

TURMERIC; ITS ACTIVE CONSTITUENTS AND BIOLOGICAL ACTIVITIES

Jasleen Singh* and Shivani Rangarh

M. Pharmacy (Pharmaceutics), Faculty of Pharmacy, Uttarakhand Technical University, Dehradun Uttarakhand.

*Corresponding Author: Jasleen Singh

M. Pharmacy (Pharmaceutics), Faculty of Pharmacy, Uttarakhand Technical University, Dehradun Uttarakhand.

Article Received on 21/08/2022

Article Revised on 11/09/2022

Article Accepted on 01/10/2022

ABSTRACT

Medicinal plants are main source of various pharmacologically active molecules. The rhizome of turmeric has been used for thousands of years as a home remedy for various diseases. The phytoconstituent present in the turmeric named curcumin possesses properties including anti-inflammatory, anti-fungal, anti-microbial, and anti-oxidant properties. The main purpose of this study is to collate the present literature on turmeric with its biological activities.

KEYWORDS: Curcumin, active constituents, biological activity, analogs.**INTRODUCTION**

Background: Turmeric is an aromatic medicinal plant known to Indians since precedent days. Turmeric (*Curcuma longa*) has been a major part of Ayurveda, Siddha, unani medicine, and traditional Chinese medicine. India has greatest diversity of *Curcuma* species around 40 to 45. chemical constituents present in turmeric includes polyphenols, sesquiterpenes, diterpenes, triterpenoids, sterols, and alkaloids.^[1] Turmeric is cultivated in many parts of the world including India, China, Taiwan, Indonesia, Sri Lanka, Africa and Australia.

General Description

Turmeric is a spice which is obtained from rhizomes of plant *Curcuma longa*, a member of the family Zingiberaceae.^[2] It has important medicinal and cultural uses. It needs temperatures between 20° C and 30° C, and a considerable amount of annual rainfall to thrive^[3] Curcumin a polyphenol is a main constituent of turmeric have many health benefits. The prime issue with ingesting curcumin is its poor bioavailability, which is because of its poor absorption, rapid metabolism, and rapid elimination. Several agents have been added to improve curcumin's bioavailability.^[4]

Appearance

Turmeric is a herbaceous plant which have height up to 1 m tall. It is highly branched, yellow to orange in colour, cylindrical in shape and has aromatic rhizomes found. The leaves are arranged in two rows in alternative pattern. Which are further divided into leaf sheath, petiole, and leaf blade.

Table 1: Taxonomic Profile.^[5]

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Sub-class	Zingiberidae
Order	Zingiberales
Family	Zingiberaceae
Genus	<i>Curcuma</i>
Species	<i>longa</i>
Scientific name	<i>Curcuma longa</i>

Description

- Overview:** An upright, perennial herb to about 1m tall. The rhizome are thick and ringed in shape. Turmeric only reproduces via its rhizomes.
- Leaves:** Large, oblong, upto 1m long, dark green on upper surface, pale green beneath. Each leafy shoot (pseudo stem) bearing 8–12 leaves.
- Flowers:** Yellow-white, borne on a spike-like stalk 10–15cm long. Flowers are sterile and do not produce viable seed.
- Seeds:** Small, ovoid, brown. Not viable.

Table 2: Chemical and Physical Properties of Curcumin.^[6]

IUPAC Name	(1E,6E)-1,7-bis(4-hydroxy-3-methoxyphenyl) hepta-1,6-diene-3,5-dione
Molecular Formula	C ₂₁ H ₂₀ O ₆
Molecular Weight	368.4 g/mol
Melting Point	356 to 361 °F
Solubility	Insoluble in water and soluble in ethanol, acetic acid
Density	0.9348 at 59 °F
Florescence	Slightly florescence

ACTIVE CONSTITUENTS OF TURMERIC

1. Turmeric powder is about 60–70% carbohydrates, 6–13% water, 6–8% protein, 5–10% fat, 3–7% dietary minerals, 3–7% essential oils, 2–7% dietary fibers and 1–6% curcuminoids.
2. Turmeric are enriched with the following compounds: curcumin, demethoxycurcumin (DMC), bisdemethoxycurcumin (BDMC). The active ingredient in turmeric is curcumin, which is approximately 0.5-6.0%
3. The commercially available curcumin mixture contains 77% curcumin, 17% DMC and 35% BDMC and they differ in methoxy substitution on the aromatic ring.
4. It also contains volatile oils including d- α -phellandrene, cineole, borneol, zingiberene, and sesquiterpenes like termerone, β -bisabolene, zingiberene.
5. Some 34 essential oils are present in turmeric, among which turmerone, germacrone and zingiberene are major constituents which are also responsible for aroma.

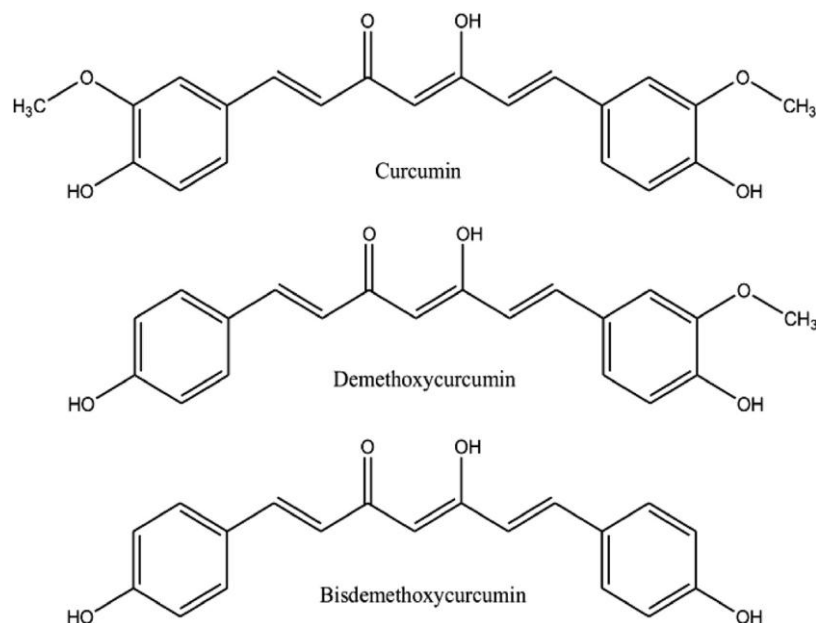


Figure 1: Chemical structure of Curcumin, Demethoxycurcumin, and Bisdemethoxycurcumin.^[7]

BIOLOGICAL ACTIVITIES OF CURCUMIN**Anti-oxidant Property**

Curcumin act as an effective antioxidant and scavenges superoxide radicals, hydrogen peroxide, and nitric oxide from activated macrophages. Curcumin works by protecting renal cells and neural glial cells from oxidative stress. Interestingly, curcumin also enhances the activities of other antioxidants, such as superoxide dismutase, catalase, and glutathione peroxidases.

Carvalo et al formulated curcumin suspension with curcumin nanoparticles in tween 80. The antioxidant activity of formulation was analysed by DPPH method. The objective of formulation was to reduce the particle size and increase the solubility. However, formulation has increased solubility but anti-oxidant activity was not affected.^[8]

Anti-inflammatory Activity

Inflammation is important process for fighting from infections. It occurs from a series of complex reactions, triggered by the host immunological response. Uncontrolled inflammatory responses may end to undesirable effects, such as tissue damage. Disease like rheumatoid arthritis, is the result of sustained production

of inflammatory mediators causing damage to joints. Many inflammatory mediators involved in these complex reactions, are modulated by curcumin.

Muniyappan N et al designed gold nanoparticles using *Curcuma pseudomontana* from isolated curcumin by utilizing cost effective method. The evaluation was done by SEM, HR-TEM, UV-vis and FT-IR spectroscopy. It was found that the prepare d gold nanoparticles have antibacterial, anti-inflammatory and antioxidant activities.^[9]

Anti-cancer Property

Curcumin behave as a potent anti-carcinogenic compound. It causes induction of apoptosis which plays an important role in its anti-carcinogenic effect. Curcumin induces apoptotic cell death by DNA-damage in human cancer cell lines.^[10]

Yallapu et al designed and developed nanoformulations of curcumin including nanoparticles, nanogels, liposomes and emulsions. The study investigated that the nanoformulations loaded curcumin has anti-cancer potential.^[11]

Platelet Aggression Activity

Curcumin inhibits platelet-activating factor (PAF), arachidonic acid, epinephrine, and collagen mediated platelet aggregation. However, at lower doses (20-25 μ M), curcumin inhibits only PAF and AA mediated platelet aggregation and not those mediated by other agonists. Curcumin hinders thromboxane A₂ (TXA₂) formation by platelets.

1. Anti-viral Properties of Curcumin

In vitro, curcumin moderately inhibited the activity of human simplex virus-2. Curcumin is also highly effective in inhibiting Type I Human Immunodeficiency Virus. Nevertheless, curcumin specifically inhibited the enzymatic reactions associated with HIV-1 integrase but not other viral (HIV-1 reverse transcriptase) and cellular (RNA polymerase II) nucleic acid processing enzymes.

2. Anti-protozoan Activity

The ethanol extract of the rhizomes has anti-Entamoeba histolytic activity. Curcumin has anti-Leishmania activity in vitro. Anti-Plasmodium falciparum has major effects of curcumin have also been reported.

3. Anti-fungal Effect

Ether and chloroform extracts and oil of *C. longa* have antifungal effects. Crude ethanol extract also possesses antifungal activity. Turmeric oil is active against *Aspergillus flavus*, *A. parasiticus*.

4. Anti-fertility Activity

Petroleum ether and aqueous extracts of turmeric rhizomes show 100% antifertility effect in rats when fed orally. Curcumin retards human sperm motility and has the potential for the formation of a novel intra-vaginal contraceptive.

5. Anti-coagulant Activity

Curcumin shows anticoagulant activity by inhibiting collagen and adrenaline-induced platelet aggregation in vitro moreover as in vivo in rat.

6. Anti-bacterial Activity

Both curcumin and its oil fraction suppress growth of several bacteria like *Streptococcus*, *Staphylococcus*, *Lactobacillus*, etc. The turmeric rhizomes aqueous extract has antibacterial effects. Curcumin prevents growth of *Helicobacter pylori*.

7. Anti-diabetic Effect

Curcumin prevents galactose-induced cataract formation at very low doses. It decreases blood sugar level in alloxan induced diabetes in rat and decreases advanced glycation end products-induced complications in diabetes mellitus.

8. Anti-fibrotic Effect

Curcumin suppresses bleomycin-induced pulmonary fibrosis in rats. Oral administration of curcumin at 300 mg/kg dose inhibits bleomycin-induced increase in total

cell counts and biomarkers of inflammatory responses. Thus curcumin acts as a potent anti-inflammatory and anti-fibrotic agent.

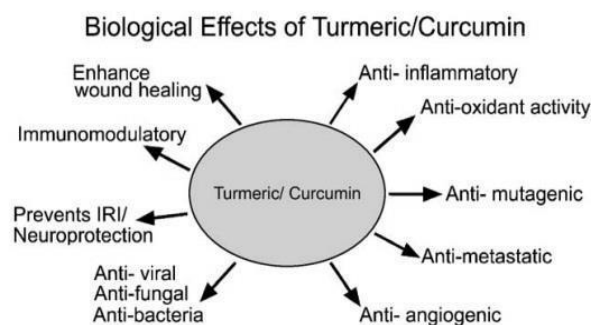


Fig. 5: Biological effects of turmeric.

CONCLUSION

Extensive research is being done on medicinal plants widely. Based on the study we can say that one medicinal plant can show many biological activities and thus a large number of chemical substances present in plants can show several pharmacological activities which can cure various diseases.

REFERENCES

- Gupta, Subash C., et al. "Multitargeting by turmeric, the golden spice: From kitchen to clinic." *Molecular nutrition & food research*, 2013; 57.9: 1510-1528.
- Cikrikci, Simay, Erkan Mozioglu, and Hasibe Yilmaz. "Biological activity of curcuminoids isolated from *Curcuma longa*." *Records of Natural Products*, 2008; 2.1: 19.
- Revathy, S., S. Elumalai, and Merina Benny Antony. "Isolation, purification and identification of curcuminoids from turmeric (*Curcuma longa* L.) by column chromatography." *Journal of Experimental sciences*, 2011; 2.7.
- Susan J. Hewlings and Douglas S. Kalam, Curcumin a review of its effects in human health, 2017 USA.
- Chanda, Sayantani, and T. V. Ramachandra. "Phytochemical and pharmacological importance of turmeric (*Curcuma longa*): a review." *Research & Reviews: A Journal of Pharmacology*, 2019; 9.1: 16-23.
- <https://pubchem.ncbi.nlm.nih.gov/compound/Curcumin#section=Color-Form>
- Monton, Chaowalit, et al. "Quantitation of curcuminoid contents, dissolution profile, and volatile oil content of turmeric capsules produced at some secondary government hospitals." *Journal of food and drug analysis*, 2016; 24.3: 493-499.
- Carvalho, Devis de Moraes, et al. "Production, solubility and antioxidant activity of curcumin nanosuspension." *Food Science and Technology*, 2015; 35.1: 115-119.
- Muniyappan, N., M. Pandeeswaran, and Augustine Amalraj. "Green synthesis of gold nanoparticles using *Curcuma pseudomontana* isolated curcumin: Its characterization, antimicrobial, antioxidant and

- anti-inflammatory activities." *Environmental Chemistry and Ecotoxicology*, 2021; 3: 117-124.
10. S Bhattacharjee, A Sengupta. Spices In Cancer Prevention: An Overview. *The Internet Journal of Nutrition and Wellness*, 2008; 7(1).
 11. Yallapu, Murali M., Meena Jaggi, and Subhash C. Chauhan. "Curcumin nanoformulations: a future nanomedicine for cancer." *Drug discovery today*, 2012; 17.1-2: 71-80.
 12. Ikpeama, Ahamefula, G. I. Onwuka, and Chibuzo Nwankwo. "Nutritional composition of Tumeric (*Curcuma longa*) and its antimicrobial properties." *International Journal of Scientific and Engineering Research*, 2014; 5.10: 1085-1089.
 13. Kocaadam, Betül, and Nevin Şanlıer. "Curcumin, an active component of turmeric (*Curcuma longa*), and its effects on health." *Critical reviews in food science and nutrition*, 2017; 57.13: 2889-2895.
 14. Labban, Louay. "Medicinal and pharmacological properties of Turmeric (*Curcuma longa*): A review." *Int J Pharm Biomed Sci.*, 2014; 5.1: 17-23.
 15. Verma, Rahul Kumar, et al. "Medicinal properties of turmeric (*Curcuma longa* L.): A review." *Int. J. Chem. Stud*, 2018; 6.4: 1354-1357.
 16. Krup, Vasavda, L. H. Prakash, and A. Harini. "Pharmacological activities of turmeric (*Curcuma longa* Linn): a review." *J Homeop Ayurv Med.*, 2013; 2.133: 2167-1206.
 17. Jurenka, Julie S. "Anti-inflammatory properties of curcumin, a major constituent of *Curcuma longa*: a review of preclinical and clinical research." *Alternative medicine review*, 2009; 14.2.
 18. Bhullar KS, Jha A, Youssef D, Rupasinghe HP. Curcumin and its carbocyclic analogs: structure-activity in relation to antioxidant and selected biological properties. *Molecules*, 2013; 18(5): 5389-5404. Published 2013 May 10. doi:10.3390/molecules18055389