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A REVIEW ON ANTI-INFLAMMATORY HERBAL DRUG *(HALDI) Curcuma longa*

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Abstract: *Curcuma longa is a recent branch of natural science dealing with various aspects such as anthropology, archeology, botany, ecology, economics and medicine, religious, cultural and several other disciplines. Recently, great interest is given to studies of herbal drugs and traditional remedies are indicated universal and there has been an increase in the scientific investigations in area. Although turmeric (Curcuma longa) has been described in Ayurveda, as treatment inflammatory diseases and is referred by different names in different cultures, active principle called Curcumin or diferuloylmethane, a yellow pigment present in turmeric has been shown to exhibit numerous activities. Extensive research over last fifty years has revealed several important functions of curcumin. Root part of the plant are widely used by different tribal communities as Curcuma Longa have been shown to have wide spectrum of biological actions, which include anti-inflammatory, anti-diabetic, analgesic, antibacterial, anti-fungal, anti-protozoal, anti-ulcer, hypocholesteremic activities. Its anti-cancer effect induced mainly mediated through induction of apoptosis and many more medicinal values.*

Keywords: *Curcuma longa, Turmeric, Anti-inflammatory, Anti-cancer, Anti-diabetic, Analgesic, Antibacterial, Anti-fungal, Anti-protozoal and Anti-ulcer.*

Introduction: The Indian system of holistic medicine known as "Ayurveda" uses mainly plant-based drugs or formulations to treat various ailments, including cancer. Of the at least 877 small-molecule drugs introduced worldwide between 1981 and 2002, the origins of most (61%) can be traced to natural products. [1] Although many synthetic drugs are produced through combinatorial chemistry, plant-based drugs are more suitable, at least in biochemical terms, for human use. Nonetheless, modern medicine has neither held in very high esteem nor encouraged the medicinal use of natural products. *Curcuma Longa* is a plant that has a very long history of medicinal use, dating back nearly 4000 years. In Southeast Asia, *Curcuma Longa* is used not only as a principal spice but also as a component in religious ceremonies. Because of its brilliant yellow color,

Curcuma Longa is also known as "Indian saffron." Modern medicine has begun to recognize its importance, as indicated by the over 3000 publications dealing with *Curcuma Longa* that came out within the last 25 years. This review first discusses in vitro studies with *Curcuma Longa*, followed by animal studies, and finally studies carried out on humans; the safety and efficacy of *Curcuma Longa* are further addressed.

The use of *Curcuma Longa* dates back nearly 4000 years to the Vedic culture in India, where it was used as a culinary spice and had some religious significance. It probably reached China by 700 AD, East Africa by 800 AD, West Africa by 1200 AD, and Jamaica in the eighteenth century. In 1280, Marco Polo described this spice, marveling at a vegetable that exhibited qualities so similar to that of saffron. According to Sanskrit medical treatises and Ayurvedic and Unani systems, *Curcuma Longa* has a long history of medicinal use in South Asia. Susruta's Ayurvedic *Compendium*, dating back to 250 BC, recommends an ointment

containing *Curcuma Longa* to relieve the effects of poisoned food.

Taxonomy

Kingdom: Plantae
Class: Liliospida
Sub class: Commelinids
Order: Zingiberales
Family: Zingiberaceae
Genus: Curcuma
Species: Curcuma longa

The wild *Curcuma Longa* is called C.aromatica and domestic species is called *C.longa*. [2]




Today, *Curcuma Longa* is widely cultivated in the tropics and goes by different names in different cultures and countries (Table-1). In North India, *Curcuma Longa* is commonly called "haldi," a word derived from the Sanskrit word *haridra*, and in the south it is called "manjal," a word that is frequently used in ancient Tamil literature. The name *Curcuma Longa* derives from the Latin word *terra merita* (meritorious earth), referring to the color of ground *Curcuma Longa*, which resembles a mineral pigment. It is known as *terre merite* in French and simply as "yellow root" in many languages. In many cultures, its name is based on the Latin word *curcuma*. In Sanskrit, *Curcuma Longa* has at least 53 different names, including *anestha* (not offered for sacrifice or homa), *bhadra* (auspicious or lucky), *bahula* (plenty), *dhirgharaja* (long in appearance), *gandhaplashika* (which produces good smell), *gauri* (to make fair), *gharshani* (to rub), haldi (that draws attention to its bright color), *haridra* (dear to hari, Lord Krishna), *harita* (greenish), *hemaragi* (exhibits golden color), *hemaragini* (gives the golden color), *hridayavilasini* (gives delight to heart, charming), *jayanti* (one that wins over diseases), *jawarantika* (which cures fevers), *kanchani* (exhibits golden color), *kaveri* (harlot), *krimighni* or *kashpa* (killer of worms), *kshamata* (capability), *laxmi* (prosperity), *mangalprada* (who bestows auspiciousness), *mangalya* (auspicious), *mehagni* (killer of fat), *nisha* (night), *nishakhya* (known as night), *nishawa* (clears darkness and imparts color), *patwaluka* (perfumed powder), *pavitra* (holy), *pinga* (reddish-brown), *pinja* (yellow-red powder), *pita* (yellow), *pitika* (which gives yellow color), *rabhangavasa* (which dissolves fat), *ranjani* (which gives color), *ratrimanika* (as beautiful as moonlight), *shifa* (fibrous root), *shobhna* (brilliant color), *shiva* (gracious), *shyama* (dark colored), *soubhagaya* (lucky), *survana* (golden color), , *tamasini* (beautiful as night), *umavara* (Parvati, wife of Lord Shiva), *varna datri* (enhancer of body complexion), *varnini* (which gives color), *vishagni* (killer of poison), *yamini* (night), *yoshitapriya* (beloved of wife), and *yuvati* (young girl).

Table-1: Various Names of *Curcuma Longa* /Curcumin in Different Languages

Language	Name
Arabic	Kurkum, Uqdah safra
Armenian	Toormerik, Turmerig
Assamese	Halodhi
Bengali	Halud
Bulgarian	Kurkuma
Burmese	Hsanwen, Sanwin, Sanae, Nanwin
Catalan	Curcuma
Chinese	Yu chin, Yu jin, Wohng geung, Geung wohng, Wat gam, Huang jiang, Jiang huang, Yu jin, Yu jin xiang gen
Dhivehi	Reen'dhoo
Danish	Gurkemeje
Dutch	Geelwortel, Kurkuma Tarmeriek, Koenjit, Koenir
English	Indian saffron
Esperanto	Kurkumo
Estonian	Harilik kurkuma, Kurkum, Pikk kollajuur, Lohnav kollajuur, Harilik kurkuma, Kurkum, Pikk kollajuur, Lohnav kollajuur
Farsi	Zardchubeh
Finnish	Kurkuma, Keltajuuri

French	Curcuma, Safran des Indes, Souchet des Indes
Galician	Curcuma
German	Curcuma, Sarga
Greek	Kitrinoriza, Kourkoumi, Kourkoumas
Gujarati	Halad, Haldar
Hebrew	Kurkum
Hindi	Haldi
Indonesian	Kunyit, Kunir; Daun kunyit
Italian	Curcuma
Japanese	Ukon, Tamerikku
Kannada	Arishina, Arisina
Khmer	Romiet, Lomiet, Lamiet
Korean	Kang-hwang, Keolkuma Kolkuma, Sim-hwang, Teomerik, Tomerik, Tumerik, Ulgum, Ulgumun
Laotian	Khi min khun, Khmin khŪn
Latvian	Kurkuma
Malay	Kunyit basah
Malayalam	Manjal
Marathi	Halad
Nepali	Haldi, Hardi, Besar
Norwegian	Gurkemeie
Pahlavi	Zard-choobag
Pashto	Zarchoba
Punjabi	Haldi
Romanian	Curcuma
Russian	Koren, kurkumy, Kurkuma
Sanskrit	Ameshta, bahula, bhadra, dhirgharaja, gandaplashika, gauri, gharshani, haldi, haridra, harita, hemaragi, hemaragini, hridayavilasini, jayanti, jwarantika, kanchani, kaveri, krimighana, kshamata, kshapa, lakshmi, mangalaprada, mangalya, mehagni, nisha, nishakhya, nishawa, patavaluka, pavitra, pinga, pinja, pita, pitika, rabhangavasa, ranjani, ratrimanika, shifa, shiva, shobhana, shyama, soubhagaya, suvarna, suvarnavarna, tamasini, umavara, vairagi, varavarnini, varnadatri, varnini, vishagni, yamini, yoshitapriya, yuvati
Singhalese	Kaha
Slovak	Kurkuma
Slovenian	Kurkuma
Swahili	Manjano
Swedish	Gurkmeja
Tagalog	Dilaw
Tamil	Manjal
Telugu	Haridra, Pasupu
Thai	Kha min chan, Kha min; Wanchakmadluk
Tibetan	Gaser, Sga ser
Turkish	Hint safrani, Sari boya, Zerdecal, Zerdali, Zerdecube
Ukrainian	Kurkuma
Urdu	Haldi, Zard chub
Vietnamese	Bot nghe, Cu nghe, Nghe, Uat kim, Khuong hoang
Yiddish	Kurkume

Source:https://www.ncbi.nlm.nih.gov/books/NBK92752/table/ch13-t1/?report=objectonly

Curcuma Longa is a product of *Curcuma longa*, a rhizomatous herbaceous perennial plant belonging to the ginger family Zingiberaceae, which is native to tropical South Asia. As many as 133 species of *Curcuma* have been identified worldwide. Most of them have common local names and are used for various medicinal formulations. The *Curcuma Longa* plant needs temperatures between 20°C and 30°C and a considerable amount of annual rainfall to thrive. Individual plants grow to a height of 1 m, and have long, oblong leaves. Plants are gathered annually for their rhizomes, and are reseeded from some of those rhizomes in the following season. The rhizome, from which the *Curcuma Longa* is derived, is tuberous, with a rough and segmented skin. The rhizomes mature beneath the foliage in the ground. They are yellowish brown with a dull orange interior. The main rhizome is pointed or tapered at the distal end and measures 2.5–7.0 cm (1–3 inches) in length and 2.5 cm (1 inch) in diameter, with smaller tubers branching off. When the *Curcuma Longa* rhizome is dried, it can be ground to a yellow powder with a bitter, slightly acrid, yet sweet, taste.

Throughout the Orient, *Curcuma Longa* is traditionally used for both prevention and therapy of diseases. Modern in vitro studies reveal that *Curcuma Longa* is a potent

antioxidant, anti-inflammatory, antimutagenic, antimicrobial, and anticancer agent (Table-2). *Curcuma Longa*, used in cooking and in home remedies, has significant antioxidant abilities at different levels of action. Studies indicate that sufficient levels of *Curcuma Longa* may be consumed from curries in vivo to ensure adequate antioxidant protection. [3] As an antioxidant, *Curcuma Longa* extracts can scavenge free radicals, increase antioxidant enzymes, and inhibit lipid peroxidation. *Curcuma Longa* (100μg/mL) inhibits lipid peroxidation in renal cells against hydrogen peroxide-induced injury when incubated with cells for 3 hours. [4] Using *Salmonella typhimurium* strains TA 100 and TA 1535, a mutagenicity study showed that *Curcuma Longa* inhibits the mutagenicity produced by direct-acting mutagens such as N-methyl N'-nitro-N-nitrosoguanidine and sodium azide. *Curcuma Longa* extracts were found to inhibit microsomal activation-dependent mutagenicity of 2-acetamidofluorene. [5]

Table-2: Effects of *Curcuma Longa* against Various Diseases/Disorders

Disease/Disorder	Dose	Cells/Organisms
	Inflammation	
TNF-α, PGE2 level	50 μg/mL[a] (IC_{50} = 15.2 and 0.92 μg/mL)	HL-60 cells [6]
Dendritic cell activation	ND[a]	Dendritic cells [7]
	Viral	
Epstein-Barr virus early antigen	10 μg/mL[a]	Raji cells [8]
HBV replication	200 or 500 mg/L[c]	HepG 2.2.15 cells [9]
	Fungal	
Multiplication	MIC 7.8 μg/mL[a]	Dermatophytes [10]
Cell viability	LD50 33 and 109 μg/mL[a]	*Lemma minor, T. longifusus* [11]
	Microbial	
Multiplication	6.25–50.00 μg/mL[f]	*H. pylori* [12]
Multiplication	0.1%-10.0%[e]	*S. typhimurium* [13]
Multiplication	5%[c]	Foodborne pathogen [14]
Multiplication	5%[c]	Histamine-producing bacteria [15]
Growth of mycobacteria	6%[a]	*M. tuberculosis* [16]
Pathogens viability	ND[g]	Foodborne pathogenic bacteria [17]
Bacterial growth and adhesion	50 mg/mL[c]	*H. pylori* [18]
Infection and pathogenesis	ND[a]	*Schistosoma mansoni cercariae* [19]
	Other	
ATPase level	131 mg/mg protein	Rat jejunal cells [20]
Procarcinogens activation	IC_{50} = 0.24[b]	Caco-2 cells [21]
Oxidative off-flavors	ND[b]	Pickles [22]
Hemolysis	1–100 μg/mL[a]	Human RBC [23]

TNF = tumor necrosis factor; PGE2 = prostaglandin E2; IC_{50} = median inhibitory concentration; NO = nitric oxide; PI = parainfluenza; AD = adenovirus; CHO = Chinese hamster ovary; HBV = hepatitis B virus; HNE = 4-hydroxy-2-nonenal; LD_{50} = median lethal dose; MIC = minimum inhibitory concentration; ND = not defined; RS = Rous sarcoma.

[a] Ethanolic extract of turmeric; [b] Turmeric powder; [c] Aqueous extract of turmeric; [d] CO^2 gas extract of turmeric; [e] Hexane extract of turmeric; [f] Methanolic extract of turmeric; [g] Turmeric oil

Source: https://www.ncbi.nlm.nih.gov/books/NBK92752/table/ch13-t3/?report=objectonly

The most important secondary metabolite of *C. longa* is curcumin, which is responsible for anti-inflammatory effect of this plant. [24] Many clinical trials have been done for proving the anti-inflammatory effect of curcumin. Their results suggest that curcumin can be effective in improving inflammation of rheumatoid arthritis (RA) and reducing clinical manifestation of RA, such as joint swelling and morning stiffness in comparison with phenylbutazone which is used as a positive control. [25] Also, curcumin was tested in patients with anterior uveitis; after 2 weeks, exhaustive remission occurred. [26] The effectiveness of curcumin in patients with dyspepsia and/or gastric ulcer was proved by another clinical trial. In this study, subjects experienced remission after 12 weeks (maximum). [27] Curcumin is beneficial in irritable bowel syndrome (IBS) treatment [28] and also works as a reducing agent to delayed graft rejection (DGR) after kidney transplant surgery. [29] Curcumin likewise has a beneficial effect in inhibition of inflammatory bowel disease (IBD) and reduction in sedimentation rate in patients who suffered from IBD. [30] It is also proven to be beneficial in maintaining amelioration of ulcerative colitis [31] and psoriasis (by the selective prohibition of phosphorylase kinase).

Phytochemistry: The phytochemical screening of petroleum ether extract, benzene extract, chloroform extract, acetone extract, methanol extract, ethanol extract and water extract was performed. Among which ethanolic extract yield (2.35%) was investigated for its anti-fertility activity. Presence of alkaloids, carbohydrates, glycosides, phytosterols, saponins, gums and mucilage in various extracts were observed. Some tests were conducted to confirm the presence of phyto-constituents in the plant extracts. Test for alkaloids was conducted by using Mayer's reagent, upon which addition to petroleum ether, chloroform, ethyl acetate, alcohol and water extracts separately showed the formation of white or cream colored precipitates which confirms the presence of alkaloids. No phenolic compounds were found which was confirmed by adding few drops of 5% lead acetate solution to alcoholic extracts. Flavonoids were absent which was confirmed by no change in color of filter paper upon dipping in ammoniated alcoholic and aqueous extracts. Saponins were considered to present when petroleum extracts and benzene extracts showed honey comb like frothing after giving a shake with sodium bi-carbonate. After performing the Millon's, Biuret's and Ninhydrin's test showed the absence of proteins and amino acids. When the petroleum extracts, benzene extracts, methanol extracts, ethanol extracts and water extracts were given a shake with chloroform and few drops of acetic anhydride along with few drops of sulphuric acid from the side tube forms the blue to brick red color formation confirms the presence of Phytosterols [32]. The major constituents, curcumin (diferulolmethane) is in the most important faction of Curcuma longa, which melts at 1760 C to 1770C and forms red-brown salts with alkalis. Curcumin is soluble in ethanol, alkalis, ketone, acetic acid and chloroform; and insoluble in water. In the molecule of curcumin, main chain is aliphatic chain, unsaturated and aryl group can be substituted or not. The main chemical components are Curcumin (60%), desmethoxycurcumin, monodemethoxycurcumin, bisdemethoxycurcumin, dihydrocurcumin andcyclocurcumin. By the oxidation of curcumins vanillin can be yielded. The essential oil (5.8%) obtained by steam distillation of rhizomes has a-phelladrene (1%), sabinene (0.6%), Cineol (1%), borneol (0.5%), Zingiberene (25%) and sesquiterpines (53%). [33, 34] Curcumin (diferuloylmethane) (3-4%) is responsible for yellow color and comprises of curcumin I (94%), curcumin II (6%) and curcumin III (0.3%). Demethoxy and bis-demethoxy derivatives of curcumin have also been isolated. [35]

Anti-helminthic Property: Alcoholic extract of rhizomes was found to have anti-protozoal activity against Entamoeba histolytica. [36] Curcumin has anti-leishmania activity.[37]

Anti-inflammatory Action: Inflammatory changes of joints are often associated with rheumatic complaints. *Curcuma Longa* is attributed with hot potency and anti-inflammatory action. It cures the etiological factors and pathological changes of inflammation. The anti-inflammatory activity of curcumin was first reported in 1971. [38] It was further reported that oral doses of curcum in possess significant anti-inflammatory action in both acute and chronic animal models. Curcumin had been proved to be safe in human trials and had demonstrated anti-inflammatory activity. [39] In clinical trials, curcumin was reported to be effective in rheumatoid arthritis. [40] A clinical trial in eight patients with definite rheumatoid arthritis showed significant improvement in morning stiffness and joint swelling after two week-therapy. [41]

***Curcuma longa* in Respiratory Diseases:** *Curcuma Longa* is well accepted as a Kaphahara drug (phlegmatic conditions are termed as "Kapha" and that which cures it is Kaphahara). *Curcuma Longa* is anti-inflammatory and anti-purulent in nature. It is reported that volatile oil of *Curcuma Longa* as oral drug in a clinical trial was found very effective in the treatment of bronchial asthma. [42] Fresh rhizome proved effective against whooping cough and other coughs and in dyspnea. [43] In catarrh and coryza, the inhalation of burning *Curcuma Longa* fumes causes copious mucous discharge and gives instant relief. [44] The root, parched and powdered, is given in bronchitis. [45] A report of clinical trials in respiratory diseases such as bronchial asthma, bronchitis, bronchiectasis, and tropical eosinophilia revealed that *Curcuma Longa* could play a vital role as an adjuvant in improving the airway resistance. Anti-asthmatic property of Curcumin had been tested in guinea pig model. [46]

Biomedical Applications of *Curcuma longa*: Curcumin (diferuloylmethane), a polyphenol, is a low molecular-weight active principle of the perennial herb Curcuma longa (commonly known as *Curcuma Longa*). Recent evidence

suggests that curcumin is a highly pleotropic molecule that interacts physically with its diverse range of molecular targets including transcription factors, growth factors and their receptors, cytokines, enzymes, and genes regulating cell proliferation and apoptosis. Curcumin possesses antioxidant, anti-inflammatory, anticarcinogenic, and antimicrobial properties, and suppresses proliferation of a wide variety of tumor cells. Several clinical trials dealing with cancer have addressed the pharmacokinetics, safety, and efficacy of curcumin in humans. [47] Despite extensive research and development, poor solubility of curcumin in aqueous solution remains a major barrier in its bioavailability and clinical efficacy. Being hydrophobic in nature, it is insoluble in water but soluble in ethanol, dimethylsulfoxide, and acetone. To increase its solubility and bioavailability, attempts have been made through encapsulation in liposomes, polymeric and lipo-NPs, biodegradable microspheres, cyclodextrin, and hydrogels. [48] In recent years, various controlled delivery forms, such as polymeric micro/nanospheres, liposomes, micelles, parenteral emulsion, and prodrugs have been investigated to increase its solubility, to minimize the side effects as well as to avoid the use of toxic adjuvant. [49]

Conclusion: *Curcuma Longa* is one of the most precious and powerful plant on earth and is being used as a natural wonder by the ancient people of India. *Curcuma Longa* is proving beneficial in the treatment of many different health conditions from cancer to Alzheimer's disease. As this review has shown Curcumin is one such agent and has potential to treat various diseases. More extensively well controlled clinical trials are now needed to fully investigate its potential. Regardless of all these Curcumin has established as a foodstuff and also a natural medicine because of its low cost, proven chemo preventive and therapeutic potential and potent pharmacological activities of *Curcuma Longa* at in-vivo and in-vitro which made it a nature's precious drug. Curcumin is rapidly moving from kitchen shelf toward the clinic.

The beneficial effects of *Curcuma Longa* are traditionally achieved through dietary consumption, even at low levels, over long periods of time. A precise understanding of effective dose, safety, and mechanism of action is required for the rational use of *Curcuma Longa* in the treatment of human diseases. Further clinical studies are warranted if *Curcuma Longa* is to be employed in meeting human needs and improving human welfare. The activities of *Curcuma Longa* include antibacterial, antiviral, anti-inflammatory, antitumor, antioxidant, antiseptic, cardioprotective, hepatoprotective, nephroprotective, radioprotective, and digestive activities. Phytochemical analysis of *Curcuma Longa* has revealed a large number of compounds, including curcumin, volatile oil, and curcuminoids, which have been found to have potent pharmacological properties.

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