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Review Article

A REVIEW ON SPICE OF LIFE CURCUMA LONGA (TURMERIC)

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ABSTRACT : Curcumin obtained by solvent extraction of turmeric i.e., the ground rhizomes of Curcuma longa L. belonging to family Zingiberaceae and most useful herbal medicinal plant. Extensive research within the last half a century has proven that most of these activities, associated with turmeric are due to curcumin. Curcumin has been shown to exhibit various diseases such as anti- inflammatory, anti-oxidant, antifungal. Antimicrobial, antiulcer, anticancer and hepatoprotective activities and thus has a potential against various malignant diseases, diabetes, allergies, arthritis, Alzheimer's disease and other chronic diseases. These effects are mediated through the regulation of various transcription factors, growth factors, inflammatory cytokines, protein kinase and other enzymes remarkably non-toxic. The purpose of this review is to provide a brief summary of the current knowledge of the effects of curcumin. Curcumin exhibits great promise as a therapeutic agent, and is currently in human clinical trials for a variety of conditions. Since multi targeted therapy is more effective than the mono targeted therapy, curcumin has promising scope in the future research.

Key words: Curcuma longa**,** Curcumin, traditional uses, Pharmacology.

INTRODUCTION

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. 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 its flavor and color, as well as having a long tradition of use in the Chinese and Ayurvedic systems of medicine; India has a rich history of using plants for medicinal purposes. Turmeric is a medicinal plant extensively used in Ayurveda, Unani and Siddha system of medicine as home remedy for various diseases. Turmeric is widely consumed in the countries of its origin for a variety of uses, including as a dietary spice, a dietary pigment, and an Indian folk medicine for the treatment of various illnesses. It is used in the textile and pharmaceutical industries and in Hindu religious ceremonies in one form or another. Current traditional Indian medicine uses it for biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism, and sinusitis. The old Hindu texts have described it as an aromatic stimulant and carminative. Powder of turmeric mixed with slaked lime is a household remedy for the treatment of sprains and swelling caused by injury, applied locally over the affected area. In some parts of India, the powder is taken orally for the treatment of sore throat. This nonnutritive Phytochemical is pharmacologically safe, considering that it has been consumed as a dietary spice.

Turmeric (*Curcuma longa*) is extensively used as a spice, food preservative and colouring material in India, for the last few decades, extensive work has been done to establish the biological activities and pharmacological actions of turmeric and its extracts. Curcumin (diferuloylmethane), the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions. These include its anti-inflammatory, antioxidant, anticarcinogenic, Antimutagenic, anticoagulant, antifertility, antidiabatic, antibacterial, antifungal, antiprotozoal, antiviral, antifibrotic, Antivenom, antiulcer, hypertensive and hypocholesteremic activities. Its anticancer effect is mainly mediated through induction of apoptosis. Safety evaluation studies indicate that both turmeric and curcumin are well tolerated at a very high dose without any toxic effects. Thus, both turmeric and curcumin have the potential for the development of modern medicine for the treatment of various diseases.

TRADITIONAL USES

In ancient times turmeric was much appreciated for its nutritional value as well as the ginger. It was mentioned in the Atharva Veda of India and in ancient Sanskrit writings. In China it is mentioned in the Pent-sao of the VII century and in Arab countries it is mentioned from the X century. However, its use began to decline in the middle Ages. Dioscorides in the year 77 called it Cyperus, although in the XVI century it was given other names: Crocus indicus, turmerack and currently, curcuma, which is derived from the Arabic kurkum and from the Hebrew karkom which means «yellow». The term longa refers to the elongated shape of its rhizome. The fact that it is a domestic plant led the botanist, Valeton, to coin the name Curcuma domestica. The English name turmeric is taken from Sanskrit and means «yellow», in reference to the colour which comes from the coloured substances of the rhizome, and with which the Hindus dyed their clothes for ceremonial acts: births, marriages or deaths. The Peruvian name «palillo» in reality is an abbreviation of Palo Amarillo (yellow stick), a name given to those plants, which can stain in that colour. The Buddhist monks still use to stain their tunics with this species.
Turmeric is traditionally used a lot in the Middle East as a liver protector, a stimulant of bile duct Secretions, anti-flatulent, diuretic, for curing catarrh, aphrodisiac, anti-parasite, for the circulation, antifever and anti-inflammatory. In extreme cases, it is used for healing and disinfection of wounds (even in purulent opthalmopathies) and for rheumatism or sprains. The boiled extract of the rhizome is used for these purposes. Some Hindu women apply or rub the turmeric rhizome on the skin to prevent or reduce hair growth. In the north-east of Brazil they usually draw a circle around the eyes of children who suffered from measles, to prevent them from contracting conjunctivitis. In the French West Indies the boiled extract is used to prevent scurvy and in the island of Guadeloupe as an antidote against poisoning by the tree, manzanillo-Hippomane mancinella. In Haiti they prepare the extract of the rhizome with salt to treat jaundice. Nowadays it is used as a food, being the main constituent of curry, medicine and colouring.

CLASSIFICATION OF CURCUMA LONGA

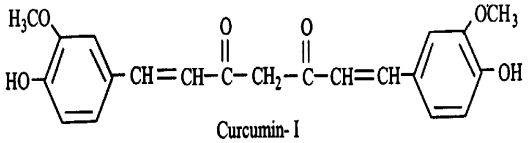
		Class	Liliopsida
Subclass	Commelinids		
		Order	Zingiberales
Family	Zingiberaceae		
		Genus	*Curcuma*
Species	*Curcuma longa*		

NAME IN INTERNATIONAL LANGUAGES

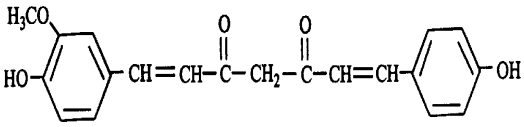
Spanish	: Curcuma
French	: Curcuma
German	: Kurkuma Gelbwurzel
Swedish	: Gurkmeja
Arabic	: Kurkum
Dutch	: Geelwortel
Italian	: Curcuma
Portuguese	: Acafrao-da-India
Russian	: Zholty Imbir
Japanese	: Ukon
Chinese	: Yu.Chin

CHEMICAL COMPOSITION OF TURMERIC

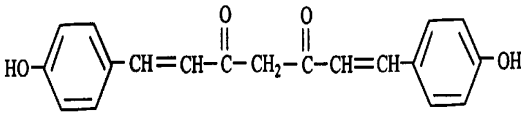
Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). The essential oil (5.8%) obtained by steam distillation of rhizomes has *a*-phellandrene (1%), sabinene (0.6%), cineol (1%), borneol (0.5%), zingiberene (25%) and Sesquiterpenes (53%)5. Curcumin (diferuloylmethane) (3–4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%)6. Demethoxy and bisdemethoxy derivatives of curcumin have also been isolated7 (Figure 1). Curcumin was first isolated8 in 1815 and its chemical structure was determined by Roughley and Whiting9 in 1973. It has a melting point at 176–177°C; forms a reddish-brown salt with alkali and is soluble in ethanol, alkali, ketone, acetic acid and chloroform.



Curcumin- I



Curcumin- II



Curcumin- III

PHARMACOLOGY OF CURCUMIN

ANTI-INFLAMMATORY ACTIVITY

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. 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 ($p<0.05$).

ANTIOXIDANT ACTIVITY

The antioxidant activity of curcumin was reported77 as early as 1975. It acts as a scavenger of oxygen free radicals. It can protect hemoglobin from oxidation. *In vitro*, curcumin can significantly inhibit the generation of reactive oxygen species (ROS) like superoxide anions, H2O2 and nitrite radical generation by activated macrophages, which play an important role in inflammation. Curcumin also lowers the production of ROS *in vivo*. Its derivatives, demethoxycurcumin and bis-demethoxycurcumin also have antioxidant effect. Curcumin exerts powerful inhibitory effect against H2O2-induced damage in human keratinocytes and fibroblasts31 and in NG 108-15 cells80.

ANTIFERTILITY ACTIVITY

Petroleum ether and aqueous extracts of turmeric rhizomes Show 100% antifertility effect in rats when fed orally. Implantation is completely inhibited by these extracts. Curcumin inhibits 5*a*-reductase, which converts testosterone to 5*a*-dihydrotestosterone, thereby inhibiting the growth of flank organs in hamster. Curcumin also inhibits human sperm motility and has the potential for the development of a novel intravaginally contraceptive.

WOUND HEALING ACTIVITY

The topical administration of curcumin extracts on skin wounds on the skin of diabetic rats demonstrated an improvement in the wound healing process. The reparation action mechanism involved an increase in the levels of beta transforming growth factor plus an increase in the activity of the enzyme nitric oxide synthase (Alonso J., 2004). The wound-healing activity of turmeric has been widely studied and it has been seen that its local application is effective. In Chinese medicine it has been used for this purpose since ancient times (Srimal RC., 1997).

ANTICOAGULANT ACTIVITY

Curcumin shows anticoagulant activity by inhibiting collagen and adrenaline-induced platelet aggregation *in vitro* as well as *in vivo* in rat thoracic aorta.

ANTIFUNGAL ACTIVITY

Ether and chloroform extracts and oil of *C. longa* have antifungal effects. Crude ethanol extract also possesses antifungal activity. Turmeric oil is also active against *Aspergillus flavus*, *A. parasiticus*, *Fusarium moniliforme* and *Penicillium digitatum*.

ANTIDIABETIC EFFECT

Curcumin prevents galactose-induced cataract formation at very low doses. Both turmeric and curcumin decrease blood sugar level in alloxan-induced diabetes in rat. Curcumin also decreases advanced glycation end products induced Complications in diabetes mellitus.

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, angiogenesis, and tumor growth. In two studies of colon and prostate cancer, curcumin inhibited cell proliferation and tumor growth.

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. 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.

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. 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 dermatophytes and fungi-infected guinea pigs, and at seven days post-turmeric application the lesions disappeared. Curcumin has also been found to have moderate activity against *Plasmodium falciparum* and *Leishmania major* organisms.

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, and inhibiting platelet aggregation. 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. 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. Inhibition of platelet aggregation by *C. longa* constituents is thought to be via potentiation of prostacyclins synthesis and inhibition of Thromboxane synthesis.

GASTROINTESTINAL EFFECTS

Constituents of *Curcuma longa* exert several protective effects on the gastrointestinal tract. Sodium curcuminate inhibited intestinal spasm and p-tolymethylcarbinol, a turmeric component, increased gastrin, secretin, bicarbonate, and pancreatic enzyme secretion. 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.

CURCUMIN AFFECTS ALZHEIMER'S DISEASE

Brain inflammation in Alzheimer's disease (AD) patients is characterized by increased cytokines and activated microglia. Epidemiological studies suggest reduced AD risk is associated with long-term use of nonsteroidal anti-inflammatory drugs (NSAIDs). Whereas chronic ibuprofen suppressed inflammation and plaque-related pathology in an Alzheimer transgenic APPSw mouse model (Tg2576), excessive use of NSAIDs targeting cyclooxygenase I can cause gastrointestinal, liver, and renal toxicity. One alternative NSAID is curcumin. Lim et al found that curcumin reduced oxidative damage and amyloid pathology in an Alzheimer transgenic mouse model. To evaluate whether it could affect Alzheimer-like pathology in the APPSw mice, they tested the effect of a low (160 ppm) and a high (5000 ppm) dose of dietary curcumin on inflammation, oxidative damage, and plaque pathology.Low and high doses significantly lowered oxidized proteins and IL-1, a proinflammatory cytokine usually elevated in the brains of these mice. With low-dose, but not high-dose, curcumin treatment, the astrocytic marker glial fibrillary acidic protein was reduced, and insoluble beta-amyloid (A), soluble A, and plaque burden were significantly decreased, by 43 to 50%.

However, levels of amyloid precursor in the membrane fraction were not reduced. Microgliosis was also suppressed in neuronal layers but not adjacent to plaques. In view of its efficacy and apparent low toxicity, this Indian spice component has promise for the prevention of Alzheimer's disease.

PHOTO-PROTECTOR ACTIVITY

This action is due to its antioxidant activity. 25% of the lipids of the surface of the skin are unsaturated, and therefore, are easily attacked by free radicals. The ultraviolet rays of the sun penetrate the skin and accelerate the damage caused by these radicals. Prolonged exposure to these radiations means that the collagen and elastin fibres, responsible for the elasticity and integrity of the skin, may be degraded by inherent enzymes, thus causing deterioration in the texture of the skin. In laboratory studies, extract of turmeric was shown to be effective in suppressing inflammation and protecting the epidermal cells from the damages caused by ultraviolet B radiation (Prakash L. & Majeed S., 2003). Curcumin, in small doses, has been shown to have the capacity to protect against chromosomal damage caused by gamma radiation. Curcumin has also been shown to inhibit the mutagenic induction effect of UV rays (Alonso J., 2004).

COSMETIC PROPERTIES

Turmeric extract – rich in curcuminoids – is widely known for its anti-inflammatory, anti-oxidant and antimicrobial properties, among others. The action mechanism of curcumin may be considered multicentric since it acts as a prostaglandin inhibitor, stabilizer of the liposomal membranes, inhibitor of the activity of leucotrienes and thromboxane B4 without affecting the synthesis of prostacyclins, stimulator of adrenal steroidogenesis, substance P depletor in nerve terminals (similarly to cayenne) and antioxidant (Alonso J., 2004; Srimal RC., 1997).

USED IN 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.

ANTI-HYPERLIPIDEMIC EFFECTS

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.

ANTIFIBROTIC EFFECT

Curcumin suppresses bleomycin-induced pulmonary fibrosis in rats. Oral administration of curcumin at 300 mg/kg dose inhibits bleomycin-induced increase in total cell counts and biomarkers of inflammatory responses. It also suppresses bleomycin-induced alveolar macrophage production of TNF-*a*, superoxide and nitric oxide.

ANTIPROTOZOAN ACTIVITY

The ethanol extract of the rhizomes has anti- Entamoeba histolytica activity. Curcumin has anti-Leishmania activity in vitro. Several synthetic derivatives of curcumin have anti-L. amazonensis effect. Anti-Plasmodium falciparum and anti-L. Major effects of curcumin have also been reported.

Plant of Curcuma longa (Turmeric)

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