

## Abstract

Nutrition experts who advise consumers to restrict caffeine intake need to be apprised of caffeine-containing ingredients in dietary supplements. These ingredients may be labeled as guarana (*Paullinia cupana* Kunth), kola nut (also kola nut [*Cola nitida* (Vent.) Schott & Endl.]), yerba mate (*Ilex paraguariensis* A. St.-Hil.), tea (*Camellia sinensis* (L.) Kuntze), and cocoa (*Theobroma cacao* L.). Sixty-four dietary supplement products for weight loss or sports performance were selected from four main sales channels, including top-selling products and randomly chosen products available in the market. Analysis of caffeine content was performed by high performance liquid chromatography and results were monitored for accuracy by the Nutrient Data Laboratory. Maximum daily intake of caffeine from the use of these supplements was computed by multiplying the analytical values by the maximum recommended label amounts. Based upon these calculations, 50% of the 54 products for which multiple lots were available would provide more than 200 milligrams of caffeine per day, which is roughly equivalent to the caffeine provided by 2 cups of brewed coffee. Twenty-six products did not declare specific labeled caffeine amounts but listed one or more of the following caffeine-containing ingredients: guarana, kola nut, green tea, or cocoa. Consumers wishing to limit caffeine intake should be aware of ingredients containing caffeine in order to identify these ingredients on dietary supplement labels. This project was funded by USDA as well as FDA and ODS through the USDA/NIH interagency agreement Y4-HV-0051.

## Introduction

The Nutrient Data Laboratory is developing a Dietary Supplement Ingredient Database (DSID) in collaboration with the Office of Dietary Supplements and other federal agencies. The DSID will initially report analytical estimates for vitamins and minerals in multivitamin/mineral products. As part of this study, caffeine levels were evaluated in products representative of weight loss and sports performance dietary supplements in the U.S. marketplace from 2004-2005. These supplements often contain caffeine as an ingredient, which may be listed specifically or may be added to the supplement as an extract from a natural source (Table 1).

**Table 1. Caffeine-Containing Ingredients**

Ingredient	Synonyms
Yerba Mate	Mate, <i>Ilex paraguariensis</i>
Guarana	<i>Paullinia cupana</i>
Kola nut	Cola seeds, <i>Cola nitida</i>
Cocoa	Cacao, <i>Theobroma cacao</i>
Coffee beans	<i>Coffea</i>
Green tea	<i>Camellia Sinesis</i> ,
Black tea	<i>Thea Sinesis</i> , <i>Camellia</i>

## Design and Methods

Dietary supplements representing sports performance enhancement and weight loss products were purchased over a nine-month period. Attempts were made to purchase three different lots of 64 products. The sample of products was drawn according to retail channel, stratified by 2001 market data from the Nutrition Business Journal<sup>1</sup>. Products were chosen based upon the market share for four channels: 1) health food/natural foods and vitamin stores (30%); 2) traditional supermarkets, grocery stores, drug stores, and mass merchandisers (25%); 3) multi-level marketers and direct (internet, catalog) sales (41%); and 4) practitioners (3%). For the first three channels, top-selling products were identified to be sampled. In addition, samples were randomly selected from all four channels.

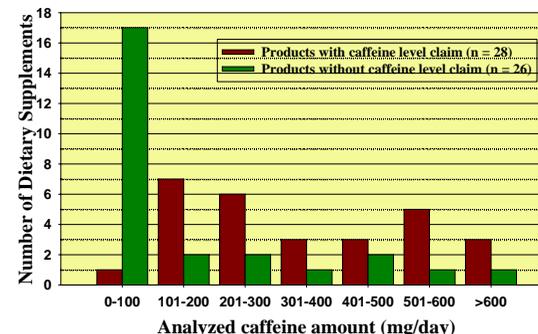
An independent laboratory analyzed the caffeine content of these products by high performance liquid chromatography with ultraviolet absorbance at 272 nm. Blinded samples plus standard reference materials were sent for analysis. Daily caffeine intake from each supplement was calculated using analytical values and label information about maximum number of pills recommended per day.

Because some products were reformulated and some products were not available at later sampling dates, replicated lots (n=2 or 3) were obtained for only 54 products. Therefore, only data from these products with replicated lots (n=54) were used for statistical analyses using general linear models.

## Results

Half (50%) of the 54 products studied would provide >200 mg caffeine per day, which is equivalent to the amount of caffeine in more than 2 cups of brewed coffee. Figure 1 shows a distribution of the number of dietary supplements with increasing levels of daily caffeine for products with and without a labeled caffeine level claim (with or without a specific labeled caffeine amount in mg/serving).

**Figure 1. Daily Intake of Caffeine from Dietary Supplements Based on Analytical Results (n=54)**



Of the 54 products, 28 had label claims for caffeine intake. For 26 of these 28 (93%), the difference between the analyzed and claimed caffeine levels was less than 20% of the analyzed value. The regression coefficient for the percentage difference regressed on analyzed caffeine was not significantly different from zero. The regression line was within  $\pm 20\%$  of the analyzed value throughout the entire range of analyzed daily caffeine intakes.

**Table 2. Label Factors<sup>1</sup> Found to be Indicators of Significantly Higher Caffeine Levels in Tested Products**

Label Factor	Factor Not Present on Label	Factor Present on Label	p value
	Median Analyzed Caffeine Level, mg/day <sup>2</sup>		
Caffeine listed as an ingredient on label	164 (121, 222) <sup>3</sup>	390 (234, 649)	0.0034
Yerba Mate listed as an ingredient on label	131 (92, 186)	489 (310, 770)	0.0001
Label message to limit other caffeine	147 (96, 226)	434 (291, 646)	0.0002
Guarana listed as an ingredient and caffeine absent from label	95 (60, 149)	284 (190, 424)	0.0004

<sup>1</sup>A label factor refers to specific information either present or absent on product labels in this study.  
<sup>2</sup>Estimated median values are the inverse transformed log means of analyzed caffeine values (mg/day).  
<sup>3</sup>Lower and upper 95% confidence limits.

Table 2 shows estimated median analytical caffeine levels for products based upon the presence or absence of specific label information (factors). When products had labels listing caffeine or yerba mate as ingredients or a recommendation to limit other caffeine intake, these products were statistically higher in caffeine than products without those factors on the label, with a 95% confidence level ( $p < .004$ ). When products had labels listing guarana as an ingredient but not caffeine, analyzed caffeine levels were significantly higher than products that did not list either ingredient ( $p < .0005$ ). Significant differences ( $p < .05$ ) were not seen between analytical caffeine levels and the presence or absence of the following ingredients on the label: kola nut, tea, cocoa, and their synonyms.

## Discussion and Conclusions

1. If taken at maximum recommended label amounts, half of the 54 products studied would provide >200 mg of caffeine/day, which is roughly equivalent to the caffeine provided by more than 2 cups of brewed coffee.
2. For the products that did not have a claimed caffeine amount on the label, nearly two-thirds (65%) would provide <100 mg caffeine/day.
3. For the products that did have a claimed caffeine amount on the label, 93% had analyzed values within  $\pm 20\%$  of the claim.
4. Caffeine, guarana, or yerba mate listed as ingredients on the dietary supplement label as well as label messages to limit total caffeine intake may be useful indicators to identify products with the caffeine equivalent of  $\geq 3$  cups of coffee/day, even when the specific caffeine amount is not labeled. Consumers and health professionals should be aware of these additional ways to identify caffeine-containing products.

<sup>1</sup>Nutrition Business Journal <http://www.nutritionbusiness.com> (accessed January 29 2004).