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On The COVER

LYCOPENE

The Rediscovered Carotene

by Terri Mitchell

New findings are confirming the benefits of a potent carotenoid that has been available to Foundation members since 1985

Beta-carotene from carrots is known for its antioxidant action. But did you know that there are over 600 known carotenoids besides beta? About 40 are found in the human diet, and not all of them turn into vitamin A. Lycopene is one that does not convert to vitamin A. Lycopene provides stronger antioxidant protection against certain types of free radicals, and may protect against certain types of cancer, better than any nutrient presently known. The carotenoid lycopene makes up about half the carotenes in human sera, yet very little research has been done on it. The few studies that have been conducted look so promising, however, that a symposium was devoted to lycopene in 1998.



Lycopene is what gives tomatoes, watermelons, grapefruits and papaya their red color. A pigment synthesized by some plants and animals to protect them from the sun, lycopene evolved as a weapon against certain types of free radicals. Lycopene is so effective at quenching free radicals, it beat out vitamin E in one study on oxidized fat. This suggests that lycopene might have importance in preventing heart disease, which involves oxidized LDL cholesterol.

The first evidence for a protective effect in heart disease was reported in the journal *Lipids*. A group from Canada demonstrated that lycopene significantly lowers LDL oxidation in human blood. What's interesting is that lycopene works better in combination with lutein, another carotenoid which is found mostly in spinach and corn. (Lutein is associated with maintenance of the macula.) People with high cholesterol have been found to have high levels of free radicals and low levels of lycopene and beta-carotene.

Humans get most of their lycopene from tomatoes-by far the richest source-yet tomato products offer a more concentrated source of lycopene than the fresh fruit itself. For example, tomato powder contains approximately 120 milligrams per 100 grams of fruit whereas fresh tomatoes have about 2 milligrams per 100. Since lycopene is a nutrient that can stand the heat, cooked tomato products, such as tomato paste, provide more of it than fresh tomatoes. Spaghetti sauce is an adequate source of lycopene because it contains fat which is necessary for absorption. It has been theorized that heating tomatoes makes their lycopene more absorbable.

The Mediterranean diet

Researchers are realizing that the cancer-preventive effects of the Mediterranean diet, which have been attributed to olive oil, may in fact be due to lycopene. Italian researchers have pointed out that it is very difficult to separate the effect of tomatoes from olive oil because they are so intertwined in the diet. Lycopene's cancer protection is in part due to its antioxidant protection. But some studies show that it may also modulate immunity, inhibit angiogenesis and affect hormones.

Prostate cancer

Just as lutein is concentrated in the macula, lycopene is concentrated in certain organs. The prostate gland is one of these organs.

Researchers at the University of Bern report that lycopene plus vitamin E inhibits the growth of two different types of prostate cancer cells in the test tube. Lycopene by itself doesn't work. Several studies have linked lycopene with a lower risk of prostate cancer. One of these studies, the Washington County study, found that men with the most lycopene in their blood halved their risk of prostate cancer compared to those with the least. For those under 70 years old, the benefit was even greater. Two other studies have looked at the consumption of tomato products and found lower risk with higher consumption. Tomato sauce, as opposed to juice which had no effect, was the ticket to prostate health in one of the studies. Vitamin E has also been linked to a lower risk of prostate cancer.

Other studies have not shown a link between lycopene and prostate cancer. A study from England found no association between lycopene and prostate cancer risk, but report that beta-carotene is protective. These conflicting reports support the notion that the carotenes work both synergistically and in ways we don't understand. It has been shown, for example, that giving a dose of combined beta-carotene and lycopene increases the level of lycopene in the blood, but not beta-carotene. It has also been shown that different combinations of carotenoids provide different degrees of protection against free radicals. Vitamin E appears to be very important in enabling the carotenes biological actions. Lycopene, in turn, can be adversely affected by inadequate supplies of vitamin C and sulfur molecules such as N-acetylcysteine.

Cholesterol-lowering drugs
deplete lycopene

Lipids, too, play a role in whether the carotenes are effective. The carotenes are lipid soluble-they must have fat to be absorbed. It has been consistently demonstrated that foods with fat in them deliver more lycopene into the body than lycopene can manage on its own-olive oil delivers the lycopene in a tomato-based spaghetti sauce, the cheese in pizza makes the lycopene in the sauce absorbable.

Lycopene is carried in the blood by the lipoprotein molecule (LDL) that also carries cholesterol. Drugs that lower cholesterol can drastically interfere with the carotenes. In one study, cholestyramine (Questran) decreased lycopene by 30% in the blood. It also reduced beta-carotene by 40% and vitamin E by 7%. Probucol (Lorelco), another cholesterol-lowering drug, decreased lycopene by 30%, beta-carotene by 39%, and vitamin E by 14%. It took one to two years for levels of lycopene and beta-carotene to return to normal after Probucol. These are alarming findings, given that these vitamins give antioxidant protection to lipids, and oxidized lipids are thought to be a mechanism of heart disease. Although Probucol is, itself, an antioxidant, it showed no effect on heart disease in a trial of Swedish patients. In addition to its antioxidant-depleting effect, Probucol also lowers "good" HDL, and reduces lipoprotein size-both of which are associated with greater risk of heart disease.

The fake fat, Olestra is another chemical that depletes the carotenoids and vitamin A. Daily consumption of Olestra can reduce lycopene by 30% within a few months. High-fiber diets can also block the absorption of the carotenes if the carotenes are taken at the same time as the fiber.

Other parts of the body besides the prostate that accumulate lycopene are the adrenal glands, liver, colon and testes. Aging reduces levels of lycopene in the blood. Elderly people are consistently deficient in nutrients, including ones that interact with lycopene such as vitamins C and E.

Other cancers

Several studies show a connection between lycopene and cancer prevention. Lycopene appears to be protective against cancer of the digestive tract. Several studies have found a lower risk for colorectal cancer in people who eat a lot of tomato products and/or have higher levels of lycopene in their blood. More direct evidence has been provided by researchers in Japan who did a study on colon cancer in rats. They found that tomato juice provided significant protection against a chemical carcinogen (N-methylnitrosourea). It's important to note, however, that pure lycopene did not. The authors of the study speculate that lycopene's action depends on other factors present in the juice that is missing in pure lycopene. Recent thinking in carotene research is that the carotenes are both interdependent and dependent on other vitamins and minerals, and this must be taken into account when studying them.

One of the largest and most important cancer/diet studies ever done shows the importance of the carotenes in digestive cancers. The study was begun in 1980 in Linxian, China. Linxian has one of the highest rates of esophageal and gastric cancer in the world. Its population also has subnormal levels of vitamins C, E, A, riboflavin and the carotenes. In an effort to see whether supplementation would cut the cancer rate, over twenty-nine thousand people were given four different nutrient combinations in the Linxian study. Four different combinations were tested: riboflavin, niacin; vitamin C, molybdenum; retinol, zinc; or beta-carotene, vitamin E, selenium. After five years, the results showed that the beta-carotene, E, selenium combination cut the cancer rate and overall mortality. The others did not. Reduction in risk began to occur one to two years after supplements were begun. It was also discovered that men who took the combination had a lower risk of stroke, and better immune response (this didn't occur in women

for some reason).

Another cancer that may relate to lycopene is pancreatic. Researchers at Johns Hopkins tested the stored blood of twenty-two people with pancreatic cancer for levels of certain vitamins and selenium. (Blood was drawn before treatment). Lycopene and selenium levels were lower in patients than controls. While this is very preliminary, animal studies do show good effects against pancreatic cancer in animals treated with beta-carotene, selenium and vitamin C. In hamsters, palm carotene (which contains lycopene) inhibits pancreatic cancer.

Stops DNA damage

One of the ways lycopene may work against cancer is by scavenging carcinogens from cooked meat. Heterocyclic amines are formed when meat is cooked, and contribute to cancer by causing DNA damage. People who eat a lot of well-done meat have an increased risk of colon and breast cancer.

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