CURCUMIN- PHARMACOLOGICAL ACTIONS AND ITS ROLE IN DENTISTRY

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ABSTRACT

Turmeric (Curcuma longa) is an ancient dye, flavouring and medical herb, widely used in Asian countries. It is a herb that has been widely used in Indian medicine, cookery, and cosmetics. The main component of turmeric is curcumin. Curcumin has a surprisingly wide range of beneficial properties includes anti inflammatory, antioxidant, chemopreventive, chemotherapeutic activity etc. The activity of curcumin derived from its complex chemistry as well as its ability to influence the multiple signalling pathways. This review article is to highlight the pharmacological action and its therapeutic role in dentistry.

KEY WORDS: Curcumin, Turmeric, Antibiotic, Antioxidant, Oral health, Dental infection.

INTRODUCTION

Phytotherapy i.e., the use of herbal agents as medicines is gaining interest in medicine and dentistry. These ethnopharmacological therapies have claimed wide attention globally. One very widely used home remedy which has been an area of focus in medicine is turmeric (Curcuma longa). The active component of turmeric is curcumin. A member of the Zingiberaceae family, it is cultivated in several parts of the Indian subcontinent, South East Asia and South America. It has widely used in cookery, cosmetics, fabric dying and medicine for more than 2000 years. The dimensions of this rhizome range between 2.7 - 7 cm in length and about 2.5 cm in diameter.

Curcumin (diferuloylmethane), the main yellow active component of turmeric has been to have a wide spectrum of biological actions. Turmeric has held an important position in India’s traditional ayurvedic medicine. In Ayurveda, it was prescribed for treatment of many medical problems ranging from constipation to skin disease and in both Ayurvedic and Chinese medicines, it is considered to be a bitter digestive and carminative. In Unani, turmeric is considered as blood purifiers and safest herb of choice. It is an excellent anti inflammatory herb, used in treatment of arthritis, rheumatoid arthritis, injuries, trauma. Curcumin exhibits a big promise as a therapeutic agents and is currently in human trails for a variety of conditions like multiple myeloma, pancreatic cancer, colon cancer, myelodysplastic syndromes, psoriasis, Alzheimer’s disease, diabetic nephropathy. It also play important role in dentistry in treating periodontal disease, to maintain good oral hygiene, oral cancers. It can also be used as a component in local drug delivery system in gel form.

CHEMISTRY OF TURMERIC

Curcumin(1,7-bis4-hydroxy-3-methoxyphenyl-1,6-heptadiene-3,5-Dione) is the most active polyphenolic constituent, powerful ingredient in the traditional herbal practices.

Chemical composition of turmeric

Turmeric includes protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%), moisture (13.1%). The essential oil obtained from the steam distillation of rhizomes has alpha-phellandrene (1%), sabinene (0.6%), cineol (1%), bornoel (0.5%), zingiberene (25%), sesquiterpines (53%) .

Components of turmeric

The components of turmeric are known as curcuminoids comprised of curcumin (diferuloylmethane), demethoxycurcumin and bisdemethoxycurcumin. Curcumin was first isolated in1815, the chemical structure was found by Roughley and Whiting in 1973. The melting point of curcumin is 184°C. It is soluble in ethanol and acetone but insoluble in water. They also exists as keto-enol tautomers. Most recent available preparation of curcumin includes approximately of 77% diferuloylmethane, 18% demethoxycurcumin, 5% bis-demethoxycurcumin.
Pharmacokinetics

Curcumin has shown therapeutic efficacy against many human diseases, one of the major concerns with curcumin is its poor oral bioavailability that can be attributed due to its poor absorption, high rate of metabolism in the intestines and rapid systemic elimination from body. Efforts have been made to improve curcumin's bioavailability and reduce their toxicity. Adjuvants that can block the metabolic pathway of curcumin have been most extensively used to increase the bioavailability of the polyphenol. For instance, in humans receiving a dose of 2g curcumin alone, serum levels have been either undetectable or very low, but concomitant administration of piperine was associated with an increase of 2000% in the bioavailability of curcumin. Other advance approaches to increase the bioavailability of curcumin based on nanotechnology include use of nanoparticles, liposomes, micelles, phosphor lipid complexes and structural analogues.

PHARMACOLOGICAL ACTIONS

The variety of human disorders against which curcumin has potential has been revealed by numerous clinical trials. The roles relevant to dentistry has been discussed below:

Anti-inflammatory effects
Curcumin has the ability to suppress the acute and chronic inflammation. It reduces inflammation by lowering histamine levels and by possibly increasing the production of natural cortisone by adrenal glands. They also reduces pain from arthritis, bursitis, tendonitis, stiffness of joints. It also inhibits the biosynthesis of inflammatory prostaglandins from the arachidonic acid and neutrophil function. Curcumin has been found to be superior to placebo and NSAID.

Anticarcinogenic effects
Curcumin potentially helps to prevent the new cancers that are caused by chemotherapy or radiation used to treat existing cancers. It effectively inhibits metastasis (uncontrolled spread) of melanoma and may be especially useful in deactivating the carcinogens in cigarette smoke and chewing tobacco.

Antimicrobial effects
Curcumin and the oil fraction inhibits the growth of variety of bacteria like Streptococci, Staphylococci, Lactobacillus, etc and also prevents Helicobacter pylori Cag A + strains in vitro. It is also effective against Enterococcus faecalis, and will serve to be useful as root canal medicaments in endodontics. It also acts as an antifungal agent which is active against Aspergillus flavus, A.parasiticus, Fusarium moniliforme, Penicillium digitatum. It has antiprotozoan activity against E.histolytica, Leishmania, Plasmodium falciparum. It also has antiviral effect which inhibits HIV in test tube studies and also inhibits UV light induced HIV gene expression.

Photodynamic effects
Curcumin (1,7-bis-4-hydroxy-3-methoxyphenyl-1,6-heptadiene-3,5-Dione) has potential as a photo sensitizer for photo dynamic treatment of localised superficial infection in eg: the mouth or skin. In vitro studies reveals that aqueous preparations of curcumin has phototoxic effects against certain bacteria like Enterococcus faecalis, Streptococcus intermedius, E.coli. Also photo dynamic inactivation of Candida albicans in a murine model of Oral candidiasis has been noted.

Antihyperalgesic effect
Curcumin has diverse therapeutic effects as anti oxidant, anti inflammatory ,anti-cancer ,etc it also exhibits antihyperalgesic effect. The vanilloid moiety of curcumin is considered most important for activation of the Transient Receptor Potential Vanilloid 1(TRPV1) which have anti nociceptive effects under behavioural studies and in vitro whole cell patch –clamp recordings in the trigeminal system.

Therapeutic role in dentistry
Turmeric has been recommended to be used in following ways to relief from the dental pain. As a mouth rinse: 5g of turmeric powder in 200 mL boiling water, mixed with two cloves and dried leaves of guava has been claimed to give significant pain relief. Paste form: Mixing 1 tsp of turmeric with salt (1/2 tsp) and mustard oil (1/2 tsp) gives a paste, which when massaged over the gums offers relief from gingivitis and periodontitis.

Pit & Fissure Sealant
Pit and fissure sealants are normally used in children to prevent development of dental caries. They may be colored for easy identification on future recalls. The use of curcumin serves two roles in that, it gives a color tint to the pit and fissure sealant. Furthermore, being antibacterial, curcumin would also serve to prevent caries. These formulations contain a resin and in addition may contain extracts of other agents apart from curcumin.

Dental –Plaque detection system
Dental Plaque is usually colourless and may not be easily detected. Dental plaque detection system involves an agent (dye, usually in solution or tablet form), which stains plaque and allows its detection. It includes dental plaque staining agent with yellow pigment of beni-koji, turmeric extracts, curcumin and a light-emitting apparatus which have outputs light having a wavelength within a range of 200 – 500 nm to an object in the oral cavity where the dental plaque staining agent is attached.
Anticariogenic effect
The inhibitory effects of an essential oil isolated from Curcuma longa on the cariogenic property of Streptococcus mutans has been observed at concentrations from 0.5 to 4 mg/ml. And also exhibits the significant inhibition of S.mutans adherence to saliva coated hydroxyapatite beads and inhibited the formation of S.mutans at concentrations higher than 0.5 mg/ml [17,18].

Prevention of plaque and gingivitis
Anti inflammatory property of turmeric has been studied and demonstrated significant reduction of inflammation[9]. Curcumin oil used as a treatment modality in Recurrent Apthous Stomatitis[19]. An orally applicable composition for treatment and prevention of periodontal diseases using a bio adhesive formulation comprises curcuminoids as an active agent. has been described in the literature, composed of curcumin, tetra hydro curcumin, bishydro curcumin, crude drug and solvents extracts of Curcuma longa, one or more bio adhesive polymers such as hydroxyl propyl cellulose, hydroxyl propyl methyl cellulose, sodium carboxy methyl cellulose , hydroxyl ethyl cellulose and caromers and sodium chloride, sodium bicarbonate or mixtures and one or more excipients[19].

Mouth wash
Turmeric mouth wash can be effectively used as an adjunct to mechanical plaque control methods. Ten mg of curcumin can be dissolved in 100 mL distilled water. The flavor may be enhanced by using peppermint oil. The pH of these mouthwashes have been adjusted to 4 and a study has shown that this mouthwash is as effective as a chlorhexidine mouth wash[19,21].

Local drug delivery system
Local drug delivery system containing 2 % whole turmeric gel form as an adjunct to scaling and root planning treatment showed significant reduction in plaque index, gingival index, sulcus bleeding index, probing, pocket depth and gain in relative attachment loss. There was significant reduction in trypsin – like enzyme activity of “red complex ” microorganisms, namely Bacteroides forsythus, Porphyromonas gingivalis and Treponema denticola[21].

As a subgingival irrigant in periodontics
Curcumin 1% as sub ginvial irrigant resulted in significant reduction in bleeding on probing and redness, when compared with chlorhexidine and saline group as an adjunctive therapy in periodontitis patients[19,21]. They can cause better resolution of inflammatory signs than chlor hexidine and saline irrigation, by selectively reducing the inflammatory mediators and causing shrinkage by reducing inflammatory oedema and vascular engorgement of connective tissues[7]. Curcumin also enhances wound healing by causing increase in fibronectin and transforming growth factor transcription[22]. One fraction of crude polysaccharides extracted from the rhizomes of wild turmeric, Curcuma aromatic Salisb (Zingiberaceae) can significantly induce human gingival fibroblasts cells proliferation by 30 % while the other fraction could inhibits gingival fibroblast cells proliferation by 92%[22].

As an intra canal medicament in endodontics
Chemo mechanical preparation is a pivotal step for infection control during root canal treatment. During the stages of cleaning and shaping, instrumentation, irrigation promotes microbial reduction. Effectiveness of Curcumin against E.faecalis biofilm in root canals was studied and compared to that with sodium hypochlorite, Curcumin over comes the disadvantages of NaOCl includes unpleasant taste, toxicity, in ability to remove smear layer and limited anti bacterial activity, dentientral effect on dentin macrophages structural integrity, elasticity and flexural strength Future scope and research warranted that Curcumin can be used as an irrigant and intra canal – medicament[19].

In precancerous lesions
Curcumin has its role in the treatment of various pre cancerous conditions like Oral submucous fibrosis, leukoplakia, oral lichen planus. Turmeric extract and oil have demonstrated oncopreventive activity in in vitro and in vivo animal experiments. Curcuminoids at doses of 6000 mg/d in 3 divided doses were well tolerated and may prove efficacy in controlling signs and symptoms of oral Lichen planus[23]. Curcumin also holds a promising future in the treatment of oral submucous fibrosis.

CONCLUSIONS
Curcumin is considered a safe, non-toxic and effective alternative for many conventional drugs due to its distinguished therapeutic properties and multiple effects on various systems on the human body. Future research is required to determine the optimal dosage, bioavailability and bioefficacy of curcumin–based drugs. As the number of research studies on therapeutic effects of Curcumin keeps on increasing across the globe, it appears that Curcumin truly holds a promising future in therapeutic applications including dentistry.

REFERENCES