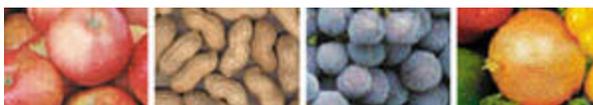


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Quercetin



Quercetin is part of the flavonoid family of compounds, members of which display a variety of biological activities, including cardiovascular protection, anti-cancer activity, and anti-inflammation.

Flavonoids occur in nearly all plant foods and give the red, blue, green, and yellow colors to many plants. Quercetin can be found in onions, apples, tea, berries, and nuts. Commercially, it is derived from blue-green algae.

Quercetin is a potent antioxidant, providing cardiovascular protection by reducing oxidative damage to LDL-cholesterol, the underlying cause of heart disease. Quercetin also blocks an enzyme that leads to accumulation of sorbitol, which has been linked to nerve, eye, and kidney damage in diabetes.

Quercetin is the major flavonoid in our diet, and the estimated average daily dietary intake of quercetin by individuals in the United States is about 5 to 70mg mostly from foods such as onions and apples.

Quercetin is frequently present in nature as glycosides (sugar derivatives) such as rutin (also known as quercetin rutinose) in which the sugar moiety is disaccharide. Quercetin is also referred to as quercetin aglycon or sugarless form of rutin (the main constituent in tea).

Bioavailability

The absorption of quercetin glycosides seems to depend on the type and position of the sugar moieties. Recent studies indicate that quercetin bound to glucose moieties could be hydrolyzed by beta-glucosidase-enzymes present in the small intestine prior to absorption.^{1,2}

In a double-blind, diet-controlled study, the bioavailability of quercetin aglycone was compared with quercetin glycoside (from rutin) in 16 healthy volunteers who received three different doses (8mg, 20mg and 50mg) of quercetin and rutin orally. Analysis of their plasma quercetin concentrations over

32 hours revealed that the maximum plasma quercetin concentration values of the two treatments were similar, but the times required to reach the maximum plasma concentration was significantly shorter after the quercetin treatment than that after the rutin treatment. The results clearly indicate that quercetin aglycon is more bioavailable than quercetin glycoside.

Researchers in The Netherlands studied the bioavailability of quercetin from onions and tea.³ In this study, nine subjects were instructed to follow a quercetin-free diet for 12 days, and were given on days 4, 8 and 12 a supplement of either fried onion (rich in quercetin glucosides, equivalent to 89mg quercetin), or tea (rich in quercetin rutinoid, equivalent to 100mg quercetin), or 100mg quercetin. The researchers found that the absorption of quercetin glycosides from onions was 52 percent, whereas the absorption of the glycoside (quercetin rutinoid), and the quercetin aglycon, was only 17 percent and 24 percent, respectively.

A follow-up study by the same authors reported that the absorption of quercetin from apples is only about half that from onions. The authors speculated that the greater bioavailability of quercetin from onions occurs because of the intestinal sugar carriers that actively transport quercetin glycosides.⁴ This hypothesis was later supported by another study.⁵

Biological Activities

The biological activity of quercetin appears to be due to its potent antioxidant activity. Quercetin scavenges oxygen-free radicals, and inhibits the enzyme xanthine oxidase,⁶ lipid peroxidation, the inflammation-producing enzymes (cyclooxygenase, lipoxygenase) as well as the subsequent inhibition of inflammatory mediators including prostaglandins.⁷ Inhibition of histamine release also contributes to quercetin's anti-inflammatory activity.⁸ Quercetin's inhibition of xanthine oxidase decreases the formation of uric acid, and thus it may be of value in the treatment of gout.

Chronic Venous Insufficiency. Quercetin is vital in its ability to increase the strength of blood vessels, and helps to prevent ruptures of the capillaries and connective tissues. Quercetin and rutin are marketed in many countries as a treatment for the venous insufficiency of the lower limbs, and are found in numerous herbal remedies.

Clinical studies indicate that buckwheat tea, which contains high amounts of rutin is useful in the treatment of chronic venous insufficiency (CVI).⁹ A German placebo-controlled, double-blind study showed that treatment of CVI with

buckwheat herb (*Fagopyrum esculentum*) tea is safe and could prevent further leg edema development in patients with CVI.⁹

Cardiovascular Diseases. Recent studies suggest a protective effect of drinking tea on cardiovascular diseases. Researchers at Harvard Medical School investigated the association of caffeinated and decaffeinated coffee, and tea (the major dietary source for flavonoids in Western populations) on myocardial infarction in 340 patients. They found that only tea was associated with a lower risk of myocardial infarction.¹⁰

Another study, known as the Rotterdam study, carried out in The Netherlands examined the association of tea intake with aortic atherosclerosis in a general population.¹¹ The study found a significant inverse association of tea intake with severe aortic atherosclerosis. This association was stronger in women than in men. The study concluded that drinking tea has a protective effect against ischemic heart disease.

Cancer. People who eat high levels of bioflavonoids have been found to have an overall lower risk of getting a wide variety of cancers.¹² The anticancer actions of quercetin include cell cycle regulation, interaction with estrogen binding sites, and inhibition of tyrosine kinase enzyme.

Early research studies suggest that large amounts of quercetin could cause cancer in animals.¹³ Recent studies, however, found quercetin to be safe and has been linked to protection from cancer.^{14,15,16,17} In a recent study, quercetin was found to enhance pretumorous lesions in a model of rat pancreatic carcinogenesis.¹⁸

In another animal study, quercetin was shown to significantly delay tumor growth and to inhibit colonization of melanoma cells in the lungs.¹⁹ The study suggests that quercetin and the flavonoid apigenin may constitute a valuable tool in the combination therapy of metastatic melanoma.

Asthma. In a recent Welsh study, scientists studied the diets and the lung function of more than 2,500 men between the ages of 45 and 59, and found a positive association between improved lung function (ability to breathe) and the number of apples eaten per week.²⁰ The antioxidant constituents of apples such as quercetin explained the association.

Chronic Prostatitis. Prostatitis, burning prostate pain, affects about five percent of men of every age, not just older men.²¹ Researchers at UCLA Medical Center in Los Angeles put 30 prostatitis patients on either a twice-daily dose of 500mg

quercetin or placebo for one month. In the quercetin group, symptoms including pain, voiding dysfunction, and impact on quality of life decreased by an average of about 40 percent, compared to an insignificant decrease of 6 percent among those taking placebo.²²

Other Health Benefits. Quercetin is also an inhibitor of the enzyme aldose reductase, which catalyzes the conversion of glucose to sorbitol, and plays a role in the formation of diabetic cataracts.²³

In an in vitro study, quercetin was shown to inhibit growth of *Helicobacter pylori* in a dose-dependent manner.²⁴ An animal study demonstrated the protective effect of quercetin against UVA-induced oxidative stress. Rats given quercetin before irradiation had a higher level of antioxidant enzymes, such as glutathione reductase and catalase, than those not given quercetin.²⁵

Research studies indicate that the consumption of quercetin-rich foods is associated with a reduced risk of coronary heart disease and possibly, some types of cancer. Quercetin appears to be of value in preventing ulcers, cataracts, chronic venous insufficiency, allergies and inflammation.

Quercetin appears to be safe with little toxicity when administered orally or intravenously. The most frequently recommended dosage is 400mg quercetin three times per day. **VR** 11-01

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