



P-ISSN: 2349-8528  
E-ISSN: 2321-4902  
IJCS 2018; 6(4): 1354-1357  
© 2018 IJCS  
Received: 24-05-2018  
Accepted: 28-06-2018

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## International Journal of Chemical Studies

### Medicinal properties of turmeric (*Curcuma longa* L.): A review

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#### Abstract

Turmeric is an herbaceous evergreen plant in the Zingiberaceae (ginger) family. Turmeric (*Curcuma longa*) is extensively used as a spice, food preservative and colouring material in India, China and South East Asia. Turmeric powder is best known as one of the main ingredients used to make the curry spice; it also gives ballpark mustard its bright yellow colour. Apart from its culinary uses, turmeric has been used widely in the traditional medicine all over the world. Curcumin (diferuloylmethane), the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions. These include its antiinflammatory, antioxidant, anticarcinogenic, antimutagenic, anticoagulant, antifertility, antidiabetic, antibacterial, antifungal, antiprotozoal, antiviral, antifibrotic, antivenom, antiulcer, hypotensive and hypocholesteremic activities. For traditional Ayurvedics, turmeric plant was an excellent natural antiseptic, disinfectant, anti-inflammatory, and analgesic, while at the same time the plant has been often used to aid digestion, to improve intestinal flora, and to treat skin irritations.

**Keywords:** Turmeric, curcumin, antibacterial and anticarcinogenic

#### Introduction

Turmeric is an herbaceous evergreen plant in the Zingiberaceae (ginger) family. It is cultivated extensively in Asia mostly in India and China. Probably originated from India, turmeric has been used in India for at least 2500 years. Turmeric plant is distributed throughout tropic and subtropical region of the world. The origin of the plant is not certain, but it is thought to be originated from south eastern Asia, most probably from India. The plant is cultivated in all parts of India (Kapoor, 2000) [8]. India produces most of the world supply (Leung and Foster, 1996) [10], but turmeric is cultivated also in southern China, Taiwan, Japan, Burma, and Indonesia as well as throughout the African continent. In Brazil, turmeric use has increased mainly due to its coloring property and its ability to improve food odour (Neghetini *et al.*, 2006) [15]. The commercially available material (i.e. turmeric powder) in Europe is obtained mainly from India and somewhat from other south eastern Asian countries (Murugananthi *et al.*, 2008) [12]. It is most common in southern Asia and particularly in India.

Turmeric is a sterile plant and does not produce any seeds. The plant grows up to 3-5 ft tall and dull yellow flowers. The rhizome is an underground stem that is thick and fleshy ringed with the bases of old leaves is part of turmeric which posses a potential medicinal property. Rhizomes are boiled and then dried and ground to make the distinctive bright yellow spice. Turmeric powder has a peppery bitter flavour and a mild fragrance slightly reminiscent of orange and ginger. While turmeric powder is best known as one of the main ingredients used to make the curry spice, it also gives ballpark mustard its bright yellow colour. Apart from its culinary uses, turmeric has been used widely in the traditional medicine in India, Pakistan, and Bangladesh because of its several beneficial properties (Chattopadhyay *et al.*, 2004) [3]. For traditional Ayurvedics, turmeric plant was an excellent natural antiseptic, disinfectant, anti-inflammatory, and analgesic, while at the same time the plant has been often used to aid digestion, to improve intestinal flora, and to treat skin irritations. Also, in South Asia it has been used as a readily available antiseptic for cuts, burns, and bruises. However, several other beneficial properties are reported in folk medicine. The rhizome is extensively used in Ayurveda and traditional medicine. Curcumin, the yellow colour pigment of turmeric, is produced industrially from turmeric oleoresin. Turmeric is commonly used as spice is well documented for its medicinal properties in India and Chinese system of medicine. It has been widely used for treatment of several diseases.

Medicinal plants have provided a reliable source for preparation of new drugs as well as combating diseases, from the dawn of civilization. The extensive survey of the literature revealed that *Curcuma turmeric* is highly regarded as universal panacea in the herbal medicine with a wide spectrum of pharmacological activities (Nasri *et al.*, 2014) [13]. It has various useful properties with antioxidant activities and is useful in conditions such as inflammation, ulcer and cancer. The presence of various metabolites such as curcuminoid, oil content, flavonoids, phenolics, some important amino acids, protein and high alkaloid content reveals that co-relation with its medicinal uses (Sarangthem and Haokip, 2010) [20]. Table 1 represent the biochemical content in dried turmeric rhizomes and table 2 representing biological activity of turmeric. It has antifungal, anti-bacterial, anti-parasitic, antimutagen, antimicrobial and renal, allergies, arthritis, Alzheimer's disease and other chronic and hard curable diseases. Several studies have shown the antioxidant and antimicrobial properties of Turmeric essential oils (NEGI *et al.*, 1999 and NAZ *et al.*, 2010) [16, 14].

The purpose of this review to focuses on the medicinal and pharmacological properties of turmeric as anti-inflammatory, antioxidant, hepatoprotective, anticarcinogenic, antidiabetic, antimicrobial and antidepressant in addition to its use in cardiovascular disease, gastrointestinal and neurological disorder. Due to these biological activities turmeric widely used as medicinal plant.

**Table 1:** Biochemical content in dried turmeric rhizomes

Curcumin	3.1-3.4%	Niranjan <i>et al.</i> , 2003.
Anthocyanins	18.9-37.0 g/g	''
Phenols	0.15- 0.62%	''
Tannins	0.32-0.76%	''
Protein content	3.6-6.8%	''
Sugars	20.5-43.4%	''
Oil	3.7-5.3%	''
Ash	6.9-9.8%	''
Moisture	90.2-91.3%	''

**Table 2:** Biological activity of turmeric and its compound

Sl. No	Compound/ extract	Biological activity	Reference
1.	Turmeric powder	Antitumor, Ant protozoan Anti inflammatory and Wound-healing	Gujral <i>et al.</i> , (1953)
2.	Methylcurcumin	Anti protozoan	Gomes <i>et al.</i> , (2002)
3.	Demethoxycurcumin and Bisdemethoxycurcumin	Antioxidant	Unnikrishnan <i>et al.</i> , (1995)
4.	Volatile oil	Anti-inflammatory, Antibacterial, Antifungal	Chandra <i>et al.</i> , (1972)
5.	Curcumin	Antibacterial, Anti protozoan, Antiviral, Antitumor and Antioxidant	Lutomski <i>et al.</i> , (1974)

Curcumin is also a powerful antioxidant. Antioxidants scavenge molecules in the body known as free radicals, which damage cell membranes, tamper with DNA, and even cause cell death. Antioxidants can fight free radicals and may reduce or even help prevent some of the damage they cause. In addition, curcumin lowers the levels of two enzymes in the body that cause inflammation. It also stops platelets from clumping together to form blood clots. Research suggests that turmeric may be helpful for the following conditions:

#### Increase the antioxidants in body

Oxidative damage is one of the mechanisms which are responsible for aging and many kind of disease. The free radicals involved in this mechanism react highly with organic substance in our body which can cause harm. Curcumin doesn't only block the free radicals: it also stimulates the antioxidant mechanism in our body. This is probably one of the best benefits of turmeric for our body. The antioxidant activity of curcumin was reported (Sharma *et al.*, 1976) [31] as early as 1975. It acts as a scavenger of oxygen free radicals (Ruby *et al.*, 1995 and Subramanian *et al.*, 1994) [29, 30]. It can protect haemoglobin from oxidation (Unnikrishnan *et al.*, 1995) [22, 28]. Curcumin also lowers the production of ROS *in vivo*. This is brought about by maintaining the activities of antioxidant enzymes like superoxide dismutase, catalase and glutathione peroxidase. Recently, we have observed that curcumin prevents oxidative damage during indomethacin-induced gastric lesion not only by blocking inactivation of gastric peroxidase, but also by direct scavenging of H<sub>2</sub>O<sub>2</sub> and ·OH (unpublished observation). Since ROS have been implicated in the development of various pathological conditions (Bandyopadhyay *et al.*, 1999) [32], curcumin has the

potential to control these diseases through its potent antioxidant activity.

#### Cancer

There has been a great deal of research on turmeric's anti-cancer properties, but results are still very early. Cancer should be treated with conventional medications. A lot of studies have shown that curcumin can be very beneficial in the treatment of cancer using herbs. It can influence the growth, development and spread of cancer cells at a molecular level. Curcumin acts as a potent anticarcinogenic compound. Among various mechanisms, induction of apoptosis plays an important role in its anticarcinogenic effects. It induces apoptosis and inhibits cell-cycle progression, both of which are instrumental in preventing cancerous cell growth in rat aortic smooth muscle cells (Gautam *et al.*, 1998) [26]. Colon carcinoma is also prevented by curcumin through arrest of cell-cycle progression independent of inhibition of prostaglandin synthesis. Curcumin suppresses human breast carcinoma through multiple pathways. Curcumin also produces nonselective inhibition of proliferation in several leukaemia, nontransformed haematopoietic progenitor cells and fibroblast cell lines (Gautam *et al.*, 1998) [26]. Nitric oxide (NO) and its derivatives play a major role in tumour promotion. Curcumin also increases NO production in NK cells after prolonged treatment, culminating in a stronger tumouricidal effect (Bhaumik *et al.*, 2000) [27]. Curcumin also suppresses tumour growth through various pathways. Recently, an interesting observation was made regarding curcumin-induced apoptosis in human colon cancer cell and role of heat shock proteins (hsp) thereon94. In this study, SW480 cells were transfected with hsp 70 cDNA in either the sense or antisense orientation and stable clones were selected

and tested for their sensitivity to curcumin. Curcumin was found to be ineffective to cause apoptosis in cells having hsp 70, while cells harbouring antisense hsp 70 were highly sensitive to apoptosis by curcumin as measured by nuclear condensation, mitochondrial transmembrane potential, release of cytochrome c, activation of caspase 3 and caspase 9 and other parameters for apoptosis (Rashmi *et al.*, 2004) [25].

### Heart Disease

Keeping healthy cholesterol level is essential to prevent cardiovascular issues and other serious health problem. High cholesterol level can be very detrimental to one's health, so people are always looking for ways to lower them. Studies have shown and proven that the simple act of adding turmeric to season your food can significantly lower blood cholesterol levels. Early studies suggested that turmeric may help prevent atherosclerosis, the build up of plaque that can block arteries and lead to heart attack or stroke. In animal studies, an extract of turmeric lowered cholesterol levels and kept LDL "bad" cholesterol from building up in blood vessels. Because it stops platelets from clumping together, turmeric may also prevent blood clots from building up along the walls of arteries. But a double-blind, placebo-controlled study found that taking curcumin, the active ingredient in turmeric, at a dose of up to 4 g per day did not improve cholesterol levels. Curcumin has significant hypocholesteremic effect in hypercholesteremic rats (Patil *et al.*, 1971) [18].

### Indigestion

Curcumin stimulates the gallbladder to produce bile, which some people think may help improve digestion. The German Commission E, which determines which herbs can be safely prescribed in Germany, has approved turmeric for digestive problems. And one double-blind, placebo-controlled study found that turmeric reduced symptoms of bloating and gas in people suffering from indigestion. Turmeric powder has beneficial effect on the stomach. It increases mucin secretion in rabbits and may thus act as gastroprotectant against irritants (Lee *et al.*, 2003) [9]. However, controversy exists regarding antiulcer activity of curcumin. Both antiulcer (Sinha *et al.*, 1975) [21] and ulcerogenic (Parsad *et al.*, 1976) [19] effects of curcumin have been reported but detailed studies are still lacking.

### Management of Obesity

People who would like to lose a couple of pounds or treat obesity and other similar condition can take benefits of turmeric powder which can be very helpful in keeping one's ideal body weight. The component in turmeric helps in boosting the flow of bile which is an essential element in the process of breaking down of dietary fats.

### Controlling Diabetes

Turmeric boosts glucose control and augments the effects of the medications which are used in the treatment of diabetes. It also lowers the body's resistance to insulin which can prevent Type-2 diabetes from developing.

### Relieve from arthritis

Turmeric has anti-inflammatory properties as well as the antioxidant properties which eliminate free radicals which are responsible for damaging the cell in the body. From this property of turmeric People who are suffering from arthritis can benefit a lot from using turmeric.

### Bacterial and Viral Infections

Test tube and animal studies suggest turmeric may kill bacteria and viruses. But researchers don't know whether it would work in people. The aqueous extract of turmeric rhizomes has antibacterial effects (Kumar *et al.*, 2001) [24]. Curcumin also prevents growth of *Helicobacter pylori* CagA+ strains *in vitro*. Both curcumin and the oil fraction suppress growth of several bacteria like *Streptococcus*, *Staphylococcus*, *Lactobacillus*, etc. Curcumin has been shown to have antiviral activity (Araujo *et al.*, 2001) [23]. It acts as an efficient inhibitor of Epstein-Barr virus (EBV). Most importantly, curcumin also shows anti-HIV (human immunodeficiency virus) activity by inhibiting the HIV-1 integrase needed for viral replication. It also inhibits UV light induced HIV gene expression [27]. Thus curcumin and its analogues may have the potential for novel drug development against HIV.

### Antifungal Property

Ether and chloroform extracts and oil of turmeric have antifungal effects (Apisariyakul *et al.*, 1995) [1]. Crude ethanol extract also possesses antifungal activity. Turmeric oil is also active against *Aspergillus flavus*, *A. parasiticus*, *Fusarium moniliforme* and *Penicillium digitatum* (Jayaprakasha *et al.*, 2001) [7].

### Skin Treatments

Turmeric has lots of benefits for the skin including speeding up the process of healing wounds, calming pores on the face to reduce acne. Since it has antioxidant and anti-inflammatory properties, which is really useful for treating skin problems.

### How does turmeric works

1. Imbalanced or depleted neurotransmitters can cause symptoms of depression.
2. Turmeric inhibits monoamine oxidase (MAO).
3. Turmeric aids serotonin and dopamine production to restore healthy neurotransmitter levels. Turmeric also creates more neurotransmitter receptor by promoting neurogenesis

### Future Prospects

Since ancient time turmeric has been used in ayurvedic medicine with various biological application. Now a day's researcher found enthusiasm in treating various diseases with natural product. Although some work has been done on the possible medicine application but not much study had done for drug development carried out yet. Curcumin is a non-toxic, highly promising natural antioxidant compound having a wide spectrum of biological functions. Curcumin is now available in pure form, which shows a wide spectrum of biological activities, it would be easier to develop new drugs from this compound after extensive studies on its mechanism of action and pharmacological effects. It is expected that curcumin may find application as a novel drug in the near future to control various disease, disorders and oxidative stress.

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