

# COLOR OF FOOD

Whole Food Insights



**WholisticMatters™**

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# Phytonutrients and Color

## WHAT ARE PHYTONUTRIENTS?

Phytonutrients are natural, plant-derived compounds that support life and offer protection – innately in plants but for plant-eating humans as well. For example, a 2014 meta-analysis found that the more vegetables eaten, the lower the risk of all-cause mortality.<sup>1</sup>

## WHY CARE ABOUT PHYTONUTRIENTS?

The human body needs phytonutrients in a different way than it needs nutrients like protein, vitamins, and minerals. Phytonutrients are uniquely able to satisfy free radicals circulating in the body looking for electrons. By providing electrons, phytonutrients prevent free radicals from taking electrons from proteins or other nutrients, a “theft” that leads to oxidative stress.

## HOW ARE PHYTONUTRIENTS AND FOOD COLOR CONNECTED?

Different plant colors are associated with the beneficial protection of phytonutrients, and encouraging diversity of plant-based colors in a given meal can be a great method for improving diet choices.



<sup>1</sup> Wang, X et al. BMJ 2014; 349:g4490

## WHAT HEALTH BENEFITS DO PHYTONUTRIENTS AND COLOR PROVIDE?

The colors of food have long been associated with improving health conditions. Green foods help improve diabetes and immunity, protect against cancer, and enhance gene expression. Red foods align with the cardiovascular system by protecting the heart and blood vessels. Red is also responsible for building muscle mass and skin protection. White foods, even though not as 'colorful', still yield a tremendous amount of immune system support by decreasing allergies, reducing inflammation, helping to maintain weight, and lowering cholesterol. Purple improves memory, protects against cancer, improves the gut, and keeps a healthy heart. Yellow or orange foods additionally protect the gut, protect our eyes and skin, fight cancer, and improve immunity.<sup>2</sup>

<sup>2</sup> NC State University Plants for Human Health Institute. Color Me Healthy.



<b>MAJOR PHYTONUTRIENTS</b>	<b>POTENTIAL HEALTH ASSOCIATIONS</b>
Flavones	Additive nutraceutical support via anti-inflammatory response and anti-microbial benefits; potential support of healthy metabolic function
Lignans	Soluble and insoluble fiber help support the immune system; often an antioxidant role and help with balancing metabolic and hormonal systems
Avenanthramides	Bitter characteristics that can influence select cell transporters in the gut modulating glucose response and appearance
Quercetin	Reduction in inflammatory responses for a wide range of health issues
Catechins	Maintain metabolic processes; improved wellness associated with longevity and cardiovascular health
Ellagic Acid	Can play a role in antioxidant and anti-mutagenic response considered health protective
Stilbenes	Anti-inflammatory response with benefits supporting longevity
Curcumin	Antioxidant and immune modulator affecting initiation of inflammation response; associated with digestive health, cardiovascular and metabolic systems functional repair
Myrosinase	Helps convert select compounds to active healthy forms of metabolites
Phenolic Acids	Antioxidant activity promoting systems important to vascular health
Glucosinolates	Shown to support cardiovascular system and detoxification processes with antioxidant activity
Carotenoids	Antioxidant process support; reduced risk of macular degeneration
Chlorophyll	Anti-inflammatory-like responses, antioxidant, and anti-bacterial activity

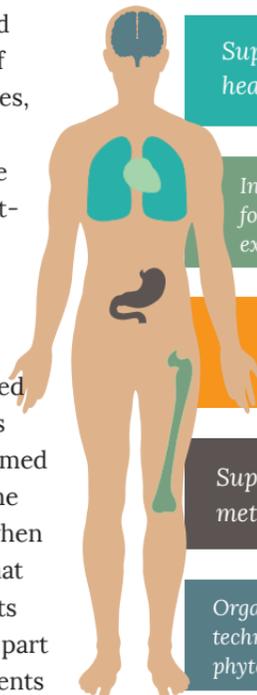
## WHAT IS GAE? A WAY TO CAPTURE TOTAL PHENOLICS

Scientists can quantify “total phenolics” between different plants by measuring Gallic Acid Equivalence (GAE), which can be used to compare the amounts of phytonutrients and the total phenolic compound content of different foods. Phenolics are a group of phytonutrients that include phenolic acids, stilbenes, flavonoids, and condensed tannins. Phenolics are universally present in plant-derived foods and have been long-linked to the health properties of a plant-based diet.

## WHAT IS THE WHOLE FOOD ADVANTAGE?

The idea of the “whole food advantage” describes the concept that bioactive phytonutrients consumed from whole foods produce stronger health benefits than when the phytonutrient is isolated and consumed alone.<sup>3,4</sup> This idea also includes the notion that some phytonutrients in foods have a synergistic effect when eaten together. Plants have a predominant color that we see, but they also have additional phytonutrients associated with colors seen in other plants. This is part of the whole food advantage – multiple phytonutrients associated with multiple health benefits in just one plant.

## The Whole Food Advantage



*Supports balance immune modulation for healthy inflammation response.*

*Increased intake of vegetables and fruits in whole food nutrition influences individual epigenetic expression of our health potential.*

*Benefits of nutrients food matrix enhances bioavailability by up to 60%.*

*Supports the gut microflora and a healthy metabolic fingerprint of the gut.*

*Organic and adaptive regenerative farming techniques delivers nutrient dense source of key phytonutrients and helps balance healthy lifestyles.*

<sup>3</sup> Lila, MA and Raskin, I. J Food Sci. 2005; 70(1):R20-27.

<sup>4</sup> Lila, MA. Ann NY Acad Sci. 2007. 1114:372-380.

# Organic and Sustainable Farming

## HOW DOES ORGANIC AND SUSTAINABLE FARMING PLAY A ROLE?

Organic and sustainable farms start with a foundation of healthy soil. Healthy soil contains rich biodiversity such as bacteria, fungi, minerals, and other organic matter. This biodiversity promotes water retention, erosion resistance, and yields more nutrient-dense crops.



# Specialty Crops

## WHAT ARE SPECIALTY CROPS?

The U.S. Department of Agriculture's (USDA) Specialty Crop Block Grant Program (SCBGP) defines “specialty crops” as fruits, vegetables, tree nuts, dried fruits, horticulture, and nursery crops. However, the USDA differentiates specialty crops from federally supported commodity crops like grains, corn, soybeans, cotton, rice, and barley.<sup>5</sup>

Less than one percent of the 2014 Farm Bill funded allocations (about \$956 billion over 10 years) went to supporting farms growing specialty crops, while five percent of the Bill went to supporting commodity programs. This funding largely aimed to protect commodity crop farms from changing prices in products like corn, wheat, soybean, and dairy.<sup>6</sup>

<sup>5</sup> “What is a Specialty Crop?” United States Department of Agriculture Agricultural Marketing Service, <https://www.ams.usda.gov/services/grants/scbgp/specialty-crop>.

<sup>6</sup> “The \$956 billion farm bill, in one graph.” Brad Plumer, The Washington Post, January 29, 2014. [https://www.washingtonpost.com/news/woonk/wp/2014/01/28/the-950-billion-farm-bill-in-one-chart/?utm\\_term=.ddea4f5514a7](https://www.washingtonpost.com/news/woonk/wp/2014/01/28/the-950-billion-farm-bill-in-one-chart/?utm_term=.ddea4f5514a7).

<sup>7</sup> “Agricultural Act of 2014: Highlights and Implications.” USDA ERS - Food Environment Atlas, United States Department of Agriculture Economic Research Service, March 19, 2018, [www.ers.usda.gov/agricultural-act-of-2014-highlights-and-implications/](http://www.ers.usda.gov/agricultural-act-of-2014-highlights-and-implications/).

# Farm Bill

## WHAT IS THE FARM BILL?

The Agriculture Improvement Act of 2018 – AKA the “Farm Bill” – was signed into law on December 20, 2018. This Act is part of the legal framework for agricultural policy that is reconsidered every five years. Considerations include farming, nutrition, conservation, rural development, research, and energy.<sup>7</sup>



# Phytonutrient Gap



**10** servings of fruits and vegetables per day can add years to your life.



**3-12%**

Only 3-12% of Americans meet fruit and vegetable intake recommendations.<sup>8,9</sup>



8 out of 10 Americans have some sort of gap in phytonutrient intake.<sup>8,9</sup>



The biggest gap is the **blue/purple** fruit and vegetable group, with only **12%** of people meeting the median intake of those phytonutrients.



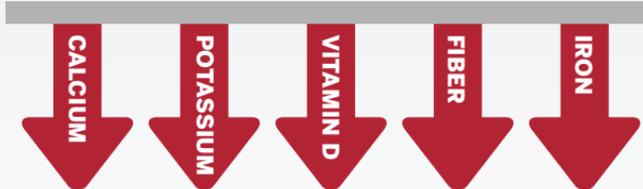
While the number of Americans consuming **green** fruits and vegetables is slightly higher, the percentage is still under **30%** of the recommended intake.<sup>8,9</sup>

<sup>8</sup> National Center for Health Statistics (NCHS). 2008. National Health and Nutrition Examination Survey Data 2005-2006. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

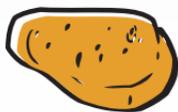
<sup>9</sup> National Center for Health Statistics (NCHS). 2007. National Health and Nutrition Examination Survey Data 2003-2004. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

# Nutrient Gap

## 5 SHORTFALL NUTRIENTS



These 5 nutrients fall short in Americans and are of public health concern.<sup>10,11</sup>



Potatoes account for more than **25%** of all vegetable consumption.<sup>12,13</sup>



More than **80%** do not eat enough green vegetables.<sup>12,13</sup>



More than **90%** do not eat enough orange and red vegetables.<sup>12,13</sup>

<sup>10</sup>United States Department of Health and Human Services and United States Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 8th ed. U.S. Government Printing Office; Washington, DC, USA: 2015.



Daily vegetable intake should be **2.5 cups**.<sup>12,13</sup>



Daily fruit intake should be **2 cups**.<sup>12,13</sup>



More than 90% of Americans do not meet this minimum.<sup>12,13</sup>

<sup>11</sup>Papanikolaou, Y and Fulgoni, Victor L. *Nutrients* 2018; 10(5):534.

<sup>12</sup> Dietary Guidelines Advisory Committee. 2015. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC.

<sup>13</sup> U.S. Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Food Surveys Research Group (Beltsville, MD) and U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics (Hyattsville, MD). *What We Eat in America, NHANES 2007–2010*.

# Green



## Foods

Alfalfa

Barley Grass

Broccoli

Brussel Sprouts

Cabbage

Chard

Collard Greens

Kale

Kalette

Lettuce

Peas

Turnip Greens

Spinach

## Phytonutrients:

**Chlorophyll**

**Lutein & Zeaxanthin**

**Isoflavones**

**Isothiocyanates**

**Phytocannabinoids**

**Myrosinase**



# Black



## Foods

Alfalfa

Barley

Black Beans

Black Eyed Peas

Chickpeas

Cinnamon

Cloves

Hemp

Oats

Spanish Black

Radish

Sorghum

## Phytonutrients:

**Tannins**

**Saponins**

**Phytocannabinoids**



# White



## Foods

Apples	Garlic	Radish
Barley	Mushrooms	Tofu
Beetroot	Oat	
Buckwheat Seed	Onion	

## Phytonutrients:

**Phenolic Acids**

**Flavanols**

**Allicin**

**Compounds**



# Yellow/Orange



## Foods

Carrots	Pineapple
Citrus Fruit	Sweet Potato
Lemons	Tumeric
Oranges	Winter Squash
Peppers	Yellow Squash

## Phytonutrients:

**Beta Carotene**

**Beta Cryptoxanthin**

**Betaxanthins**

**Flavones**

**Curcumin**

**Bromelain**

**Flavanones**



# Purple



## Foods

Acai	Cranberries	Red Cabbage
Aronia Berry	Currants	Red Wine
Blueberries	Eggplant	Whole Buckwheat
Cherries	Elderberry	Plant

## Phytonutrients:

**Anthocyanidins**

**Procyanidins**

**Stilbenes**

**Resveratrol**



# Red



## Foods

Beets	Pink Grapefruit	Swiss Chard
Cherries	Pomegranates	Tomatoes
Chilies	Raspberries	Watermelon
Peppers	Strawberries	

## Phytonutrients:

**Lycopene**

**Nitrate**

**Betacyanins**

**Ellagic Acid**

**Capsaicin**



# Brown



## Foods

Apricot

Beans

Cocoa

Figs

Flaxseed

Green Banana

Lentils

Mushrooms

Nuts

Oats

Potato

Rye

Tea

## Phytonutrients:

**Lignans**

**Beta Glucans**

**Theobromine**

**Resistant Starch**

**Other Fibers**



## About the Series

### COLOR OF FOOD SERIES

This overview booklet is just one part of a multi-faceted series on the Color of Food. Understanding the significance of phytonutrient and nutrient gaps, the GAE connection, the whole food advantage, and the role of specialty crops and the Farm Bill provides the tools needed to make conscious decisions about our health and the health of the people around us.

Please check out other items in the Color of Food Series:

- *Featured Crops: Nutrient and Phytonutrient Profiles*
- *Adopting Nutritional Practices*
- *Fruits and Vegetables*



*We are dedicated to advancing the latest insights and information available in nutrition therapy and clinical nutrition and to presenting only the most balanced, credible, and reliable clinical nutrition and science available.*

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