



## Biochemistry, Safety and Pharmacological Action of Turmeric: A Review

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### ABSTRACT:

Turmeric (*Curcuma longa* Linn) is much grown and used as a spice throughout the Indian subcontinent. Traditional medicine has utilised the turmeric plant as a treatment for a number of illnesses, such as diabetes, liver problems, and cough.[1] *Curcuma longa* L., also known as turmeric, is a well-liked natural medication that has long been used to cure a variety of illnesses. The most widely utilised component of the plant for therapeutic purposes is the root, which has a variety of minerals and phytochemicals.[2] The medical and pharmacological properties of turmeric in illness prevention and treatment are the main topic of this review. The information was gathered from online publications that have been published in Pubmed. Abstract: Throughout the Indian subcontinent, turmeric (*Curcuma longa* Linn) is farmed and consumed extensively as a spice.

**Key words:** Medicinal plant, Anticancer, Anti-inflammatory, Antioxidant, Hepatoprotective agent

### Introduction:

Originating from the rhizomes of *Curcuma longa*, a member of the ginger family (Zingiberaceae), turmeric is an ancient spice. India has traditionally used turmeric, sometimes known as the "Golden Spice of India," for medicinal purposes.[4] Curcumin, also known as diferruloylmethane. Antioxidant, anticarcinogenic, antimutagenic, anticoagulant, antifertility, antidiabetic, antibacterial, antifungal, antiprotozoal, antiviral, antifibrotic, antivenom, antiulcer, hypotensive, and hypocholesteremic are a few of these properties.[5] It was recommended in Ayurveda medicine to treat a wide range of illnesses, from skin conditions to constipation. It was used to cure fever, inflammation, wounds, infections, dysentery, arthritis, trauma, injuries, jaundice, and other liver issues in addition to aiding in digestion. Turmeric is regarded by Unani as the best herb for treating blood issues since it stimulates, cleanses, and increases blood flow. Turmeric is referred to as the "KITCHEN QUEEN" by most Indians, including housewives and hermits living in the Himalayas, and is the primary spice used in cooking.[6] Throughout history, functional foods have been used traditionally for medical purposes. Research on dietary supplements and functional foods for various disorders has gained more attention in the last several decades. Turmeric is one of the functional foods that has been studied the most.[2]



Figure. 1 [20]

### History of turmeric:

Turmeric was first utilised approximately 4,000 years ago in India's Vedic culture, when it was both a culinary spice and a holy herb. It most likely made its way to China by the year 700, East Africa by the year 800, West Africa by the year 1200, and Jamaica in the eighteenth century.[7] In Sanskrit, haridra translates to "a potent medication for jaundice." It is a key component of Ayurvedic medicine and is regarded as one of the oldest spices, having been used for thousands of years in Western and Southern India. It is also documented that in the thirteenth century, Europeans were introduced to turmeric by Arab traders.[1] India, which produces almost all of the world's crop, is a major producer of turmeric.

### Nutritional composition

The short nutritional profile of turmeric is shown in Table 1. Although it contains a lot of fats and carbohydrates, turmeric doesn't contain any cholesterol. Numerous minerals and vitamins are included in turmeric.

**Table 1:** Nutritional Value of Curcuma Longa [19, 20, 20, 21]

Nutrients	Value per table spoon (7g)
Calories	23.9
Water	0.8g
Cholesterol	0 mg
Protein	1.5(6.3kJ)
Fat	5.6(23.4kJ)
Carbohydrate	16.8(70.3Kj)
Fiber	1.4g
<b>Minerals</b>	
Calcium	12.4mg
Phosphorous	18.1mg
Iron	2.8mg
Zinc	0.3mg
Magnesium	13.0mg
Potassium	170mg
Sodium	2.6 mg
<b>Vitamins</b>	
Thiamine	0.0mg
Riboflavin	0.0 mg
Betaine	0.7 mg
Vitamin C	1.7mg
Vitamin A	0.0 IU
Folate	2.6mcg
Choline	3.3mg

Fig.2

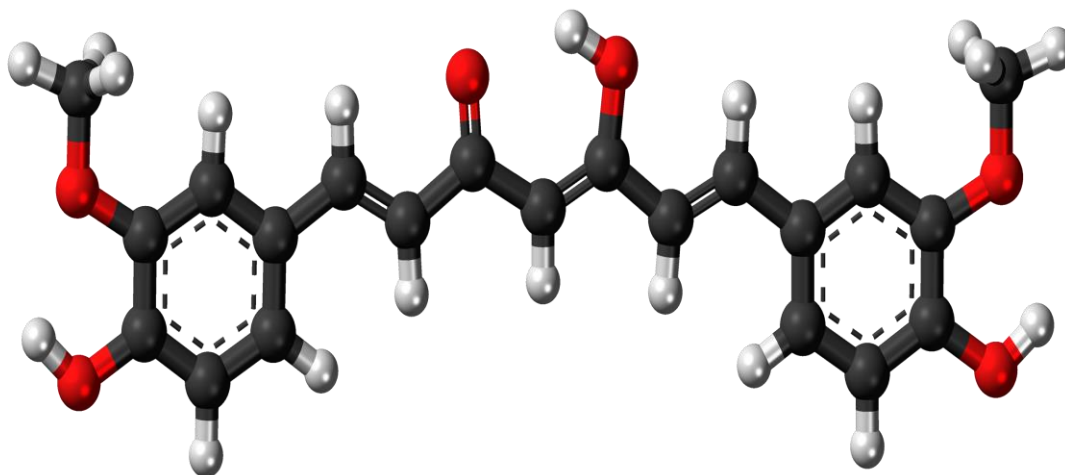
**Chemical Structure of curcumin :**

Fig.3 : 3D Structure of curcumin

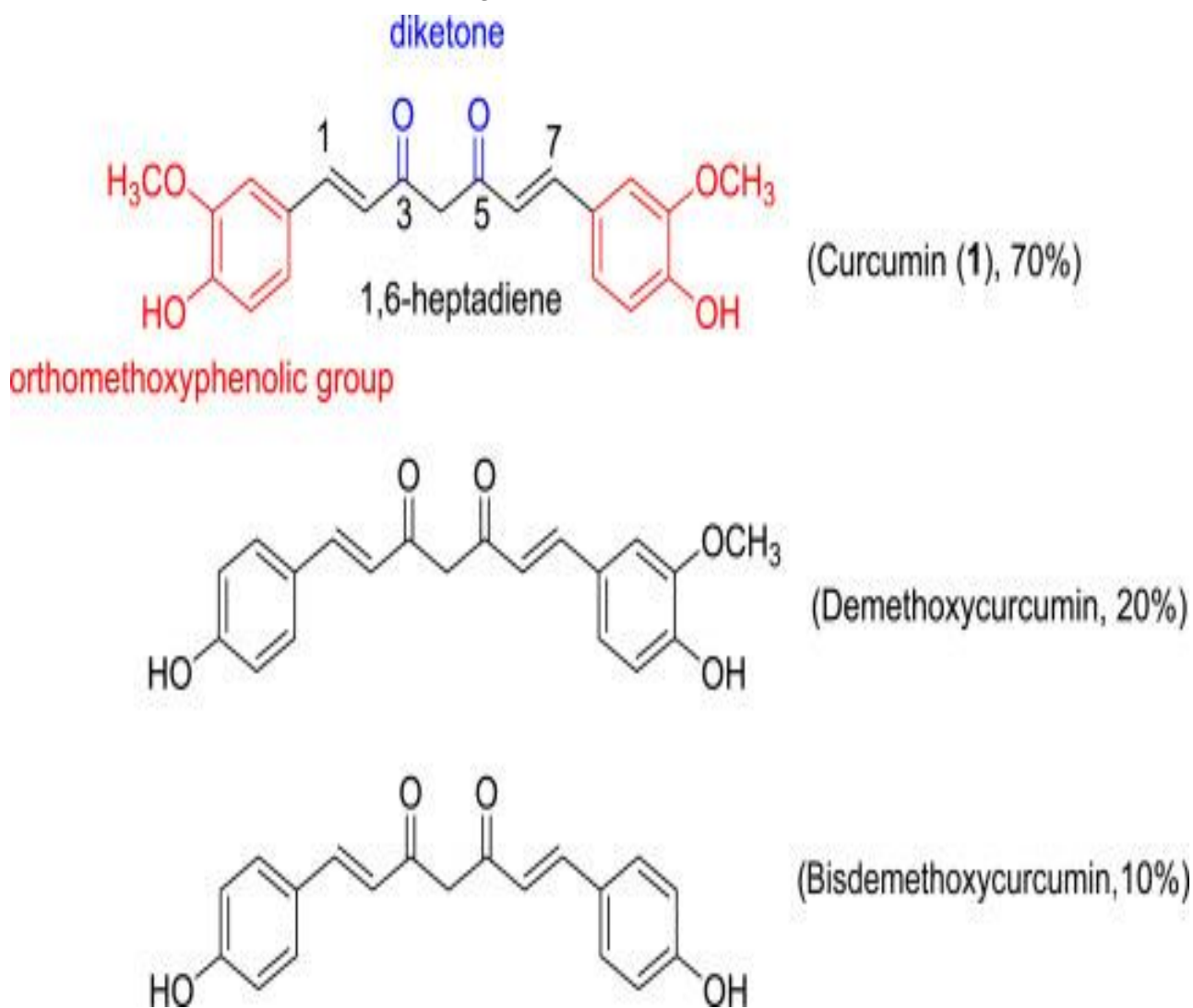


Fig.4 : 2D molecular Structures of curcumin: Curcumin, Demethoxycurcumin and Bisdemethoxycurcumin.

## Pharmacological action of turmeric:



Fig.5 : A schematic diagram representing turmeric's medicinal attributes.

### 1. Anticancer activity-

Numerous laboratory investigations have shown that curcumin has some anticancer activities, both in terms of treatment and chemoprevention. Various mechanisms have been proposed to explain these abilities. It was suggested in one study to have something to do with the metabolism of arachidonic acid and to do with its antiangiogenic properties.[8] Curcumin's distinct anticancer activity is mostly exhibited by inducing apoptosis and preventing tumour growth and invasion through the suppression of numerous cellular signalling pathways.[9] Curcumin has been investigated in connection with a number of human carcinomas, including melanoma, head and neck, breast, colon, pancreatic, prostate, and ovarian cancers. The low incidence of colon cancer in India is attributed by epidemiological research to the antioxidant and chemopreventive qualities of curcumin-rich diets.[10] \*Curcumin has anticancer properties against numerous signalling pathways, including phosphoinositide 3-kinase, AKT, Wnt/ $\beta$ -catenin, Ras, p53, and mammalian target of rapamycin. Turmeric also alters the regulation of the expression of the microRNA network. It should be mentioned that research conducted in vitro and in vivo have shown curcumin to suppress the activity of histone deacetylases.[2]

### 2. Antioxidant activity-

Since curcumin is a lipophilic polyphenol, it is easily soluble in organic solvents including ethanol, dimethyl sulfoxide, and acetone but insoluble in water. The curcuminoids' chemical makeup gives them their antioxidant properties.[10] Using cow aortic endothelial cells, an in vitro investigation was carried out to determine the impact of curcumin on endothelial heme oxygenase-1, an inducible stress protein. Curcumin incubation increased the cells' resistance to oxidative damage. [3] To assess its antioxidant potential, the DPPH radical scavenging activity assay was used.

DPPH free radical scavenging activity: A slightly modified version of Blis's (1958) method was used to measure the scavenging activity for DPPH free radicals.[11]

### 3. Antimicrobial activity-

An further antibacterial agent against deadly bacterial infections could be turmeric. When epigallocatechin gallate (EGCG) is present, curcumin's antibacterial activity against the multidrug-resistant *Acinetobacter baumannii* increases significantly. \* In medicine, EGCG and curcumin together can be used to prevent or treat *Acinetobacter baumannii* infections.[2] Turmeric's phenolic compounds, curcuminoids, are said to be the source of its antibacterial activity against *B. subtilis*, *S. aureus*, and *E. coli*, according to Chandarana et al. The components of turmeric that are responsible for its

antibacterial effect are turmerol, veleric acid, curcumins, essential oil, and alkaloid.[12]Khattak et al. studied the antifungal, antibacterial, phytotoxic, cytotoxic, and insecticidal qualities of an ethanolic extract of turmeric in 2005.[3]

#### 4. Anti-inflammatory activity:

Curcumin has been demonstrated to inhibit several molecules that are involved in inflammation, such as MCP-1, interferon-inducible protein, tumour necrosis factor, phospholipase, lipooxygenase, COX-2, leukotrienes, thromboxane, prostaglandins, nitric oxide, collagenase, elastase, hyaluronidase, and interleukin-12.[1]. Numerous medical conditions, including Alzheimer's disease, cardiovascular disease, diabetes, asthma, inflammatory bowel disease, arthritis, pancreatitis, and renal illness, have been studied in relation to curcumin's anti-inflammatory qualities.[10]The results of this investigation provide credence to the idea that AgNPs mediated by turmeric oil possess strong anti-inflammatory characteristics that avert protein denaturation.[13]

#### 5. Anti-diabetic and wound healing:

It was discovered that adipocyte differentiation was dose-dependently stimulated by a hexane extract containing ar-turmerone, an ethanolic extract containing ar-turmerone, curcumin, demethoxycurcumin, and bisdemethoxycurcumin, and an ethanolic extract from the hexane extraction residue containing curcumin, demethoxycurcumin, and bisdemethoxycurcumin. [3] To assess if *Curcuma longa* is effective in delaying the improvement of NIDDM in people with prediabetes. [14] The proliferative phase of wound healing includes the formation of granulation tissue, collagen deposition (the creation of the extracellular protein matrix), fibroblast proliferation, epithelialisation, and the death of undesirable cells.[15] The four stages of wound healing are proliferation, tissue remodelling, inflammation, and homeostasis.[16] Curcumin was one of three nutrients that had the most significant supplementation effect in related animal research, according to a comprehensive assessment of the effectiveness of nutritional supplementation in diabetic wound healing.[17]

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#### Safety and toxicity:

Numerous studies using in vitro testing, animal experiments, and clinical trials were conducted to evaluate the safety of turmeric and its compounds.[2] Additional evaluation is not required for the addition of naturally existing compounds if doing so

won't significantly raise their concentration in the environment (EFSA, 2008).[18] It should be mentioned that curcumin may influence the pharmacokinetics of antibiotics, antidepressants, cardiovascular medicines, chemotherapeutic treatments, anticoagulants, and antihistamines. As such, using it concurrently with some conventional medications needs to be done so carefully. [2]Since the period of Ayurveda (1900 Bc) different medicinal actions have been given to turmeric for a wide variety of diseases and conditions, including those of the skin, respiratory, and gastrointestinal systems, aches, pains, wounds, sprains, and liver disorders (Aggarwal et al., 2007). [19]

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#### Conclusion:

\* The most commonly utilised part of turmeric is the root, which has a wealth of vitamins, minerals, and phytochemicals that can be used to treat a wide range of illnesses in people. Turmeric appears to be a generally safe herb for medical use. It is important to carefully consider its use in patients with renal and hepatic failure, as well as during pregnancy and lactation. Turmeric is used to extract several compounds.\* The most commonly utilised part of turmeric is the root, which has a wealth of vitamins, minerals, and phytochemicals that can be used to treat a wide range of illnesses in people. Turmeric appears to be a generally safe herb for medical use. It is important to carefully consider its use in patients with renal and hepatic failure, as well as during pregnancy and lactation. Turmeric is used to extract several compounds. Its primary active ingredient, curcumin, is followed by other important ingredients such as flavonoid curcumin (diferuloylmethane), curcuminoids atlantone, dimethoxycurcumin, diarylheptanoids, and tumerone. These ingredients have antioxidant, antimicrobial, and anti-inflammatory qualities that give them their protective ability against various forms of cellular damage. Turmeric and its components also regulate the pathophysiology of neurologic disorders such as Parkinson's and Alzheimer's diseases in addition to providing neuroprotection.Its primary active ingredient, curcumin, is followed by other important ingredients such as flavonoid curcumin (diferuloylmethane), curcuminoids atlantone, dimethoxycurcumin, diarylheptanoids, and tumerone. These ingredients have antioxidant, antimicrobial, and anti-inflammatory qualities that give them their protective ability against various forms of cellular damage. Turmeric and its components also regulate the pathophysiology of neurologic disorders such as Parkinson's and Alzheimer's diseases in addition to providing neuroprotection.

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