



Caffeine Containing Dietary Supplements

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Abstract

Caffeine (1,3,7-trimethylxanthine), a potent stimulant of the central nervous system, is a common ingredient in beverages such as coffee, tea, and soft drinks. Values for these products range from 20 to 50 mg/100 gm beverage. Caffeine is also added to dietary supplements to increase energy and suppress appetite. As part of a new program to develop composition databases for dietary supplements, the US Department of Agriculture, the Food and Drug Administration and the National Institutes of Health are assessing dietary supplement products which contain caffeine. Data from the 1999-2000 National Health and Nutrition Examination Survey (NHANES) were analyzed to determine the consumption of various dietary supplement products. Approximately 53 caffeine containing dietary supplements were taken by about 95 respondents. Extracts from one or more of six plant genera (*Coffea*, *Camellia*, *Theobroma*, *Cola*, *Ilex* and *Paullinia*) are used in these products as sources of caffeine. Guarana and green tea were the most frequently added extracts in these caffeine containing dietary supplements. A sampling plan was developed to guide the procurement of representative units of various products. Levels of caffeine, theobromine, and theophylline will be determined by high performance liquid chromatography. Funding for this study was provided by the Food and Drug Administration through Interagency Agreement No 224-03-2787.

Objectives

- To obtain information on caffeine-containing ingredients that are found in dietary supplements
- To determine the caffeine content of these supplements
- To assess the potential impact of these caffeine levels on consumers

Introduction

Caffeine (1,3,7-trimethylxanthine) is a common ingredient in beverages such as coffee, tea, and soft drinks. Values for these products range from 20 to 50 mg/100 gm beverage. The mean consumption of caffeine is over 200mg/day for adults in the United States (1). Caffeine is also added to dietary supplements to increase energy and suppress appetite. Although many people take dietary supplements and herbal products for weight loss or to relieve fatigue, others may want to reduce their caffeine consumption for health or lifestyle reasons. These consumers, as well as their health care providers, may be unaware that supplements can contain caffeine, even if caffeine is not listed as an ingredient. Some commonly used herbal dietary supplement ingredients, such as guarana and green tea, are natural sources of caffeine. We currently have information on the caffeine content of many foods; however, we lack similar information for dietary supplements and their ingredients. This study will analyze 60 caffeine containing dietary supplements from different sales channels to assess their caffeine content.



Methods and Materials

National Health and Nutrition Examination Survey (NHANES) 99-00 Dietary Supplement Data Search

Extracts from one or more of six plant genera (*Coffea*, *Camellia*, *Theobroma*, *Cola*, *Ilex* and *Paullinia*) are used in dietary supplements as sources of caffeine (1-4). The following table identifies the key words that were used to search the ingredient and blend component files in the NHANES 99-00 dietary supplement dataset (5) to obtain a list of the supplement products containing caffeine.

Table 1: Caffeine Containing Genera and Compounds

Genera	Common Name	Compounds	Key words
<i>Coffea</i>	coffee	Caffeine, Theobromine (TB)	Caffeine, coffea, coffee
<i>Camellia</i>	Tea	Caffeine, Theobromine Theophylline (THP)	Green tea, black tea, kucha, tea (<i>Camellia, sinensis</i>)
<i>Theobroma</i>	Cocoa, Cacao	Caffeine, Theobromine	Cocoa, Cacao, chocolate, <i>Colanida</i>
<i>Cola</i>	Cola	Caffeine	Cola nut, kola nut
<i>Ilex</i>	Yerba mate	Caffeine, Theobromine	Yerba mate, mate, ilex, <i>Ilexparaguarensis</i>
<i>Paullinia</i>	Guarana	Caffeine, Theobromine	Guarana, <i>P. Cupana</i> , Yoco
<i>Citrus</i>	Bitter orange	Caffeine, Theophylline	Citrus, <i>Citrus aurantium</i> , bitter orange, <i>limon, paradisi, maxima, medica</i> (citron), orange flower tea

Sample Selection

Approximately 60 dietary supplement products will be analyzed. Sample units representing 3 different lots of each of the 60 products will be selected. Sports and weight loss supplements represent the segment of the dietary supplement market that is most likely to contain caffeine. Some multi-vitamins/minerals contain caffeine as well.

The sample of products was drawn according to retail channel, stratified by 2001 market data from the Nutrition Business Journal (6). Products were chosen based upon the market share for four categories: 1) health food/natural foods and vitamin stores (30.1%, n=18); 2) traditional supermarkets, grocery stores, drug stores and mass merchandisers (25.4% n=15); 3) multi-level marketers and direct (internet, catalog) sales (41.3% n=25); and 4) practitioners (3.2% n=2). For the categories with n>2, top-selling products were identified and plan to be sampled. Additional samples were randomly selected.

Analytical Methods

High Performance Liquid Chromatography (HPLC) will be used to analyze the 60 products for their caffeine content, and possibly for theobromine and theophylline (7). The analyses will be monitored using quality control procedures.

References

1. Durrant, Karen L. 2002. Known and Hidden Sources of Caffeine in Drug, Food and Natural Products. Journal of American Pharmaceutical Association. Vol. 42(4): 625-637.
2. Ashihara, Hiroshi, Crozier, Alan. 2001. Caffeine: a Well Known but Little Mentioned Compound in Plant Science. Trends in Plant Science. Vol 6(9): 407-413.
3. Lopez-Martinez, Leticia. 2003. Simultaneous Determination of Methylxanthines in Coffees and Teas by UV-Vis Spectrophotometry and Partial Least Squares. Analytica Chimica Acta. 493: 83-94.
4. Weckerle, Caroline S. 2003 Purine Alkaloids in Paullinia. Phytochemistry. 64: 735-742.
5. National Center for Health Statistics. National Health and Nutrition Examination Survey 1999-2000 Dietary Supplement Use http://www.cdc.gov/nchs/about/major/nhanes/NHANES99_00.htm (Accessed October 2nd 2003)
6. Nutrition Business Journal <http://www.nutritionbusiness.com> (accessed January 29 2004)
7. Blauch, J. L., Tarka Jr., S. M., 1983. HPLC Determination of Caffeine and Theobromine in Coffee, Tea, and Instant Hot Cocoa Mixes. Journal of Food Science, 48: 745-750.

Results

Caffeine Containing Dietary Supplement Products from NHANES Data

The ingredients and blend components in the NHANES dataset were searched for the identified key words. A total of 53 supplement products contained one or more of the compounds listed previously. Green tea (43% n=23) and guarana (42%, n=22) or their extracts are the most common ingredients among these supplements. Only six (10%) supplements contained directly added caffeine. Cacao and yerba mate are presented in 9% and 8% of these supplements, respectively. Bitter orange (4%) and cola nut (6%) are not common ingredients among these supplements (Figure 1). A total of 95 survey respondents reported that they had taken one or more of these 53 supplements. Over half of these respondents (53%) took dietary supplements containing guarana. Approximately one-third (32%) of respondents took supplements containing green tea. Fewer respondents took caffeine (7%), cacao (7%) and yerba mate (8%) containing supplements. Bitter orange (2%) and cola (5%) containing supplements were less commonly consumed (Figure 1).

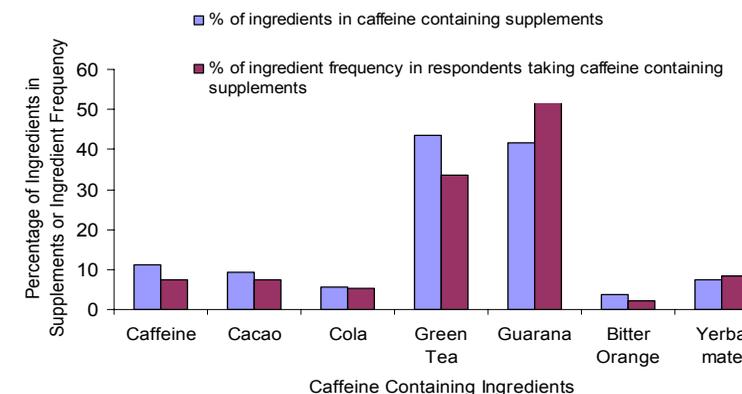


Figure 1: Caffeine Containing Supplements: Ingredient Distribution in Supplements and Ingredient Frequency in Surveyed Respondents Taking Caffeine Containing Supplements

Future Plans

1. Sixty products will be purchased three times over a period of six months to access three different lots for every product.
2. Products will initially be shipped to the Nutrient Data Laboratory, where labels will be removed, product information documented, and samples sent out for chemical analysis.
3. Samples will be analyzed by a qualified commercial laboratory for caffeine and possibly, theobromine and theophylline. The matrices involved will be botanical blends, multivitamin/multimineral blends and combinations of the two.
4. The caffeine content in products will be analyzed to assess variability between lots, differences from label values and to estimate the caffeine content in product categories and in natural ingredients.
5. Information about caffeine levels in supplements might have potential impact on consumers and health providers.