

**Review Article**

**The Medicinal Chemistry of Curcuma Longa : A Narrative Review**

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**Abstract:**

In Asian nations, the spice curcuma longa (often known as turmeric) is utilised in traditional medicine. Curcumin, which is the most active component, has a lot of therapeutic potential. Turmeric, a rhizome of the Curcuma longa plant, is a more palatable and practical alternative for the average person. It has been proven to have hepatoprotective, anti-inflammatory, antioxidant, antiseptic, antibacterial, and antimutagenic effects. These characteristics make it highly valuable in dentistry, particularly for the treatment of periodontal disease and oral cancer. It aids in the local delivery of medication when used in the gel form. Additionally, it can be utilised in various mouthwash formulations, subgingival irrigants, and pit and fissure sealants. This article looks at its medical uses in dentistry.

**Keywords:** Curcuma longa, Health, Oral health, anti-inflammatory

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**Introduction:**

An ancient spice known as turmeric is generated from the turmeric plant's rhizome, a perennial member of the ginger family with a short stem, broad oblong leaves, and ovate, pyriform, or oblong rhizomes. that are frequently branching and brownish-yellow in colour. In India, it is known as haldi, and the British termed it curry spice. <sup>1,2</sup> Traditionally, turmeric is used as a curry spice as well as a food flavouring and colouring ingredient. Nigeria, Australia, the West Indies, Peru, Jamaica, as well as a few other Caribbean and Latin American nations, China, Taiwan, Sri Lanka,

Bangladesh, Burma (Myanmar), are the major producers of turmeric. <sup>1,3</sup> In India, Turmeric is produced in the world's largest quantity, making up roughly 78% of global production and is the most significant exporter and consumer of turmeric. <sup>4</sup>

Carbs (69.4%), fat (5.1%), moisture (23.1%), protein (6.3%), minerals (3.5%) make up the chemical makeup of turmeric. By steam distilling rhizomes, sesquiterpines (53%), zingiberene (25%), a-phellanderene (1%), cineol (1%), sabiene (0.6%), borneol (0.5%), are extracted as volatile oils (5-

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8%).<sup>5,6</sup> Curcumin, bisdemethoxycurcumin and demethoxycurcumin are included as the curcuminoids, which are a class of substances found in turmeric. The main curcuminoid, curcumin, makes up about 2-5% of turmeric accountable for the colour yellow which is the spice's characteristic as well as significant proportion of its healing abilities. The majority of curcumin preparations now on the market comprise roughly 77% diferuloylmethane, 18% desmethoxycurcumin, and 5% bis-desmethoxycurcumin.<sup>7,8</sup>

### **Mechanism of Action of Turmeric:**

The significant therapeutic efficacy of curcumin is because of its poor solubility and bioavailability. The objective of this review is to emphasize on the beneficial anti-inflammatory properties, current advances in the dosage form and nanoparticle distribution system of curcumin. Curcumin may also be used therapeutically to prevent or treat cancer. The subsequent mechanisms were suggested.<sup>9</sup>

### ***Anti-Inflammatory Effects:***

Excellent anti-inflammatory medicines, curcumin is administered orally and is proven to be half as efficient in treating acute inflammation as phenylbutazone or in situations of chronic inflammation as cortisone. Oral treatment of turmeric significantly decreased inflammatory swelling in comparison to controls in mice that had Freund's adjuvant-induced arthritis. Curcumin reduced inflammation-related neutrophil aggregation in monkeys. The anti-inflammatory effects of curcuma longa may also be due to its capacity to suppress the neutrophil activity and the release of inflammatory prostaglandins from arachidonic acid. Curcumin can also be administered topically to reduce swelling and itching brought on by allergies and inflammatory skin diseases, yet caution must be taken to avoid clothes discoloration due to the yellow colour.<sup>10</sup>

### ***Antibacterial Property of Curcumin:***

In 2010, Shagufta Naz conducted a study where the volatile oils of Kasur, Faisalabad and Bannu varieties were tested against four bacterial strains using the agar well diffusion method to assess the antibacterial activity of turmeric forms against various bacterial strains. All bacterial strains in this study revealed a zone of inhibition following the ethanol-based extraction of curcuminoids and oil. In comparison to the other two types, the Kasur variety of turmeric demonstrated the strongest ability to suppress the growth of all examined bacterial strains.<sup>11</sup>

### ***Antiplatelet Aggregation:***

Turmeric has been recognized to inhibit platelets from clumping and thus, improving circulation over time. Curcumin prevents platelet aggregation by stimulating prostacyclin synthesis and inhibiting thromboxane synthesis.<sup>12</sup>

### ***Antioxidant Property:***

Due to its potent antioxidant properties, curcumin defends against oxidative damage.<sup>13</sup> Extracts of turmeric and its curcumin component that are both fat-soluble and water-soluble have been shown to have potent antioxidant properties comparable to those of vitamins A and C.<sup>14</sup> In an in vitro experiment which was assessed on endothelial heme oxygenase-1, using bovine aortic endothelial cells, the effect of curcumin, which was a stress-inducible protein. Curcumin exhibits enhanced cellular resilience to oxidative damage after an 18-hour incubation.<sup>15</sup>

### ***Antimutagenic Property:***

Curcumin has antimutagenic properties as it may aid in preventing new malignancies brought on by chemotherapy or radiotherapy when used to treat tumours. It successfully prevents melanoma (skin cancer) cells from metastasizing (spreading uncontrollably), and it should be immensely beneficial in eliminating the toxins in tobacco chewing and cigarette smoke.<sup>16,17</sup> Curcumin has been shown to be able

to block carcinogenesis at three different phases, including tumour promotion,<sup>18</sup> angiogenesis, and tumour growth,<sup>19</sup> in both animal experiments and in vitro research using human cell lines.<sup>20</sup> Curcumin suppressed tumour growth and cell division in 2 trials on prostatic and colon cancer. Because of their direct antioxidant and free radical elimination effects, turmeric and curcumin have anticarcinogenic potential and their capacity to indirectly raise glutathione levels.<sup>21,22</sup>

#### ***Local Effects:***

Leprosy, snake bites, and pregnancy-related nausea and vomiting are typically treated with fresh extract, a paste derived from turmeric, or a plant decoction.<sup>23</sup>

#### ***Gastric effects:***

A substantial role for curcumin is seen in cases of stomach ulcers. On 25 patients who had peptic ulcers that were determined by endoscopy, a phase II open clinical study was conducted. Five times a day, they received 600 mg of turmeric powder. In 48% of patients, ulcers were fully cured after 4 weeks. According to the study's findings, after receiving treatment for 12 weeks, 76% of all participants were free of ulcers.<sup>24</sup>

#### ***Dental Applications of Turmeric:***

Uses of turmeric in dentistry are multi-fold, as follows:

The use of turmeric leaves has been reported in literature for alleviation of dental pain. To get a quick relief, boil 200 g of water with two cloves, two dried guava leaves, and 5 g of turmeric powder. Additionally, bishop's weed seed and turmeric powder make the gums and teeth stronger.

#### ***Disease of the Periodontium:***

##### ***Preventing the Development of Plaque and Gingivitis:***

Turmeric mouthwash was utilised by Bhandari & Shankwalker, who discovered that curcumin has

antibacterial properties. Curcumin has been proposed as an alternate antibacterial agent for treating serious bacterial infections.<sup>25</sup>

Mouthwash: In their investigation, 100 patients were randomly chosen by Waghmare et al. The plaque index and gingival index were also tested at days 0, 14, and 21. When adjusted to a pH of 4, turmeric mouthwash that contains 10 mg of curcumin extract and 0.005% of the flavor enhancing substance, the oil of peppermint is shown to be just as efficient as the commonly used mouthwash chlorhexidine.<sup>26</sup>

#### ***Subgingival Irrigant:***

Suhag et al, conducted a study where root planning was completed for periodontal areas on day 0, which served as the baseline data. On the same day, as soon as the instrumentation was completed, sites that had been chosen were irrigated with 1% curcumin. Bleeding on probing (BOP), probing pocket depth (PPD), and inflammation for all locations was documented in 20 patients having periodontitis. Results showed that the irrigated sites significantly improved in all metrics. After 5 days, the curcumin group showed a significantly reduced inflammation (96%)<sup>27</sup>

#### ***Local Drug Delivery System:***

Behal et al. used a split-mouth experimental design and 30 individuals affected with localised or generalised periodontitis having 5-7 mm of probing depths.<sup>28-30</sup> Scaling and root planing alone was used to treat control sites, whereas 2% whole turmeric gel was applied to experimental sites. Both the groups showed a decrease in the gingival index,<sup>31</sup> sulcus bleeding index,<sup>32</sup> probing pocket depth and plaque index<sup>33</sup> was observed which was significant statistically<sup>34</sup> and an attachment loss increase was noted. A local medication delivery method with 2% whole turmeric gel may be utilised in addition to root planning and scaling.<sup>35</sup>

#### ***Recurrent Aphthous Stomatitis:***

20% of people in the population get recurrent aphthous ulcers at some point in their lives. Single or numerous ulcers that are painful with relapse and

recovery characterise the condition, which primarily affects nonkeratinized mucosal surfaces. Turmeric demonstrated positive results in lowering aphthous ulcer size and pain intensity.<sup>36-37</sup>

#### ***Endodontic Irrigant (Intracanal Medicament):***

Due to its widespread availability, low cost, and biological activity, turmeric can be used effectively as a means of treating root canal infections. Due to its antibacterial capabilities against endodontic pathogens, turmeric has the potential to be employed as an endodontic irrigant or intracanal medication.<sup>38-41</sup>

#### ***Pit and Fissure Sealants:***

Turmeric-containing pit and fissure sealants have been demonstrated to aid in the prevention or decrease of dental cavities. An autopolymerizing resin and at least one colourant, chosen from a group that comprises L-Apo-8-Carotenal, Annatto extract, and turmeric extract, are included in the composition.<sup>28</sup>

#### ***Surgical Wound Healing:***

In a study involving beagle dogs, Habiboallah et al. examined how hyaluronic acid and a formulation of curcuma longa affected the healing of gingival wounds following surgery. The findings pointed to a potential therapeutic benefit for surgical wound healing, specifically an improvement in the postoperative periodontal treatment effects.<sup>29</sup>

#### ***Precancerous Lesions:***

Studies have demonstrated the successful treatment of precancerous disorders such lichen planus, leukoplakia, and oral submucous fibrosis. It reduces localised discomfort and burning sensations, and a partial reversal of mouth opening has also been seen.<sup>30</sup>

#### ***Adverse effects and Safety Aspects:***

It may induce adverse skin reaction, stomach discomfort, nausea, diarrhoea, and antithrombotic action that hinders blood clot formation, along with gastric irritation.

Cost-effective turmeric is proven to have health advantages. has been regarded as pharmacologically

secure. Human beings can handle a daily consumption of up to 12 g of curcumin without experiencing dangerous adverse consequences, even though consumption of the culinary spice varies up to 100 mg/day.<sup>30</sup>

#### ***Potential for Adverse Interactions :***

There is a chance that there will be negative interactions with turmeric preparations, which are available as liquid extracts, capsules, and powdered root. In addition to curcumin, which has anti-inflammatory and antiplatelet qualities, turmeric also includes "turmerone," and "zingiberen" that are vaporizable oils which have antibiotic and antispasmodic characteristics. It promotes the release of hydrocortisone and inhibits the production of thromboxanes and prostaglandins. Thus, there is a chance that turmeric and NSAIDs interact in a way that is additive, and using both medications concurrently may increase the risk of bleeding and coagulation issues.<sup>29,30</sup>

#### ***Future Challenges:***

Due to limited absorption, a high intestinal metabolism, and quick removal within the body, curcumin has a low bioavailability. One of the main issues with the development of curcumin for therapeutic efficacy is this. Its safety at greater doses is still unknown. Nanotechnology-based innovative solutions are being investigated to increase the bioavailability of curcumin and decrease the apparent toxicity. Since there are more and more studies on the therapeutic properties of curcumin around the world, it seems that turmeric (*Curcuma longa*) has a bright future in medical fields, including dentistry.

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