

# Facts about Antioxidants<sup>1</sup>

Kaitlin G. Clark and Wendy J. Dahl<sup>2</sup>

Our bodies are made up of cells. Chemical reactions, known collectively as metabolism, are constantly occurring inside our cells. These reactions are necessary for life, but sometimes they create free radicals. Free radicals are highly reactive molecules that can initiate damaging chain reactions in our cells (Jenkins and Honig 1996). This is known as oxidative stress. Research has linked oxidative stress to many diseases: arthritis, lung diseases (such as emphysema), heart disease, stroke, ulcers, hypertension, Parkinson's and Alzheimer's diseases, muscular dystrophy, and others. Oxidative stress also contributes to the normal aging process (Lobo et al. 2010).

Antioxidants can inactivate free radicals and protect our cells from oxidative stress and the damage it causes. Antioxidants also can help our immune system defend against bacteria, fungi, viruses, and some cancers (Mandelker 2008). The body produces some of its own antioxidants, but eating a plant-based diet increases the level of antioxidants in our bodies.

## Sources of Antioxidants

There are many different compounds that can act as antioxidants. Some, such as carotenoids (e.g., beta-carotene, lutein, lycopene), can be identified by the orange-red color of the vegetables containing them. Vitamin C and vitamin E also function as antioxidants. Table 1 shows some common food sources of antioxidants.

## Antioxidant Activity

The amount of antioxidants in a food can be determined as “antioxidant activity,” which is a measure of how well they inhibit free radicals. The fruits highest in antioxidant activity are blueberries, pomegranates, blackberries, strawberries, and raspberries (Wolfe et al. 2008). The vegetables highest in antioxidant activity are beets, red peppers, eggplant, Brussels sprout, and broccoli (Song et al. 2010).

## Recommended Intake

The Recommended Dietary Allowances (RDA) for antioxidant vitamins are given in Table 2. Because smokers have higher levels of oxidative stress, an additional 35 mg per day of vitamin C is recommended (IOM 2001).

Other antioxidants are not vitamins and do not have recommended intakes. Plant foods are the best source of antioxidants. Making half of your daily food intake fruits and vegetables (especially dark-green, red, and orange vegetables) and choosing whole grains should provide plenty of antioxidants in your diet. It is also important to consume a variety of fruits and vegetables, since different antioxidants are found in different foods.

## Antioxidant Supplements

While consuming antioxidants from fruits and vegetables is associated with a decreased risk of cancer and cardiovascular disease (Garrido, Terron, and Rodriguez 2013), taking

1. This document is FSHN14-02, one of a series of the Department of Food Science and Human Nutrition, UF/IFAS Extension. Original publication date February 2014. Revised May 2017. Reviewed January 2018. Visit the EDIS website at <http://edis.ifas.ufl.edu>.

2. Kaitlin G. Clark, former graduate student; and Wendy J. Dahl, associate professor; Department of Food Science and Human Nutrition, UF/IFAS Extension, Gainesville, FL 32611.

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antioxidants as supplements is not recommended due to increased risk of disease (Bjelakovic et al. 2012).

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Table 1. Some common food sources of antioxidants.<sup>1</sup>

Food Source	Antioxidant Content	Food Source	Antioxidant Content
	Vitamin C <sup>1</sup> mg		Lutein + Zeaxanthin <sup>1</sup> mg
red peppers (1 medium)	152	spinach (1/2 cup cooked)	15
green pepper (1 medium)	96	kale (1/2 cup cooked)	13
broccoli (1 cup chopped)	81	collards (1/2 cup cooked)	9
orange (1 medium)	68	peas (1/2 cup cooked)	2
kiwifruit (1)	64	squash (1/2 cup cooked)	2
grapefruit (1 medium)	38	broccoli (1/2 cup cooked)	1
	Vitamin E <sup>1</sup> mg		Lycopene <sup>1</sup> mg
wheat germ (1 oz.)	4.5	tomato juice (1 cup)	22
almonds (1 oz.)	7.3	watermelon (1 wedge)	13
safflower oil (1 Tbsp.)	4.6	ketchup (1 Tbsp.)	2.5
hazelnuts (1 oz.)	4.3	pink grapefruit (1/2)	2
	Vitamin A <sup>1</sup> RAE* micrograms		Beta-carotene <sup>1</sup> micrograms
sweet potato (1/2 cup canned)	955	pumpkin pie (1 slice)	7366
pumpkin (1/2 cup canned)	953	spinach (1/2 cup cooked)	5659
carrots (1/2 cup cooked)	665	sweet potato (1 small baked)	6905
cantaloupe (1 small)	745	carrot (1 medium)	5054
spinach (1/2 cup cooked)	472	collards (1/2 cup cooked)	4287

<sup>1</sup> (USDA 2013)  
 \*RAE = Retinol Activity Equivalents; 1 RAE = 1 microgram retinol; 1 microgram retinol = 12 micrograms beta-carotene, thus values for vitamin A include beta-carotene.

Table 2. RDA for vitamins C, E, and A

Age (years)	Vitamin C (mg/day)	Vitamin E (mg/day) (as α-tocopherol)	Vitamin A (micrograms/day) (RAE*)
Children 1–3 years	15	6	300
Children 4–8 years	25	7	400
Males 9–13 years	45	11	600
Males 14–18	75	15	900
Males >19	90	15	900
Females 9–13	45	11	600
Females 14–18	65	15	700
Females >19	75	15	700

\*Retinol Activity Equivalents