



## Review Article

## Ethnopharmacological review of turmeric for anticancer activity

Amit Gajanan Nerkar<sup>1,2,3,\*</sup>, Rushikesh Nagarkar<sup>1</sup>, Shubhangi Badar<sup>1</sup><sup>1</sup>Dept. of Pharmacy, CAYMET's Siddhant College of Pharmacy, Sudumbare, Pune, Maharashtra, India<sup>2</sup>Ateos Foundation of Science Education and Research, Pune, Maharashtra, India<sup>3</sup>Carolene Therapeutics, Pvt. Ltd, Aurangabad, Maharashtra, India

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## ABSTRACT

These reviews suggest that in the Indian subcontinent, turmeric (*Curcuma longa* Linn) is widely grown and consumed as a spice. Traditional medicine has used turmeric to treat a variety of ailments, such as diabetes, liver disease, and cough. Many studies have been conducted over the past decades to determine the pharmacological effects of turmeric and its derivatives. The main chemical component of turmeric, curcumin, has been shown to have pharmacological properties including anti-inflammatory, antioxidant, anti-mutagenic, antidiabetic, and antibacterial properties., protect liver, expectorant and anti-cancer. Turmeric, also known as *Curcuma longa* L. (root and rhizome), is a plant of high medicinal and commercial value, mainly used as a spice and food supplement around the world. The three curcuminoids - curcumin (diferuloylmethane, the main ingredient that gives turmeric its yellow color), demethoxycurcumin, and bisdemethoxycurcumin - are the main active ingredients of turmeric. Volatile oils (zingiberene, atlantone, tomerol, etc.) also have pharmacological effects. In addition, turmeric contains proteins, resins and carbohydrates. Turmeric is a powerful antioxidant and has significant anti-inflammatory properties. Turmeric's anti-inflammatory properties may be directly related to its anti-cancer properties. In this review, the anticancer properties of Turmeric have been reviewed.

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## 1. Introduction

Turmeric, or *Curcuma longa* Lin.,<sup>1</sup> belongs to the Zingiberaceae plant family. The plant has a lot of potential in terms of medicinal properties.<sup>2,3</sup> It has a number of beneficial qualities including those of anti-inflammatory, biliary, hepatoprotective, blood purifier, antioxidant, detoxifying and regenerating liver tissue, anti-asthmatic, anti-cancer, anti-toxin, digestion and carminative, as noted in the literature.<sup>4-9</sup> Plasma cholesterol levels can be lowered using curcumin. The heart and arteries are preserved by its antiplatelet activity. It also protects against DNA damage in lymphocytes.<sup>10</sup> The parts of this plant contain curcumin,

a type of flavonoid. About 60-70% of turmeric powder is made up of carbohydrates, while other ingredients include 6-8% protein, 5-8%, 3-7% minerals, 3-7% essential oils, 2-7% fiber<sup>11</sup> and 1-6% curcuminoids. The phytochemicals in turmeric are found in Diarylheptanoids, a different group of curcuminoids that includes curcumin, demethoxycurcumin, and bisdemethoxycurcumin.<sup>12</sup> It was also observed that *Zingiber officinale* Roscoe and *Curcuma longa* Linnaeus are the two main species of Zingiberaceae studied for a variety of pharmaceuticals, including anti-inflammatory, anti-angiogenic, antibacterial, analgesic, immunomodulatory, pro-apoptotic, anti-HIV and anti-cancer.<sup>13</sup> Further some researchers also found that the Curcumin is a polyphenol natural product isolated from turmeric, interacting with different cellular and molecular targets and, consequently,

\* Corresponding author.

E-mail address: [dragnerkar@gmail.com](mailto:dragnerkar@gmail.com) (A. G. Nerkar).

showing a wide range of pharmacological effects.<sup>14</sup>

#### Taxonomical Classification.

1. Kingdom: Plantae
2. Subkingdom: Tracheobionta
3. Super division: Spermatophyta
4. Division: Magnoliophyta
5. Subclass: Zingiberidae
6. Order: Zingiberales
7. Family: Zingiberaceae
8. Genus: Curcuma
9. Species: longa
10. Scientific name: Curcuma longa

#### 1.1. Geographical distribution<sup>15</sup>

1. *World scenario*: It is commonly found in Cambodia, China, India, Nepal, Indonesia, Madagascar, Malaysia, Philippines and Viet Nam.
2. *India scenario*: It is commonly found in West Bengal, Tamil Nadu, and Maharashtra and also in Madras.
3. *History*: In the year the Vedic civilization of India, it was used as a culinary spice and has some religious significance, turmeric has been used for about 4000 years. By AD 700, it could have spread to China, East Africa, West Africa, and Jamaica. In 1200 AD, it may have reached China. Marco Polo wrote about this spice in 1280, showing a vegetable very close in character to saffron. Turmeric has a long history of medicinal use in South Asia, according to Sanskrit medical texts, Ayurvedic and Unani traditions. An ointment containing turmeric is suggested in the Ayurvedic compendium of Sushruta, dating back to 250 BC. In AD, it was used to treat the effects of contaminated food.<sup>16</sup>

#### 1.2. Cultivation<sup>16,17</sup>

1. *Climate*: For proper growth, the turmeric plant requires temperatures between 20°C and 30°C as well as a good amount of annual rainfall. Individual plants have long, oblong leaves and can reach a height of 1 m. Both the tropics and the subtropics are suitable for growing the tropical herb turmeric. If the shade is not too dense, it will grow lushly, but on open land that is exposed to the light, it generates bigger and better rhizomes. Turmeric needs a humid environment.
2. *Soil*: The soil should be rich and friable while growing turmeric. Suitable soils have a slightly higher sand content. It is grown in a variety of soil types, from clay loams to light black, sandy loam, and red soils. It thrives in irrigated and rain-fed locations on light black, ashy loam, red soils, and stiff loams.
3. *Harvesting*: Typically, the harvest season is from January until March or April. Early and medium varieties reach maturity in 7-8 and 8-9 months,

respectively. The crop is ready to be cut when the leaves begin to dry out and turn yellow. When the plant reaches maturity, the leaves are removed just above the soil, the earth is tilled, and rhizomes are collected by hand plucking or by carefully lifting the clumps with a spade.

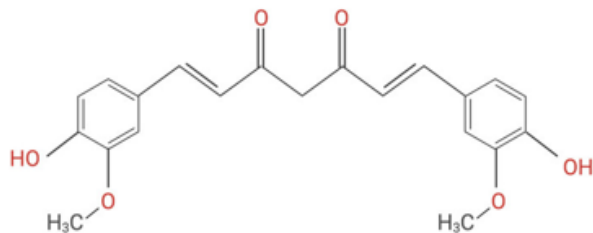
4. *Irrigation*: The amount of irrigations for turmeric will depend on the soil and weather. In medium-heavy soils, 15 to 25 irrigations are supplied, while in red soils with a light texture, 35 to 40 irrigations are required. Rhizomes for seed are typically piled up and covered with turmeric leaves under trees or in sheds with good ventilation. The seed rhizomes can also be kept in sawdust-filled pits.

#### 1.3. Health benefits/Uses<sup>1,9-20</sup>

1. Turmeric promotes balanced mood.
2. Turmeric helps wounds healing.
3. Turmeric group seemed to enjoy more relief from joint pain.
4. Turmeric helps in balanced blood sugar
5. Leprosy, dysentery, heart disease, jaundice, diabetes, lactation antimicrobials, and antioxidants.
6. They have been used for rheumatism, diabetes, stomach ulcers, hepatic disorders, boils, skin conditions, enlarged liver, spleen, and chest pain, among other traditional medical conditions.
7. Older research indicates that curcumin has antimicrobial, anti-inflammatory, dyspepsia and gastric ulcer, irritable bowel syndrome, pancreatitis, rheumatoid arthritis, osteoarthritis, and antioxidant properties.
8. It is also the primary active component of all curcuma plants and is responsible for the yellow colour of curcuma.

#### 1.4. Side effects, contraindications and precautions<sup>21-25</sup>

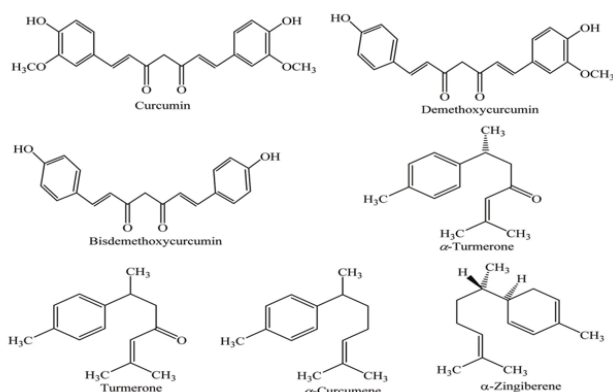
1. The patient facing gall bladder is recommended not to eat turmeric.
2. If any patient had bleeding problems, it is recommended to steer clear of turmeric.
3. High doses of turmeric cause uterine contraction in pregnant women.
4. Turmeric might lower testosterone levels and decrease sperm movement when taken by mouth by men.
5. Turmeric might slow blood clotting so stop using it at least two weeks before a scheduled surgery.
6. Taking high amounts of turmeric might prevent the absorption of iron. So it should be used with caution in people with iron deficiency.



**Fig. 1:** Curcumin

## 2. Chemical Constituents of Turmeric<sup>26–28</sup>

The active constituent of Turmeric is shown in the figure viz Curcumin. Further the following are the active constituents of Turmeric, in a standard form, turmeric contains moisture (>9%), curcumin (5–6.6%), extraneous matter (<0.5% by weight), mould (<3%), and volatile oils (<3.5%). Volatile oils include d- $\alpha$ -phellandrene, d-sabinene, cinol, borneol, zingiberene, and sesquiterpenes). The active constituents of turmeric are shown in Figure below. Curcumin, the active ingredient in the *Curcuma longa* plant, has received a lot of attention over the past two decades as an antioxidant, anti-inflammatory, and anti-cancer agent. In this review, a summary of the pharmacology and pharmacology of curcumin and its derivatives for their antitumor activity, their main mechanisms of action, and cellular targets has been provided based on Data from the literature from experimental and clinical reviews of curcumin in cancer cell lines, animal models and human subjects showed promising results.



**Fig. 2:** Active constituents of Turmeric

## 3. Review for Anticancer Activity of Turmeric

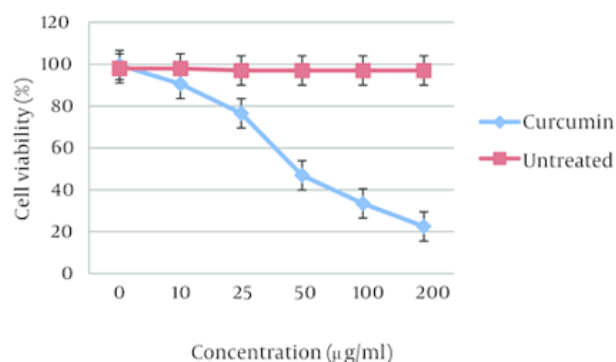
Through its effects on several biological pathways involved in mutation, oncogene expression, cell cycle regulation,

apoptosis, tumorigenesis, and metastasis, curcumin has been proven to have anti-cancer properties. Curcumin inhibits NF- $\kappa$ B transcription factor and downstream gene products, and has demonstrated anti-proliferative effects in several malignancies (including c-myc, Bcl-2, COX-2, NOS), Cyclin D1,<sup>29</sup> TNF- $\alpha$ ,<sup>30</sup> interleukin and MMP-9). Various growth factor receptors and cell adhesion molecules involved in tumor growth, angiogenesis, and metastasis are also affected by curcumin. By modifying the deregulated cell cycle by,

1. Cyclin-dependent<sup>31</sup>
2. p53-dependent and<sup>32</sup>

Curcumin demonstrates its anti-tumor effects in cancer cells. Because of its effects on key cell cycle signaling pathways and its success in animal model systems, curcumin has been recognized as a multifaceted weapon in the fight against cancer.<sup>33</sup> deadly cancer. Natural phytochemicals such as curcumin could connect to these new targets and synergize with chemotherapy. Curcumin is also well tolerated in humans. Therefore, potential targets and procedures in the treatment of lung cancer could include EGFR-miRNA autophagy and cancer stem cell therapy in the presence of curcumin. Curcumin exerts its anticancer activity through multiple mechanisms, interfering with various cellular pathways and inducing the production of a variety of cytokines, enzymes or growth factors such as MAPK, EGF, NF $\kappa$ B,<sup>34</sup> PKD1, COX-2, STAT3, TNF- $\alpha$  and I $\kappa$ K $\beta$ . Treatment with curcumin simultaneously reduced anticancer drug IC<sub>50</sub> and stem cell counts. Also it was found to be good for treated breast cancer cell lines MBA-MB-231 and MCF-7 with paclitaxel, cisplatin or doxorubicin alone or in combination with curcumin or other natural compounds. Chemotherapy drugs reduce survival and curcumin reduces IC<sub>50</sub> of experimental cell lines.<sup>35–38</sup> In a research on turmeric it was also demonstrated that curcumin reduced chemo resistance while increasing chemosensitivity of tumor cells. The law of Bcl-2-mediated apoptosis, including the PI3K and Wnt signaling pathways, may be the basis for these effects. The convenience of the Bcl-2 protein is an important factor for the development of drug resistance. By combining with other apoptosis-related proteins, Bcl-2 inhibits the tumor suppressor effects of drugs and promotes drug resistance.<sup>39</sup> Anti-cancer activity of turmeric against a variety of human cancers. The anticancer mechanism of curcumin involves the regulation of multiple signaling pathways. Numerous experiments have demonstrated that curcumin can modulate the Wnt/ $\beta$ -catenin, PI3K/Akt, JAK/STAT, MAPK, p53 and NF- $\kappa$ B signaling pathways in cancer cells.<sup>40</sup> Curcumin also possesses apoptotic and autophagic pathways. Curcumin may show the development of chemoresistance due to its multitarget activity in cancer. The effects of curcumin were studied in a dose-responsive experiment. The proliferation

of MCF7 cells was significantly inhibited by curcumin in a concentration-dependent manner for 48 h ( $P < 0.01$ ). Different concentrations of curcumin after 48 h had different cytotoxic effects on the MCF7 cell line.<sup>41</sup>



**Fig. 3:** Concentration

It has been proven that cancer is the second leading cause of death in the world and one of the major public health problems. With great advances in cancer treatment, cancer morbidity and mortality rates remain high. The search for more effective and less toxic cancer treatment strategies is at the forefront of current research<sup>42–46</sup> The research in this regard, the effects of numerous common fruit, herb, and vegetable extracts on the in vitro viability of two human ovary cancer cell lines (SKOV-3 and PEO1) were investigated.<sup>43</sup> In another research turmeric was evaluated the in vitro anti-tumor potential (human thyroid cancer cell line) of curcumin and elucidated its molecular mechanism. Here, we investigated the effects of curcumin on cell viability, apoptosis, migration and invasion of the human thyroid cancer cell lines FTC133. Polyphenols and other natural substances have been found by Kashifa et.al from turmeric have the ability to affect cancer cells without causing negative side effects.<sup>47</sup> They increase chemosensitivity, have higher absorption capacity, and can combat and reduce multidrug resistance. Neuroprotective effects of demethoxycurcumin, a natural derivative of curcumin on neurotoxicity induced by rotenone in the cells of SH-SY 5Y neuroblastoma have been found positive.<sup>48</sup> T. Liu et al. found that human CD44+/CD133+ prostate cancer stem cells (HuPCaSC) were isolated from the prostate cancer cell lines Du145 and 22RV1,<sup>49,50</sup> Curcumin treatment of these cells resulted in inhibition of proliferation and invasion in vitro and cell cycle arrest.<sup>51</sup> Turmeric oil and curcumin, derived from *Curcuma Longa*.<sup>52–54</sup>

#### 4. Conclusion

Curcumin has been recognized as a complex weapon in the fight against cancer, a deadly disease, due to its effects on key cell cycle signaling pathways and its effectiveness in animal model systems. Curcumin is

a natural phytochemical that can interact with these new targets and aid chemotherapy. A wide range of important chemicals, including starches, proteins, vitamins, volatile oils and the main components of curcumin and curcuminoids, have been identified through phytochemical research on turmeric. These compounds have been shown to have many potent pharmacological properties. This review renews the impetus for the use of turmeric as a treatment and prevention approach of cancer.

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None.

#### 6. Conflict of Interest

None.

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**Rushikesh Nagarkar**, Student

**Shubhangi Badar**, Student

### Author biography

**Amit Gajanan Nerkar**, Professor and Research Head  
 <https://orcid.org/0000-0002-1377-8466>

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