

Review article

Curcuma longa: A treasure of medicinal properties

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ABSTRACT

Nature is full of precious treasure to cure us from various disorders. One of them is *Curcuma longa* belonging to *Zingiberaceae* family, present with outstanding therapeutic value and used since time immemorial. Part used from the plant is rhizome native to India (south east continent) which is the world's largest producer, consumer and exporter of turmeric. The active principle called curcumin or diferuloylmethane is a yellow pigment that exhibits numerous activities and wide spectrum of biological actions which include anti-inflammatory, hepatoprotective, anti-cancerous, anti-fungal, neuroprotective activities and many more. This paper focuses on the comparative evaluation of medicinal properties of *Curcuma longa* as mentioned in Unani classical literature with its modern scientific researches.

Keywords Turmeric, Unani medicine, therapeutic uses.

INTRODUCTION

Curcuma longa Linn (vernacular names: Arabic - Urooq ul Asfar, Chinese – Chiang Huang, Yu Chin, English – Turmeric, (Indian saffron), Sanskrit- Haridra, Persian – Zard chob, Darzardi, Urdu-Haldi), belonging to *Zingiberaceae* family, is used in Unani medicine of system since time immemorial and has been attributed a significant place as a single drug or as a constituent in various formulations to treat innumerable medical conditions. Traditional use of (*Curcuma longa*) Haldi dated back to nearly 4000 years to the Vedic culture in India, where it was used in the Indian kitchen as culinary spice as well as to treat various ailments which included improving digestion and intestinal flora, relieving gas and eliminate intestinal worms, relieve swelling, strengthens liver, for local application on sprains, burns, cuts, bruises, insect bites and itches, for soothing action in cough and asthma, and in any condition of weakness or debility, indicated topically and internally (Meylers, 2009). Various pharmacological actions and uses of *Curcuma longa* have been mentioned in classical Unani literature ranging from gastroenterology, cosmetology and respiratory system to name a few. Because of its multifaceted pharmacological actions and uses it is the focus of various research activities which includes both animal and clinical studies. A few clinical studies (Meylers, 2009) as well as the Food and Drug Administration (FDA) concluded curcumin to be safe (Prasad, *et al.*, 2014).

CLASSIFICATION OF CURCUMA LONGA (Lal, 2012)

Kingdom	Plantae
Subkingdom	<i>Tracheobionta</i>
Super division	<i>Spermatophyta</i>
Division	<i>Magnoliophyta</i>
Class	<i>Magnoliopsida</i>
Sub class	<i>Zingiberidae</i>
Order	<i>Zingiberales</i>
Family	<i>Zingiberaceae</i>
Genus	<i>Curcuma</i> L.
Species	<i>Curcuma longa</i> L.

BOTANICAL DESCRIPTION

Curcuma longa is a perennial herb, grows to a height of 60-90 cm. Its leaves are very large, in tuft up to 1.2 m or longer including the petiole which resembles blade, oblong lanceolate, tapering to the base (Parrotta, 2001). Turmeric is mainly cultivated at 20° to 30° C in tropical regions in Southeast Asia especially in India (Punjab, Bihar, Tamil Nadu) and China. (Chopra, *et al.*, 1956) (Sirisidthi, *et al.*, 2016) (Bentley, *et al.*, 2009) (Parrotta, 2001). It is an important medicinal and aromatic plant considered as one of the golden resource with massive exports prospective as medicine, cosmetic, cooking spice dye (Das, 2016) (Anonymous, 1986). Flowers are yellow, 10-15 cm in length and grouped together in dense spikes, which appears from the end of spring till mid of autumn (Evans, *et al.*, 2002) (Kumar, *et al.*, 2013) (Thomas, YNM) (Khan, 2013). This plant is devoid of fruits. Rhizome is used which is ovate or pear shaped and resembles the bulb known as round turmeric measuring 2.5-7.0 cm in length and 2.5 cm in diameter with finger like projection branching off. It is yellowish brown with a dull orange from interior section that looks bright yellow or when powdered. (K.R, *et al.*, 1996) (Kabiruddin, 2007)

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CHEMICAL CONSTITUENTS

Curcumin (diferuloylmethane) is the active principal curcuminoid present in *Curcuma longa*. The other two curcuminoids are demethoxycurcumin and bis-demethoxycurcumin and various volatile oils, including tumerone, atlantone, and zingiberone. Other constituents include sugars, proteins, and resins.

The curcuminoids are polyphenols and are responsible for the yellow colour of turmeric.

Derivatives of curcumin are

- demethoxycurcumin
- bis-demthoxycurcumin
- 5'-methoxycurcumin
- dihydrocurcumin
- cyclocurcumin

(Sambhav, *et al.*, 2014) (Asolkar, *et al.*, 1992) (Omosa, *et al.*, 2017).

PART USED

In Unani classical literature Rhizomes (root) is mentioned for use (Khan, 2013) (Anonymous, 2004) (Kabiruddin, 2007) (WHO, 2004) (CCRUM, 2001) (Government of India, 2001) (CCRUM, 2009).

MIZAJ (TEMPERAMENT)

According to Hakeem Mohd.Azam Khan its temperament is Hot³ and Dry³ (Kabiruddin, 2007) (Khan, 2013).

According to Sheikh Ibn Sina, its temperament is Hot² and Dry² (Khan, 2013).

TASTE & COLOUR

Bitter & Yellow

(K.R, *et al.*, 1996) (Thomas, YNM)

Afaal (ACTIONS)

<i>Qatil-e-didaan</i> (Antihelmenthic) (Kabiruddin, 2007) (Ghani, 1912)	<i>Mufatteh</i> (Dissolve blood clots) (Ghani, 1912)
<i>Qatil-e -Jarasim</i> (Antimicrobial) (Kabiruddin, 2007)	<i>Jali</i> (Detergent) (Kabiruddin, 2007) (Khan, 2013)
<i>Qatil e didaan</i> (Antiparasitic) (Ghani, 1912)	<i>Mudammil-Qarah</i> (Healing) (Kabiruddin, 2007) (Khan, 2013) (Ghani, 1912) (CCRUM, 2009) (CCRUM, 2001)
<i>Mubakkhir</i> (Antiflatulant) (CCRUM, 2009)	<i>Muaqawwi-e-Kabid</i> (Hepatoprotective) (Kabiruddin, 2007)
<i>Kasir e riyah</i> (Carminative) (CCRUM, 2009)	<i>Muqawwi-e-Basr</i> (Improves eye sight) (Kabiruddin, 2007) (Khan, 2013) (Ghani, 1912)
<i>Mohallil-e-Warm</i> (Antiinflammatory) (Kabiruddin, 2007) (Khan, 2013) (Ghani, 1912) (CCRUM, 2009)	<i>Habis ud dam</i> (Bleeding disorders) (Ghani, 1912)
<i>Qabiz</i> (Astringent) (Kabiruddin, 2007) (Khan, 2013) (CCRUM, 2009)	<i>Mufatteh</i> (Deobstruent) (Kabiruddin, 2007)
<i>Musaafi-e-Khoon</i> (Blood purifier) (Kabiruddin, 2007) (Ghani, 1912) (CCRUM, 2001)	<i>Muaqawwi-e-Asab</i> (Neuroprotective) (Kabiruddin, 2007) (Ghani, 1912)

Istemaal (USES)

<i>Istisqa</i> (Ascites) (Kabiruddin, 2007) (Ghani, 1912)	<i>Waram al-Kabid</i> (Hepatitis) (Ghani, 1912)
<i>Diq-al-Nafas</i> (Asthma) (Kabiruddin, 2007) (CCRUM, 2009)	<i>Tukhma</i> (Indigestion) (Ghani, 1912)
<i>Ehtebas e Tams</i> (Amenorrhea) (CCRUM, 2001)	<i>Yaraqan Suddi</i> (Obstructive Jaundice) (Khan, 2013) (Kabiruddin, 2007) (Ghani, 1912)
<i>Dummal</i> (Boils) (Ghani, 1912)	<i>Namla & Humayqa</i> (Herpes & chicken pox) (Khan, 2013)
<i>Radd</i> (Bruise) (Ghani, 1912) (CCRUM, 2001)	<i>Kalaf</i> (Melasma) (Khan, 2013) (Ghani, 1912)
<i>Dama</i> (Catarrh) (Khan, 2013) (Ghani, 1912)	<i>Nakhuna</i> (Pterygium) (Ghani, 1912) (Khan, 2013)
<i>Muzmin Sual-o-Surfa</i> Chronic bronchitis (Kabiruddin, 2007)	<i>Jarab</i> (Scabies) (Kabiruddin, 2007) (Khan, 2013)
<i>Muzmin Ishal</i> (Chronic diarrhoea) (Ghani, 1912)	<i>Amraz-e-Jild</i> (Skin diseases) (Khan, 2013) (Ghani, 1912)
<i>Muzmin Humma</i> (Chronic fever) (Ghani, 1912)	Skin lightening (Khan, 2013) (Ghani, 1912)
<i>Ramad</i> (Conjunctivitis) (Khan, 2013) (Kabiruddin, 2007) (Ghani, 1912)	<i>Bahaq Abyad</i> (Pitryasis Alba) (Khan, 2013)
<i>Sual</i> (Cough) (Ghani, 1912)	<i>Fasad al-Hazm</i> (Dyspepsia) (Ghani, 1912)
<i>Mukhrij-i-Didan-i-Ama</i> (Helmenthiasis) (Ghani, 1912) (Kabiruddin, 2007)	

MUSLEH (CORRECTIVE)

Distilled Lemon water and Turanj (Citrus senensis) (Khan, 2013) (Kabiruddin, 2007)

BADAL (SUBSTITUTE)

Majeeth (Rubia cordifolia) (Khan, 2013) (Kabiruddin, 2007) (Ghani, 1912)

MIQDAAR E KHURAK (DOSAGE)

Powder- 1 to 3 gms (Kabiruddin, 2007) (WHO, 2004)

Powder- 3 to 7 gms (Khan, 2013) (Ghani, 1912)

PHARMACOLOGICAL STUDIES

I. Anti-inflammatory Activity

- ♦ In a study on male Sprague-Dawley rats , use of crude extract of Curcuma longa shows anti-inflammatory effect on collagen-induced arthritis and inhibition of inflammatory markers, such as phospholipase, lipooxygenase, cyclooxygenase-2, leukotrienes, thromboxane, prostaglandins, nitric oxide, collagenase, elastase, hyaluronidase, interferon-inducible protein,

tumor necrosis factor, and interleukin-12 (Chainani, 2003) (Taty, *et al.*, 2011).

- ♦ In another study performed in vitro Curcumin derivative (bis-demethylcurcumin) is found effective as an anti-inflammatory agent as it suppresses factor-induced nuclear factor (NF- κ B) of tumour necrosis (Ravindran, *et al.*, 2010).

II. Hepatoprotective Activity

- ♦ The hepatoprotective effect of curcumin was evidenced in lipopolysaccharide/d-galactosamine model of liver injury in rats, via decrease in ALT and AST levels as well as in lipid peroxidation (Cerny, *et al.*, 2011).
- ♦ Ethanolic extract of *Curcuma longa* was reported to have hepatoprotective effect in liver cirrhosis in rats via its ability to act as an antioxidant and anti-inflammatory agent (Salama, *et al.*, 2013).
- ♦ In another study for evaluating the hepatoprotective effect of fermented *Curcuma longa* in rats under carbon tetrachloride (CCl₄)-induced oxidative stress, it was observed that pre-treatment with plant extract at a dose of 30 or 300 mg/kg body weight orally administered for 14 days drastically prevented the elevated activities of serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), and lactate dehydrogenase (LDH) caused by CCl₄-induced hepa-totoxicity. Furthermore, extract from fermented *Curcuma longa* enhanced antioxidant capacities with higher activities of catalase, glutathione-S-transferase, glutathione reductase, and glutathione peroxidase. Hence, researcher advised that the extract could be used as prevention against various liver diseases induced by oxidative stress via elevating antioxidative potentials and decreasing lipid peroxidation (Kim, *et al.*, 2014).

III. Antibacterial Activity

- ♦ Aqueous extract of *Curcuma longa* exhibits antibacterial effect against *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Escherichia coli* with the minimum inhibitory concentration (Moghadamtousi, *et al.*, 2014) (Niamsa, *et al.*, 2009).
- ♦ In a study of methanol extracts *Curcuma longa* also showed antibacterial effect against an array of bacteria including, *Vibrio harveyi*, *Vibrio alginolyticus*, *Vibrio vulnificus*, *Vibrio parahaemolyticus*, *Vibrio cholerae*, *B. subtilis*, *Bacillus cereus*, *Aeromonas hydrophila*, *Streptococcus agalactiae*, *S. aureus*, *Staphylococcus intermedius* (Lawhavinit, *et al.*, 2010).

IV. Antifungal Activity

- ♦ The methanol extract of *Curcuma longa* inhibited the growth of some clinical isolates of dermatophytes (Wuthi-udomlert, *et al.*, 2000).
- ♦ Active constituent of *Curcuma longa* (curcumin) prepared with ethyl acetate extract exhibited inhibitory effects on the growth of *R. solani*, *P. recondita*, and *P. infestans* (Kim, *et al.*, 2003).
- ♦ The methanol extract of *Curcuma longa* revealed antifungal activity against *Cryptococcus neoformans* and *Candida albicans* (Ungphaiboon, *et al.*, 2005).

V. Antiviral Activity

- ♦ The aqueous extract of *Curcuma longa* exhibited antiviral activity against hepatitis B virus (HBV) in HepG2 cells

containing HBV genomes via repression of HBsAg secretion from liver cells, without any cytotoxic effect. The HBV particles production and the rate of mRNA production of HBV on infected cells were also suppressed (Kim, *et al.*, 2009).

- ♦ Curcumin was recognised as the antiviral constituent of the plant against hepatitis C virus (HCV), decreasing HCV gene expression and replication through suppression of the Akt-SREBP-1 pathway in vitro (Kim, *et al.*, 2010).

VI. Wound healing Activity

- ♦ Wound healing property of *Curcuma longa* showed progressive decrease in wound area and margin was traced every 3 days on tracing paper. Wound contraction was measured as percentage and reduction of damaged skin prior to treatment and regenerated skin after in wound area in each animal was examined. Powdered *Curcuma longa* with *Oleum olivae* showed a faster contraction when compared to normal control (Gayathri, *et al.*, 2015).
- ♦ *Curcuma longa* rhizome is reported to possess antibacterial, antifungal, anti-inflammatory and also show regeneration as well as wound healing properties in rats (Alam, *et al.*, 2011).

VII. Fibrinolytic Activity

- ♦ Shivalingu reported the possible involvement in blood coagulation cascade with respect to procoagulant activity by reducing the human plasma clotting time from the dialyzed crude enzyme fractions of turmeric species viz., *Curcuma aromatica*, *Curcuma longa*. It was concluded that turmeric species are rich in serine and cysteine proteases that exhibited procoagulant associated with fibrinolytic activity (Shivalingu, *et al.*, 2015).

VIII. Anti-platelet Activity

- ♦ Lee studied the antiplatelet activity of *Curcuma longa* rhizome-derived materials using rabbit's platelet through aggregometer and compared with those of aspirin as antiplatelet agent. Active constituent of *Curcuma longa* was isolated and characterized as ar-turmerone by various spectral analyses. At 50% inhibitory concentration value, ar-turmerone was effective in inhibiting platelet aggregation induced by collagen and arachidonic acid. In comparison, ar-turmerone was significantly more potent platelet inhibitor than aspirin against platelet aggregation induced by collagen (Lee, 2006).
- ♦ In another study, it has been shown that curcumin inhibits human platelet aggregation and dense granule secretion induced by GPVI agonists through interfering with the kinase activity of Syk (spleen tyrosine kinase) (Mayanglambam, *et al.*, 2010).

IX. Anti-coagulant Activity

- ♦ It has been reported that curcumin and its derivative (bisdemethoxycurcumin) prolong activity of partial thromboplastin time and prothrombin time significantly and inhibits thrombin and activated factor X activities (Kim, *et al.*, 2012).

X. Neuroprotective Activity

- ♦ Ethanol extract of *Curcuma longa*, in demonstration of neuroprotective effects on neuronal loss induced by dexamethasone treatment in rat hippocampus (Issuriya, *et al.*, 2014).

- ♦ Neuroprotective effect of curcumin, through attenuation of quinoprotein formation, p-p38 mitogen activated protein kinases (MAPKs) expression, and caspase-3 activation in 6-hydroxydopamine treated SH-SY5Y neuroblastoma cells in vivo and vitro system (Meesarapee, *et al.*, 2014).
- ♦ Chronic administration of curcumin significantly improved memory retention, attenuated oxidative damage, acetylcholinesterase activity, and aluminium concentration in aluminium treated rats indicating that this compound has neuroprotective effects against aluminium-induced cognitive dysfunction and oxidative damage (Kumar, *et al.*, 2009).

XI. Cardio protective Activity

- ♦ Curcumin showed promising role as a cardio protective agent in vitro and vivo studies against palmitate and high fat diet mediated cardiac dysfunction (Zeng, *et al.*, 2015).
- ♦ Curcuma oil was also reported to reduce endothelial cell-mediated inflammation in post myocardial ischemia/reperfusion in rats (Manhas, A, *et al.*, 2014).
- ♦ In a study of curcumin to know effect on cardiovascular risk factors in humans with coronary artery disease, it has been observed that serum triglyceride, LDL and VLDL cholesterol levels lowers significantly in the group of individuals taking curcumin. Blood lipid profile shows proven effects to lower levels, but no such effect on inflammatory markers (Mirzabeigia, *et al.*, 2015).

XII. Anticancer Activity

- ♦ Curcumin, decreases the proliferation of cell lines involved in various cancers, such as prostate carcinoma PC-3 cells (Wilken, *et al.*, 2011) (Cheng, *et al.*, 2013), breast adenocarcinoma MDA-MB-231 cells (Sun, *et al.*, 2012) MCF- 7 cells (Liu, *et al.*, 2013), colon carcinoma HCT-8/VCR cells (Lu, *et al.*, 2013) HCT-15 cells (Shehzad, *et al.*, 2013) and liver cancer HepG2 cells (Fan, *et al.*, 2014).
- ♦ Curcumin is effective in reducing and preventing various cancer types including multiple myeloma, colon, pancreas, breast, prostates and lung cancers in clinical study (Anand *et al.*, 2008) (Devassy, *et al.*, 2015).
- ♦ In-vitro and in-vivo study on colon cancer cells dealing with monocarbonyl analogue of B63 acquired through some chemical modifications of curcumin's structure, this component has been shown develop antiproliferative effect and at the same time, suppression of tumor growth with use of less B63 (50 mg/kg B63, 100 mg/ kg curcumin) (Zheng, *et al.*, 2014).

XIII. Antidiabetic Activity

- ♦ Frozen dried rhizome powder of Curcumin longa dissolved in milk in streptozotocin-induced diabetic rats was effective with dose 200 mg/kg body weight as it increases high density lipoprotein (HDL), haemoglobin and body weight with significant decrease in the levels of blood glucose, lipid profile, and hepatoprotective enzymes (Rai, *et al.*, 2010).
- ♦ In vitro study showed antidiabetic effect and low-density lipoprotein (LDL) oxidation, angiotensin converting enzyme, α -glucosidase and α -amylase were inhibited by the ethyl acetate extract of plant with advanced outcome compared to that of reference drug acarbose. Protein glycation inhibitory potential of ethyl acetate extract was 800 times higher than that of ascorbic acid. The

accumulation of advanced glycation end products (AGE's) in the body, due to the nonenzymatic glycation of proteins is associated with numerous pathological conditions like aging and diabetes mellitus (Lekshmi, *et al.*, 2014).

XIV. Topical Activity (Skin diseases)

- ♦ In a mouse model, curcumin relieves the psoriasis-like inflammation by decreasing the levels of IL-17A, IL-17F, IL-22, IL-1 β , IL-6 and TNF- α cytokines (Sun, *et al.*, 2013)

XV. Anti -allergic and Anti asthmatic Activity

- ♦ Allergy and asthma are proinflammatory diseases, stemming from inflammatory cytokines. In a study it is proven that *Curcuma longa* exhibits anti-allergic activity by suppressing the 48/80-induced histamine release from rat mast cells (Yano, *et al.*, 2000).
- ♦ Curcumin has been determined to lower the production of IgE antibodies and cytokine, and enabling the formation of less inflammatory response in murine models (Vishwanath, *et al.*, 2008).

CONCLUSION

Curcuma longa has been reputed as a treasure of medicinal properties and has been used for the same in most traditional systems of medicine, especially Unani system of medicine. The scientific research, based on the results of various in vitro studies, in vivo studies, and clinical trials, has generated enough evidence based data to support the same. Besides, the fact that curcumin is a safe natural product and its cost is lower than many drugs may indicate that curcumin may be effective in prevention and treatment of various disorders. Even after exhaustive work has been reported on this herb, still its extensive medicinal potential remains un-trapped and leaves room for future exploration in this field.

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CONFLICT OF INTEREST

No conflict of interest is involved in writing of this article

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