

# FOOD INSIGHT

YOUR NUTRITION AND FOOD SAFETY RESOURCE



- About
  - News Room
  - Hot Topics
  - Blog
  - Newsletter
  - FoodInsightTV
  - Resources**
  - For Professionals
  - For Consumers
  - Store
- All Foundation Resources   Survey Research   International Resources

## Functional Foods Fact Sheet: Antioxidants

October 15, 2009



### Background

Plant foods, such as fruits, vegetables, and whole grains contain many components that are beneficial to human health. Research supports that some of these foods, as part of an overall healthful diet, have the potential to delay the onset of many age-related diseases. These observations have led to continuing research aimed at identifying specific bioactive components in foods, such as antioxidants, which may be responsible for improving and maintaining health.

Antioxidants are present in foods as vitamins, minerals, carotenoids, and polyphenols, among others. Many antioxidants are often identified in food by their distinctive colors—the deep red of cherries and of tomatoes; the orange of carrots; the yellow of corn, mangos, and saffron; and the blue-purple of blueberries, blackberries, and grapes. The most well-known components of food with antioxidant activities are vitamins A, C, and E;  $\beta$ -carotene; the mineral selenium; and more recently, the compound lycopene.

### Health Effects

The research continues to grow regarding the knowledge of antioxidants as healthful components of food. Oxidation, or the loss of an electron, can sometimes produce reactive substances known as free radicals that can cause oxidative stress or damage to the cells. Antioxidants, by their very nature, are capable of stabilizing free radicals before they can react and cause harm, in much the same way that a buffer stabilizes an acid to maintain a normal pH. Because oxidation is a naturally occurring process within the body, a balance with antioxidants must exist to maintain health.

### Research

While the body has its defenses against oxidative stress, these defenses are thought to become less effective with aging as oxidative stress becomes greater.<sup>1</sup> Research suggests there is involvement of the resulting free radicals in a number of degenerative diseases

## Blog



[See All »](#)

### Burgers and a Salad: Avoiding Risky Food Safety Mistakes!

By: Dr. Christine Bruhn, University of California, Davis Date: 12/16/11 [more »](#)

### Hunger in America: Farm Journal Forum Addresses the Realities

[more »](#)

### Are You “Addicted” to Food? Unlikely

By: Eric Mittenthal Date: 12/12/11 A couple of recent stories in the media brought a... [more »](#)

## Newsletter

[See All »](#)

- **Food Insight Interviews Dr. Bill Harris on Omega-3 and Omega-6 Fatty Acids** | 12/16/2011  
Food Insight Interviews Dr. Bill Harris on Omega-3 and Omega-6 Fatty Acids. [more »](#)
- **Ageing: Changing Nutrition Needs** | 12/16/2011  
Food Insight interviewed Dr. Nancy Wellman, the IFIC Foundation Chair Emeritus, on the subject of th [more »](#)
- **Food Safety: Scoops and Predictions for 2012** | 12/16/2011  
The art of predicting a future event is tricky, usually unscientific and in many respects unreliable [more »](#)

associated with aging, such as cancer, cardiovascular disease, cognitive impairment, Alzheimer's disease, immune dysfunction, cataracts, and macular degeneration.<sup>2-9</sup> Certain conditions, such as chronic diseases and aging, can tip the balance in favor of free radical formation, which can contribute to ill effects on health.

Consumption of antioxidants is thought to provide protection against oxidative damage and contribute positive health benefits. For example, the carotenoids lutein and zeaxanthin engage in antioxidant activities that have been shown to increase macular pigment density in the eye. Whether this will prevent or reverse the progression of macular degeneration remains to be determined.<sup>10</sup> An increasing body of evidence suggests beneficial effects of the antioxidants present in grapes, cocoa, blueberries, and teas on cardiovascular health, Alzheimer's disease, and even reduction of the risk of some cancers.<sup>11-15</sup>

Until recently, it appeared that antioxidants were almost a panacea for continued good health. It is only as more research has probed the mechanisms of antioxidant action that a far more complex story continues to be unraveled. Although recent research has attempted to establish a causal link between indicators of oxidative stress and chronic disease, none has yet been validated. A new area of research, led by the study of the human genome, suggests that the interplay of human genetics and diet may play a role in the development of chronic diseases. This science, while still in its infancy, seeks to provide an understanding of how common dietary nutrients such as antioxidants can affect health through gene-nutrient interactions.<sup>16</sup>

There still remains a lack of direct experimental evidence from randomized trials that antioxidants are beneficial to health, which has led to different recommendations for different populations. For example, the use of supplemental  $\beta$ -carotene has been identified as a contributing factor to increased risk of lung cancer in smokers.<sup>17</sup> However, because the risk has not been indicated in non-smokers, these studies suggest that a precaution regarding the use of supplemental  $\beta$ -carotene is not warranted for non-smokers. If supplementation is desired, the use of a daily multivitamin-mineral supplement containing antioxidants has been recommended for the general public as the best advice at this time.<sup>18</sup>

A recent review of current literature suggests that fruits and vegetables in combination have synergistic effects on antioxidant activities leading to greater reduction in risk of chronic disease, specifically for cancer and heart disease.<sup>19</sup> For some time, health organizations have recognized the beneficial roles fruits and vegetables play in the reduced risk of disease and developed communication programs to encourage consumers to eat more antioxidant-rich fruits and vegetables. The American Heart Association recommends healthy adults "Eat a variety of fruits and vegetables. Choose 5 or more servings per day."<sup>20</sup> The American Cancer Society recommends to "Eat 5 or more servings of fruits and vegetables each day."<sup>21</sup> The World Cancer Research Fund and the American Institute for Cancer Research 1997 Report *Food, Nutrition and the Prevention of Cancer: A Global Perspective* states, "Evidence of dietary protection against cancer is strongest and most consistent for diets high in vegetables and fruits."<sup>22</sup> The potential for antioxidant-rich fruits and vegetables to help improve the health of Americans led the National Cancer Institute (NCI) to start the, "5-A-Day for Better Health" campaign to promote consumption of these foods.<sup>23</sup>

Given the high degree of scientific consensus about consumption of a diet that is high in fruits and vegetables—particularly those which contain dietary fiber and vitamins A and C; the Food and Drug Administration (FDA) released a health claim for fruits and vegetables in relation to cancer. Food packages that meet FDA criteria may now carry the claim "Diets low in fat and high in fruits and vegetables may reduce the risk of some cancers."<sup>24</sup> In addition the FDA, in cooperation with NCI, released a dietary guidance message for consumers, "Diets rich in fruits and vegetables may reduce the risk of some types of cancer and other chronic diseases."<sup>25</sup> Most recently the *Dietary Guidelines for Americans* stated, "Increased intakes of fruits, vegetables, whole grains and fat-free or low-fat milk and milk products are likely to have important health benefits for most Americans."<sup>26</sup>

Antioxidant research continues to grow and emerge as new beneficial components of food are discovered. Reinforced by current



**SIGN UP NOW!**  
Stay informed with the FoodInsight Online Newsletter:

- Monthly Updates
- Articles & News
- Nutrition & Food Safety

[Sign me up now »](#)

## Look What Others Are Reading

You do not have any favorite article

### Most Recent Most Popular Most Shared

- [Food Insight Interviews Dr. Bill Harris on Omega-3 and Omega-6 Fatty Acids](#)
- [Aging: Changing Nutrition Needs](#)
- [Food Safety: Scoops and Predictions for 2012](#)
- [Moving Protein from MyPlate to Your Plate](#)
- [Cornell's Dr. Robert Gravani Elected Chair of the IFIC Foundation Board of Trustees](#)

research, the message remains that antioxidants obtained from food sources, including fruits, vegetables and whole grains, are potentially active in disease risk reduction and can be beneficial to human health.<sup>27</sup>

Examples of Functional Components*		
Class/Components	Source*	Potential Benefit
<b>Carotenoids</b>		
Beta-carotene	carrots, various fruits	neutralizes free radicals which may damage cells; bolsters cellular antioxidant defenses
Lutein, Zeaxanthin	kale, collards, spinach, corn, eggs, citrus	may contribute to maintenance of healthy vision
Lycopene	tomatoes and processed tomato products	may contribute to maintenance of prostate health
<b>Flavonoids</b>		
Anthocyanidins	berries, cherries, red grapes	bolster cellular antioxidant defenses; may contribute to maintenance of brain function
Flavanols—Catechins, Epicatechins, Procyanidins	tea, cocoa, chocolate, apples, grapes	may contribute to maintenance of heart health
Flavanones	citrus foods	neutralize free radicals which may damage cells; bolster cellular antioxidant defenses
Flavonols	onions, apples, tea, broccoli	neutralize free radicals which may damage cells; bolster cellular antioxidant defenses

- [Functional Foods Fact Sheet: Antioxidants](#)
- [Everything You Need to Know About Sucralose](#)
- [Questions and Answers About Energy Drinks and Health](#)
- [2010 Food & Health Survey: Consumer Attitudes Toward Food Safety, Nutrition & Health](#)
- [2009 Food & Health Survey: Consumer Attitudes toward Food, Nutrition and Health](#)
- [Americans Falling Behind on Proper Food Safety Practices](#)
- [Protein: A Nutrient for All Ages](#)
- [Quick Tips to Be Sodium Savvy](#)
- [Food & Health--Health Benefits](#)
- [Food & Health--Food Safety](#)

## FoodInsight TV

[See All >](#)

### Foods for Health: Eating for Digestive Health

"Guyatitian" David Grotto offers tips on eating for digestive health.

Proanthocyanidins	cranberries, cocoa, apples, strawberries, grapes, wine, peanuts, cinnamon	may contribute to maintenance of urinary tract health and heart health
<b>Isothiocyanates</b>		
Sulforaphane	cauliflower, broccoli, Brussels sprouts, cabbage, kale, horseradish	may enhance detoxification of undesirable compounds and bolster cellular antioxidant defenses
<b>Phenols</b>		
Caffeic acid, Ferulic acid	apples, pears, citrus fruits, some vegetables	may bolster cellular antioxidant defenses; may contribute to maintenance of healthy vision and heart health
<b>Sulfides/Thiols</b>		
Diallyl sulfide, Allyl methyl trisulfide	garlic, onions, leeks, scallions	may enhance detoxification of undesirable compounds; may contribute to maintenance of heart health and healthy immune function
Dithiolthiones	cruciferous vegetables— broccoli, cabbage, bok choy, collards	contribute to maintenance of healthy immune function
<b>Whole Grains</b>		
Whole grains	cereal grains	may reduce risk of coronary heart disease and cancer; may contribute to reduced risk of diabetes
<p><i>Chart adapted from International Food Information Council Foundation: Media Guide on Food Safety and Nutrition: 2004-2006.</i></p> <p><i>*Not a representation of all sources</i></p>		

For more information on additional beneficial components of food, visit [Background on Functional Foods](#).

Examples of Antioxidant Vitamins and Minerals			
Vitamins	Daily Reference Intakes*	Antioxidant Activity	Sources
Vitamin A	300-900 µg/d	Protects cells from free radicals	Liver, dairy products, fish
Vitamin C	15-90 mg/d	Protects cells from free radicals	Bell peppers, citrus fruits
Vitamin E	6-15 mg/d	Protects cells from free radicals, helps with immune function and DNA repair	Oils, fortified cereals, sunflower seeds, mixed nuts
Selenium	20-55 µg/d	Helps prevent cellular damage from free radicals	Brazil nuts, meats, tuna, plant foods

*Chart adapted from Food and Nutrition Board Institute of Medicine DRI reports and National Institutes of Health Office of Dietary Supplements*

*\*DRI's provided are a range for Americans ages 2-70.*

For information on Daily Reference Intakes for specific populations click here: <http://www.iom.edu>

### The Bottom Line

Most research indicates that there are overall health benefits from antioxidant-rich foods consumed in the diet. The results of clinical trials with antioxidant supplements have yet to provide conclusive indication of health benefits. Current recommendations by the U.S. government and health organizations are to consume a varied diet with at least five servings of fruits and vegetables per day and 6-11 servings of grains per day, with at least three of those being whole grains.

### Other Resources:

- American Cancer Society [www.cancer.org](http://www.cancer.org)
- American Dietetic Association [www.eatright.org](http://www.eatright.org)
- American Heart Association [www.americanheart.org](http://www.americanheart.org)
- American Institute for Cancer Research [www.aicr.org](http://www.aicr.org)
- The Dietary Guidelines for Americans [www.healthierus.gov/dietaryguidelines](http://www.healthierus.gov/dietaryguidelines)
- Food and Drug Administration [www.fda.gov](http://www.fda.gov)
- Institute of Food Technologists [www.ift.org](http://www.ift.org)
- Institute of Medicine Food and Nutrition Board [www.iom.edu](http://www.iom.edu)
- National Cancer Institute [www.cancer.gov](http://www.cancer.gov)
- National Institutes of Health Office of Dietary Supplements [www.ods.od.nih.gov](http://www.ods.od.nih.gov)
- United States Department of Agriculture [www.usda.gov](http://www.usda.gov) and [www.mypyramid.gov](http://www.mypyramid.gov)

### References:

1. Knight, JA. The biochemistry of aging. *Adv Clin Chem*. 2000;35:1-62.
2. McCall MR, Frei B. Can antioxidant vitamins materially reduce oxidative damage in humans? *Free Radic Biol Med*.

1999;26;7/8:1034-53.

3. Halliwell B. Oxygen and nitrogen are pro-carcinogens. Damage to DNA by reactive oxygen, chlorine and nitrogen species: measurement, mechanism and effects of nutrition. *Mutat Res.* 1999;443:37-52.
4. Valko M, Izakovic M, Mazur M, Rhodes CJ, Telser J. Role of oxygen radicals in DNA damage and cancer incidence. *Mol Cell.* 2004;266:37-56.
5. Packer L, Weber SU, Rimbach G. Molecular aspects of  $\alpha$ -tocotrienol antioxidant action and cell signaling. *J Nutr.* 2001;131:369S-373S.
6. Aslan M, Ozben T. Reactive oxygen and nitrogen species in Alzheimer's disease. *Curr Alzheimer Res.* 2004;1:111-119.
7. Ryan-Harshman M, Aldoori W. The relevance of selenium to immunity, cancer, and infectious/inflammatory diseases. *Can J Diet Prac Res.* 2005;66:98-102.
8. Meyer CH, Sekundo W. Nutritional supplementation to prevent cataract formation. *Dev Ophthalmol.* 2005;38:103-119.
9. Harman D. Nutritional implications of the free-radical theory of aging. *J Am Coll Nutr.* 1982;1:27-34.
10. Burke JD, Curran-Celentano J, Wenzel AJ. Diet and serum carotenoid concentrations affect macular pigment optical density in adults 45 years and older. *J Nutr.* 2005;135:1208-1214.
11. Fassina G, Vene R, Morini M, Minghelli S, Benelli R, Noonan DM, Albibi A. Mechanisms of inhibition of tumor angiogenesis and vascular tumor growth by epigallocatechin-3-gallate. *Clin Cancer Res.* 2004;10:4865-73.
12. Rietveld A, Wiseman S. Antioxidant effects of tea: Evidence from human clinical trials. *J Nutr.* 2003;13:3285S-3292S.
13. Rezai-Zadeh K, Shytle D, Sun N, Mori T, Hou H, Jeanniton D, Ehrhart J, Townsend K, Zeng J, Morgan D, Hardy J, Town T, Tan J. Green tea epigallocatechin-3-gallate (EGCG) modulates amyloid precursor protein cleavage and reduces cerebral amyloidosis in Alzheimer transgenic mice. *J Neurosci.* 2005;25:8807-8814.
14. Lau FC, Shukit-Hale B, Joseph JA. The beneficial effects of fruit polyphenols on brain aging. *Neurobiol Aging.* 2005.
15. Wiesburger JH. Lifestyle, health and disease prevention: the underlying mechanisms. *Eur J Cancer Prev.* 2002;S2:1-7.
16. Kaput J, Ordovas JM, Ferguson L, Ommen BV, Rodriguez R, Allen L, Ames B, Dawson K, German B, Krauss R, Malj W, et. al. The case for strategic international alliances to harness nutritional genomics for public and personal health. *Br J Nutr.* 2005;94:623-632.
17. Goodman GE, Thornquist MD, Balmes J, Cullen MR, Meyskens FL Jr, Omenn GS, Valanis B, Williams JH Jr. The Beta-Carotene and Retinol Efficacy Trial: incidence of lung cancer and cardiovascular disease mortality during 6-year follow-up after stopping beta-carotene and retinol supplements. *J Natl Cancer Inst.* 2004;96:1743-1750.
18. Fairfield K, Fletcher R. Vitamins for Chronic Disease Prevention in Adults: Clinical Applications. *JAMA.* 2002; 287:3127-3129.
19. Liu RH, Potential Synergy of Phytochemicals in Cancer Prevention: Mechanism of Action. *J. Nutr.* 2004;134:3479S-3485S.
20. Krauss RM, Eckel RH, Howard B, Appel LJ, Daniels SR, Deckelbaum RJ, Erdman JW, Etherton PK, Goldberg IJ, Kotchen TA, Lichtenstein AH, Mitch WE, Mullis R, Robinson K, Wylie-Rosett J, St. Jeor S, Suttie J, Tribble DL, Bazzarre TL. AHA Dietary Guidelines

Revision 2000: A statement for healthcare professionals from the nutrition committee of the American Heart Association. *Circulation*. 2000. Available at: <http://circ.ahajournals.org/cgi/content/full/4304635102>.

21. ACS Recommendations for Nutrition and Physical Activity for Cancer. Available at: [http://www.cancer.org/docroot/PED/content/PED\\_3\\_2X\\_Recommendations.asp?sitearea=PED](http://www.cancer.org/docroot/PED/content/PED_3_2X_Recommendations.asp?sitearea=PED).

22. World Cancer Research Fund International—Food, Nutrition and the Prevention of Cancer: a global perspective. Available at: <http://www.wcrf.org/research/fnatpoc.lasso>.

23. Heimendinger J, Stables G, Foerster S. The Scientific, Policy, and Theoretical Foundations for the National 5 A Day for Better Health Program. Available at: [http://5aday.gov/about/pdf/5aday\\_ch1.pdf](http://5aday.gov/about/pdf/5aday_ch1.pdf).

24. Food and Drug Administration—Center for Food Safety and Applied Nutrition Code of Federal Regulations: Title 21, V 2. Available at: <http://www.cfsan.fda.gov/~lrd/cf101-78.html>.

25. Food and Drug Administration—Center for Food Safety and Applied Nutrition Dietary Message about Fruits and Vegetables: Available at: <http://www.cfsan.fda.gov/~dms/lab-dg.html>.

26. U.S. Department of Health and Human Services, U.S. Department of Agriculture. *Dietary Guidelines for Americans 2005*. 6th ed, Washington, DC: U.S. Government Printing Office; 2005.

27. Tribble DL. Antioxidant consumption and risk of coronary heart disease: Emphasis on vitamin C, vitamin E and  $\beta$ -carotene. *Circulation*. 1999;99:591-595.

Average (1 Ratings):



## Add a comment

[Log in or create an account](#) to post a comment

Rate It:





Facebook



Twitter



LinkedIn

Copyright 2011 International Food Information Council Foundation | Web Development: R2integrated