**America’s Phytonutrient Report: Quantifying the Gap**

**BACKGROUND**

Eating more fruits and vegetables has been associated with a decreased risk for chronic diseases including cardiovascular disease, cancer and diabetes. Fruits and vegetables are important sources of key nutrients, such as potassium, dietary fiber, folic acid, vitamins A, C and E. Additionally, they contain naturally occurring compounds referred to as phytochemicals or phytonutrients, which may have health benefits beyond basic nutrition. Therefore, in the simplest of terms, most Americans could become healthier by choosing to eat more fruits and vegetables daily.

When the current Dietary Guidelines for Americans were released in 2005, the federal recommendations for fruits and vegetables increased from 5-9 servings to 5-13 servings per day for adults, which is about 2.5 to 6.5 cups a day depending on gender, age and activity level. The Dietary Guidelines for Americans 2005 also state:

- Consume a variety of nutrient-dense foods;
- Consume a sufficient amount of fruits and vegetables while staying within energy needs;
- Choose a variety of fruits and vegetables each day; and
- Select from all five vegetable subgroups (dark green, orange, legumes, starchy vegetables and other vegetables) several times a week.

Regardless of whether a dietary pattern is evaluated against these guidelines, or MyPyramid fruit and vegetable consumption, this report asks one main question – what is the gap in phytonutrient consumption among Americans?

**What are Phytonutrients?**

The term “phyto” originates from the Greek word meaning plant. Phytonutrients are natural components of plants thought to offer benefits to health. Fruits, vegetables, grains, legumes, nuts and teas are rich sources of phytonutrients. Unlike the basic nutrients (protein, fat, carbohydrates, vitamins, minerals), phytonutrients are not “essential” for life, so some scientists prefer the term “phytochemical” rather than “phytonutrient”. However, for consumer messaging, the term “phytonutrient” conveys a stronger health message given people prefer to eat “nutrients” rather than “chemicals”. For the purposes of encouraging consumers to eat more fruits and vegetables, it is advised to use the nutrient terminology.

While phytonutrients have been part of the chemical composition of fruits and vegetables for as long as they have been grown, it is only in recent years
that specific phytonutrients have been isolated, identified and studied for their many beneficial qualities. Scientists are continuing to identify new phytonutrients in fruits and vegetables -- one orange is believed to contain over 170 phytonutrients! For the purposes of quantifying the phytonutrient gap, this report focuses on 14 phytonutrients of interest including carotenoids (alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein/zeaxanthin, lycopene), flavonoids (anthocyanidins, epigallocatechin-3-gallate or “EGCG”, hesperitin, quercetin), phenolics (ellagic acid, resveratrol), isoflavonanes, isoflavones and allicin.

The descriptive science names may be confusing to the average consumer, and yet, it is important for consumers to understand a “food first” message within an “eat by color” paradigm which encompasses the phytonutrients. Therefore, for a generalized “eat by color” approach, consumers should ideally eat the richest colors from each color grouping, and consume 2 servings a day from each for a total of 10 servings of fruits and vegetables per day.

In order to align the consumer-facing “eat by color” paradigm with the research findings about the “gap”, this report will quantify the phytonutrient gap by color. The “phytonutrient gap” referred to in this report is defined as the percentage of the population with phytonutrient intakes less than the median intake (‘prudent intake” or PI) by adults who meet recommended daily intakes of fruits and vegetables. In other words, this “gap” represents the shortfall of phytonutrient intakes based on an average level of phytonutrient intake consistent with a “prudent diet” which is high in fruits and vegetables. It is important to point out that a “prudent diet” may still fall short of desirable or optimal levels of some or even most phytonutrients found in fruits, vegetables and other plant sources including teas and beans.

The 14 phytonutrients are grouped as follows:

- Green: EGCG, Isothiocyanate, Lutein/Zeaxanthin, Isoflavones
- Red: Lycopene, Ellagic Acid
- White: Allicin, Quercetin
- Purple/Blue: Anthocyanidins, Resveratrol
- Yellow/Orange: Alpha-carotene, Beta-Carotene, Hesperitin, Beta-cryptoxanthin

**Methodology & Data Sourcing**

Nutrient intakes were based on food consumption records collected as part of the National Health and Nutrition Examination Surveys (NHANES) conducted in 2003-2004 and 2005-2006. The NHANES datasets provide nationally representative nutrition and health data and prevalence estimates for nutrition and health status measures in the United States. A total of 16,783 individuals in the survey period 2003-2006 provided 2 complete days of dietary recalls. The analyses in this report utilize 2-day average intakes, not usual intakes.

For each food reported in NHANES, USDA databases provide information on the amount of energy and approximately 60 nutrients or food constituents per 100 g of each food. USDA's Food and Nutrient Database for Dietary Studies 3.0 (FNDDS 3), which is based on nutrient composition data in the USDA National Nutrient Database for Standard Reference, Release 20 (SR 20), was the source of nutrient concentration data for NHANES 2003-2006. This database was used to identify the amount of each phytonutrient found in foods including alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein/zeaxanthin, and lycopene. The most recent USDA flavonoid database was used to identify concentrations of anthocyanidins, epigallocatechin-3-gallate, hesperitin, and quercetin in each food reported by NHANES respondents in 2003-2006. The USDA isoflavone database was used to identify concentrations of total isoflavones in each food as reported.

For the remaining phytonutrients, concentration data were identified from published literature.

**Fruit and Vegetable Intake Falling Short**

MyPyramid dietary guidance, which supports the 2005 Dietary Guidelines for Americans, includes recommendations for amounts of fruits and vegetables that should be consumed daily as part of a

<table>
<thead>
<tr>
<th>POPULATION</th>
<th>DAILY FRUIT INTAKE</th>
<th>DAILY VEGETABLE INTAKE</th>
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<tbody>
<tr>
<td>WOMEN</td>
<td></td>
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<tr>
<td>19-30 YEARS OLD</td>
<td>2 CUPS</td>
<td>2 ½ CUPS</td>
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<tr>
<td>31-50 YEARS OLD</td>
<td>1 ½ CUPS</td>
<td>2 ½ CUPS</td>
</tr>
<tr>
<td>51+ YEARS OLD</td>
<td>1 ½ CUPS</td>
<td>2 CUPS</td>
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<tr>
<td>MEN</td>
<td></td>
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</tr>
<tr>
<td>19-30 YEARS OLD</td>
<td>2 CUPS</td>
<td>3 CUPS</td>
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<tr>
<td>31-50 YEARS OLD</td>
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<tr>
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<td>2 CUPS</td>
<td>2 ½ CUPS</td>
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</table>
healthy diet. Women should consume 2.0-2.5 cups of vegetables and 1.5-2.0 cups of fruits, which means up to 4.5 cups or 9 servings of fruit and vegetables per day (see Table 2). Men should have between 2.5-3.0 cups of vegetables and 2.0 cups of fruits, which means up to 5.0 cups or 10 servings of fruits and vegetables per day. Each cup equivalent of fruits is generally equivalent to 1 cup of fresh fruit, 8 ounces of 100% fruit juice, or 0.5 cup of dried fruit. A cup equivalent of vegetables is generally equivalent to 1 cup of raw or cooked vegetables, 8 ounces of vegetable juice, or two cups of raw leafy greens.

Based on these analyses, 3 to 12% of Americans are able to meet their MyPyramid target for combined fruit and vegetable intake recommendations – the so-called “meeters” (see Table 3). Notably, females over the age of 65 years tend to fare best (12% meet recommendations), while defined by a “prudent diet” while 45-64 years meet their vegetable intake recommendations.

**A Dietary Reference Intake for Phytonutrients?**

Because these plant-based compounds found in fruits and vegetables – the phytonutrients – are not considered “essential” to human health, there are no Dietary Reference Intakes (DRIs) as there are for the macronutrients and micronutrients. The lack of a DRI is not a result of the lack of importance of phytonutrients in the diet, but rather the establishment of reference intakes would be an arduous process not yet given a high priority.

To be clear, this report is not designed to establish DRIs for phytonutrients. Rather, in order to determine a “prudent intake” (PI) for each of the phytonutrients, the median intake of phytonutrients by the subpopulation of adults who meet recommended daily intakes of fruits and vegetables was identified. Thus, a PI is the median level of intake among American adults who consume a “prudent diet” consistent with fruit and vegetable intake guidance. Importantly, this “prudent diet”, while defined by a certain number of fruit and vegetable servings, is not defined by the nutrient (or phytonutrient) concentration of those servings. For example, one vegetable serving of iceberg lettuce provides a different amount of phytonutrients than a same-size serving of romaine lettuce or kale. Therefore, the PI value does not necessarily capture intake levels consistent with optimal health – in fact, optimal levels may likely be higher than prudent levels.

Specifically, the 50th percentile (median) of those meeting MyPyramid recommendations (“meeters”) was selected as the PI (see Table 4). For example, the median intake for EGCG was 0.6 mg/day, so this value became the “PI” for EGCG. For two phytonutrients (isothiocyanates and allicin), the median was zero, and therefore the mean intake was selected as the PI.

**Quantifying the Gap By Color**

Beginning with the green group, the following sections identify the phytonutrients and their health benefits, the PI for each phytonutrient and the percentage of Americans who fall short by color grouping based on the definitions of this report.

**THE GREEN GROUP**

Epigallocatechin-3-gallate, or EGCG, is a polyphenolic compound present

<table>
<thead>
<tr>
<th>POPULATION</th>
<th>MEET FRUIT RECOMMENDATIONS</th>
<th>MEET VEGETABLE RECOMMENDATIONS</th>
<th>MEET FRUIT AND VEGETABLE RECOMMENDATIONS</th>
<th>DO NOT MEET FRUIT AND VEGETABLE RECOMMENDATIONS</th>
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<td></td>
<td>N</td>
<td>PERCENT</td>
<td>N</td>
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</tr>
<tr>
<td>M 19 – 44 Y</td>
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<td>15</td>
<td>293</td>
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<tr>
<td>F 19 – 44 Y</td>
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<td>255</td>
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<td>M 45 – 64 Y</td>
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</tr>
<tr>
<td>F 65+ Y</td>
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<td>36</td>
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<td>21</td>
<td>1631</td>
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</table>

Y=years, M= male, F= female, N=sample size
in green tea, and tea is second only to water as a major component of fluid intake worldwide.18 EGCG may offer neuroprotective effects for people with Alzheimer’s disease19 and may help stop the proliferation of cancerous cells in the lungs.20 Further, a recent meta-analysis on breast cancer showed the combined results of green tea consumption from four studies showed a reduced risk of breast cancer for the highest versus lowest intake groups.21

The PI for EGCG was found to be 0.6 mg/day. Among all adults 19 years and older, 37% meet this PI, which means 63% fall short. Graph 1 shows the percentage of Americans, by age group, who has a gap in their EGCG consumption.

**ISOTHIOCYANATE**

Isothiocyanates are derived from the breakdown of glucosinolates – sulfur-containing compounds found in cruciferous vegetables such as broccoli, cabbage and kale. Research on isothiocyanates has shown them to be protective of DNA, to inhibit cell proliferation and to stop the progression of some tumors.22 Several epidemiological studies have reported an inverse association between consumption of dietary isothiocyanates and cancer risk in several organs.23-26 Among genetically susceptible individuals, low intakes of cruciferous vegetables may be associated with higher kidney cancer risks in particular.27

The PI for isothiocyanate was found to be 1.7 mg/day. Among adults 19 years and older, 18% meet this PI, which means 82% fall short. Graph 2 shows the percentage of Americans, by age group, who has a gap in their isothiocyanate consumption.

**LUTEIN/ZEAXANTHIN**

Lutein is found in green, leafy vegetables, and offers a high level of antioxidant activity. High levels of lutein and zeaxanthin (a closely related carotenoid pigment derived from lutein), are thought to reduce the risk of age-related macular degeneration, which is the leading cause of blindness in the elderly.28 Lutein/zeaxanthin pigments function as blue-light filters, and offer the potential to preserve vision. In one study of older individuals, those with the highest dietary intake of lutein/zeaxanthin had the lowest risk of age-related macular degenerative disease (AMD),29 and more recent research supports the reversal of eye dysfunction with daily supplementation over the course of one year.30

The PI for lutein/zeaxanthin was found to be 2055 mcg/day. Among adults 19 years and older, 17% meet this PI, which means 83% fall short. Graph 3 shows the percentage of Americans, by age group, who has a gap in their lutein/zeaxanthin consumption.

**ISOFLAVONES**

Isoflavones are a class of phytoestrogens – plant-derived compounds with estrogenic activity. Soybeans and soy products are the richest source of isoflavones in the human diet. The consumption of soy products has been investigated for many possible health benefits. One of the major isoflavones, daidzein, has been shown to offer natural antioxidant properties,31 and there is growing evidence that isoflavones may play a role in decreasing the risk of lung cancer.32

The PI for isoflavones was found to be 0.4 mg/day. Among adults 19 years and older, 52% meet this PI, which means 48% fall short. Graph 4 shows the percentage of Americans, by age group, who has a gap in their isoflavone consumption.

**THE GREEN GROUP SUMMARY:**

The average percentage of Americans who fail to meet their EGCG PI is 63% across all age groups. The average percentage of Americans who fail to meet their isothiocyanate PI is 82% across all age groups. The average percentage of Americans who fail to meet their lutein/zeaxanthin PI is 83% across all age groups. The average percentage of Americans who fail to meet their isoflavone PI is 48% across all age groups. Therefore, on average, approximately 69% [(63+82+83+48)/4] of Americans fail to meet their phytonutrient intake within the green phytonutrient color grouping.

**THE RED GROUP Lycopene**

Lycopene, a naturally occurring plant compound extracted from tomatoes, is a carotenoid that exhibits potent antioxidant activity. Epidemiological studies have indicated that there is a correlation between increased tomato intake and reduced risk of prostate cancer33 and men with high serum lycopene levels appear to be at a lower risk of prostate cancer than men with low levels.34

The PI for lycopene was found to be 6332 mcg/day. Among adults 19 years and older, 31% meet this PI, which means 69% fall short. Graph 5 shows the percentage of Americans, by age group, who has a gap in their lycopene consumption.

**ELLAGIC ACID**

Ellagic acid is a substance found in
Various fruits, nuts and vegetables, including pomegranates, strawberries and walnuts. Research suggests that ellagic acid may help reduce DNA damage and possibly help protect against breast cancer. In one study of prostate cancer, patients receiving ellagic acid in combination with chemotherapy had lower rates of a chemotherapy-related side effect (reduced white blood cells) compared to patients receiving chemotherapy alone, although the ellagic acid did not slow tumor growth, or increase survival time.

The PI for ellagic acid was found to be 3.7 mg/day. Among adults 19 years and older, 15% meet this PI, which means 85% fall short. Graph 7 shows the average percentage of Americans, by age group, who fail to meet their ellagic acid consumption.

THE RED GROUP SUMMARY:
The average percentage of Americans who fail to meet their lycopene PI is 69% across all age groups. The average percentage of Americans who fail to meet their ellagic acid PI is 79% across all age groups. Therefore, on average, approximately 74% [(69+79)/2] of Americans fail to meet their phytonutrient intake within the red phytonutrient color grouping.

THE WHITE GROUP

allicin

Allicin is a sulfur compound found in garlic and other members of its plant family. Much of the research investigating the impact of allicin on health has focused on garlic and biomarkers of heart health. In randomized, placebo controlled clinical studies summarized in recent meta-analyses, garlic has shown to reduce total cholesterol and blood pressure. A review of human trials concluded that garlic promotes a modest, but significant reduction in total cholesterol driven mostly by the reduction of the lipoproteins that transport triglycerides. Neither HDL nor LDL were significantly altered. In terms of blood pressure, garlic was found to lower blood pressure in hypertensive individuals, while other research on blood pressure showed mixed effects or no effect among healthy adults. Other investigations suggest that allicin potentially offers anti-platelet activity, helping to prevent blood clots which are associated with risk of heart disease.

The PI for allicin was found to be 0.85 mg/day. Among adults 19 years and older, 15% meet this PI, which means 85% fall short. Graph 7 shows the percentage of Americans, by age group, who has a gap in their allicin consumption.

QUERCETIN

Commonly found in apples and onions, quercetin is a type of plant-derived flavonoid, known as a flavonol. Quercetin has been shown to be a powerful antioxidant, and to offer strong antimitogenic properties. Daily doses of quercetin (150 mg/day) have been shown to reduce blood pressure and “bad cholesterol” (plasma LDL cholesterol concentrations) in overweight individuals at high risk for heart disease. Quercetin may also inhibit bone loss by regulating both systemic and local factors including hormones and cytokines.

The PI for quercetin was found to be 17.9 mg/day. Among adults 19 years and older, 20% meet this PI, which means 80% fall short. Graph 8 shows the percentage of Americans, by age group, who has a gap in their quercetin consumption.

THE WHITE GROUP SUMMARY:
The average percentage of Americans who fail to meet their allinic PI is 85% across all age groups. The average percentage of Americans who fail to meet their quercetin PI is 80% across all age groups. Therefore, on average, approximately 83% [(85+80)/2] of Americans fail to meet their phytonutrient intake within the white phytonutrient color grouping.
**THE PURPLE/BLUE GROUP ANTHOCYANIDINS**

Anthocyanidins, a subclass of flavonoids, are typically found in berries such as blueberry, elderberry or grapes. Research findings suggest blueberry or Concord grape juice supplementation, both offering high levels of anthocyanidins, can increase verbal memory performance in humans with mild cognitive impairment. It is believed that anthocyanidins may exert their beneficial effects through signal transduction and neuronal communication, thereby helping to protect against age-related brain deficits and neurodegeneration.

The PI for anthocyanidins was found to be 22.0 mg/day. Among adults 19 years and older, 15% meet this PI, which means 85% fall short. Graph 9 shows the percentage of Americans, by age group, who has a gap in their anthocyanidins consumption.

**RESVERATROL**

Resveratrol is found in grapes, which produce it as a defense against fungi. Wine is a major source of resveratrol in the diet, but resveratrol is also found in cocoa, dark chocolate and peanuts. Resveratrol has been shown to improve endothelial function and to reduce oxidative stress in people with type II diabetes, and is believed to aid in the prevention and treatment of common clinical conditions of aging including antioxidant defense, regulation of the cell cycle, mitochondrial energy production, cancer gene suppression and related phenomena typically associated with aging.

The PI for resveratrol, excluding wine, was found to be 8.2 mg/day. Among adults 19 years and older, 32% meet this PI, which means 68% fall short. Graph 10 shows the percentage of Americans, by age group, who has a gap in their resveratrol consumption.

**THE PURPLE/BLUE GROUP SUMMARY:**

The average percentage of Americans who fail to meet their anthocyanidins PI is 85% across all age groups. Excluding wine, the average percentage of Americans who fail to meet their resveratrol PI is 68% across all age groups. Therefore, on average, approximately 76% [(85+68)/2] of Americans fail to meet their phytonutrient intake within the purple/blue phytonutrient color grouping.

**THE YELLOW/ORANGE GROUP**

**ALPHA-CAROTENE**

Alpha-carotene, like beta-carotene and beta-cryptoxanthin, are provitamin A carotenoids, meaning they can be converted by the body to vitamin A. Food sources include orange foods like pumpkin and carrots. Low circulating levels of carotenoids have been associated with cardiovascular disease. Both alpha and beta-carotene have been shown to be inversely associated with 15-year cardiovascular disease mortality in elderly men.

The PI for alpha-carotene was found to be 518 mcg/day. Among adults 19 years and older, 23% meet this PI, which means 77% fall short. Graph 11 shows the percentage of Americans, by age group, who has a gap in their alpha-carotene consumption.

**BETA-CAROTENE**

Beta-carotene is found in many orange fruits and vegetables like cantaloupe, carrots and sweet potatoes. Beta-carotene is a powerful antioxidant, protecting the cells of the body from damage caused by free radicals. It is also one of the carotenoids believed to enhance the function of the immune system, and may play a protective role in bone health.

The PI level of intake for beta-carotene was found to be 3787 mcg/day. Among adults 19 years and older, 16% meet this PI, which means 84% fall short. Graph 12 shows the percentage of Americans, by age group, who has a gap in their beta-carotene consumption.

**HESPERITIN**

Hesperidin is a flavanone glycoside consisting of the flavone hesperitin bound to the disaccharide rutinose. Because the USDA flavonoid database quantifies hesperitin (not hesperidin), this report uses hesperitin, which is mainly found in citrus fruits such as lemons and oranges. Hesperitin is a flavonoid, and flavonoids are effective antioxidants and may protect against several chronic diseases. Epidemiological evidence indicates the incidence of cerebrovascular disease was lower at higher intakes of hesperitin, and the incidence of asthma was lower at higher total flavonoid intakes including hesperitin.

The PI level of intake for hesperitin was found to be 9.6 mcg/day. Among adults 19 years and older, 23% meet this PI, which means 77% fall short. Graph 13 shows the percentage of Americans, by age group, who has a gap in their hesperitin consumption.

**BETA-CRYPTOXANTHIN**

Beta-cryptoxanthin is found in fruits like tangerines. Epidemiologic studies suggest that the antioxidant potential of dietary carotenoids may protect against the oxidative damage...
that can result in inflammation. Research shows that a modest increase in betacryptoxanthin intake, equivalent to one glass of freshly squeezed orange juice per day, is associated with a reduced risk of developing inflammatory disorders such as rheumatoid arthritis.56

The PI level of intake for beta-cryptoxanthin was found to be 223 mcg/day. Among adults 19 years and older, 20% meet this PI, which means 80% fail short. Graph 14 shows the percentage of Americans, by age group, who has a gap in their beta-cryptoxanthin consumption.

THE YELLOW/ORANGE GROUP

SUMMARY:
The average percentage of Americans who fail to meet their alpha-carotene PI is 77% across all age groups. The average percentage of Americans who fail to meet their beta-carotene PI is 84% across all age groups. The average percentage of Americans who fail to meet their hesperitin PI is 77% across all age groups. The average percentage of Americans who fail to meet their beta-cryptoxanthin PI is 80% across all age groups. Therefore, on average, approximately 80% ((77+84+77+80)/4) of Americans fail to meet their phytonutrient intake within the yellow/orange phytonutrient color grouping.

EATING BY COLOR

The Gap by Color

Collectively, the phytonutrient gaps in consumption in terms of the percentage of Americans not meeting their PIs are as follows (see table 5).

Filling the Gap

Based on the analyses of this report, Americans are falling short in virtually every color category of phytonutrients:

- 69% fall short in green
- 74% fall short in red
- 83% fall short in white
- 76% fall short in purple/blue
- 80% fall short in yellow/orange

The biggest “gap” is among the white color category (only 17% meet “prudent intake” levels), while Americans are doing somewhat better in the “green” category (31% meet “prudent intake” levels).

Based on the five color groupings, on average, 8 out of 10 Americans (76%) have a phytonutrient gap. Ideally, Americans should seek approximately 10 servings of fruits and vegetables daily, which could be interpreted as 2 servings from each color category presented. While the exact balance of servings per color could be debated among health and nutrition professionals, the goal of having Americans consume 2 servings from each color category for a total of 10 servings is easy and straightforward for consumers to follow. A simple message of whole foods first is important, along with the message to choose richer and more vibrantly colored foods whenever possible. Beyond this, dietary supplementation may be an option for individuals looking to reduce their phytonutrient gap.

References


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44. Singh BN, Singh BR, Singh RL, et al. Polyphenolics from various extracts/fractions of red onion (Allium cepa)


Instructions to receive credit:

1) Read the article,
2) Answer the questions listed at the end of the article on page 65. For each question, select the one best response. Compare your answers to the answer key on page .
3) Mail, fax or email the application for CPE credit to Amy Jarck, Executive Assistant at: DIFM DPG c/o Amy Jarck, P.O. Box 3624 Pittsfield, MA 01202 phone: 800-279-6880 or info@integrativerd.org.
4) Once this information has been received, Amy Jarck DIFM Executive Assistant, will email verification of completion for the CPE credit. Complete and retain the Certificate of Completion for your records along with the verification you receive in case you are audited by ADA.

**Answer Key:** 1 - True; 2 - True; 3 - False; 4 - D; 5 - C; 6 - D; 7 - A; 8 - C; 9 - D
CPE Objectives and Questions
America’s Phytonutrient Report

Objectives, Learning Codes, and CPE questions for Spring 2010 CPE—America’s Phytonutrient Report

This CPE is approved for 1 hour of continuing education. Possible codes include: 2000, 2010, 2020, 4000, 4010, and 4030

After reading this CPE article the dietetics practitioner (RD, DTR) will be able to:
1. Define phytonutrient/phytochemical.
2. Define and explain the approach used to determine “phytonutrient gap” in this analysis.
3. Identify at least 3 phytonutrients inclusive of their food/color source.
4. Identify populations at greatest/least risk of higher/lower phytonutrient intakes.
5. State a simple public health “take home” message for increasing phytonutrient intake.

Questions:
True/False
1. T/F Phytonutrients are non-essential plant chemicals.
2. T/F An easy message to encourage consumption of phytonutrients is to advise Americans to consume a “rainbow of color” of fruits and vegetables on a daily basis.
3. T/F Intakes of phytonutrients by adults meeting fruit and vegetable recommendations are based on actual foods consumed by adults, and therefore represent optimal intakes for health.

Multiple Choice
Please choose the answer that best fits the question.
4. Which is not a primary reason Americans eat too few fruits and vegetables?
   a. Price.
   b. Availability.
   c. Convenience.
   d. Taste.
5. The term “phytonutrient gap” in this analysis refers to:
   a. The phytonutrients lost between harvest and consumption.
   b. The phytonutrient difference between consuming 5-9 servings of fruits and vegetables daily versus 5-13 servings.
   c. The percentage of American adults with phytonutrient intakes less than the level consumed by those eating a diet containing recommended servings of fruits and vegetables.
   d. The gap or difference between the phytonutrient composition between the various pigmented groups (i.e., difference between red fruits/vegetables and foods in the green group).
6. Which phytonutrients are found in green pigmented fruits/vegetables?
   a. Kale, soybeans.
   b. Ellagic acid, quercetin.
   c. Allicin, resveratrol.
   d. Isothiocyanates, isoflavones, lutein, EGCG.
7. “Prudent intake” of phytonutrients is defined in this analysis as:
   a. Median (50th percentile) intakes by those meeting MyPyramid recommendations.
   b. The Dietary Reference Intake (DRI) for fruits/vegetables.
   c. 5-9 servings of fruits/vegetables daily.
   d. The value that captures intake levels which promote optimal health.
8. In order to increase phytonutrients found in white foods (allicin & quercetin), Americans should consume more:
   a. Cauliflower, milk.
   b. White and red wines.
   c. Apples, onions, garlic.
   d. White and pink grapefruit.
9. On balance, which age group was most likely to meet recommended intakes of fruits and vegetables?
   a. No difference between age groups.
   b. 19-44 year olds.
   c. 45-64 year olds.
   d. > 65 year olds.

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Expiration Date 5-31-11

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1. T/F 2. T/F 3. T/F 4. a/b/c/d. 5. a/b/c/d. 6. a/b/c/d. 7. a/b/c/d. 8. a/b/c/d. 9. a/b/c/d.
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#### COPY II: STATE LICENSURE VERIFICATION

Please complete a separate Certificate of Attendance Form for each session attended. Present a completed form to your state Licensure Board upon request.

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The Growing Evidence for Supporting the Goodness of Tea

Eva M.R. Kovacs, PhD
Development Nutrition Manager, Unilever

Introduction

True teas, i.e. black, green, oolong, and white (but not herbal) teas, come from the same plant, Camellia Sinensis. The flavonoid composition varies between types of tea and will depend on the way the tea leaves are processed.

The tea plant is naturally rich in flavonoids called catechins. Typically heated after harvesting, green tea leaves undergo minimal oxidation. This stops enzymatic reactions and therefore green tea is rich in catechins. During black tea production, the newly harvested leaves are crushed and exposed to air. In the presence of air/oxygen, an enzymatic reaction occurs, which allows for the catechins to be polymerized into other flavonoids called thearubigins and theaflavins, which provide the darker color and rich flavor of black tea. Oolong tea is made using the same process as black tea, but with a shorter enzymatic reaction, oolong tea contains flavonoids that are found in both green and black tea. White tea has a higher proportion of young leaves that have undergone no oxidation.

Because they come from the same plant, all these teas contain the same tea "goodies" such as flavonoids, theanine, caffeine, and fluoride. The level of flavonoids varies between types of tea. It may range between 100 and 300 mg of total flavonoids per cup (240 ml), depending on the tea format (loose leaf, tea bag), as well as the amount of tea used, the size of the tea leaves, the duration of the infusion, whether stirring occurs (and how many times), and whether the tea bag is squeezed. On average, the flavonoid content in black tea is approximately 180 mg and in green tea it is approximately 160 mg per cup (values based on tea brands available in the US). Decaffeinated teas have slightly lower flavonoid contents because some of the flavonoids are lost during the decaffeination process.

Tea is the major dietary source of flavonoids in the US diet. Based on 1999-2002 NHANES data, 65.4% of total flavonoid intake in US adults is from tea, 20.8% is from cocoa, and 13.4% is from other sources.1,2 Other sources of flavonoids include grapes, apples, and citrus fruits.

Several health benefits have been associated with tea drinking and often they are attributed to its flavonoid content. Those health benefits where the scientific support is most developed include hydration, cardiovascular health, cognition, weight management and oral health. For some other potential health benefits such as cancer prevention, type 2 diabetes, neuroprotection, the immune system, or digestion the evidence is growing but is not sufficient to draw conclusions.

Hydration

Water is a basic nutrient and critical for the human body. One of the vital roles of water is the elimination of toxins and wastes from the body. Maintenance of a good hydration status is critical to support the detoxifying function of water. Hydration is fundamental to a number of physical and mental performances such as concentration, alertness, speed and sports performance.3,4

Based on the World Health Organization (WHO) Guidelines, water requirements are 2.2 liters (74 ounces) per day for women and 2.9 liters (98 ounces) per day for men. Tea can contribute to the recommended daily fluid intake. Scientific experts agree that unsweetened tea is second only to water as the most ideal beverage for hydration. This conclusion was based on the world’s first Healthy Beverages Guidelines that were created by a panel of independent scientists and who ranked commonly consumed beverages based on their caloric content and potential health benefits.4 Tea consumption was recommended at up to 8 cups per day.

There is a belief that caffeinated beverages may have adverse effects on fluid balance and may lead to dehydration. Ingestion of relatively large doses of caffeine (>250 mg) at one sitting has been shown to result in short-term stimulation of urine output. However, single caffeine doses at levels found in commonly consumed beverages have little or no diuretic effect.

Moreover, regular caffeine users become habituated to the effects of caffeine, diminishing its action. Research shows that the levels of caffeine in regularly consumed amounts of tea do not lead to dehydration and the fluid in tea contributes to hydration.3,5

Cardiovascular health

There is evidence from population studies that tea drinkers have a decreased risk of cardiovascular disease. For example, a meta-analysis by Peters et al., investigating the impact of tea consumption on cardiovascular disease and based on epidemiological studies published from 1966-2000, concluded that tea consumption of three cups per...
improved flow-mediated dilation and peripheral arterial stiffness, and this effect was apparent with only 100 mg of tea flavonoids daily, the equivalent of less than 1 cup of tea.\textsuperscript{10}

**Cognition**

Earlier research has shown that drinking tea may help maintain focus and improve alertness throughout the day.\textsuperscript{11-13} Two components in tea have been associated with these effects: L-theanine, an amino acid found almost only in tea, and caffeine, a methylxanthine mainly found in coffee, tea, cocoa and chocolate products, mate\textsuperscript{7}, and cola drinks. L-theanine has been shown to modulate alpha brain wave activity. At rest, 50-200 mg L-theanine can increase alpha brain wave activity, indicating a more relaxed yet alert state of mind.\textsuperscript{14-16} During performance of cognitive tasks, 250 mg of L-theanine alone as well as 100 mg of L-theanine combined with 50 mg of caffeine were shown to decrease alpha brain wave activity, indicating the ability to focus.\textsuperscript{17-19} Two recent double-blind randomized placebo-control intervention studies showed that consumption of 2-3 cups of tea improved attention and alertness relative to placebo.\textsuperscript{20}

**Weight management**

Unsweetened tea is a 0 calorie beverage and as such can help maintain a healthy body weight, especially when replacing sweetened beverages. This is particularly relevant today, when there is global pressure to reduce the consumption of sweetened beverages that have been shown to contribute to excess caloric intake and to increased prevalence of overweight and obesity.\textsuperscript{4} The evidence for the long-term beneficial effects of green tea on body weight and body composition is becoming stronger.\textsuperscript{21} Green tea contains high quantities of catechins and modest amounts of caffeine, ingredients proposed to affect energy and fat metabolism through sympathetic stimulation. Most acute studies have observed increased energy expenditure and/or fat oxidation with green tea administration. The relative role of caffeine, catechins, or their combination, in the potency of green tea effects is unclear, though acute green tea effects seem to be potentiated by added caffeine (and possibly exercise). Acute effects of green tea without added caffeine may be present, but below detection, and thus may still have a cumulatively important role in the longer-term. Chronic consumption of green tea appears to increase energy expenditure and/or fat oxidation, and the effects seem to be unrelated to caffeine. The body of evidence so far is limited. Several medium- to long-term studies (twelve to twenty weeks) showed that catechin-rich green teas (500-600 mg of catechins daily) may improve body composition by reducing body fat, particularly visceral fat. Most of the evidence has been generated from studies performed in Asian populations. Excess visceral fat is increasingly recognized as a greater risk factor for metabolic diseases than a high body weight or body fat.\textsuperscript{22,23} The prevalence of abdominal obesity among adults in the United States has increased continuously during past decades, with half manifesting abdominal obesity in 2003-2004.\textsuperscript{24} The link between catechins and body composition, particularly body fat distribution, and possible associated long-term health benefits, are important areas for further research.

**Oral health**

Tea drinking has also been associated with better dental health, e.g. reduced number of carious teeth. This effect may be due to the fact that tea contains fluoride, which promotes dental health, and flavonoids, which may increase acid...
The Growing Evidence for Supporting the Goodness of Tea

resistance to enamel, have antibacterial activity, and inhibit salivary amylase that in turn may reduce the cariogenic potential of starchy foods.3,25,26 There is some evidence that tea may also reduce bad breath.

**Conclusion**

Tea consumption has been associated with several health benefits, such as hydration, cardiovascular health, cognition, weight management, and oral health. Different tea “goodies”, such as flavonoids, theanine, caffeine, and fluoride, have been associated with the different health benefits. Other potential health benefits associated with tea are cancer prevention, blood glucose regulation, neuroprotection, immune function, and digestion, but more scientific research is needed before these links can be confirmed.

**Supported by the Lipton Institute of Tea (www.liptoninstituteoftea.org) a division of Unilever.**

**Nutrition Manager at Unilever in Englewood Cliffs, NJ. Green tea and weight management has been one of Dr. Kovacs’ primary research areas of interest. She has been involved in several human trials investigating the effects of green tea consumption on energy expenditure, fat oxidation, body weight and body composition. Contact Dr. Kovacs at eva.kovacs@unilever.com**

**References**


The Three C's are the new buzz words regarding the recent developments within Medical Nutrition Therapy (MNT) policy issues. The New York Academy of Medicine (NYAM) and The Greater New York Dietetic Association (GNYDA) were the hosts for the cutting-edge presentation Coding, Coverage, and Compensation for Medical Nutrition Therapy (MNT) on November 5, 2009, described in the winter issue of the DIFM newsletter. This event was perfect timing in preparation for the insurance coding changes coming with healthcare reform and 2010.

The evening began with a tribute to Maurice E. Shils, MD, PhD, the father of nutrition, for his contributions to medicine in general and to the Academy in particular. Dr. Shils has had an amazing career by starting the first nutrition school, Institute of Human Nutrition, at Columbia University, and was the founder of the nutrition department at NYAM.

Erica Giovinazzo, GNYDA student intern chair, introduced the speaker Jane V. White, PhD, RD, FADA, LDN, who spoke about how coding, coverage, and practice management remain viable in today’s society. The attendees gained valuable information pertaining to: identifying procedure codes for nutrition and nutrition-related services that may be reimbursed by commercial third party payers, recognizing coding use and payment trends among Registered Dietitians (RDs) across the country, and recognizing opportunities to expand nutrition practice to receive payment for nutrition and nutrition-related services in multiple settings.

What was presented and what does it mean to RD’s as practitioners?

Highlighted below is a list of the reimbursement codes and information that RDs should use for insurance reimbursement that was presented by Dr. White and provided by the ADA Coding and Coverage Committee. Note, members can review a similar coding presentation from ADA’s web page at: http://www.eatright.org/Members/content.aspx?id=11339 (member log in required).

1. Compared with other Current Procedural Terminology (CPT) codes, the following MNT-CPT codes best describe the services that RDs provide patients/clients receiving medical nutrition therapy services for a particular disease and condition.

   - 97802 Medical Nutrition Therapy: initial assessment and intervention, individual, face to face with the patient, each 15 minutes.
   - 97803 Reassessment and intervention, individual, face to face with the patient, each 15 minutes.
   - 97804 group (2 or more individuals, each 30 minutes).

2. Centers for Medicare and Medicaid Services (CMS) also established healthcare common procedure codes (HCPCs) for use with Medicare covered services, effective for dates of service on or after January 1, 2003.

   - G0270 Medical Nutrition Therapy: reassessment and subsequent interventions following second referral in the same year for change in diagnosis, medical condition, or treatment regimen (including additional hours needed for renal disease), individual, face to face with the patient each 15 minutes.
   - G0271 Medical Nutrition Therapy: reassessment and subsequent interventions following second referral in same year for change in diagnosis, medical condition, or treatment regimen (including additional hours needed for renal disease) group (2 or more individuals), each 30 minutes.

3. Private insurance payers, but not Medicare, may accept other CPT codes such as:

   - Education and Training codes (98960 through 989602): Medical Team Conference (99366 and 99368); Telephone Services (98966 through 98968); and Online Medical Evaluation (98969).
   - Medicare Part B covers diabetes self-management training (DSMT) when these services are furnished by a certified provider at an accredited program. The following HCPCS codes are used for DSMT:
     - G0108 Diabetes outpatient self-management training services, individual, per 30 minutes.
     - G0109 Diabetes outpatient self-management training, group session, (2 or more), per 30 minutes.

The information that is typically listed on the claim form is:

1. The name of the insured policy holder, the patient name, gender, address, phone number, date of birth, social security number.
2. Name of the patient’s insurance, the individual’s number and group number.
3. CPT code and number of code units for the provider’s service.
5. Referring MD name and National Provider Identifier (NPI); and RD provider name and NPI.
6. Date of service and charge for the service.
7. Signature and date.

For a copy of the claims forms that are used to bill nutrition services visit www.eatright.org and search for CMS 1500 and CMS 1450(UB92).

Continued on page 73
Getting Ready to Serve

Ane Marie Kis, MS RD LDN
Incoming DIFM DPG Delegate

Wishes of peace, love, and prosperity. These three words came to me via e-mail from a newly “minted” registered dietitian (RD) who recently joined the Dietitians in Integrative and Functional Medicine (DIFM) DPG. How fitting for the new RD’s career track and our future practice as integrative and functional dietitians!

Peace. Our new DPG name, brand, and tremendous efforts by your leadership team to build and bridge knowledge about integrative and functional practices within the American Dietetic Association (ADA) and its members gives me great peace of mind.

Love. Newly minted or new to integrative practice, I have yet to find an RD who does not love their work. While attending the recent Integrative Health Care Symposium in New York City, I had the pleasing of chatting with Integrative and Functional Medicine practitioners who would love to find fellow integrative practitioners well versed in nutrition. These folks clearly recognize the value and benefits of integrative-minded RDs.

I encourage each one of you to log on to create and/or update your profile in “Find a DIFM RD”. By hanging out your web shingle, people can find you and start to develop relationships. Multidisciplinary collaboration with and for your patients will bring positive benefits and outcomes of all kinds and types. You gotta love that.

And, as for prosperity, do not under estimate the value of becoming a Medicare provider,(See the article on the Student Speak Page, page ___ for more information.) Being present in current reimbursement systems will surely help RDs shift into future systems whatever they may.

Remember also, there are far greater riches than monetary ones when you are sought out as an insightful functional medicine practitioner/teacher. You will undoubtedly be seen as an empathic listener who personalizes care and coaches clients as they move from passive to active sources of optimizing their health and achieving wellness.

Only time will tell how the steps to become more visible enrich your practice. But of this you can be sure, patients will shift in their thinking about integrative RDs. Our knowledge and clinical expertise will expand and flourish in interdisciplinary (multidisciplinary) team-based care approaches into practice settings.

I know all of us are ready and excited to be at this point in our continuum. But having served as an Affiliate Delegate, I know I will not have peace if you do not share your thoughts, words, and ideas about future practice and ADA with me and with ADA. I would love to meet you electronically or face to face, so reach out to me by emailing me at amkis@verizon.net. If you are able to come to Boston this fall, join us for our pre-FNCE symposium, CPE breakfast meeting, and networking events, since they will not only add to your practice investment portfolio, but also will help you meet like minded individuals. Plus it will be fun to put a face to a name.

Thank you to the following student volunteers who assisted with the DIFM booth and display at the Integrative Health Symposium in New York City in February, 2010.

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Other Important Points to Consider

a. The value of the codes is determined based on the following criteria:

b. Pre-service work: review medical records, lab work, obtain vitals, room set up.

c. Intra-service work: history and presenting problem, review of systems, treatment options, distribution of materials, arrange follow up and/or referral as needed.

c. Post-service work: documentation and communication with referring physician and care coordinators; short term communication with patient as needed.

Some RDs may find it beneficial to hire a biller to handle claims for nutrition services. Billers usually get paid anywhere from 4-7% of the RDs payments.

The program concluded with a panel: Rita Batheja, MS RD, CDN; Dr. White; and Nichola Davis, MD MS addressing the audience’s questions regarding MNT insurance reimbursement.

Additional coding and coverage resources can be reviewed from ADA’s web page at www.eatright.org/coverage; Medicare resources at www.eatright.org/mnt.

Erica Kasuli Hart is 2009-2010 Student Membership Representative to DIFM.

Contact Erica at egk209@nyu.edu

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Spring 2010 Volume 12, Issue 4
www.integrativeRD.org
**Chair’s Corner:**
**Kathie Swift, MS, RD, LDN**

**Spring Forward…and Fear Not to Sow**

What a delightful surprise when the first birds of spring return and their cheerful songs wake us to the dawn of a new morning. We welcome spring, nature’s season of light, growth, and the greening of our earth as we spring forward with hope and energy to the promises of a new season.

Years ago, I had the opportunity to meet Paul Keene, one of our country’s cherished organic farmers who founded Walnut Acres. Paul shared his book of essays on country living and natural farming with me, entitled Fear Not to Sow Because of the Birds, a title he adopted as his farm’s motto from an inscription found on an old tombstone in a country churchyard. The secrets of the soil motivated Paul to share his wise insights and reflections on the seasons and our intimate bonds with nature. Paul explores the seasons and notes that “spring performs a great alteration in the landscape—colors change en masse, the soil gives up its secrets, the wind rises, water floods, flowers burst forth, birds mate, and lands are born. The purpose in all life suddenly appears to be beauty.”

The whisper of spring may affect each of us in a unique way. It may inspire you to clean house and let go of a stale project and start afresh with renewed inspiration to tackle what needs to be done and has lied dormant in winter slumber. It may be time for a spring tune-up or embarking on a personal self-care program. Spring may invigorate you to expand your integrative and functional medicine skills or commit to serving as a volunteer for a practice group.

For me, spring is the natural unfolding of my season as your DIFM DPG Chair. I hope that we, your leadership team, have successfully tilled the soil for DIFM’s future growth and planted new seedlings for a rich harvest in the years to come. I want to extend my sincere gratitude to you, the members, to Diane Juskelis, our DIFM Director DPG Relations, to Amy Jarck, our Executive Assistant, and to each and every DIFM Executive Committee member, all of whom have dedicated their time and energy to realize DIFM’s mission, vision, and strategic initiatives.

In closing, I leave you with the words of Leo Rosten: “I think the purpose of life is to be useful, to be responsible, to be compassionate. It is above all, to matter, to count, to stand for something, to have made some difference that you lived at all.”

I encourage you to fear not to sow, as our profession needs our united passion to spring forward for the greater good and health of our nation.

Cheers,
Kathie
Welcome to Spring. First, I must apologize for the tardiness of this issue. I hope everyone will find the topics and the quality of the information have made it worth the wait.

There are so many things I want to do, but I am too busy to do them - do you ever feel that way? The multitude of opportunities to expand our knowledge about integrative and functional medicine is becoming endless, or so it seems. The books to read, the seminars to attend, and the networking that expands our horizons all take time and planning. And with an already busy schedule and work, where do we find the time?

This is where your DIFM membership will prove most valuable. The DIFM member survey provided us with the information that the Executive Committee is using to plan for the coming year. The members have spoken and we ARE listening. We may not be able to do everything at once, but we will be looking at the top priorities. Two of the priorities that were noted were the desire for a better understanding of member benefits. We send out eblasts on a regular basis and offer the newsletters online, but questions continue to arise regarding how to access the many benefits you are eligible to receive as a DIFM member. So, this summer we will be sending out a mid-summer hard copy update with valuable information about YOUR member benefits and DIFM FNCE activities. Keep your eye on your mailbox for this all important issue. It will also be available on line for future reference.

A change in the online newsletter format is here. Many of you want to print individual articles instead of the entire newsletter. As you may have noticed this option is now available with this issue.

As always, I am open to suggestions for newsletter article topics of interest to our members and authors for these articles. Please feel free to email me at peaknut@cascadeaccess.com or give me a call at 702-346-7968 with any offers of articles or suggestions for improving the newsletter.

Congratulations and Welcome 2010-2011 New DIFM Leaders

The following members were elected to fill the terms indicated for the 2010-2011 term.

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Nominating Committee Members
Marlisa Brown MS RD CDE CDN
Susan Drake MS RD

Keith Randolph, PhD, Technology Strategist, Nutrilite Health Institute presenting the America’s Phytonutrient Report to the DIFM Executive Committee at the Spring Leadership meeting on 4/21/2010

The views expressed in this newsletter are those of the authors and do not necessarily reflect the policies and/or official positions of the American Dietetic Association.

We invite you to submit articles, news and comments. Contact us for author guidelines.

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For international orders for individuals ineligible for ADA membership, please add $5 shipping and handling for the printed issue available in the fall. Make checks payable to DIFM DPG#18 and mail to DIFM DPG Dietitians in Integrative and Functional Medicine, PO Box 3624, Pittsfield, MA 01202. ISSN 1524-5209
How Our Food Communicates With Us: what are we telling our bodies?

Laura Palazzolo, MS

As a Dietitian in Integrative and Functional Medicine (DIFM) Student Stipend Award Recipient, I attended the Integrative Healthcare Symposium in New York City. The presentation by Robert Rountree, MD about antioxidants intrigued me since antioxidants are discussed everywhere from scientific research to food packaging on the supermarket shelf. The promise of antioxidants as a possible new medical therapy has prompted research studying single chemically-produced antioxidants, such as vitamin E, vitamin C, selenium, and beta-carotene. Unfortunately, much of the results in relation to disease prevention or treatment have been disappointing. Though some studies show benefits, most show insignificant or even harmful effects, resulting in negative media attention about the safety and efficacy of these compounds. In contrast to the studies of single antioxidants, epidemiological studies cite low incidence of disease in people who consume higher amounts of fruits and vegetables. What is it then, that is protective about eating these foods? This question was the focus of Dr. Roundtree’s lecture. He suggested that compounds in plant foods exert genomic effects and only contribute a very small antioxidant effect.

Many of the phytochemicals in plants, called phytoalexins, are produced when the plant is stressed. According to Dr. Roundtree, they are a toxic defense mechanism produced in order to deter other organisms from consuming them. They do appear to be toxic in large amounts even in human cells, but humans have adapted to them and are able to consume these compounds without negative consequences, but only in the small amounts found in the foods we eat. We can benefit from these phytochemicals, which appear to have become a communication tool that links the human body to the natural world. Our bodies interpret these molecules in the exact way they were meant to be interpreted: as stress signals. As a result of the interaction with these chemicals, our bodies become primed to deal with stress. The indirect antioxidant effect of phytochemicals involves up-regulating genes in endogenous antioxidant enzymes systems, such as glutathione peroxidase and superoxide dismutase, as well as Phase II detoxification enzymes and other protective proteins. These systems preserve cell integrity, making the body less susceptible to chronic disease. The ability of phytochemicals to induce this effect is referred to as the adaptive stress response. This response enables the body to respond more quickly to cellular threats. Strangely enough, one of the proposed ways in which this mechanism is achieved is through a phytochemical’s pro-oxidant nature. The response to reactive oxygen species is dose-dependent, with small amounts inducing the adaptive response and higher amounts causing damage to the cell. The profound affect of substances in small amounts is referred to as “hormesis.”

Phytochemicals have the ability to influence the genome by binding directly to DNA or transcription factors, which in turn influences DNA transcription. Dr. Roundtree emphasized that many of the sites to which phytochemicals bind also influence the inflammatory process. This process is very complex and is not fully elucidated but can be linked to two genes: nuclear factor kappa beta (NF-κB) and nuclear factor erythroid-2 related factor 2 (Nrf-2). NF-κB can be thought of as the central regulator of the inflammatory process. It orchestrates the production of inflammatory compounds, including cytokines and prostaglandins. This gene is often over-expressed during the chronic inflammatory response. Nrf-2, on the other hand, decreases inflammation through the up-regulation of antioxidant and detoxification systems. One way in which phytochemicals exert their effects is through down-regulation of NF-κB and up-regulation of Nrf-2, effectively producing a protective effect.

Though acute inflammation is an essential defense mechanism, chronic low-level inflammation has come to the forefront as a contributor in many diseases processes, including diabetes, cardiovascular disease, and possibly Alzheimer’s disease. Polyphenols are one subclass of phytochemicals found to have indirect antioxidant effects. Polyphenols can be found in a variety of whole foods such as berries, tea, coffee, chocolate, herbs, and spices. Sulfur-containing glucosinolates are found in cruciferous vegetables such as cabbage, broccoli, Brussel sprouts, and bok choy. These compounds have anti-inflammatory, detoxification, neuroprotective, and anti-cancer effects through modulation of gene expression. Broccoli sprouts are commonly used in research because of their high levels of sulforaphane (a type of glucosinolate). Green tea has also received considerable attention for its anti-cancer, cardioprotective, neuroprotective, and detoxification properties. Most commonly studied is the polyphenol epigallocatechin-3-gallate (EGCG), which works by manipulating genomic expression. Turmeric has become recognized as a potent anti-inflammatory spice. Its active component, curcumin, has been studied for its role in cancer prevention and treatment, arthritis, Alzheimer’s disease, Parkinson’s disease, Multiple Sclerosis, detoxification, and cardioprotection. Nutraceutical companies have designed supplements using curcumin as the active ingredient, which they market as having anti-inflammatory properties.

Dr. Roundtree presented the unifying concept that even though each phytochemical is different, many of them...
produce similar responses in the body. The above mentioned phytochemicals are just a few of the compounds that are being studied and there are many more yet to be discovered.

Each system of the body benefits from protection from reactive oxygen species, but optimizing the antioxidant system is especially important to brain health because of the unique composition of brain tissue. The brain is composed largely of unsaturated lipids, leaving brain tissue vulnerable to oxidative damage that can lead to DNA mutation and even neuronal death. Another presenter, David Perlmutter MD, FACN, ABIMH, explained that the adaptive stress response also occurs in the brain in response to lifestyle factors such as exercise, mental challenges, and appropriate calorlc restriction. A reduction in calories simply to maintain weight may produce similar responses in the body. The authors proposed that the mechanisms underlying the increase in memory scores may be due to greater synaptic plasticity, improved insulin sensitivity, and a reduction in inflammation. Dietary factors can also influence BDNF expression. According to Dr. Perlmutter, docosahexaenoic acid (DHA) is an inducer of BDNF expression and subsequently neurogenesis. Its intake is inversely correlated with risk of dementia and general cognitive impairment common in some aging individuals. One study showed a 47% risk reduction for Alzheimer’s disease in people who consumed the most phosphatidylcholine DHA. Besides low DHA blood levels, additional data demonstrated that being overweight, especially when the weight is centrally located, is a risk factor for the development of cognitive disorders such as Parkinson’s and Alzheimer’s diseases. Much is still being learned about reducing risk and optimizing brain function, making that particular prediction not so inevitable.

**Take Home Message**

The emerging field of nutrigenomics is still in its infancy, but holds much promise in understanding the core medical problems that plague modern society. As we learn more about gene interactions with our food and environment, we can begin to understand disease on a more comprehensive level, enhancing the care given to patients. These concepts clearly demonstrate the value of food beyond what is thought of as traditional nutrition. It is important to explore these mechanisms to better establish protocols to target individual problems.

Laura Palazzolo, MS

Laura Palazzolo holds a Master’s Degree from Bastyr University and is currently a Dietetic Intern in NYC. Laura is the student stipend award winner for 2010 from DIFM. Contact Laura at palazzolo.laura@gmail.com or (914) 262-7879

**References**

“SNIP” Update - The Genetics of Fatty Acid Metabolism

Colleen Fogarty Draper  MS, RD, LDN
DIFM Nutritional Genomics
Advisor 2010 - 2012

Picture this: you are sitting across from a client in your office reviewing a genetic test result on fatty acid metabolism. Her historical dietary fat intake, coupled with omega-3 fatty acid supplementation seemed sufficient; however, her serum fatty acid profile seemed to indicate sub-optimal omega-3 intake. As a result, you ordered a genetic test to give you some clues about how her unique genetic profile may have influenced her capacity to metabolize fats. You and your client learn she has a risk of insufficient enzyme activity that can lead to a decrease in the utilization of certain fats from her diet. With this information you are able to give your client a root cause understanding of her genetic differences, how they may influence her unique biochemistry, and the rationale for her need to increase her intake of certain fats including omega-3s, beyond the usual amount to optimize her health. Congratulations! You have entered the new era of nutritional genomics.

Unfortunately, that genetic test does not exist, yet. The good news is the published research literature continues to unveil new evidence that will eventually be sufficient to substantiate the development of this kind of test. Until then, the role of the registered dietitian (RD) is to be knowledgeable about the mounting evidence and the principles and concepts which are woven into the field to be prepared for its future potential. To better understand this, the following describes the enzymes and gene polymorphisms that will be a component of a future genetic test of fatty acid metabolism.

The delta-5 desaturase (D5D) and delta-6 desaturase (D6D) enzymes play a significant role in the desaturation and elongation of omega-3 and omega-6 fatty acids by the body. They facilitate the conversion of linoleic acid into arachidonic acid (AA) and alpha linolenic acid (ALA) into eicosapentaenoic acid (EPA). These enzymes are expressed in the liver, brain, heart, and lungs. The fatty acid desaturase 1 and 2 (FADS1 and FADS2) genes encode the D5D and D6D enzymes, respectively; and their polymorphisms are associated with differences in fatty acid composition in phospholipid membranes and atopic disease development, particularly allergic rhinitis and atopic eczema. They are also associated with increased risk of atherosclerotic vascular disease and attention-deficit/hyperactivity disorder. The current hypothesis is that these polymorphisms are associated with lower enzyme activity, decreasing the body’s capacity for cellular metabolism and incorporation of essential fats into cellular membranes, and increasing the rate of fatty acid oxidation, to account for the excess, un-metabolized fats that accumulate. These variants may impact the amount of dietary polyunsaturated fatty acids (PUFAs) required to optimize the fatty acid composition in cellular membranes and minimize the chronic disease that can ensue.

Lattka et al., recently conducted a review of the research on the FADS1 and FADS2 gene cluster and concluded additional research is necessary on the mechanisms and effects of polymorphisms in these genes with a particularly important emphasis on the need for gene-X diet interaction studies to further understand their impact on PUFA requirements. This need for further gene-X diet interaction research on these polymorphisms presents an opportunity for the registered dietitian and clinical researcher to take a lead in the field of nutrigenetics.

Keep an eye on the research on FADS1 and FADS2 gene polymorphisms, their influence on disease risk, and PUFA requirements in the literature. Hopefully, more RDs will take the lead on conducting and publishing the kind of research necessary to utilize this knowledge to its full potential. Also, consider this research as evidence of how some individuals experience a greater improvement in their health when following what appears to be the optimal diet, while with others the lack of improvement in health outcomes may not simply be a compliance issue but an issue of genetic predisposition and biochemistry.

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