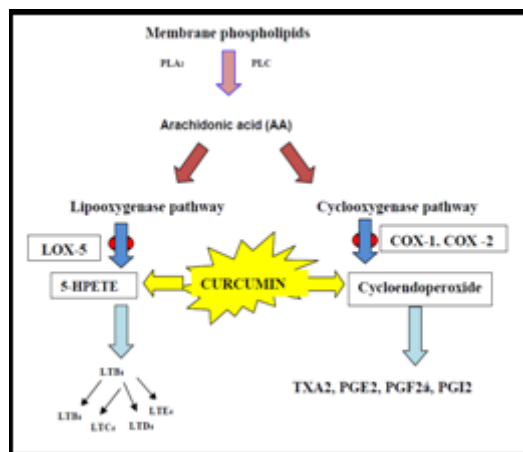




### Flow Chart Showing Inhibitory Effect of Curcumin on Arachidonic Acid Pathway



COX: Cyclooxygenase; HPETE: Hydroperoxyeicosatetraenoate; LOX: Lipoxygenase; LT: Leukotriene; PL: Phospholipase; PG: Prostaglandin; TX: thromboxane.

### Medicinal and Pharmacological Properties of Turmeric

#### Anti-Inflammatory Effects

The volatile oils and curcumin of *Curcuma longa* exhibit potent anti-inflammatory effects. Oral administration of curcumin in instances of acute inflammation was found to be as effective as cortisone or phenylbutazone and one-half as effective in cases of chronic inflammation. In rats with Freund's adjuvant-induced arthritis, oral administration of *Curcuma longa* significantly reduced inflammatory swelling compared to controls. In monkeys, curcumin inhibited neutrophil aggregation associated with inflammation. *Curcuma longa*'s 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. Curcumin may also be applied topically to counteract inflammation and irritation associated with inflammatory skin conditions and allergies, although care must be used to prevent staining of clothing from the yellow pigment.<sup>9</sup>

**R. Vivek in 2009** conducted a study to evaluate the anti-inflammatory effect of activity of cyclodextrin (CD) complex of curcumin for the treatment of inflammatory bowel disease (IBD) in colitis-induced rat model. In vitro dissolution studies showed that curcumin has higher affinity for hydroxypropyl- $\beta$ -CD (HP $\beta$ CD) than other CDs. HP $\beta$ CD complex of curcumin was further investigated for its antiangiogenic and anti-inflammatory activity using chick embryo and rat colitis model and concluded that the degree of colitis caused by administration of DSS (dextran sulfate solution) was significantly attenuated by CD of curcumin. Being a nontoxic natural dietary product, curcumin could be useful in the therapeutic strategy for IBD patients.<sup>10</sup>

### Antibacterial Property of curcumin

The study was conducted by **Shagufta naz in 2010** to evaluate the antibacterial activity of *Curcuma longa* varieties against different strains of bacteria using crude extracts of curcuminoids and essential oil of *Curcuma longa* varieties Kasur, Faisalabad and Bannu were studied for their antibacterial activity against 4 bacterial strains using agar well diffusion method. Ethanol was used for the extraction of curcuminoids and oil showed zone of inhibition against all tested strains of bacteria. Among all the 3 turmeric varieties Kasur variety had the most inhibitory effect on the growth of all bacterial strains tested as compared to other two varieties.<sup>11</sup>

### Anti-fungal action of curcumin

The in vivo action of curcumin and materials derived from *Curcuma longa* rhizomes against several plant pathogenic fungi. The responses varied with the tested pathogen. Fungicidal action comparable to that of the fungicidal agent chlorothalonil was observed with curcumin.<sup>12</sup>

### Anti oxidant property of curcuminoids

The study was conducted by **Simay Cikriker and Erkan Mozioglu in 2008** to assess the biological activities of curcuminoids which were isolated from *Curcuma longa*. The antioxidant activity of curcumin and turmeric were also determined by the CUPRAC method and found that the moderate antibacterial and antifungal activity have been determined for the turmeric extracts and pure curcumin and also showed very good anti oxidant property.<sup>13</sup>

### Hepatoprotective effects of curcumin

Turmeric's hepatoprotective effect is mainly a result of its antioxidant properties, as well as its ability to decrease the formation of pro inflammatory cytokines. Turmeric extract inhibited fungal aflatoxin production by 90 % when given to ducklings infected with *Aspergillus parasiticus*.<sup>14</sup>

### Effect of curcumin on macrophages

Macrophages play an important role in the immune system. They help the body to fight against foreign proteins and then effectively clear them. Curcumin was treated with macrophages in blood taken from 9 volunteers; 6 AD patients and 3 healthy controls. Beta amyloid was then introduced. The AD patients, whose macrophages were treated with curcumin, showed an improved uptake and ingestion of the plaques. Thus, curcumin may support the immune system to clear the amyloid protein.<sup>15</sup>

### Liver Diseases

Turmeric is beneficial for its influence on the liver. In spring more consumption of herbs and foods can strengthen the liver. Turmeric shares similar liver protectant compounds that milk thistle and artichoke leaves contain. It is said to shrink engorged hepatic ducts,

so it can be useful to treat liver conditions such as hepatitis, cirrhosis and jaundice.

Effect of curcumin supplementation on blood glucose, plasma insulin, and glucose homeostasis related enzyme activities

The study was conducted by **Kwon-Il So in 2008** to evaluate the effect of curcumin supplementation on blood glucose, plasma insulin and glucose homeostasis related enzyme activities in diabetic mice. Results of the study suggest that curcumin seemed to be a potential glucose-lowering agent and antioxidant in a type 2 diabetic db/db mice but had no affect in non-diabetic db/plus mice.<sup>16</sup>

#### **Iron chelator**

A study was conducted by **Yan Jiao in 2005** to evaluate iron chelation in the biological activity of curcumin by measuring the effect of curcumin on transferrin receptor 1, a protein stabilized under conditions of iron limitation as well as the ability of curcumin to activate iron regulatory proteins(IRPs). Both transferrin receptor 1 and activated IRP indicators of iron depletion increased in response to curcumin. Consistent with the hypothesis that curcumin acts as an iron chelator, mice that were fed diets supplemented with curcumin exhibited a decline in levels of ferritin protein in the liver. These results suggest that iron chelation may be an additional mode of action of curcumin.<sup>17</sup>

#### **Anti cancer agent**

Turmeric shows real promise as an anticancer agent due in part to its antioxidant activity. Several recent studies demonstrate that the frequent use of turmeric has been linked to lower rates of breast, colon, lung and prostate cancer.

Laboratory tests conclude that curcumin may prevent the development of tumours and slow the spread of cancer cells. Currently, clinical trials are under way to assess the efficacy of curcumin in patients with advanced pancreatic cancer.

In addition, curcumin is often recommended to protect healthy cells from the harmful effects of radiation and chemotherapy without reducing the effectiveness of these treatments.<sup>18</sup>

#### **Therapeutic applications in dentistry.<sup>2</sup>**

##### **Relief from dental problems;**

**Following ways of obtaining relief from dental problems by using turmeric have been reported in the literature**

Rinsing the mouth with turmeric water (boil 5 g of turmeric powder, two cloves and two dried leaves of guava in 200 g water) gives instant relief. Massaging the aching teeth with roasted ground turmeric eliminates pain & swelling. Applying the powder of burnt turmeric pieces and bishop s weed seed on teeth and cleaning them makes the gums and strong teeth. 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. Rub the teeth and gums with this paste twice daily.

##### **Periodontal disease;**

##### **Prevention of plaque formation and gingivitis;**

Bhandari & Shankwalker used turmeric in the form of mouthwash and found it to be an effective anti-inflammatory agent. Curcumin has been found to possess antimicrobial property. It has been suggested that curcumin may be used as an alternative antimicrobial agent against severe bacterial infections.<sup>19</sup>

Mali Amitha in 2012 used 0.1% of turmeric mouth wash in 100 subjects in a 21 days follow up period and shown significant reduction in the gingival inflammation.<sup>20</sup> They concluded that turmeric mouthwash can be effectively used as an adjunct to mechanical plaque control methods in prevention of plaque and gingivitis.

##### **Influence of curcumin on human gingival fibroblasts**

It has been reported that the effect of curcumin treated normal human fibroblasts and microvascular endothelial cells (hMVEC) using MTT assay and observed that lower doses of curcumin stimulated the proliferation of normal human fibroblasts and hMVED, whereas higher doses inhibited it.<sup>21</sup> According to other authors curcumin treated hPGF cells exhibited maximum and significant apoptosis at 75 µM and showed a decrease in cell population and shrinkage of cell size and morphologic alterations in basal cell carcinoma cells after treatment with 50nM curcumin and found cell shrinkage, disappearance of microvilli and appearance of membrane blebbing.<sup>22, 23</sup>

##### **Local drug delivery systems;**

Behal Roobal in 2011 conducted a study to compare the effect of experimental local drug delivery system containing 2% whole turmeric (gel form) as an adjunct to scaling and root planning alone and shown significant reduction in plaque and gingival index and reduction in probing pocket depth.<sup>24</sup>

##### **Pit and fissure sealant**

It has been found that tinted pit and fissure sealant is useful for applying to tooth surfaces for the prevention or reduction of dental caries. 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 L-Apo-8-Carotenol.<sup>25</sup>

##### **Miscellaneous Health benefits of turmeric<sup>18</sup>**

It is a natural antiseptic and antibacterial agent useful in disinfecting cuts and burns. When it is combined with cauliflower it has shown to prevent prostate cancer and stop the growth of existing prostate cancer.

It may prevent melanoma and cause existing melanoma cells to commit suicide. It prevented breast cancer from spreading to the lungs in mice also reduces the risk of childhood leukemia. It may prevent and slow the progression of Alzheimer's disease by removing amyloid plaque buildup in the brain and may prevent metastases from occurring in many different forms of cancer.

It is a potent natural anti-inflammatory that works as well as many anti-inflammatory drugs but without the side effects. It has shown promise in slowing the progression of multiple sclerosis in mice. Curcumin is a natural painkiller and COX-2 inhibitor which may aid in fat metabolism and help in weight management. It has long been used in Chinese medicine as a treatment for depression. Because of its anti-inflammatory properties, it is a natural treatment for arthritis and rheumatoid arthritis. Studies are ongoing in the positive effects of turmeric on multiple myeloma which has been shown to stop the growth of new blood vessels in tumors. It speeds up wound healing and assists in remodeling of damaged skin. It may help in the treatment of psoriasis and other inflammatory skin conditions.

#### Safety of Turmeric

A phase 1 human trial with 25 subjects using up to 8000 mg of curcumin per day for 3 months found no toxicity from curcumin. Five other human trials using 1125-2500 mg of curcumin per day have also found it to be safe.<sup>4</sup>

#### 4. Conclusion

Curcumin has been demonstrated to be safe in many human trials and has revealed anti-inflammatory, anti-bacterial, anti-oxidant, anti-parasitic activities without any systemic toxicity thus further studies are needed to assess its further properties in the treatment of oral disease.

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