

Curcuma longa (turmeric) Indena photo



Curcuma longa

Description

Curcuma longa, a perennial herb and member of the Zingiberaceae (ginger) family, grows to a height of three to five feet and is cultivated extensively in Asia, India, China, and other countries with a tropical climate. It has oblong, pointed leaves and funnel-shaped yellow flowers.¹ The rhizome, the portion of the plant used medicinally, is usually boiled, cleaned, and dried, yielding a yellow powder. Dried *Curcuma longa* is the source of the spice turmeric, the ingredient that gives curry powder its characteristic yellow color. Turmeric is used extensively in foods for both its flavor and color, as well as having a long tradition of use in the Chinese and Ayurvedic systems of medicine, particularly as an anti-inflammatory and for the

treatment of flatulence, jaundice, menstrual difficulties, hematuria, hemorrhage, and colic. Turmeric can also be applied topically in poultices to relieve pain and inflammation.² Current research has focused on turmeric's antioxidant, hepatoprotective, anti-inflammatory, anticarcinogenic, and antimicrobial properties, in addition to its use in cardiovascular disease and gastrointestinal disorders.

Active Constituents

The active constituents of turmeric are the flavonoid curcumin (diferuloylmethane) and various volatile oils, including tumerone, atlantone, and zingiberone. Other constituents include sugars, proteins, and resins. The best-researched active constituent is curcumin, which comprises 0.3-5.4 percent of raw turmeric.²

Pharmacokinetics

Pharmacokinetic studies in animals have demonstrated that 40-85 percent of an oral dose of curcumin passes through the gastrointestinal tract unchanged, with most of the absorbed flavonoid being metabolized in the intestinal mucosa and liver.^{3,4} Due to its low rate of absorption, curcumin is often formulated with bromelain for increased absorption and enhanced anti-inflammatory effect.

Mechanisms of Action

Antioxidant Effects

Water- and fat-soluble extracts of turmeric and its curcumin component exhibit strong antioxidant activity, comparable to vitamins C and E.⁵ A study of ischemia in the feline heart demonstrated that curcumin pretreatment decreased ischemia-induced changes in the heart.⁶ An *in vitro* study measuring the effect of curcumin on endothelial heme oxygenase-1, an inducible stress protein, was conducted utilizing bovine aortic endothelial cells. Incubation (18 hours) with curcumin resulted in enhanced cellular resistance to oxidative damage.⁷

Hepatoprotective Effects

Turmeric has been found to have a hepatoprotective characteristic similar to silymarin. Animal studies have demonstrated turmeric's hepatoprotective effects from a variety of hepatotoxic insults, including carbon tetrachloride (CCl₄),^{8,9} galactosamine,¹⁰ acetaminophen (paracetamol),¹¹ and *Aspergillus* aflatoxin.¹² Turmeric's hepatoprotective effect is mainly a result of its antioxidant properties, as well as its ability to decrease the formation of pro-inflammatory cytokines. In rats with CCl₄-induced acute and subacute liver injury, curcumin administration significantly decreased liver injury in test animals compared to controls.⁹ Turmeric extract inhibited fungal aflatoxin production by 90 percent when given to ducklings infected with *Aspergillus parasiticus*. Turmeric and curcumin also reversed biliary hyperplasia, fatty changes, and necrosis induced by aflatoxin production.¹² Sodium curcumin, a salt of curcumin, also exerts choleric effects by increasing biliary excretion of bile salts, cholesterol, and bilirubin, as well as increasing bile solubility, therefore possibly preventing and treating cholelithiasis.¹³

Anti-inflammatory Effects

The volatile oils and curcumin of *Curcuma longa* exhibit potent anti-inflammatory effects.¹⁴⁻¹⁶ Oral administration of curcumin in instances of acute inflammation was found to be as effective as cortisone or phenylbutazone, and one-half as effective in cases of chronic inflammation.¹⁶ In rats with Freund's adjuvant-induced arthritis, oral administration of *Curcuma longa* significantly reduced inflammatory swelling compared to controls.¹⁵ In monkeys, curcumin inhibited neutrophil aggregation associated with inflammation.¹⁷ *C. longa's* anti-inflammatory properties may be attributed to its ability to inhibit both biosynthesis of inflammatory prostaglandins from arachidonic acid, and neutrophil function during inflammatory states. Curcumin may also be applied topically to counteract inflammation and irritation associated with inflammatory skin conditions and allergies, although care must be used to prevent staining of clothing from the yellow pigment.¹⁶

Anticarcinogenic Effects

Animal studies involving rats and mice, as well as *in vitro* studies utilizing human cell lines, have demonstrated curcumin's ability to inhibit carcinogenesis at three stages: tumor promotion,¹⁸ angiogenesis,¹⁹ and tumor growth.²⁰ In two studies of colon and prostate cancer, curcumin inhibited cell proliferation and tumor growth.^{21,22} Turmeric and curcumin are also capable of suppressing the activity of several common mutagens and carcinogens in a variety of cell types in both *in vitro* and *in vivo* studies.²³⁻²⁶ The anticarcinogenic effects of turmeric and curcumin are due to direct antioxidant and free-radical scavenging effects, as well as their ability to indirectly increase glutathione levels, thereby aiding in hepatic detoxification of mutagens and carcinogens, and inhibiting nitrosamine formation.²⁷

Antimicrobial Effects

Turmeric extract and the essential oil of *Curcuma longa* inhibit the growth of a variety of bacteria, parasites, and pathogenic fungi. A study of chicks infected with the caecal parasite *Eimera maxima* demonstrated that diets supplemented with 1-percent turmeric resulted in a reduction in small intestinal lesion scores and improved weight gain.²⁸ Another animal study, in which guinea pigs were infected with either dermatophytes, pathogenic molds, or yeast, found that topically applied turmeric oil inhibited dermatophytes and pathogenic fungi, but neither curcumin nor turmeric oil affected the yeast isolates. Improvements in lesions were observed in the dermatophyte- and fungi-infected guinea pigs, and at seven days post-turmeric application the lesions disappeared.²⁹ Curcumin has also been found to have moderate activity against *Plasmodium falciparum* and *Leishmania major* organisms.³⁰

Cardiovascular Effects

Turmeric's protective effects on the cardiovascular system include lowering cholesterol and triglyceride levels, decreasing susceptibility of low density lipoprotein (LDL) to lipid peroxidation,³¹ and inhibiting platelet aggregation.³² These effects have been noted even with low doses of turmeric. A study of 18 atherosclerotic rabbits given low-dose (1.6-3.2 mg/kg body weight daily) turmeric extract demonstrated decreased susceptibility of LDL to lipid peroxidation, in addition to lower plasma cholesterol and triglyceride levels. The higher dose did not decrease lipid peroxidation of LDL, but cholesterol and triglyceride level decreases were noted, although to a lesser degree than with the lower dose.³¹ Turmeric extract's effect on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increased conversion of cholesterol to bile acids in the liver.¹³ Inhibition of platelet aggregation by *C. longa* constituents is thought to be via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis.³²

Gastrointestinal Effects

Constituents of *Curcuma longa* exert several protective effects on the gastrointestinal tract. Sodium curcumin ate inhibited intestinal spasm and p-tolymethylcarbinol, a turmeric component, increased gastrin, secretin, bicarbonate, and pancreatic enzyme secretion.³³ Turmeric has also been shown to inhibit ulcer formation caused by stress, alcohol, indomethacin, pyloric ligation, and reserpine, significantly increasing gastric wall mucus in rats subjected to these gastrointestinal insults.³⁴

Clinical Indications

Hepatoprotection, Cholelithiasis, and Cholestasis

Turmeric's hepatoprotective effects, evidenced in a number of animal studies, suggest it may be used in cases of toxic insult due to exogenous toxins from lifestyle and environmental exposures. Curcumin has choleric activity that increases bile output and solubility, which may be helpful in treating gallstones.⁸⁻¹³

Inflammation

Curcumin is a potent anti-inflammatory with specific lipoxygenase- and COX-2- inhibiting properties. Animal, *in vitro*, and *in vivo* studies demonstrate turmeric's effectiveness at decreasing both acute and chronic inflammation.¹⁴⁻¹⁷ A double-blind, crossover, placebo-controlled human study of 42 patients with osteoarthritis used a combination product containing turmeric, *Boswellia serrata*, *Withania somnifera*, and zinc. After three months on the combination or placebo, patients noted a significant reduction in pain ($p < 0.001$) and disability ($p < 0.05$).³⁵

Cancer

Numerous animal, *in vitro*, and *in vivo* studies have demonstrated the anticarcinogenic effects of turmeric and its flavonoid component curcumin against colon,^{36,37} breast,³⁸⁻⁴⁰ and prostate^{22,41} cancers, as well as melanoma.⁴² A human study of 25 individuals at high risk of neoplasia or with pre-malignant lesions noted histologic improvement in one of two patients with recently resected bladder cancer, two of seven patients with oral leukoplakia, one of six patients with intestinal metaplasia of the stomach, one of four patients with cervical intra-epithelial neoplasm, and two of six patients with Bowen's disease. More clinical trials need to be performed to further elucidate the potential of this botanical in cancer prevention and treatment.⁴³

Hyperlipidemia

Animal³¹ and *in vitro* studies have shown the potential for turmeric to decrease blood lipids. Further clinical studies need to be performed in this area to discover optimal dosages for cardiovascular protection and lipid lowering.

Gastric Ulcer

An open, phase II trial was performed on 25 patients with endoscopically-diagnosed gastric ulcer. Participants were given 600 mg powdered turmeric five times daily. After four weeks, ulcers had completely healed in 48 percent of patients. The success rate increased over time, with 76 percent being ulcer free after 12 weeks of treatment. No significant adverse reactions or blood abnormalities were noted.⁴⁴

Chronic Anterior Uveitis

Thirty-two patients with chronic anterior uveitis took 375 mg curcumin three times daily for 12 weeks. Curcumin was effective in 86 percent of individuals, and was as effective as corticosteroid therapy, the only available standard treatment.⁴⁵

Side Effects and Toxicity

No significant toxicity has been reported following either acute or chronic administration of turmeric extracts at standard doses. At very high doses (100 mg/kg body weight), curcumin may be ulcerogenic in animals, as evidenced by one rat study.³³

Dosage

Doses of 500-8,000 mg of powdered turmeric per day have been used in human studies. Standardized extracts are typically used in lower amounts, in the 250-2,000 mg range.

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