

# Nutritional Outlook

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## Antioxidants

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### Radical Departure

Antioxidants are popping up in the most unlikely places.

by Daniel Schatzman, Managing Editor

Antioxidants have been fixtures in the nutritional supplement industry since it began. Although many of the key players in the antioxidant arsenal such as vitamins A, C, and E have remained constant over time, new sources of these antioxidants are constantly being discovered. Moreover, antioxidant research has accelerated in the past few years, with major efforts under way at the National Institutes of Health (NIH; Bethesda, MD) and centers of academic learning. What follows is a brief survey of several antioxidant sources.



Camu camu berries contain high amounts of vitamin C and bioflavonoids.

Photo courtesy of Synergy Production Laboratories.

### CAMU CAMU BERRIES

A novel source of vitamin C is the camu camu berry (*Myrciaria dubia*). Camu is a popular fruit in the Amazonian regions of Latin America, where it is added to drinks and desserts. According to Mitchell May, PhD, CEO of Synergy Production Laboratories (Moab, UT), which supplies standardized non-GM camu camu berry powder, vitamin C exists throughout the berries and is particularly concentrated in camu camu berry juice.

"What determines the level of vitamin C present in the berry is its stage of ripeness at the time of harvest," May explains. "Immature, green berries have a higher vitamin C content than fully ripened berries. At this stage, camu camu berries are the single richest known source of naturally occurring vitamin C. They provide an astonishing 2780–4000 g per 100 g of raw, concentrated fruit. That is substantially more vitamin C than amla, acerola, or citrus."

In addition to vitamin C, the berries are also loaded with other nutrients. "Berries and other vitamin C-rich foods contain an abundance of naturally occurring phytonutrient antioxidants that support and enhance the activity of vitamin C," May says. "In fact, some of the benefits mistakenly associated with ascorbic acid are actually due to the other food phytonutrients and cofactors related to vitamin C, such as bioflavonoids."

May believes that whole-food sources of vitamins are superior to isolated or synthesized vitamins, so Synergy uses a proprietary temperature-controlled system to convert the berries into a whole-fruit concentrate.

"Research has shown time and again that food-source vitamin C is more efficacious than its isolated counterpart, ascorbic acid," May says. "Our Synergized Camu is a whole-fruit 20:1 concentrate that has had the fiber removed in a cold-extraction process. This allows us to fully capture all the beneficial food phytonutrients and cofactors while also providing a minimum of 20% naturally occurring vitamin C."

Synergy adds manioc root powder to the concentrate to enhance the flow of the powdered berries, and to help stabilize and protect the vitamin C from oxidation. "Our studies show that Synergized Camu remains stable at temperatures as high as 225°F, and has an extended shelf life of three years," May says. "Additionally, manioc is an heirloom food; unlike most corn-based carriers, it is not genetically engineered."

### CRANBERRY AND RASPBERRY SEED EXTRACTS

Two other berries that are known for their antioxidant activity are the American cranberry (*Vaccinium macrocarpon*) and Meeker red raspberry (*Rubus idaeus*). In fact, according to Gregory Drew, director of sales and marketing at Regal Trade and Consult LLC (Hoboken, NJ), which exclusively distributes cold-press-extruded American cranberry and Meeker raspberry seed oils and powders, cranberries are one of the most potent sources of antioxidants such as polyphenols and tocotrienols. Regal will introduce the product line, which is produced by Northern Lights Food Processing LLC (Nekoosa, WI), in October at Natural Products Expo East in Washington, DC.

"American cranberry seed oil contains the highest amount of naturally occurring tocotrienols of any botanical oil," Drew says, adding that the oil yields about 17–30 mg of gamma tocotrienol per kilogram. The oil also contains significant amounts of several other important compounds, including phytosterols such as beta-sitosterol and phospholipids such as phosphatidylcholine.

"American cranberry seed oil contains a high amount of polyunsaturated and essential fatty acids (EFAs), including a 1:1 ratio of omega-3 to omega-6 fatty acids, yet is incredibly stable due to its naturally occurring antioxidant profile," he adds.



Cranberry and raspberry seed extracts contain a 1:1 ratio of omega-3 to omega-6 EFAs.

Photos courtesy of Regal Trade and Consult LLC.



Researchers at Loma Linda University found that chewing gum containing 5 mg of Pycnogenol pine bark extract helped reduce bleeding of oral capillaries.

Photo courtesy of Horphag.

Aside from the oil, Regal offers American cranberry protein powder, which, according to Drew, contains 25% complete protein. In addition, Northern Lights produces ellagic acid extract from Meeker red raspberry. The extract, which is standardized to contain 550 ppm of ellagic acid, tests at 525 ORAC units.

One of the most exciting aspects of the American cranberry and Meeker raspberry seed oils is that, besides their polyunsaturated and essential fatty acid profiles, they also serve as antioxidant oils. According to Drew, the oils can actually enhance the stability of other oils such as flax, borage, and evening primrose. "High EFA oils traditionally carry along the connotation of rancidity and instability; however, the oils from these deep pigmented fruits are far more stable than most vegetable oils," he says.

### PYCNOGENOL

Research suggests that Pycnogenol, a water-soluble, standardized extract from French maritime pine bark (*Pinus pinaster*), may have some interesting uses. In a double-blind study published in the September 2002 issue of *Phytomedicine*, scientists found that the extract had an antiinflammatory and sealing effect on fragile oral capillaries that helped to reduce gingival bleeding.

The researchers, led by Benjamin Lau, MD, PhD, of Loma Linda University (Loma Linda, CA), gave 40 volunteers either normal chewing gum or chewing gum containing 5 mg of Pycnogenol per piece. Each person was instructed to chew six pieces of gum per day, once after each meal and three additional times per day, for a minimum of 15 minutes per piece.

According to the researchers, the subjects who received gum containing Pycnogenol showed a more than 50% reduction of gum bleeding compared with those who received regular chewing gum. Moreover, the volunteers who received the normal chewing gum

also showed a significant increase in plaque accumulation compared with those who received the gum containing Pycnogenol. A possible explanation for Pycnogenol's effect on plaque formation, according to Lau, is that it inhibits the growth of oral bacteria.

Frank Schonlau, PhD, director of scientific communications for Horphag Research (Geneva), the exclusive worldwide distributor of Pycnogenol, says that nearly all of the constituents of the extract act as antioxidants. "This has been shown for the individual phenolic acids, the monomers catechin and taxifolin, as well as the procyanidins," Schonlau says, adding that Pycnogenol also contains traces of glucose that lack comparable antioxidant activity. Horphag's extraction procedure yields about 6575% procyanidins.

Schonlau explains that Pycnogenol's apparent capillary-sealing effect stems from the activity of the procyanidins. "Pharmacological studies have shown that the decrease of capillary-wall permeability corresponds with the size of the procyanidins," Schonlau says. "The procyanidins have a physical affinity to collagen, which plays a great role in the integrity of blood vessels. The binding of the procyanidins to 'leaky' areas of the blood vessels has been the proposed mechanism underlying the capillary-sealing effect."

### ASTAXANTHIN

Astaxanthin is a carotenoid that acts as an antioxidant by quenching singlet oxygen and scavenging free radicals. There are several natural sources of astaxanthin, including marine sources that contain the carotenoid in significant concentrations. For instance, salmon, which obtains its pinkish hue by consuming carotenoid-rich zooplankton, contains about 540 mg of astaxanthin per kilogram of body weight.

One marine source that contains particularly high concentrations of astaxanthin is the green algae *Haematococcus pluvialis*. *Haematococcus*, which grows in pools of water, contains 10,000–40,000 mg of astaxanthin per kg.

According to Kelly Moorhead, marketing manager at Cyanotech Corp. (Kailua-Kona, HI), astaxanthin is a potent antioxidant. "The astaxanthin molecule has been shown to be about 10 times stronger than beta carotene and up to 550 times stronger than vitamin E in singlet-oxygen quenching," Moorhead says, adding that ORAC tests with Cyanotech's BioAstin natural astaxanthin suggest that it is five times stronger than synthetic astaxanthin.

"Japanese researchers have noted that the difference in astaxanthin's antioxidant strength compared with other carotenoids is particularly pronounced at very low concentrations," Moorhead adds. "This is important because in the body's tissues, the concentrations are much lower than levels used in typical in vitro tests."

In addition, research conducted by the Health Research and Studies Center of Los Altos, CA, suggests that natural-source astaxanthin may be beneficial for people with bone and joint problems. In one double-blind, placebo-controlled study, people with rheumatoid arthritis who consumed 4 mg of BioAstin three times per day for 30 days reported that they felt more satisfaction with their abilities to perform their usual activities.

Although the mechanism of action is not clearly understood, Moorhead says astaxanthin is thought to act as a COX-2 inhibitor. "Astaxanthin, in its natural form, is able to span cell membranes with a water-soluble end and a fat-soluble end," he says. "This capacity affects its mobility within cells and may help with its unusually strong antiinflammatory activity."

"This study, combined with the results of other studies showing positive effects from using BioAstin on carpal-tunnel syndrome and knee soreness, adds to the growing body of scientific evidence that BioAstin offers a viable natural alternative for people who suffer from a variety of joint pains," says Gerald Cysewski, PhD, Cyanotech's chairman, president, and CEO. "These results should provide Twinlab Corp. and other major dietary supplement companies that plan to include BioAstin in their products with further scientific support."

The results of the study are expected to be presented at the College of Nutrition scientific meeting in October.

## TOCOTRIENOLS

Tocotrienols have been gaining much attention over the past few years and, with a new NIH study on the way, it looks like there is more publicity in store for these nutrients in the near future. In August, NIH's National Institute of Neurological Disorders and Stroke awarded more than \$1 million to researchers who are studying the neuroprotective activity of alpha-tocotrienol.

"Eighty years after the discovery of vitamin E in 1922, it is long overdue to closely examine all naturally occurring forms of vitamin E side by side," says Chendan Sen, PhD, director of the laboratory of molecular medicine at Ohio State University Medical Center (Columbus, OH). Sen will be leading the NIH-sponsored research.

Sen's research will consist of a four-year in vitro and in vivo study that focuses on how alpha-tocotrienol protects neurons under challenging conditions. New gene-transfer and transgenic technologies will also be used to study genes that are sensitive to tocotrienols.

Carotech (Edison, NJ) has supplied palm-derived pure tocotrienol fractions and its Tocomin full-spectrum tocotrienol complex to Sen for the past few years, along with funding for the initial phase of the study. According to Carotech president W. H. Leong, a paper by Lester Packer that was published in *Free Radical Biology and Medicine* suggested that alpha-tocotrienol was 40–60 times more potent than alpha-tocopherol at preventing lipid oxidation.

Leong adds that even though much of the research currently under way focuses on the effects of pure tocotrienol fractions, a whole vitamin E complex affords the best antioxidant protection.

"In nature, plants, fruits, and vegetables produce eight different forms of vitamin E, including alpha, beta, gamma, and delta tocopherols and alpha, beta, gamma, and delta tocotrienols," Leong explains. "Hence, the best policy is to mimic nature by taking all eight forms of vitamin E. Each of the forms has its own unique properties. Most importantly, they all work synergistically to confer the maximum antioxidant protection."

Leong notes that Carotech has recently teamed up with General Nutrition Companies (Pittsburgh) to launch two new products, E Complete 200/20 and E Complete 400/40, that contain all eight forms of vitamin E.

## SELENIUM

Researchers have known since the 1950s that selenium is an essential nutrient. Since then, scientists have learned much more about this important trace element. In the 1970s, researchers discovered that selenium is a fundamental component of glutathione peroxidase, an enzyme that helps break down the free radical hydrogen peroxide and prevents lipid oxidation.

A more current study, NIH's ongoing SELECT study, a 12-year prospective trial, is examining whether or not selenium may play a protective role against prostate cancer. According to Vladimir Badmaev, vice president of scientific and medical affairs for Sabinsa Corp. (Piscataway, NJ), the NIH researchers recently decided to extend the SELECT study to explore selenium's possible neuroprotective effects as well. Sabinsa, which produces SeLect L-selenomethionine, supplies the selenium used in the NIH trial.

"The research is based on a concept that has been around for some time—that antioxidants and antiinflammatory drugs can be useful in the prevention of both cancer and neurodegenerative diseases," says Badmaev. "As far as selenium goes, this is the first study of that magnitude."

## VITAMIN C

Although previous research indicates that some antioxidants may offer protection against the most common form of cataracts, known as nuclear cataracts, there have not been many studies that show a protective effect against other, less-common forms of cataracts, such as cortical and posterior subcapsular cataracts (PSC).

However, a recent study sponsored by Roche Vitamins Inc. (Parsippany, NJ) that was published in the March issue of the *American Journal of Clinical Nutrition* suggests that vitamin C may be beneficial for some people.

The research, an analysis from the Nurses Health Study, was led by Alan Taylor, PhD, director of the laboratory for Nutrition and Vision Research at the Jean Meyer USDA Human Nutrition Research Center on Aging at Tufts University (Boston).

Taylor found that women who were less than 60 years old and who had a vitamin C intake of more than 362 mg/day had a 57% lower risk for cortical lens opacities than women who had an intake of less than 140 mg/day. Moreover, he found that women who took vitamin C supplements for less than 10 years had a 60% lower risk than those who didn't take a vitamin C supplement. In addition, women who never smoked but who had high intakes of carotenoids also had a lower prevalence of PSC opacities.

"This research adds more weight to the accumulating evidence that antioxidant nutrients can be utilized to alter the development of these serious, but less studied, forms of cataracts," according to Taylor.

## ANTIOXIDANT HERBS

When people hear the word antioxidants, they usually think about vitamins. However, many herbs also possess antioxidant properties.

Martin Bauer's Plantextrakt division (Vestenbergsgreuth, Germany) has developed several functional beverages based on herbal antioxidants that were presented at Health Ingredients Europe in Paris this past September. The drinks include herbs such as hibiscus (*Hibiscus rosa-sinensis*) and green tea (*Camellia sinensis*), along with fruits and other extracts. Hibiscus and green tea are both known to contain polyphenols, and hibiscus leaves also contain anthocyanic compounds.

One of the most potent botanical antioxidants is the herb rosemary (*Rosmarinus officinalis*). According to Peter Hafermann, vice president of sales and marketing at BI Nutraceuticals (Long Beach, CA), carnosic acid, one of rosemary's constituents, combats free radicals.

"Carnosic acid is the starting element of the 'carnosic acid cascade', a series of chemical reactions that involve the transformation of carnosic acid into carnosol, then rosmanol, and finally galdosol," Hafermann explains. "With each of these transformations, free radicals are quenched."

BI Nutraceuticals has two rosemary products, RoseOx and Rossentia. RoseOx, a lipid-soluble extract, is standardized to carnosic acid. Rossentia, a water-soluble rosemary extract, has an ORAC value of more than 6000 trolox equivalents per gram.

"This means consumers would get the antioxidant benefits from about three-quarters of a gram of Rossentia, which is equal to about five servings of fruit and vegetables per day, the recommended USDA requirement," Hafermann says.

OxyPhyte, a line of antioxidant products from RFI Ingredients (Blauvelt, NY) derived from GRAS fruits, vegetables, and spices, also provides ORAC-tested antioxidants.

"Today, scientists say you should eat foods containing 2000–5000 ORAC units per day," says Ellen Schutt, marketing director at RFI Ingredients. "We know that people don't eat their five fruits and vegetables." Moreover, single servings of most fruits and vegetables typically provide only 600–800 ORAC units.

Schutt notes that all of the products in the OxyPhyte line, which includes six single ingredients and nine blends of ingredients, have higher ORAC values than kale, broccoli, and spinach, which are all known for being antioxidant powerhouses. For instance, the OxyPhyte Super Antioxidant Blend provides 10,000 units, and the OxyPhyte Berry Blend offers 2300–2400 ORAC units. OxyPhyte Apple has some of the highest ORAC values in the product line, according to Schutt, because the apples used to manufacture the extract contain 80% polyphenols.

One of the newest products is OxyPhyte White Tea. Derived from the same species as

other forms of tea, *Camellia sinensis*, white tea is the least processed of all teas. "It's something that's kind of new to the market," Schutt says. "After it's picked, it's rapidly steamed and dried, rather than roasted."

## CONCLUSION

Antioxidants consistently have been strong sellers in the supplement marketplace. According to data from Information Resources Inc. (Chicago), total dollar sales of antioxidants increased by 23.7% in 2001. Although much more work needs to be done to discover and verify the potential beneficial effects of antioxidants, a great deal of research is currently under way. As additional sources of antioxidants are discovered, consumer interest in these nutrients is likely to continue. \*

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