

**USDA Dietary Supplement Ingredient Database
Release 5.0 (DSID-5)**

**Green Tea in Multi-Ingredient Dietary Supplements
(GT-2 Study)**

Research Summary

Prepared by

Dietary Supplement Ingredient Database Team

US Department of Agriculture
Agricultural Research Service
Beltsville Human Nutrition Research Center
Methods and Application of Food Composition Laboratory,
10300 Baltimore Avenue, Building 307C
Beltsville, Maryland 20705
<https://dsid.nih.usda.gov/>

1. Introduction

The Dietary Supplement Ingredient Database (DSID) provides statistically predicted estimates of ingredient levels in dietary supplement (DS) products sold in the United States. These predictions result from chemical analysis of representative market samples, combined with regression-based statistical modeling. These mean estimates can replace label information in studies assessing the dietary intake of the US population from foods and DS. The Methods and Application of Food Composition Laboratory (MAFCL), Beltsville Human Nutrition Research Center, Agricultural Research Service (ARS), US Department of Agriculture (USDA), maintains and updates the DSID in partnership with the Office of Dietary Supplements (ODS) of the National Institutes of Health and other federal agencies (National Center for Health Statistics of the Centers for Disease Control and Prevention, Food and Drug Administration, National Cancer Institute of the National Institutes of Health, and National Institute of Standards and Technology [NIST] of the Department of Commerce). ODS is the primary funder of the DSID, which builds on ARS's recognized expertise in creating nutritional databases that support comprehensive assessments of nutrient intakes from foods.

A botanical initiative for the DSID was established to evaluate levels of ingredients and ingredient constituents in botanical DS. The DSID Working Group identified non-vitamin/mineral bioactive ingredients in DS for analysis and inclusion based on these criteria: public exposure (intake and sales), the availability of validated analytical methods and analytical reference materials, research interest and economic and safety concerns. The top scoring 11 ingredients from this ranking process were: CoQ10, garlic, saw palmetto, ginkgo biloba, glucosamine, ginseng, green tea catechins (EGCG and other catechins), milk thistle, echinacea, flaxseed, and turmeric (curcumin).

According to the 2007-10 National Health and Nutrition Examination Survey (NHANES), 7.5% of the United States population reports taking botanical DS (the 4th most common supplement type reported). A single serving of a DS containing a botanical extract may provide amounts of bioactive components (e.g., flavonoids) equal to or significantly exceeding their daily intake from foods. However accurate intake estimation of these ingredients is difficult.

Supplement labels may provide only partial information about the actual content of bioactive components in botanicals. For botanicals, current label regulations require information on the total weight of each botanical or botanical extract present in a DS. Label information on the phytochemical concentration or percent concentration of extracts used in formulations is not required. However, the phytochemical concentration of extracts used in DS may differ. Some extracts may be coated to prolong constituents' stability or increase their bioavailability, and thus the total weight of extracts with different concentration would also include the weight of the coating material. Although companies can voluntarily list information about the concentration of phytochemical constituents, many do not. In addition, DS with botanicals as part of a blend are required to list only the weight of the total blend. To more accurately estimate phytochemical intakes from

botanicals, analytical testing is necessary to identify any patterns for the constituent concentration in the products.

2. Overview of Green Tea-2 DS study: Multi-Ingredient GT DS

Green tea is a botanical product that is commonly consumed and frequently studied for its health benefits. Since the botanical constituents in GT are also commonly found in foods and beverages, the data from these studies will complement data on the phytochemical intake from foods.

In a previous study (single ingredient green tea study; GT-1), products with GT as the only or primary botanical were tested for their constituent content. This study (multi-ingredient green tea study; GT-2) evaluated the content of catechins and caffeine in complex mixtures that include several botanical ingredients along with minerals, vitamins and/or other compounds (Appendix, Table 1). These products were marketed for the purposes of weight loss, increasing energy, sports performance or increasing intake of antioxidants or bioflavonoids. Approximately half of the 37 products listed a claim for the amount green tea on the label. The other half listed green tea as part of a blend (no listed amount).

The goal of this study was to measure the content of catechins and caffeine from all botanical sources present in these DS and compare results to label claims. The percentage difference from the label claim was calculated for each analyzed constituent in each sample:

$$\% \text{ difference from label} = ((\text{analytical value} - \text{label value}) / \text{label value}) \times 100\%.$$

Representative and top-selling products were tested for the content and variability of individual catechins and caffeine. Two experienced laboratories were chosen for participation. Seven catechins (including (+)-catechin, (–)-epicatechin, (–)-epicatechingallate, (–)-epigallocatechin, (–)-epigallocatechingallate (EGCG), (–)-gallocatechin, (–)-gallocatechingallate), and caffeine were measured. The data for two lots of 37 GT DS tested in two labs were combined for each product and the mean results compared to label information, if available.

3. Sampling Plan

A sampling plan was developed to identify representative products for purchase and analysis. The scope and variety of GT DS reported in NHANES 2009-2010 and the Dietary Supplement Label Database (DSLDB; <https://dslid.nlm.nih.gov/dslid/>) were evaluated for information about GT composition, component levels and health claims. In addition, we conducted a detailed survey of GT products sold via various channels including local stores, the internet and multi-level marketing companies in 2013-14.

DS were purchased within a five-month timeframe in 2014-2015 from the three major sales channels: mass market retail (e.g., Walmart, CVS, Safeway, Target), natural and

specialty retail (e.g., GNC, Whole Foods), and direct sales (products sold exclusively on-line or by multi-level marketers like Amway). The purchased products were in a variety of dosage forms (hard-shell capsules, caplets, tablets, soft gels, gummies and liquid-filled capsules).

Three DS were purchased in bulk for use as in-house control materials to monitor laboratory performance over time. Samples were repackaged and sent for laboratory analysis in defined batches.

4. Analytical Methods

Laboratories analyzed the sample sets using validated sample-handling protocols and appropriate methods to obtain analytical information about ingredient levels. For the catechin monomers, high-performance liquid chromatography (HPLC) using a reversed phase column with either ultraviolet absorbance (UV) or mass spectrometric (MS) detection was used. For caffeine, HPLC with UV detection was used. Samples were sent for retesting if there was a large discrepancy among lab results or to confirm unusually high or low values.

Quality control (QC) materials, including three certified reference materials (NIST® SRM® 3255 “Green Tea Extract”, 3254 “Green Tea Leaves” and 3256 “Green Tea Solid Oral dosage”) were analyzed with each batch of samples to evaluate the accuracy and precision of the laboratory methods. In addition, product duplicates and in-house control materials were included. The consistent results seen in the catechin and caffeine values for these quality control materials gave confidence in the results for these constituents in the commercial GT DS under study.

The percentage difference from the label claim was calculated for each analyzed constituent in each sample: % difference from label = $((\text{analytical value} - \text{label value}) / \text{label value}) \times 100\%$. Laboratory data were reviewed and samples with unusually large % differences from label claims, high variability among lots of the same product, and/or samples from batches with QC results showing biased results were retested. The final laboratory data were sent to MAFCL’s consulting statistician for statistical analysis.

5. Statistical Analysis

Least squares means and standard deviations (SDs) were computed for each constituent in each product using a SAS mixed model procedure. Results for EGCG (the most prevalent catechin), total catechins (TC; the summed content of 7 individual catechins) and caffeine are reported as amount per serving (Appendix, Table 2), amount per day (Appendix, Table 3) and percentage difference from label, if applicable (Appendix, Table 4).

For many products, the label recommended more than one serving per day (1 serving per day, n=20; 2 servings per day, n=17; 3 servings per day, n=7). Therefore, the most useful

comparison among these products is the per day amount. If the label suggested a range of servings per day (for example, 1-2 servings per day), the maximum serving size was used to calculate per day amounts.

Laboratory results reported in mg/g were compared to Food and Drug Administration (FDA) required label information about the weight of GT and to any voluntary label claims for constituent content.

6. Results and Discussion

The mean analytical content for EGCG, total catechins, and caffeine in GT DS showed wide ranges (0-301.6, 0-518.7, and 0-327.3 mg/serving, respectively; Appendix, Table 2). Median per serving values for EGCG, total catechin, and caffeine content were 38.7, 76.4, and 16.2 mg/serving, respectively.

The analytical mean per day for EGCG, TC, and caffeine also showed wide ranges (0-441.8, 0-710.7, and 0-982. mg/day, respectively; Appendix, Table 3). Median per day values for EGCG, TC, and caffeine content were 61.5, 126.5, and 16.3 mg/day, respectively.

For the 20 products that had a claim for the weight of GT, labeled levels ranged from 40-400 mg/serving and 40-800 mg/day. However, these labeled amounts did not predict the EGCG amount present in these products (determined by chemical analysis). For example, in DS with GT as the only botanical containing catechins (n=11; 200-300 mg/serving of GT), the mean measured EGCG values ranged from ~2% to ~58% of the labeled GT weight. In DS containing GT along with other botanicals that could contribute to catechin content (n=9; 400-500 mg/serving of mixed botanical material), the mean measured EGCG values ranged from ~19% to ~45% of the total labeled weight of GT.

Some GT DS had voluntary label claims for the amount of EGCG and/or TC per serving. DS labeled for EGCG content had significantly higher measured content than products not labeled for EGCG content (155 ± 26 vs 37 ± 7.5 mg/serving; 219 ± 41 vs 142.8 ± 66 mg/day, mean \pm SE, Table 1). There were no significant differences for TC measured in Labeled vs Not Labeled TC amounts. Declared caffeine content was associated with higher measured caffeine for per serving but not per day amounts.

Table 1. Comparison of analytical results based on label type.

Constituent		Measured, mg, mean± SE				
		Labeled	n	Not Labeled	n	p
TC	Per Serving	154±56	6	129±25	31	0.69
	Per Day	270±85	6	194±38	31	0.42
EGCG	Per Serving	155±26	12	37±7.5	25	0.0007*
	Per Day	219±41	12	66±16	25	0.0037*
Caffeine	Per Serving	94±19	16	38±15	18	0.030*
	Per Day	171±53	16	86±42	18	0.22

For the products that voluntarily provided label claims for EGCG, TC or caffeine, we compared the mean measured results to the label claims. For the 12 products with EGCG label claims, the percentage differences from label ranged from 5.9% below label to 21.1% above label. For the 6 products with TC label information, the percentage differences from label ranged from 3.4% to 78.9% above label and for the 16 products with a label claim for caffeine, the ranges were 49.9% below label to 54.3% above label (Appendix, Table 4).

For the 17 products that listed GT as part of a proprietary blend, the mean analytical EGCG amount ranged from 0.3 to 149 mg/serving and 0.3 to 298 mg/day. The EGCG calculated as a percentage of the weight of the proprietary blend ranged from 0.4 to 44%.

No significant differences were found in the EGCG and TC content in DS with and without blends. However, the caffeine content was higher in DS containing blends as compared to DS containing labeled GT amounts (Table 2).

Table 2. Measured constituent content in DS with and without GT labeled amounts.

Green Tea constituents	Dose	Measured amount, mg mean \pm SE			
		DS with labeled GT amounts	DS with non-labeled GT amounts (GT in a blend)	p	n
TC	Per Serving	149 \pm 30	114 \pm 33	0.32	20
	Per Day	226 \pm 47	183 \pm 51	0.42	17
EGCG	Per Serving	87 \pm 18	60 \pm 19	0.44	20
	Per Day	131 \pm 28	97 \pm 31	0.54	17
Caffeine	Per Serving	34 \pm 12	88 \pm 22	0.039*	18
	Per Day	49 \pm 15	197 \pm 63	0.037*	16

In summary, the GT DS in the multi-ingredient products analyzed in this study have a variety of label formats and a wide range of labeled amounts for GT and GT constituents. The weight of GT and other catechin-containing sources on the label may not permit accurate predictions for the content of specific phytochemical constituents. The GT weight may include the weight of dried leaf powder and/or botanical extract powders, which may or may not be highly concentrated or microencapsulated for improved shelf life or bioavailability. Voluntary label information (EGCG per serving and per day or caffeine per serving) is associated with a higher level of the actual phytochemical content, on average, compared to products without such information.

It is important to track the intake of phytochemicals, especially those that have intakes from foods and supplements to evaluate their association with health. An evaluation of flavonoid intake in NHANES 2007-08 using the USDA Flavonoid Values for Survey Foods and Beverages 2007–2008 (Bhagwat and Haytowitz, 2015), estimates the mean US daily intake of flavonoids to be 251 mg (81% are catechins; 203 mg) (Sebastion, et. al, 2015). If that number is compared to the analytical results for *total catechins* in this study, 13 products (listed in the Appendix, Table 3) would provide more catechins per day than the average daily estimate of 203 mg from foods and beverages. Since many DS in this study also contained other flavonoids, we would expect a higher number of flavonoid rich DS to exceed this average daily estimate.

7. Conclusions and Implications

DS containing green tea and sold in the U.S. have a wide range of catechin and caffeine content. On average, products that voluntarily provided information about their EGCG or caffeine content, were found to have more than twice the measured levels than those that were not labeled for these constituents.

The label information for GT amounts did not predict either total catechins or EGCG measured content. Thus, label claims with only the required FDA information do not have a strong relationship with the actual content of the phytochemical constituents analyzed in this study. Voluntary label claims for EGCG amount (per serving, per day) were positively associated with measured TC and EGCG amounts. These findings indicate that complete and more accurate label information on extract concentration would benefit consumers who make decisions on botanical DS use and researchers who track phytochemical bioactive intakes and their association with health outcomes.

8. Compliance with United States Pharmacopeia (USP) Performance Standards

In both of our green tea studies, we tested dosage form performance using USP protocols. We identified a high rate of failure for both disintegration (measures if the tablet/capsule breaks apart properly) and dissolution (measures the ability of the constituent to dissolve and be available for absorption by the body) in this *in vitro* testing. Compliance with the USP or other compendia's performance standards for DS is currently voluntary, but the widespread inadequate DS performance for GT DS raises concerns that DS users may not achieve health benefits expected from GT DS and jeopardizes confidence in efficacy and safety studies for GT DS produced and sold in the US and used in clinical trials (See more details: Gusev et al., 2020).

10. References

McCullough ML, Peterson JJ, Patel R, Jacques PF, Shah R, Dwyer JT. Flavonoid intake and cardiovascular disease mortality in a prospective cohort of US adults. *Am J Clin Nutr*. 2012 Feb;95(2):454-64. doi: 10.3945/ajcn.111.016634. Epub 2012 Jan 4. PMID: 22218162 Free PMC article.

Bhagwat, S, Haytowitz, DB, 2015. USDA Database for the Flavonoid Content of Selected Foods, Release 3.2. U.S. Department of Agriculture, Agricultural Research Service. Nutrient Data Laboratory Home Page: <http://www.ars.usda.gov/nutrientdata/flav>

Sebastion, RS, Wilkinson, CE, Goldman JD, Martin CL, Steinfeldt, LC, Murayi, T, and Moshfegh, AJ. 2015. A New Database Facilitates Characterization of Flavonoid Intake, Sources, and Positive Associations with Diet Quality among US Adults. *J Nutr* 145:1239–48.

Gusev PA, Andrews KW, Savarala S, Tey PT, Han F, Oh L, Pehrsson PR, Dwyer JT, Betz JM, Kuszak AJ, Costello R, Saldanha LG. Disintegration and Dissolution Testing of Green

Appendix

Table 1. Dosage forms and composition for multi-ingredient green tea -containing dietary supplements.

Supplement ID	Dosage form	Ingredient categories in Supplement Facts panel
GT2P01	gummy	carbohydrates, sugars, phosphatidylcholine, GTE
GT2P02	softgel	botanical blend with GTE, others
GT2P04	capsule	vitamins, botanical blend with GTE
GT2P05	capsule	vitamin, minerals, botanical & electrolyte blends, botanical blend with GTE
GT2P07	caplet	mineral, probiotic, botanical blend with GTE
GT2P08	capsule	vitamin, botanical blend with GTE
GT2P09	caplet	GTE, other botanical
GT2P10	tablet	GTE, pre-probiotic blend, other botanicals
GT2P11	tablet	botanical blend with GTE, vitamins
GT2P12	capsule	botanical, botanical blend with GTE
GT2P15	softgel	GTE, botanical blends
GT2P16	tablet	botanical blend with GTE
GT2P17	capsule	botanical blend with GTE
GT2P18	capsule	botanical, botanical blend with GTE
GT2P19	caplet	vitamins, minerals, botanical blend with GTE, others, botanicals
GT2P20	caplet	vitamins, minerals, botanical blends, GTE, others, botanicals
GT2P22	capsule	vitamins, botanical blend with GTE
GT2P23	capsule	botanical, GTE
GT2P24	tablet	vitamin, botanicals, GTE
GT2P25	capsule	GTE, botanicals
GT2P26	capsule	botanical blends, botanical blend with GTE, botanical blends
GT2P27	softgel	vitamin, mineral, others, botanicals, GTE
GT2P28	softgel	vitamins, minerals, others, GTE, botanicals, botanical blend
GT2P29	capsule	GTE, others, botanicals

GT2P30	capsule	botanical blends, blend with GTE
GT2P32	tablet	vitamins, minerals, GTE, botanicals
GT2P33	capsule	botanical, GTE, other botanicals
GT2P35	capsule	botanicals, GTE, GT leaf, botanicals aerial parts
GT2P36	tablet	vitamins, minerals, botanical, GTE, botanicals
GT2P37	capsule	vitamins, minerals, botanical blend with GTE, fiber blend, pre/probiotic blend
GT2P41	liquid capsule	botanical blend with GTE
GT2P47	capsule	vitamins, minerals, botanical blend with GTE
GT2P48	capsule	vitamins, minerals, botanical blend with GTE, others, botanicals
GT2P50	capsule	botanical, GTE, botanicals
GT2P51	capsule	botanical, GTE
GT2P53	tablet	vitamins, minerals, botanical, GTE, others
GT2P54	capsule	botanical, GTE, botanical

Each ingredient was categorized as a vitamin, mineral, botanical, blend (proprietary) or other. Examples of “other” included N-acetyl-L-tyrosine, 5-hydroxytryptophan, collagen, hyaluronic acid (HA), phosphatidylserine, inositol, amino acid blend, L-carnitine, omega-3 fatty acids, betaine, bromelain, phospholipids, alpha-lipoic acid. The ingredients are listed in the order they appear on Supplement Facts panels.

Table 2. Label claims and measured content per serving for EGCG, total catechins and caffeine in 37 multi-ingredient GT DS.

Product ID	Form	Matrix	Amount of GT	EGCG			Total Catechins			Caffeine		
			mg/serving									
			Label	Label	Measured, mean	SD	Label	Measured, mean	SD	Label	Measured, mean	SD
GT2P01	Gummy	GTE ¹ (Leaf)	150	-	22.0	3.5	-	35.1	5.6	-	0.0	0.0
GT2P02	Softgel	GTE (Leaf)	-	-	28.6	3.5	-	70.3	4.4	110	169.7	4.4
GT2P04	Capsule	GTE (Leaf)	-	-	110.7	5.1	-	188.7	9.6	160	155.4	9.4
GT2P05	Capsule	GTE (Leaf)	-	-	0.4	0.3	-	3.4	0.8	75	69.2	5.3
GT2P07	Caplet	GTE (Leaf)	-	-	84.1	2.9	-	145.8	8.2	50	50.2	0.1
GT2P08	Capsule	GTE (Leaf)	-	-	16.1	1.7	-	33.9	2.0	300	327.3	23.3
GT2P09	Caplet	GTE (Leaf)	389	175.1	185.2	9.6	291.8	314.5	17.9	50	57.0	3.6
GT2P10	Tablet	GTE (Leaf)	262.5	90	84.7	5.5	-	140.6	12.2	62	58.5	4.4
GT2P11	Tablet	GTE (Leaf)	-	-	82.3	10.0	-	190.0	25.0	120	154.3	52.8
GT2P12	Capsule	GTE (Leaf)	-	-	3.3	0.2	-	7.2	0.2	Decaf	0.4	0.0
GT2P15	Softgel	GTE (Leaf)	400	200	220.9	35.4	-	355.3	43.1	160	151.0	30.2
GT2P16	Tablet	GTE (Leaf)	-	-	15.2	0.6	-	34.0	0.7	82	82.7	1.1
GT2P17	Capsule	GTE (Leaf)	-	-	147.2	10.8	-	264.6	16.6	-	99.9	5.5
GT2P18	Capsule	GTE (Leaf)	-	270	286.2	26.5	-	518.7	20.4	-	9.5	6.9
GT2P19	Caplet	GTE (Leaf)	-	-	0.0	0.0	-	0.0	0.0	-	0.0	0.0
GT2P20	Caplet	GTE (Leaf)	40	-	0.5	0.0	-	0.7	0.0	100	91.0	4.1
GT2P22	Capsule	GTE (Leaf)	-	-	22.9	0.6	-	32.8	0.8	-	125.2	1.4
GT2P23	Capsule	GTE (Leaf)	100	15	18.2	0.1	-	52.6	5.3	-	2.0	0.5
GT2P24	Tablet	GTE (Leaf)	250	-	38.7	10.4	-	78.7	21.3	-	16.2	1.1
GT2P25	Capsule	GTE (Leaf)	150	-	73.2	1.3	75	118.4	1.7	-	16.3	0.7
GT2P26	Capsule	GTE (Leaf)	150	60	61.5	4.4	-	132.7	5.7	-	1.2	0.6
GT2P27	Softgel	GTE (Leaf)	50	-	6.2	0.3	15	15.5	0.3	15	16.6	0.5
GT2P28	Softgel	GTE (Leaf)	375	300	301.5	21.8	-	493.9	40.2	151.2	149.3	20.4
GT2P29	Capsule	GTE (Leaf)	200	-	65.9	1.2	80	143.1	2.9	16	8.1	0.3
GT2P30	Capsule	GTE (Leaf)	-	135	144.9	8.2	-	271.8	20.2	142.5	128.2	7.3

GT2P32	Tablet	GTE (Leaf)	100	-	48.4	2.7	-	76.4	3.7	-	3.2	2.1
GT2P33	Capsule	GT Leaf	125	-	7.1	0.5	-	13.5	0.9	-	3.0	0.1
GT2P35	Capsule	GTE + GT Leaf	180	-	30.0	1.4	-	51.6	2.9	-	6.3	0.2
GT2P36	Tablet	GTE (Leaf)	75	-	34.4	0.8	-	53.1	1.9	-	0.9	1.2
GT2P37	Capsule	GT	-	-	4.3	1.5	-	11.3	4.4	-	1.0	0.8
GT2P41	Liquid Capsule	GT Leaf	-	-	25.6	1.8	-	55.5	3.3	-	12.9	3.9
GT2P47	Capsule	GTE (Leaf)	-	-	33.9	6.9	-	70.6	6.8	-	15.6	1.7
GT2P48	Capsule	GTE (Leaf)	-	-	22.4	0.9	-	47.3	2.7	-	9.5	0.4
GT2P50	Capsule	GTE (Leaf)	300	136.4	145.9	3.2	-	237.3	14.5	-	2.2	0.4
GT2P51²	Capsule	GTE (Leaf)	400	180	208.8	2.7	-	342.8	15.4	Decaf	3.2	0.4
GT2P53	Tablet	GTE (Leaf)	167	67	78.0	3.9	100	126.5	6.7	Decaf	1.3	0.7
GT2P54	Capsule	GTE (Leaf)	200	100	118.6	1.5	160	206.1	10.0	18	21.4	2.3

¹GTE = green tea extract; ²GT251 was tested only by one laboratory.

Table 3. Label claims and measured content per day consumption for EGCG, total catechins and caffeine in 37 multi-ingredient GT DS.

Product ID	Form	Matrix	Amount of GT	EGCG				Total Catechins			Caffeine	
			mg/day									
			Label	Label	Measured	SD	Label	Measured	SD	Label	Measured	SD
GT2P01	Gummy	GTE (Leaf)	300	-	44.0	7.1	-	70.2	11.1	-	0.0	0.0
GT2P02	Softgel	GTE (Leaf)	-	-	85.9	10.5	-	210.8	13.2	330	509.1	13.3
GT2P04	Capsule	GTE (Leaf)	-	-	221.5	10.2	-	377.4	19.1	320	310.8	18.8
GT2P05	Capsule	GTE (Leaf)	-	-	0.8	0.5	-	6.8	1.5	150	138.4	10.7
GT2P07	Caplet	GTE (Leaf)	-	-	252.4	8.6	-	437.4	24.7	150	150.5	0.4
GT2P08	Capsule	GTE (Leaf)	-	-	48.4	5.1	-	101.6	6.0	900	982.0	69.9
GT2P09	Caplet	GTE (Leaf)	778	350.1	370.4	19.3	583.5	629.0	35.7	100	114.1	7.1
GT2P10	Tablet	GTE (Leaf)	263	90	84.7	5.5	-	140.6	12.2	62	58.5	4.4
GT2P11	Tablet	GTE (Leaf)	-	-	82.3	10.0	-	190.0	25.0	120	154.3	52.8
GT2P12	Capsule	GTE (Leaf)	-	-	3.3	0.2	-	7.2	0.2	Decaf	0.4	0.0
GT2P15	Softgel	GTE (Leaf)	800	400	441.8	70.7	-	710.7	86.3	320	302.1	60.5
GT2P16	Tablet	GTE (Leaf)	-	-	45.5	1.8	-	101.9	2.1	246	248.1	3.4
GT2P17	Capsule	GTE (Leaf)	-	-	294.5	21.7	-	529.2	33.1	-	199.8	10.9
GT2P18	Capsule	GTE (Leaf)	-	270	286.2	26.5	-	518.7	20.4	-	9.5	6.9
GT2P19	Caplet	GTE (Leaf)	-	-	0.0	0.0	-	0.0	0.0	-	0.0	0.0
GT2P20	Caplet	GTE (Leaf)	40	-	0.5	0.0	-	0.7	0.0	100	91.0	4.1
GT2P22	Capsule	GTE (Leaf)	-	-	45.7	1.2	-	65.6	1.6	-	250.4	2.8
GT2P23	Capsule	GTE (Leaf)	300	45	54.5	0.3	-	157.7	15.9	-	5.9	1.6
GT2P24	Tablet	GTE (Leaf)	250	-	38.7	10.4	-	78.7	21.3	-	16.2	1.1
GT2P25	Capsule	GTE (Leaf)	150	-	73.2	1.3	75	118.4	1.7	-	16.3	0.7
GT2P26	Capsule	GTE (Leaf)	150	60	61.5	4.4	-	132.7	5.7	-	1.2	0.6
GT2P27	Softgel	GTE (Leaf)	150	-	18.5	0.9	45	46.5	1.0	45	49.7	1.4
GT2P28	Softgel	GTE (Leaf)	375	300	301.5	21.8	-	493.9	40.2	151.2	149.3	20.4
GT2P29	Capsule	GTE (Leaf)	400	-	131.9	2.4	160	286.3	5.9	32	16.1	0.6
GT2P30	Capsule	GTE (Leaf)	-	135	144.9	8.2	-	271.8	20.2	142.5	128.2	7.3
GT2P32	Tablet	GTE (Leaf)	100	-	48.4	2.7	-	76.4	3.7	-	3.2	2.1

GT2P33	Capsule	GT Leaf	125	-	7.1	0.5	-	13.5	0.9	-	3.0	0.1
GT2P35	Capsule	GTE + GT Leaf	180	-	30.0	1.4	-	51.6	2.9	-	6.3	0.2
GT2P36	Tablet	GTE (Leaf)	75	-	34.4	0.8	-	53.1	1.9	-	0.9	1.2
GT2P37	Capsule	GT	-	-	4.3	1.5	-	11.3	4.4	-	1.0	0.8
GT2P41	Liquid Capsule	GT Leaf	-	-	76.7	5.5	-	166.4	9.8	-	38.6	11.7
GT2P47	Capsule	GTE (Leaf)	-	-	33.9	6.9	-	70.6	6.8	-	15.6	1.7
GT2P48	Capsule	GTE (Leaf)	-	-	22.4	0.9	-	47.3	2.7	-	9.5	0.4
GT2P50	Capsule	GTE (Leaf)	300	136.4	145.9	3.2	-	237.3	14.5	-	2.2	0.4
GT2P51	Capsule	GTE (Leaf)	800	360	417.5	5.5	-	685.7	30.9	Decaf	6.4	0.9
GT2P53	Tablet	GTE (Leaf)	167	67	78.0	3.9	100	126.5	6.7	Decaf	1.3	0.7
GT2P54	Capsule	GTE (Leaf)	400	200	237.2	2.9	320	412.3	20.0	36	42.7	4.7

Per day values were calculated by multiplying per serving amounts by number of servings per day from the manufacturer suggested use printed on the product label.

Table 4. Mean percentage differences from labels for EGCG, total catechin, and caffeine content measured in GT DS

Product ID	Form	Matrix	EGCG		Total Catechins		Caffeine	
			Percentage Differences from Label					
			mean	SD	mean	SD	mean	SD
GT2P02	Softgel	GTE (Leaf)	-	-	-	-	54.3	4.0
GT2P04	Capsule	GTE (Leaf)	-	-	-	-	-2.9	5.9
GT2P05	Capsule	GTE (Leaf)	-	-	-	-	-7.8	7.1
GT2P07	Caplet	GTE (Leaf)					0.3	0.3
GT2P08	Capsule	GTE (Leaf)					9.1	7.8
GT2P09	Caplet	GTE (Leaf)	5.8	5.5	7.8	6.1	14.1	7.1
GT2P10	Tablet	GTE (Leaf)	-5.9	6.2	-	-	-5.7	7.1
GT2P11	Tablet	GTE (Leaf)	-	-	-	-	28.6	44.0
GT2P15	Softgel	GTE (Leaf)	10.4	17.7	-	-	-5.6	18.9
GT2P16	Tablet	GTE (Leaf)	-	-	-	-	0.9	1.4
GT2P18	Capsule	GTE (Leaf)	6.0	9.8	-	-	-	-
GT2P20	Caplet	GTE (Leaf)					-9.0	4.1
GT2P23	Capsule	GTE (Leaf)	21.1	0.6	-	-	-	-
GT2P25	Capsule	GTE (Leaf)	-	-	57.9	2.3	-	-
GT2P26	Capsule	GTE (Leaf)	2.5	7.3	-	-	-	-
GT2P27	Softgel	GTE (Leaf)	-	-	3.4	2.3	10.4	3.1
GT2P28	Softgel	GTE (Leaf)	0.5	7.3	-	-	-1.2	13.5
GT2P29	Capsule	GTE (Leaf)	-	-	78.9	3.7	-49.6	1.8
GT2P30	Capsule	GTE (Leaf)	7.4	6.1	-	-	-10.0	5.1
GT2P50	Capsule	GTE (Leaf)	7.0	2.3	-	-	-	-
GT2P51 ²	Capsule	GTE (Leaf)	16.0	1.5	-	-	-	-
GT2P53	Tablet	GTE (Leaf)	16.4	5.8	26.5	6.7	-	-
GT2P54	Capsule	GTE (Leaf)	18.6	1.5	28.8	6.2	33.5	14.7

²GT251 was tested only by one laboratory