

Quercetin

Description

Quercetin (3,3',4',5,7-pentahydroxyflavone)¹ is a flavonoid that forms the chemical backbone for other flavonoids such as hesperidin, naringin, rutin and tangeritin. Rutin is the most common flavonoid containing the quercetin backbone, in which quercetin is attached to a glucose-rhamnose moiety. Quercetin is also found bound to one or two glucose molecules (monoglycoside and diglycoside forms).²

Dietary sources

Quercetin is one of the most abundant dietary flavonoids. It is found in apples; black, green and buckwheat tea; onions (particularly the outer rings); raspberries; red wine; red grapes; cherries; citrus fruits; broccoli and other green leafy vegetables.³ Preliminary work by the University of Queensland, Australia, suggests that quercetin is also found in varieties of honey such as that derived from eucalyptus and tea tree. Quercetin is also found in ginkgo biloba and St John's wort.

Dietary intake

Estimated dietary intake is 25–50 mg daily.⁴

Action

Quercetin has a range of activities. It has been shown *in vitro* to:

- act as an antioxidant;⁵
- inhibit LDL oxidation;^{4,6,7}
- inhibit the nitric oxide pathway;^{8,9}
- have anti-inflammatory activity, possibly due to an influence on the production

of eicosanoids, including leukotrienes and prostaglandins,⁴ and also cytokines;¹⁰

- have potential as an anti-cancer agent through interaction with type II oestrogen-binding sites,¹¹ inhibition of tyrosine kinase,¹² up-regulation of tumour suppressor genes,^{13,14} induction of apoptosis,^{15,16} and inhibition of tumour necrosis factor-alpha;¹⁷
- have antihistamine activity.¹⁸

Possible uses

Quercetin offers several potential therapeutic uses in the prevention of CVD, cancer, cataract, schizophrenia and prostatitis. However, there are few clinical trials in humans to date.

Cardiovascular disease

Quercetin may have a role in the prevention of CVD, but there are no data from controlled clinical trials. An epidemiological study suggested that high intakes of dietary flavonoids, particularly quercetin, are associated with a reduced risk of CVD in older men.¹⁹ This protective effect is thought to be due to a variety of quercetin's activities, such as its antioxidant capacity,⁴ including inhibition of LDL oxidation,⁶ nitric oxide inhibition,⁸ inhibition of tissue factor (the cellular receptor that initiates blood coagulation),²⁰ platelet aggregation,²¹ and a range of anti-inflammatory activities. However, quercetin supplementation does not appear to reduce total and LDL cholesterol or to increase HDL cholesterol.^{21,22}

Cancer

In vitro studies have shown quercetin to have various properties that could give it anti-cancer activity (e.g. cell cycle regulation, interaction

with type II oestrogen-binding sites, inhibition of tyrosine kinase and reduction in the number of aberrant crypt foci;²³ inhibition of tyrosine kinase,¹² inhibition of tumour necrosis factor- α ¹⁷ and inhibition of tumour angiogenesis.¹)

Quercetin has been shown *in vitro* to inhibit growth of colorectal cancer cells,^{14,24,25} possibly by up-regulation in the expression of tumour suppressor genes¹⁴ and modulation of cell-cycle related and apoptosis genes.²⁵

It has also been shown to have potential activity against prostate cancer. It can attenuate the function of the androgen receptor (AR), inhibiting AR-mediated expression of prostate-specific antigen (PSA),²⁶ up-regulating tumour suppressor genes while down-regulating oncogenes and cell cycle genes,¹³ and inhibit other receptors involved in growth and metastasis of prostate cancer.²⁷

Quercetin has also been shown *in vitro* to have activity against leukaemia cells^{15,16} and pancreatic tumour cells.²⁸ Other preliminary studies suggest that quercetin could have inhibitory effects on other cancer types, including breast, ovary, endometrial, non-small-cell lung, gastric and squamous cell.²⁹

Cataract

One study in rats has shown that quercetin could have a possible role in reducing the incidence of cataracts, by inhibiting oxidative damage in the lens. Quercetin was converted to its metabolite 3-O-methyl quercetin by catechol-O-methyltransferase (COMT) in the rat lens, and both compounds were found to inhibit hydrogen peroxide-induced opacification.³⁰

Autoimmune disease

Quercetin was found in one study to ameliorate experimental allergic encephalomyelitis by blocking IL-12 signalling and Th1 differentiation, suggesting that it may be effective in treating multiple sclerosis and other Th1-cell-mediated autoimmune diseases.³¹

Schizophrenia

Evidence from one study suggests that quercetin (in combination with other antioxidants) might benefit patients with schizophrenia.³²

Miscellaneous

Preliminary evidence suggests that quercetin may be of benefit in allergic rhinitis and against various viruses, including herpes simplex and respiratory syncytial viruses.⁴

Conclusion

Quercetin is the subject of intense research on the basis of its antioxidant, anti-inflammatory and anti-cancer activities. *In vitro* studies have demonstrated that quercetin offers potential in preventing CVD and cancer, and possibly cataract. However, controlled clinical trials in humans are needed before any conclusions can be drawn about the value of quercetin supplementation.

Precautions/contraindications

None reported.

Pregnancy and breast-feeding

No problems have been reported, but there have not been sufficient studies to guarantee the safety of quercetin in pregnancy and breast-feeding.

Adverse effects

Orally, quercetin may cause headache and tingling of the extremities.

Interactions

None reported.

Dose

The dose is not established. Typical oral doses range from 400 to 500 mg three times daily.

Quercetin is administered by injection (but this is not a dietary supplement use).

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274 Quercetin

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