Special Report

What is the antioxidant power of your diet and supplements?

by Bill Sardi

Americans hear a lot about antioxidants these days. How much antioxidant power do your foods plus dietary supplements provide?

Before this question is answered it would be helpful to gain an understanding of your need for antioxidant protection, which varies from individual to individual.

What generates "rusting" free radicals in the body?

First, we need to understand what generates oxidation in the body. The oxygen you breathe, the fat and iron/copper content of your meals, the frequency and calorie content of meals, and your age, to a large extent determine the amount of *"rusting"* going on in your body. Exercise, infection and exposure to radiation (solar, x-rays) also increase oxidation.

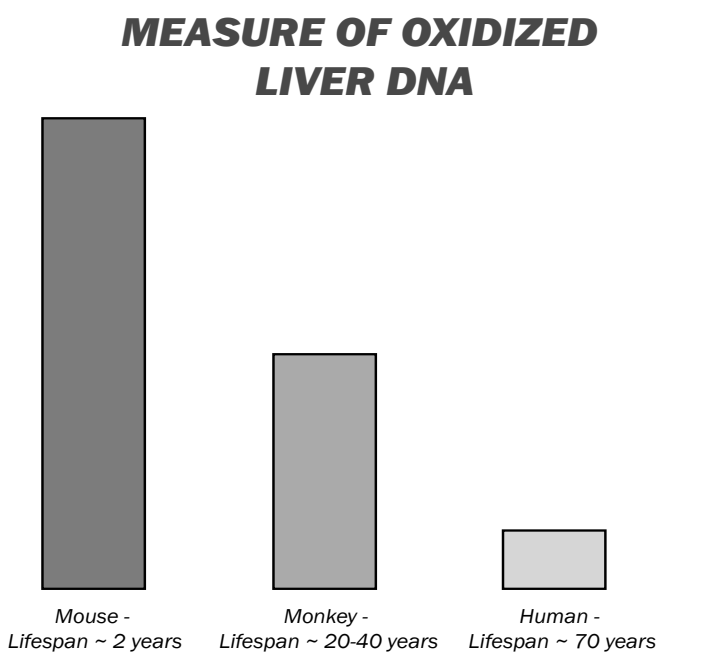
Oxygen is a necessary and good thing in the human body, but also a potentially harmful factor. While much is made of toxins in the air, ranging from smog to radon gas, it is **oxygen itself that is the primary toxin in the body.** About 4 percent of the oxygen humans breathe converts into a toxic byproduct called an oxygen free radical. These oxygen radicals are the *"rusting agents"* of the body. Exposure to greater than 21% oxygen can produce injurious side effects. Pure O_2 for as little as six hours can cause chest soreness, cough and sore throat. High oxygen levels in incubators produces blindness in babies. [Nutrition Reviews 52: 253-65, 1994] The faddish *"oxygen bars"* that once received publicity, where people would come into a bar for a drink while inhaling oxygen through a nasal tube, improves oxygenation of tissues but also can be problematic. That is why antioxidants (anti-rusting agents) are widely promoted in plant foods and dietary supplements to counter aging, improve immunity from disease and to promote health.

A 1993 issue of the Journal of the American Medical Association conceded that "all human disease has some relationship with free radical species." [J Am Med Assoc 270: 2024, 1993]

While oxygen (O_2) and naturally-produced hydrogen peroxide (H_2O_2) are sources of rusting in the human body, they are not very reactive until they are brought into contact with **unbound metals such as iron and copper** which then generate the most powerful of all rusting agents, the dreaded **hydroxyl radical** which attacks and damages almost everything found in the human body. [Nutrition Reviews 55: 44-52S, 1997] The hydroxyl radical is believed to be the toxicant that triggers genetic mutations that leads to cancer.

Since DNA damage is considered the initial event in cancer, **the importance of DNA protection from oxidative damage becomes paramount.** Supplementation with 100 mg of vitamin C, 100 mg (~100 IU) of vitamin E, 6 mg of beta carotene and 50 mcg of selenium has been shown to reduce breaks in chromosomes by half with an even greater effect in smokers. [Mutagenesis 18: 371-76, 2003]

Researchers at the University of California at Berkeley estimate that **the number of oxidative hits to DNA per cell per day is about 10,000 in humans.** Enzymes can repair most but not all the breaks in strands of DNA in human cells. DNA damage accumulates with advancing age. There is a greater need for antioxidants with advancing age. The *"flame"* of oxidation in the body increases with advancing age and is associated with unsuccessful aging (disability, disease). [J Am Geriatrics Society 44: 823-27, 1996] In **old age there are about 2 million DNA breaks per cell per day!** [Proceedings Nat'l Academy Sciences 90: 7915-22, 1993] Think of this as bullets riddling your cells



Oxidative by-products in liver DNA may determine lifespan of mammals.

with destruction. The cells can rebuild, but the repair process may not be able to keep up.

One intriguing study shows that the lifespan of various mammals is dependent upon a marker of oxidation in liver DNA. Mice, which only live about 2 years, exhibit high levels of oxidative by-products in their livers, whereas monkeys which live 20-40 years have half as much toxic byproducts and humans who live about 70 years about 1/8th as much. [Am J Clin Nut 53: 373-79S, 1991] So limitation of oxidation may help control longevity, or it just may be a marker and not an age controlling agent at all. There is still a lot to learn. In one study vitamin E and strawberry supplements reduced oxidative byproducts in the livers of mice but did not affect maximum life span. [Annals NY Academy Sci 20: 854-60, 1998] So gaining an understanding of these dynamic factors can be perplexing.

Reducing the need for antioxidants by limiting food

Calorie restricted diets, or fasting, reduce the *"flame"* of oxidation in living tissues. Another way of saying this is, **the less food you eat the less antioxidants you need from foods and supplements to counter adverse effects of free radicals.** [Arch Biochem Biophysics 333: 189-97, 1996] This obviously validates the idea of fasting. Even brief fasts are beneficial.

Food stokes the fires of free radical production and Americans generally eat a lot of food, about 3700+ calories per day. (For comparison, the long-lived Japanese consume about 2800 calories and the Japanese on Okinawa consume only about 1100-1500 calories per day. Okinawa is where many are living beyond the age of 100 years in good health.) With about 40% of the US population consuming fat-laden fast foods on a daily basis, there is a great need to counter the adverse effects posed by over-consumption with antioxidants. [J Am Dietetic Assn 103: 1332-38, 2003]

The best advice is to **take antioxidant supplements with meals, when the "flame" of oxidation is high.** The provision of high dose vitamins C and E has been shown to counter the adverse effects after consumption of a sugar or fat-laden meal. [University at Buffalo, American Diabetes Association, June 16, 2002]

A high-fat meal impairs the ability of blood vessels to widen (control blood pressure) for at least 4 hours after a meal. The provision of a powdered fruit-vegetable concentrate can reverse this effect. [J Am College Cardiology 41: 1744-49, 2003]

This is in contrast to another study which showed that 1000 mg of vitamin C and 800 IU of vitamin E did not improve blood flow following consumption of a high or low-fat meal. [Journal Am Med Assn 278: 1682-86, 1997]

Why didn't the high-dose antioxidant vitamins work while the plant-food concentrate was effective?

Here is an important point. According to the US Department of Agriculture, **the iron and copper binding molecules called polyphenols in fruits (in particular grapes, berries, cherries, olives, cocoa, tea and citrus rind) account for most of the antioxidant capacity of fruits and vegetables.** [J AOAC Int 83: 950-56, 2000] A plentiful supply of polyphenols may or may not be provided in the best plant food diet or supplement regimen. Interestingly, a major measure of oxidation is not reduced among vegetarians compared to nonvegetarians. [European J Epidemiology 11: 207-11, 1995] Even dedicated herbivores may not get enough antioxidants.

Even most multivitamins do not provide a significant amount of polyphenols (sometimes called bioflavonoids) either. Maybe, even with mega doses of

vitamins C and E, multivitamins just don't have enough antioxidant punch. In comparative studies, vitamin E did not affect markers of DNA damage in liver cells, but green tea, which contains polyphenols, did. [Free Radical Research 25: 57-74, 1996]

Certainly Americans are likely to consume antioxidant-poor plant foods. The most popular plant foods consumed by Americans (in order of consumption) are iceberg lettuce, tomatoes, French fries, orange juice and onions.

So how many servings of antioxidant-rich plant foods do we need to consume per day? When 25 men consumed 5-7 servings of fruits and vegetables or an equivalent in plant food concentrates their antioxidant blood levels rose but a chemical marker of oxidation was not affected. [British J Nutrition 85: 459-64, 2001] Does this mean humans need far more antioxidants than most optimal diets and supplement regimens provide?

The mixed message

So now that you are all set to load up on antioxidants, especially the polyphenols, here is the current mistaken advice you are reading in the lay press. A Los Angeles Times article published late last year said: *"In recent years, several larger research studies have found that people who took antioxidant supplements received no greater protection from chronic diseases than those who didn't... They are no longer considered the miracle cure they once were."* [LA Times Oct 27, 2003] The LA Times article cited a study of more than 20,000 British adults who took antioxidant supplements but showed no difference in heart attack, stroke or cancer rates compared to people who took a worthless placebo tablet. So the LA Times concluded by saying *"For now, many doctors and scientists agree that you're better off consuming antioxidants in their natural form --- by eating fruits and vegetables --- than by taking a vitamin pill."* Melanie Polk, director of nutrition education at the American Institute of Cancer Research ended by saying*: "We should be spending our money in the produce department, not the vitamin aisle*." There is always an element of truth in these news reports. Could it be that antioxidant supplements, in particular multivitamins, simply don't provide enough antioxidant power? Are the vitamin supplement nay-sayers correct?

Even small incremental increases in fruit and vegetable consumption yields potential health benefits. Just an increase of 1.4 servings of plant foods has been shown to lower systolic blood pressure (the first pressure number) by 4 points, equal to what some drugs accomplish. [Lancet 359: 1969-74, 2002]

Run to the vegetable stand?

OK, OK, we're all headed to the vegetable stand. The impetus to increase fruit and vegetable consumption arose over a decade ago when a review of over 200 scientific studies revealed plant food consumption decreases the risk of cancer. Additionally, every serving of plant food reduces a person's risk for heart disease by 4 percent. So the American Cancer Institute developed its 5-a-day program. [J Am Dietetic Assn 94: 32-36, 1994] However, human compliance has been low. A study of 15,000 US adults revealed only 17% consumed 5 or more servings of fruits and vegetables. [J Am Dietetic Assn 99: 1241-48, 1999]

But horrors, **the 5-a-day program has met failure also**. We know that low dietary intake of fruits and vegetables doubles the risk for most types of cancer. [Proceedings Nat'l Academy Sciences 90: 7915-22, 1993] But high consumption of plant foods doesn't necessarily lower the risk of cancer either. Maybe now we understand why. It could be lack of those important phytonutrients, from dark-green vegetables and in particular the polyphenols in fruits.

It's now a decade later and the National Cancer Institute (NCI) can't report its 5-a-day program has dented the rate of cancer. So it has launched its updated version of its plant food campaign --- 9-a-day. **Five servings is *"just the bare minimum,"*** says the NCI. **Only 4 percent of US males consume 9 servings a day!** [British Medical Journal 326: 1003, 2003] While the vegetables provide important antioxidants like the folic acid (required for DNA repair), lutein, beta carotene and lycopene, it is the fruits that provide the all important iron-binding antioxidants, the polyphenols. [J Nutrition 130: 3063-67, 2000]

High antioxidant foods

To help sort out which foods have the most antioxidant power, the US Department of Agriculture developed a measure of the combined antioxidant power of foods and supplements. It's called the Oxygen Radical Absorption Capacity (ORAC). Throw all the plant foods you eat into a pile and how much *"anti-rusting"* power do you get? The consumption of 5 servings of plant foods yields about 1750 ORAC units, and 9-servings about 3150 ORAC units. Here is a comparison of the ORAC values of various plant foods.

High ORAC antioxidant plant foods (provide iron-binding polyphenols)

Lower ORAC antioxidant vegetables

Plant food	ORAC antioxidant values per milligram	Increase in ORAC antioxidant power over broccoli, carrots or barley
Broccoli, carrots, barley	Reference for comparison	---
Garlic, nettles, onion	0.05	1.25 times
Spinach, kale	0.07	1.70 times
Melon seed	0.10	2.50 times
Cherry	0.29	7.25 times
Red wine grape	0.30	7.50 times
Blueberry	0.40	10.00 times
Pomegranate	0.45	11.25 times
Grape seed	8.00	200.00 times
Apple peel	15.0	375.00 times

Most health conscious Americans simply are not going to be able to consume nine servings of fruits and veges a day, certainly not on a consistent basis. Is there any shortcut? Yes, we can juice. But people who juice often use vegetable green drinks rather than the polyphenol-rich fruits. Certainly, fresh food should not be shunned for a pill or a greens drink. But there is a crying need for more ORAC anti-oxidant power in multivitamins to make up for any shortages in the diet.

Multivitamin antioxidant power

Just how much ORAC antioxidant power do multivitamins provide? Various brands of multivitamins were selected based upon their labels which advertised extra antioxidant potency or inclusion of plant extracts. They were tested for ORAC antioxidant power by Genox, an independent laboratory. Here are the results.

BRAND OF MULTIVITAMIN	ANTIOXIDANT ORAC UNITS
Source of Life- Nature's Plus	88.5
Centrum	92.2
Soft Gelatin Multiple – Nature's Life	123.1
Maxilife capsules – Twinlab	137.0
Bio Align Life Force Multiple-Source Naturals	151.2
My Favorite Multiple – Natrol	151.9
One Day Vitamin & Mineral Formula – Mega Food	188.1
Green Multi – Nature's Life	197.5
Alive Multivitamin – Nature's Way	291.3
Purity Perfect Multivitamin – Purity Products (4 caps/day))	342.4
ORAC antioxidant score – 5 servings fruits & veges	1750.0
ORAC antioxidant score – 9 servings fruits & veges	3150.0
Purity Perfect Multi Super Greens Formula (5 caps/day)	5450.0
Tests conducted by independent laboratory: Genox	

The above chart ranks some brands of multivitamins by their total ORAC antioxidant power. Most brands don't even provide the ORAC value of one serving of plant foods. The addition of selected antioxidant-rich plant extracts can make a dramatic difference in total antioxidant power. An example is Purity Products Perfect Multivitamin which provides some plant extracts and herbs (ORAC score 342.4) compared to the same product with added fruit-based polyphenols and green vegetable extracts (Purity Products Perfect Multi Super Greens Formula) which exhibits an incredible ORAC score of 5450.0, equivalent to 15.5 servings of fruits and vegetables).

The chart above shows that the addition of antioxidant-rich fruit (polyphenol) extracts to a multivitamin, compacted into just one extra capsule per day, can make a big difference in delivery of antioxidant power,

equivalent in this case to 15.5 servings of fruits and vegetables (5450 ORAC units).

Bottom line: eat the high ORAC antioxidant-rich fruits (apple peel, grapes, pomegranates, cherries, blueberries. Juicing may be advantageous but poses challenges in having to consume high volumes of food and maintaining fresh stocks in the kitchen. Greens formulas (drinks, powders) may or may not be advantageous and should be labeled for their ORAC values to help consumers evaluate their antioxidant power. The addition of a relatively small amount of fruit extracts to a 5-capsule a day multivitamin regimen could deliver the ORAC antioxidant power needed when the body is challenged by oxidative stress.

Apples provide about 8-12 milligrams of vitamin C which represents less than one percent of the total antioxidants in apples. Most of the antioxidant power of an apple is found in the peel. [Am J Clin Nutrition 78: 517-20S, 2003]

*The author has a commercial interest as a radio spokesperson for Purity Products.

Photos courtesy Agriculture Research Service, US Dept. of Agriculture