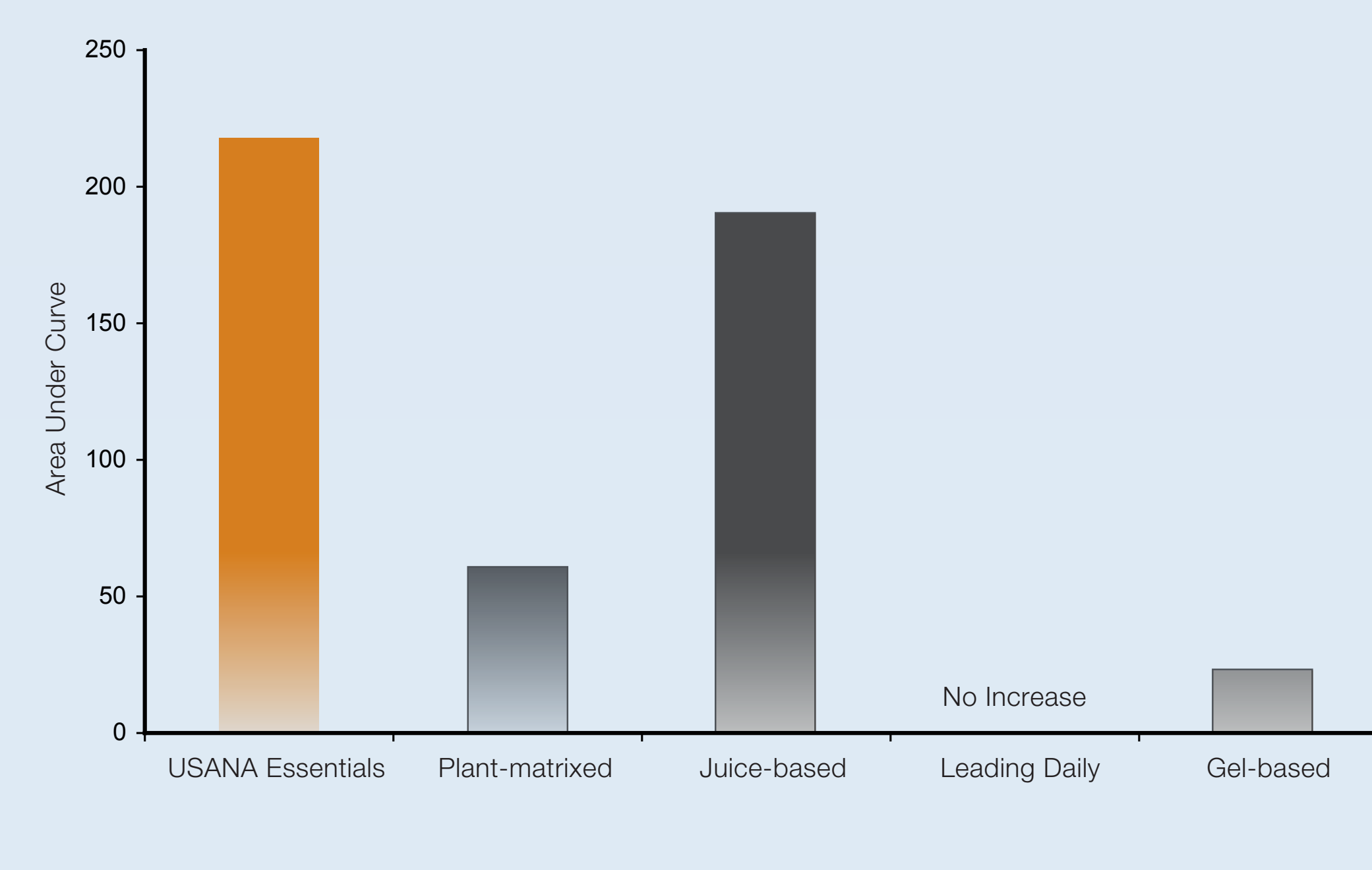
### USANA® Essentials Increases Riboflavin in Plasma More Than Other Products†



### USANA® Essentials Increases Vitamin B6 in Plasma More Than Other Products†



### USANA® Essentials Increases Plasma Antioxidant Reserve (PAR) More Than Other Products†



**Figure 1.** Change in select nutrient levels over 7 hours after supplementation with various products: A) vitamin C serum levels; B) riboflavin plasma levels; C) vitamin B6 plasma levels. Symbols represent mean + SEM.

**Figure 2.** Total area under the curve for plasma antioxidant reserve. The area under the curve was calculated over 7 hours following supplementation with various products.

**TABLE 1. PRODUCTS ANALYZED FOR SELECT NUTRIENTS**

PRODUCT ID	PROPERTIES
USANA® Essentials	A tablet supplement formulated with high levels of most key nutrients
Plant-matrixed	A tablet supplement utilizing minerals obtained through hydroponic cultivation
Juice-based	A food based capsule-form supplement consisting of dehydrated fruits and vegetables
Leading daily multivitamin	Leading single-tablet-per-day supplement formulated to meet RDA levels of select vitamins and minerals
Gel-based	A gel-based supplement containing up to the RDA levels of vitamins and minerals



\*Intellectual property portrayed in this comparison remains the property of the respective owners. †Comparisons are valid as of May 2007.

## Plasma Antioxidant Reserve

To determine SIN-1 induced isoprostanes, and hence the plasma antioxidant reserve, plasma samples from each subject were treated with an enzyme mixture consisting of catalase (50 u/ml) and uricase (2.5 u/ml) in 0.15M NaCl and incubated at 25°C for 10 minutes. Samples were then treated with SIN-1 chloride (0.2 mmol) and incubated at 37°C for 4 hours with shaking. Subsequent 8-isoprostane concentrations were measured using an ELISA kit according to manufacturer's instructions (8-iso Prostaglandin F2α Kit. Cayman Chemical, Ann Arbor, MI).

## RESULTS

For every nutrient examined, the USANA Essentials had the best bioavailability profiles. The Essentials produced the largest change in blood levels of ascorbic acid, 15% greater than the next closest product and ranged between 64% to 73% greater than all the others examined (p=0.046) (Figure 1A).

For riboflavin, the mean area under the curve (AUC) was the greatest after supplementation with USANA's Essentials. There was a 56% greater appearance of riboflavin than the next closest competitor and 96% over the worst (Figure 1B).

Supplementation with the Essentials also had the best absorption of vitamin B6. The AUC was at least 92% higher than all of the competitors. The juice-based product did not change the blood levels of vitamin B6 at any of the time points following supplementation, indicating that either this product contained no vitamin B6 or poor, if any, bioavailability (Figure 1C).

In terms of a functional endpoint, plasma antioxidant reserve, a measure of resistance of plasma to oxidative stress, was measured. Supplementation with the USANA Essentials produced a 13% increase in PAR over the next closest competitor. The other 3 supplements had only a minimal effect on PAR (Figure 2).

## CONCLUSIONS/DISCUSSION

The USANA Essentials outperformed the other products tested by providing the highest levels of key nutrients in the most efficacious forms. The gel-based, plant-matrixed, and leading daily supplement all have similar amounts of nutrients listed on their labels. However, it appears that neither the “novel delivery system” nor the various sources of the raw materials affected the bioavailability of the nutrients analyzed for these 3 products. The Essentials provided the largest increase in circulating concentrations for all three nutrients examined. Interestingly, the leading daily multivitamin produced a larger absorption curve for riboflavin than the plant-matrixed, juice-based, and gel-based products, even though all 4 products contain the same amount of riboflavin in their formulations. As seen in the vitamin C curve, only the juice-based product produced an absorption curve that approached that of the Essentials. Plasma antioxidant reserve seems to match the curve for vitamin C, suggesting that PAR is heavily influenced by vitamin C status.

Studies where multiple doses are given over a longer period of time could also provide insight into the absorption of fat-soluble vitamins, such as vitamin E, coenzyme Q10, vitamin K, and the carotenoids, as these vitamins take longer to accumulate in the body. It also appears that for vitamin C, riboflavin, and vitamin B6, the Essentials not only had the best absorption, but also maintained increased levels of the nutrients longer over the time period examined. Therefore, it appears that the USANA Essentials provides optimal levels of the most bioavailable forms of nutrients to obtain blood levels significantly higher than the competition. Thus, if taken twice daily, one could expect to maintain elevated levels of these nutrients throughout the day to help obtain optimal nutritional status.