

Role of curcumin in systemic and oral health: An overview

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Abstract

Various modalities of treatment are available for different dental diseases, but the major drawback of these conventional drug therapies is the numerous side effects associated with their use. This has led to renewed interest in the discovery of novel anti-infective natural compounds derived from plants. Plants have been the major source of medicine since the time immemorial. Turmeric has been attributed a number of medicinal properties in the traditional system of medicine. The objective of this article is to review the efficacy of turmeric herb in maintenance of oral health, in particular, and overall health, in general. Turmeric, a rhizome of *Curcuma longa*, is a herb known for its medicinal properties and is a more acceptable and viable option for a common man. It has proven properties like anti-inflammatory, antioxidant, antimicrobial, hepatoprotective, immunostimulant, antiseptic, and antimutagenic. Due to these properties, it is quite useful in dentistry as well. It has a role in the treatment of periodontal diseases and oral cancers. Turmeric can also be used as a pit and fissure sealant, mouth wash, and subgingival irrigant in different preparations. It can also be used as a component in local drug delivery system in gel form.

Key words: Antimicrobial, medicine, mouthwash, oral health, turmeric

INTRODUCTION

Medicinal plants have been used as a traditional treatment agent for numerous human diseases since ages in many parts of the world. In rural areas of the developing countries, they continue to be used as the primary source of medicine. About 80% of the people in developing countries use traditional medicines for their health care. The frequent use and misuse of the currently used therapeutic agents has led to the evolution of resistant strains of common pathogens as well as increased incidence of adverse effects associated with their usage. Hence, the search for alternative products continues, and natural phytochemicals isolated from plants used as traditional medicines are considered as a good alternative source. As

only 1% of approximately 5,00,000 plant species worldwide has been phytochemically investigated until date, there is great potential for discovering novel bioactive compounds.

Turmeric (*baldi*), a rhizome of *Curcuma longa*, is a flavourful yellow-orange spice. Its plant is 3 feet in height and has lance-shaped leaves and spikes of yellow flowers that grow in a fleshy rhizome or in underground stem. An orange pulp contained inside the rhizome constitutes the source of turmeric medicinal powder.^[1] Components of turmeric are named curcuminoids, which include mainly curcumin (diferuloyl methane), demethoxycurcumin, and bisdemethoxycurcumin. Curcumin (diferuloylmethane) is a polyphenol derived from *Curcuma longa* plant, commonly known as turmeric. 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% of raw turmeric. Curcumin has been used extensively in ayurvedic medicine for centuries, as it is nontoxic and has a variety of therapeutic properties including antioxidant, analgesic, anti-inflammatory, antiseptic activity, and anticarcinogenic activity.^[2]

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As a natural product, turmeric (curcumin) is nontoxic and has diversified effects in various oral diseases. About 40-85% 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. Due to its low rate of absorption, curcumin is often formulated with bromelain for increased absorption and enhanced anti-inflammatory effect.^[3,4]

APPLICATIONS OF CURCUMIN

Therapeutic applications of turmeric

The active constituent of turmeric is known as curcumin, which has been shown to have a wide range of therapeutic effects.^[5]

Antioxidant

Curcumin protects against free radical damage because it is a strong antioxidant.^[6] Water- and fat-soluble extracts of turmeric and its curcumin component exhibit strong antioxidant activity, comparable to that of vitamins C and E.^[7] 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 (for 18 hours) with curcumin resulted in enhanced cellular resistance to oxidative damage.^[8]

Anti-inflammatory

It reduces inflammation by lowering histamine levels and possibly by increasing the production of natural cortisone by the adrenal glands.^[9] Oral administration of curcumin in instances of acute inflammation was found to be as effective as cortisone or phenylbutazone, and half as effective in cases of chronic inflammation.^[10] Its 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.^[10]

Hepatoprotective

It protects the liver from a number of toxic compounds such as carbon tetrachloride (CCl₄),^[11,12] galactosamine,^[13] acetaminophen (paracetamol),^[14] and *Aspergillus* aflatoxin.^[15] Turmeric's hepatoprotective effect is mainly a result of its antioxidant properties as well as its ability to decrease the formation of proinflammatory cytokines. Sodium curcumin, a salt of curcumin, also exerts choleric effects by increasing biliary excretion of bile salts, cholesterol, and bilirubin as well as by increasing bile solubility, therefore, possibly preventing and treating cholelithiasis. Curcumin has choleric activity that increases bile output and solubility, which may be helpful in treating gallstones.^[16]

Antiplatelet aggregation

It has been shown to prevent platelets from clumping together, which in turn improves circulation.^[17] Inhibition of platelet aggregation by curcumin constituents is thought to be via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis.^[17]

Antimutagenic

Curcumin is antimutagenic as it potentially helps to prevent new cancers that are caused by chemotherapy or radiation therapy used to treat existing cancers. It effectively inhibits metastasis (uncontrolled spread) of melanoma (skin cancer) cells and may be especially useful in deactivating the carcinogens in cigarette smoke and chewing tobacco.^[18,19] 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,^[20] angiogenesis,^[21] and tumor growth.^[22] In two studies of colon and prostate cancer, curcumin inhibited cell proliferation and tumor growth. The anticarcinogenic effects of turmeric and curcumin are due to direct antioxidant and free-radical scavenging effects and their ability to indirectly increase glutathione levels, thereby aiding in hepatic detoxification of mutagens and carcinogens and in inhibiting nitrosamine formation.^[23,24]

Antimicrobial

Turmeric extract and the essential oil of *Curcuma longa* inhibits the growth of a variety of bacteria, parasites, and pathogenic fungi. Improvements in lesions were observed in the dermatophyte- and fungi-infected guinea pigs, as at 7 days post-turmeric application, the lesions disappeared.^[25] Curcumin has also been found to have moderate activity against *Plasmodium falciparum* and *Leishmania major*.^[26]

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,^[27] and inhibiting platelet aggregation.^[17] These effects have been noted even with low doses of turmeric. A study of 18 atherosclerotic rabbits administered 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. Higher dose did not decrease lipid peroxidation of LDL, but cholesterol and triglyceride level decreases were noted, although to a lesser degree than with lower dose. Turmeric extract's effect on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increase conversion of cholesterol to bile acids in the liver.^[16]

Local effects

Fresh juice from the rhizome or a paste prepared from turmeric or decoction is often used as a local application as well as internally in the treatment of leprosy, snake bites, and vomiting associated with pregnancy.^[28]

Gastric effects

Curcumin has a significant role in cases of gastric ulcers. An open, phase II trial was performed on 25 patients with endoscopically diagnosed gastric ulcer. Participants were provided 600 mg powdered turmeric, five times daily. After 4 weeks, ulcers had completely healed in 48% patients. The success rate increased over time, with 76% being ulcer free after 12 weeks of treatment. No significant adverse reactions or blood abnormalities were noted.^[29]

Chronic anterior uveitis

Thirty-two patients with chronic anterior uveitis were provided 375 mg curcumin, three times daily for 12 weeks. Curcumin was effective in 86% patients and was as effective as corticosteroid therapy, the only available standard treatment.^[30]

Dental applications of turmeric

Turmeric can be used in following ways to offer relief from dental problems.

Dental pain

Massaging the aching teeth with roasted, ground turmeric eliminates pain and swelling.^[2]

Periodontal problems

Topical application Applying a paste made from 1 tsp of turmeric with ½ tsp of salt and ½ tsp of mustard oil provides relief from gingivitis and periodontitis. It is recommended to rub the teeth and gums with this paste twice daily.^[2]

Mouth wash In a study by Waghmare *et al.* about 100 subjects were randomly selected. Both gingival index and plaque index were recorded at 0, 14, and 21 days. It was concluded that chlorhexidine gluconate as well as turmeric mouthwash can be effectively used as an adjunct to mechanical plaque control methods in prevention of plaque and gingivitis. Turmeric mouthwash prepared by dissolving 10 mg of curcumin extract in 100 ml of distilled water and 0.005% of flavouring agent peppermint oil with pH adjusted to 4 is found to be as effective as most widely used chlorhexidine mouthwash. Though chlorhexidine gluconate has been found to be more effective when antiplaque property was considered. The effect of turmeric observed may be because of its anti-inflammatory action. Reduction in total microbial count was observed in both the groups.^[31]

Local drug delivery system

In a study conducted by Behal *et al.*, 30 subjects with chronic localized or generalized periodontitis with pocket depth of 5-7 mm were enrolled in a split-mouth study design. Control sites received Scaling and Root Planing [SRP] alone, while experimental sites received SRP plus 2% whole turmeric gel. Both groups demonstrated statistically significant reduction in plaque index, gingival index, sulcus bleeding index, probing pocket depth, and gain in relative attachment loss. There was a significant reduction in the trypsin-like enzyme activity of “red complex” microorganisms. Greater reduction was observed in all parameters in the experimental group in comparison to those in the control group. Thus, the local drug delivery system containing 2% whole turmeric gel can be used as an adjunct to scaling and root planning.^[32]

Subgingival irrigant

In a study conducted by Suhag *et al.*, periodontal sites were treated on day 0 (baseline) by a single episode of scaling and root planing. Subsequently selected sites were irrigated (triple irrigation regimen) with either saline (0.9%), chlorhexidine (0.2%), curcumin (1%), or served as nonirrigated control sites on day 0 (baseline) immediately following instrumentation. Triple irrigation regimen was repeated for the next 5 consecutive days and on days 15 and 21. Clinical parameters recorded were probing pocket depth (PPD), bleeding on probing (BOP), and redness for 200 sites in 20 patients with chronic periodontitis. The results indicated that the irrigated sites had significant improvement in all parameters as compared with the nonirrigated sites on days 2, 3, 4, and 5. The curcumin group showed significant reduction in BOP (100%) and redness (96%) when compared with the chlorhexidine group and saline group on day 5. However, the difference between groups was not significant at the next recall visits. Mean PPD reduction was significantly greater for the curcumin group than all other groups on all post-treatment days. Thus, 1% curcumin solution can cause better resolution of inflammatory signs than chlorhexidine and saline irrigation as a subgingival irrigant.^[33]

Pit and fissure sealant

This sealant can be produced from a composition comprising a polymerizable resin system containing acrylic monomer and at least one colorant selected from the group consisting of annatto extract, turmeric extract, and β -Apo-8'-Carotenol.^[2]

Anticancer properties

Curcumin has been found to possess anticancer activities because of its effect on a variety of biological pathways involved in mutagenesis, oncogene expression, cell cycle regulation, apoptosis, tumorigenesis, and metastasis. It

potentiates the effect of chemotherapy and acts as an enhancer of radiotherapy. Also, it is found to arrest carcinomatous cells in the G2/M phase of cell cycle, in which cells are more susceptible to cytotoxic effects of radiotherapy.^[34]

Precancerous lesions

Its role in the treatment of various precancerous conditions like oral submucous fibrosis, leukoplakia, and lichen planus has also been studied. Turmeric extract and turmeric oil have demonstrated oncopreventive activity in *in vitro* and *in vivo* animal experiments. The local symptoms of burning sensation and pain were reduced and partial reversal of opening of the mouth was also observed.^[35]

Adverse effects

Generally considered safe, but may cause gastric irritation, stomach upset, nausea, diarrhoea, allergic skin reaction, and antithrombosis activity interfering with blood-clot formation.

Future challenges

One of the major concerns with developing curcumin for clinical efficacy is its low oral bioavailability that can be attributed to its poor absorption, high rate of metabolism in the intestines, and rapid elimination from the body. Also, little information is available to determine its safety in higher doses. Nanotechnology-based novel strategies are being aggressively explored worldwide to enhance curcumin's bioavailability and reduce perceived toxicity.^[36]

CONCLUSION

Turmeric is considered a safe, nontoxic, and effective alternative for many conventional drugs due to its distinguished therapeutic properties and multiple effects on various systems of the body. Its role in the treatment of cancers is very promising. However, there is scarcity of information and research in this field. Therefore, further research is required to determine the optimal dosage, bioavailability, and bio-efficacy of curcumin-based drugs.

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