P.O. Box 144345 Austin, TX 78714-4345 ▪ 512.926.4900 ▪ Fax: 512.926.2345 ▪ www.herbalgram.org

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Mariann Garner-Wizard, Brenda Milot, ELS, Diane Graves, MPH, RD, Heather S Oliff, PhD, Shari Henson, Densie Webb, PhD

FILE: ▪Curcumin (*Curcuma longa*)
▪Turmeric Chemistry & Pharmacology

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RE: Review of the Biological Activity of Curcumin

Cronin JR. Curcumin: Old spice is a new medicine. *Alternative & Complementary Therapies* February 2003:34-38.

Curcumin (*Curcuma longa*; a.k.a. *C. domestica*) is derived from the spice turmeric, which is related to ginger (*Zingiber officinale*), and has been culinary and medical staple in Asia for thousands of years. In Ayurvedic medicine, it is used to treat arthritic pain, inflammation, skin disease, dysentery, fever, infection, and jaundice. In traditional Chinese medicine, it is used for gallbladder and liver disorders, to control bleeding, and to treat chest congestion and menstrual discomfort.

Fractional crystallization of an alcohol extract of the rhizome yields several curcuminoids: curcumin, bis-desmethoxycurcumin, desmethoxycurcumin, and α- and β-curcumene as well as the sesquiterpenoids zingerberene, turmerone, and ar-turmerone. Steam distillation yields different compounds, principally α-curmerene. Components of an aqueous extract, while not well-characterized, include the polypeptide turmerin. Curcumin contains 133 chemicals. The diketone curcumerin (1,7-bis[4-hydroxyl-3-methoxyphenyl]-1.6-heptadiene-3/5-dione) is currently receiving the most research attention.

The U.S. Agricultural Research Service lists 78 biologic activities associated with curcumin, from anti-HIV actions to antiulcerogenic actions. Over 760 articles are listed on the PubMed database; nearly 400 of these have been published within the last four years. Twenty-six U.S. patents were issued for medicinal uses of curcumin in 2001 and 2002, while only 12 were granted in the previous ten years.

Recent research focuses on antioxidant, hepatoprotecive, anti-inflammatory, anticarcinogenic, and antimicrobial properties of curcumin. Studies conducted prior to 1993 found positive results for curcumin in treating gastric ulcers and dyspepsia, lowering serum cholesterol, relieving symptoms related to external cancerous lesions, and treating postoperative inflammation. The author also reviews a number of recent studies.

Most research on curcumin has been done in animal and in vitro studies. Several studies have examined the potential of curcumin to control angiogenesis, and positive results have been obtained with squamous-cell carcinoma, breast cancer, and prostate cancer cell cultures, as well as in reducing the angiogenesis of diabetic retinopathy. Animal studies have also found that curcumin enhances apoptosis (genetically determined process of cell self-destruction) and suppresses proliferation of tumor cells. In a recent study, multidrug-resistant human cervical cancer cells were treated with curcumin. Expression of P-glycoprotein,

which often protects cancer cells from treatment drugs, was reduced, and the cells' sensitivity to vinblastine was increased.

Curcumin is a potent antioxidant. Cultured endothelial cells from bovine aorta, when incubated with curcumin, expressed heme oxygenase, an enzyme that reacts to oxidative stress, produced the antioxidant biliverdin, and showed enhanced resistance to oxidative damage. Curcumin's ability to quench singlet oxygen in an aqueous system has recently been reported. Rabbits fed an extract of curcumin and a high-cholesterol diet developed fewer fatty streak aortal lesions and showed less depletion of vitamin E and coenzyme Q10 than controls.

Animal studies have confirmed curcumin's ability to protect the liver from various toxic substances. In cultures of human liver cells, three curcuminoids, including curcumin, showed strong protective effects against tacrine, used to treat Alzheimer's disease, which has hepatotoxic side effects.

Dosage and toxicity studies have found that curcumin is well-tolerated; however, no therapeutic dosages have been determined. In late 2002, the University of Michigan at Ann Arbor was recruiting subjects for a phase I dosage/toxicity trial of curcumin, in preparation for testing its efficacy in preventing colorectal cancer. There may be a potential for interaction between curcumin and blood-thinners such as warfarin, as there is with many anti-inflammatory drugs. There have been reports of liver toxicity involving large dietary doses given to rats or mice, but there are also several reports in clinical studies of high human tolerance to curcumin. Low bioavailability, due to curcumin's rapid metabolization and excretion, has been reported in many studies, but the author points out that only low serum levels of curcumin may be needed to account for observed effects, that metabolites of curcumin may be as important or even more so than curcumin itself, and that the action of curcumin or its metabolites may be centered in cell membranes rather than cytoplasm or serum. Synergistic interactions have been reported between curcumin and other phytochemicals. Cronin specifically mentions piperine, an extract of black pepper (*Piper nigrum*). Combining the two has been found to increase absorption, serum level, and bioavailability of curcumin. Also, green tea (*Camellia sinensis*), and catechin, a polyphenol from tea, combined with curcumin, have been found to inhibit and to reduce cancer growth in animal models, and, in combination with chemoprevention, were more efficacious than individual components alone. A study of curcumin and radiation therapy found that mice receiving a curcumin supplement prior to radiation had less damage from the radiation, and that its effectiveness was enhanced.

While there is no evidence that supplementation with curcumin or turmeric is effective in preventing any disease, Cronin writes that, except for people taking blood-thinners, and possibly pregnant women or individuals with gallstones, "there seems little reason to recommend that anyone avoid taking a moderate (e.g., 1–2 g) dose of turmeric powder per day...or its equivalent in curcumin."

¾ *Mariann Garner-Wizard*

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