

REVIEW ARTICLE



Curcumin: A medicinal plant and its effects in medicine and dentistry

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Abstract

Since ancient time plants have been a major source of medicine. Curcumin (diferuloylmethane) is an orange-yellow component of turmeric (*Curcuma longa*), a spice often found in curry powder. Traditionally known for its anti-inflammatory effects, *C. longa* has a long history of the curative use in the Ayurvedic and Chinese systems of medicine. Curcumin, a polyphenolic constituent, is the active ingredient in dietary spice turmeric. While numerous pharmacological activities, including antioxidant and antimicrobial properties, anti-inflammatory properties have been attributed to curcumin, turmeric can also be used as a pit and fissure sealant, mouthwash, and subgingival irrigant in various preparations. In gel form, it is a component in local drugs delivery system. This review gives a bird's eye view mainly on the biological activities of the miswak and plausible medicinal and dental applications.

Keywords: Alternative therapy, *Curcuma longa*, dentistry, turmeric

Introduction

Turmeric is commonly used as a spice in curries, food additive and also, as a dietary pigment. It has been used to treat various illnesses in the Indian subcontinent from the ancient times.^[1] Turmeric 3-5 ft tall bearing oblong, pointed short-stemmed leaves and funnel-shaped yellow flowers. The rhizome of turmeric is a valuable cash crop, which is widely cultivated in Asia, India, China, and other tropical countries. Turmeric is used to treat angina pectoris, stomachache, postpartum abdominal pain, and gallstones in the Chinese system of medicine. Topical application is commonly used to treat bruises, pains, sprains, boils, swellings, sinusitis, and various skin disorder. It is used in Hindu religious ceremonies, and Hindus also apply a mixture of turmeric and sandalwood powder on their foreheads. Turmeric has been used as a nontoxic drug in Ayurveda for centuries to treat a wide variety of disorders including rheumatism, body ache, skin diseases, intestinal worms, diarrhea, intermittent, fevers, hepatic disorders, biliousness, urinary discharges, dyspepsia, inflammations, constipation, leukoderma, amenorrhea, and colic. Curcumin as such does not possess any nutritive value, however; it has been in constant use by humans as turmeric powder since Vedic times or even earlier and could be considered as pharmacologically

safe. Curcumin reportedly possesses several pharmacological properties including anti-inflammatory, antimicrobial, antiviral, antifungal, antioxidant, chemo sensitizing, radio sensitizing, and wound healing activities. Curcumin can suppress tumor initiation, promotion, and metastasis in experimental models. It can also act as an antiproliferative agent by interrupting the cell cycle, disrupting mitotic spindle structures, and inducing apoptosis and micronucleation. Apparently, curcumin is a pluripotent pharmacological agent that utilizes multiple molecular pathways to leave its imprint on biological systems.^[2]

Constituents

Turmeric is comprised of a group of three curcuminoids: Curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin, as well as volatile oils (tumerone, atlantone, and zingiberone), sugars, proteins, and resins. Curcumin is a lipophilic polyphenol that is nearly insoluble in water but is quite stable in the acidic pH of the stomach.^[3]

Commercial available form where curcumin is used as the main ingredient:

- Capsules
- Mouth wash

- Sub gingival irrigant
- Pit and fissure sealant

Medical Implications

Anti-oxidant effects

Water-and fat-soluble extracts of turmeric and its curcumin component exhibit strong antioxidant activity, comparable to vitamins C and E. A study of ischemia in the feline heart demonstrated that curcumin pre-treatment decreased ischemia-induced changes in the heart.^[4] Evaluating the outcome of curcumin by an *in vitro* study on endothelial heme oxygenase-1, an inducible stress protein, which was carried out by utilizing bovine aortic endothelial cells. Incubation (18 h) with curcumin ensued in intensified cellular resistance to oxidative damage.^[5]

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),^[6,7] galactosamine, acetaminophen (paracetamol), and *Aspergillus aflatoxin*.^[8] In rats with CCl₄-induced acute and subacute liver injury, curcumin administration significantly decreased liver injury in test animals compared to controls.^[7] Turmeric extract inhibited fungal aflatoxin production by 90% when given to ducklings infected with *Aspergillus parasiticus*. Turmeric and curcumin also reversed biliary hyperplasia, fatty changes, and necrosis induced by aflatoxin production.^[8]

Anti-inflammatory effects

The curcumin and volatile oils manifest anti-inflammatory effects. Curcumin given orally in cases of acute inflammation was found to be as efficacious as phenylbutazone or cortisone, and one-half potent in cases of chronic inflammation. Anti-inflammatory properties of *Curcuma longa* may be attributed to its potential to inhibit both the production of prostaglandins from arachidonic acid and neutrophil function during inflammation. Topical application of curcumin prevents inflammation caused due to inflammatory skin conditions and allergies. Take adequate care to prevent staining of clothes with the yellow pigment.^[9]

Anti-carcinogenic effects

Animal studies including rats and mice, also *in vitro* studies employing human cell lines, have revealed curcumin's potential to hamper carcinogenesis at three stages: tumor promotion, angiogenesis, and tumor growth. Curcumin shows cell proliferation and tumor growth which were studied in colon and prostate cancer. *In vitro* and *in vivo* studies Turmeric and curcumin have the ability of repressing the activity of various mutagens and carcinogens in a medley of cell types. Due to direct antioxidant and free-radical scavenging effects turmeric and curcumin produce anti-carcinogenic effect, their capability to

indirectly enhance glutathione levels, thereby assisting in hepatic detoxification of mutagens and carcinogens, and hindering nitrosamine formation.

Anti-microbial effects

Growth of bacteria, parasites, and pathogenic fungi is hampered by the turmeric extracts and the essential oil of *C. longa*. According to a study uptake of 1% turmeric as a dietary supplement showed improved weight gain and decline in small intestinal lesions in chicks infected with the cecal parasite *Eimeria maxima*. Another study which involved infecting guinea pigs with either dermatophytes, pathogenic molds or yeast revealed that topical application of turmeric oil reticent dermatophytes and pathogenic fungi. Although neither turmeric oil nor curcumin affected the yeast isolates. Dermatophytes and fungi-infected guinea pigs showed improvement in the lesions. The lesions disappeared completely after 7 days of applying turmeric. Curcumin possesses moderate activity against *Plasmodium falciparum* and *Leishmania major* organisms.

Cardiovascular effects

Protective effect of turmeric on the cardiovascular system lowers the triglyceride and cholesterol levels to decline the susceptibility of low-density lipoprotein (LDL) to lipid peroxidation, and hampers platelet aggregation. Even with low doses of turmeric these effects are visible. Triglyceride and cholesterol level decline were observed, but elevated dose did not decline lipid peroxidation of LDL. The reason for Turmeric extract's effect on cholesterol levels may be due to increased transformation of cholesterol to bile acids in the liver and reduced cholesterol uptake in the intestines. Platelet aggregation Inhibition by *C. longa* constituents is via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis.

Gastrointestinal effects

On the gastrointestinal tract the constituents of *C. longa* has several beneficial effects. Bicarbonate, pancreatic enzyme, secretin, and gastrin, secretion enhanced by p-tolymethylcarbinol, a turmeric component and intestinal spasm reduced by sodium curcumin. Turmeric is effective in inhibiting ulcers caused by alcohol indomethacin, reserpine, stress, and pyloric ligation, significantly enhancing the gastric wall mucus subjected to these gastrointestinal insults in rats.^[10]

Dental Implications

Dental problems can be relieved with the help of turmeric in the following ways. Dental pain ground, roasted turmeric eliminates pain and swelling of the aching teeth by massaging. Periodontal problems ½ tsp of mustard oil, 1 tsp of turmeric and ½ tsp of salt can be used to prepare a paste and utilized to treat gingivitis and periodontitis. This paste is used to rub gums and teeth twice a day.

Dental-Plaque Detection System

Caries is thought to be highly infectious diseases caused by microbes present in dental plaques, and it is well-known fact that the removal of dental plaque is extremely important for maintaining the oral health. However, naked eye is not capable of identifying the dental plaque. Hence, dyes are used to stain dental plaques to disclose their location. The dental-plaque detection system contains a dental-plaque staining agent, comprising of turmeric extracts and curcumin; and a light-emitting apparatus, which emits light in a range 250-500 nm wavelength to target dental plaque staining agent.^[11]

Pit and Fissure Sealant

In order to reduce the incidence of dental caries tinted pit and fissure sealant is applied on tooth surfaces. Acrylic monomer and one colorant selected from the group comprising of annatto extract, turmeric extract, and β -Apo-8.-Carotenal can help produce a pit and fissure sealant.^[12]

Mouth wash

Waghmare *et al.* conducted a study on about 100 subjects, which were randomly selected. On 0, 14, and 21 days both plaque index and gingival index were recorded. In addition to mechanical plaque control for the prevention of gingivitis, a very effective role of turmeric as well as chlorhexidine gluconate has been observed. When compared with chlorhexidine mouthwash turmeric mouthwash, which was prepared by dissolving 10 mg of curcumin extract in 100 ml of distilled water and 0.005% of flavoring agent peppermint oil with pH adjusted to 4 was equally effective. When anti plaque property was considered, the chlorhexidine gluconate is very effective. The effect of turmeric was contemplated to be because of its anti-inflammatory action. In both the groups, depletion of total microbial count was observed.^[13]

Sub gingival irrigant

Suhag *et al.* conducted a study in which periodontal sites were treated by scaling and root planning and later selected sites were irrigated (triple irrigation regimen) with chlorhexidine (0.2%), curcumin (1%), saline (0.9%), or control sites (non-irrigated) following instrumentation on baseline (day 0). For the next 5 consecutive days and on days 15 and 21 triple irrigation regimen was repeated. Clinical parameters (probing pocket depth, bleeding on probing, and redness) were recorded for 200 sites in 20 patients with chronic periodontitis. On days 2, 3, 4, and 5 there was a significant improvement in irrigated sites as compared with the non-irrigated sites for all the parameters, which were recorded. There was a significant reduction in redness (96%) and BOP (100%) by curcumin group as compared to the saline group and chlorhexidine group on day 5. At the next recall visits the difference between the groups was not significant. On all post-treatment days, mean paired-pulse depression depletion

was significantly higher for the curcumin group as compared to all other groups. As a subgingival irrigant, the inflammatory signs were better resolved by 1% curcumin solution when compared to saline and chlorhexidine irrigation.^[14]

Precancerous lesions

Curcumin has a crucial role in the treatment of in diverse precancerous conditions like lichen planus, oral submucous fibrosis and leukoplakia. *In vitro* and *in vivo* animal experiments activities of turmeric extract and turmeric oil have demonstrated. Symptoms of pain and burning sensation were decline and mouth opening was also reversed partially.^[12]

Recurrent Aphthous Stomatitis (RAS)

RAS is an inflammatory condition of unknown etiology affecting the oral mucosa. Approximately about 20% of the population suffers from RAS sometime in their lives. The disease mainly involves non-keratinized mucosal surfaces and is characterized by single or multiple painful ulcers with periodic recurrence and healing. The appearance of ulcers is preceded by a prodrome of localized burning or pain with lasts for around 24-48 h. The peak age of onset is between 10 and 19 years and may continue throughout life. Reports have shown that in patients who used conventional antiseptic gel, the lesion healed only after the period as in previous attacks. They experienced no early reduction in pain or frequency of recurrence. Patient noticed there is a decline in the pain and also the curcumin oil initiated healing effects on ulcers at an earlier stage of the application. A follow-up for 1 year has shown no recurrence in these patients.^[12]

Influence on Human Gingival Fibroblasts

Several studies have also revealed apoptosis of human primary gingival fibroblasts (hPGF) cells at lower doses like 1, 10 and 25 μ M of curcumin but at higher doses like 50, 60, 75 and 100 μ M, was statistically significant high apoptosis was noted. The effect of curcumin to treat microvascular endothelial cells and normal human fibroblasts using MTT assay and also noticed that normal human fibroblasts were stimulated by the lower dose of curcumin and hMVED, whereas higher doses inhibited it.^[12] According to other authors hPGF cells was treated by curcumin, which exhibit significant and maximum apoptosis at 75 μ M and showed a decrease in cell population and shrinkage of cell size and morphologic alterations in basal cell carcinoma cells after treatment with 50 nM curcumin and found cell shrinkage, disappearance of microvilli and appearance of membrane blebbing.^[15]

Side Effects and Toxicity

No significant toxicity was observed either acute or chronic administration of turmeric extracts at standard doses. Curcumin

may be ulcerogenic in animals, as evidenced by one rat study, at very high doses (100 mg/kg body weight).^[10]

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.^[10]

Conclusion

Turmeric benefits are: anti-septic, anti-allergic, astringent, analgesic, carminative, anti-inflammatory, anti-oxidant, appetizer, cardiovascular, anti-bacterial, anti-spasmodic, anti-tumor, diuretic, cholagogue and digestive. In dentistry, turmeric has various uses as sub gingival irrigant, mouth wash, dental-plaque detection system and pit and fissure sealant. Herbs and plant are used for dental care owing to their medicinal properties, and it is used in the day to day life. More research is required to know the use of turmeric in the field of dentistry.

Serial number	Constituents	Quantity % ^[12]
1	Curcumin (curcuminoids)	2-4
2	Volatile (essential) oil	3-7
3	Fiber	2-7
4	Mineral matter	3-7
5	Protein	6-8
6	Fat	5-10
7	Moisture	6-13
8	Carbohydrates	60-70

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