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TURMERIC (THE GOLDEN SPICE) - A TREASURE OF MOTHER NATURE

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ABSTRACT

Turmeric is a rhizomatous herbaceous perennial plant (Curcuma longa) of the ginger family, Zingiberaceae. Although we can find so much of literature and abundance of traditional uses in our daily routine of this herb yet its use as a medicine for specific disease is lacking. Turmeric is certainly no magic but it is indeed magical. The most important chemical components of turmeric are a group of compounds called curcuminoids, which include curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin. The best-studied compound is curcumin, which constitutes approximately 3.14% of the powdered turmeric. Several medical properties have been attributed to Curcuma longa Linn. It is well known for its anti- diarrheal, anti-inflammatory, hepatoprotective, cardioprotective properties. It also has the potential to fight against cancer, diabetes, asthma and so many other chronic diseases. This review has been written to provide current knowledge of its medicinal properties and need for further research in drug design and development has been emphasized.

KEYWORDS: Turmeric, spice, rhizome, curcumin, medicinal properties, drug development.

INTRODUCTION

Natural plant products have been used throughout human history for various purposes. Many of these natural products have pharmacological or biological activity that can be used in pharmaceutical drug discovery and drug design. The Indian subcontinent is rich in a variety of such flora. In India, the earliest mention of the use of medicinal plants is to be found in Rigveda which was written between 4500-1600 BC.[1] Turmeric (*Haridra*) is one such medicinal plant explained extensively in Indian material medica. Application of turmeric as paste to the bride is an essential procedure of Hindu rituals [2]. The rhizomes are boiled and then dried in hot ovens, after which they are ground into a deep-orange-yellow powder commonly used as a coloring and flavoring agent in many Asian cuisines, especially for curries, as well as for dyeing. Turmeric powder has a warm, bitter, pepper-like flavor and earthy, mustard-like aroma. In Ayurveda, turmeric has been well documented for its therapeutic potentials and described in *Dashemani Lekhaniya* (emaciating), *Kusthagna* (Anti-dermatosis), *Visaghna* (Anti-poisonous).[3] Turmeric has a very long history of medicinal use, dating back nearly 4000 years. In Southeast Asia, turmeric is used not only as a principal spice but also in religious ceremonies. Due to its brilliant yellow color, turmeric is also known as "Indian saffron." Turmeric's effects on health are generally centered upon an orange-yellow colored, lipophilic polyphenol substance called "curcumin," which is found in the rhizomes of the herb. Curcumin is known recently to have antioxidant, anti-inflammatory, anticancer effects and, hence it has an important role in prevention and treatment of various illnesses ranging from cancer to autoimmune, neurological, diabetic and cardiovascular diseases.

Taxonomy
Kingdom: Plantae
Genus: Curcuma
Species: C. longa

Botanical name: Curcuma longa

Common Names: Kunyit, Haridra, Haldi, Indian Saffron, and Arishina.

Indian Names: Haldi (Hindi), Pasupu (Telugu), Manjal (Tamil), Manjal (Malayalam), Arasina (Kananda), Haldar (Gujarati), Halud (Bengali) and Halad (Marathi).

Turmeric is the dried rhizome of Curcuma longa L. (Zingiberaceae).[4]

Synonyms: Kunyit, Haridra, Haldi, Indian Saffron, and Arishina.

Selected vernacular names: Acafrao, arqussofar, asabi-e-safr, avea, cago rerega, chiang-huang, common tumeric, curcum, curcuma, dilau, dilaw, Gelbwurzel, gezo, goeratji, haladi, haldi, haldu, haku halu, hardi, haridra, huang chiang, hsanwen, hurid, Indian saffron, jiânghuang, kaha, kakoenji, kalo haledo, khamin chan, khaminchan, kilunga kuku, kitambwe, kiko eea, koening, koenit, koenjet, kondin, kooneit, kunyit, kurcum, kurkum, Kurkumawurzelstock, luyang dilaw, mandano, manjano, manjal, nghe, nisha, oendre, pasupu, rajani, rame, renga, rhizome de curcuma, saffran vert, safran, safran des indes, skyer-rtsa, tumeric, tumeric root, tumeric rhizome, turmeric, yellow root, zardchob.[4–6,6–14]

Description: Perennial herb up to 1.0 m in height; stout, fleshy, main rhizome nearly ovoid (about 3 cm in diameter and 4 cm long). Lateral rhizome, slightly bent (1cm × 2–6cm), flesh orange in colour; large leaves lanceolate, uniformly green, up to 50cm long and 7–25cm wide; apex acute and caudate with tapering base, petiole and sheath sparsely to densely pubescent. Spike, apical, cylindrical, 10– 15cm long and 5–7 cm in diameter. Bract white or white with light green upper half, 5–6 cm long, each subtending flowers, bracteoles up to 3.5 cm long. Pale yellow flowers about 5cm long; calyx tubular, unilaterally split, unequally toothed; corolla white, tube funnel shaped, limb 3-lobed. Stamens lateral, petaloid, widely elliptical, longer than the anther; filament united to anther about the middle of the pollen sac, spurred at base. Ovary trilocular; style glabrous. Capsule ellipsoid. Rhizomes orange within.[4,7]

Plant material of interest: dried rhizome

General appearance: The primary rhizome is ovate, oblong or pear-shaped round turmeric, while the secondary rhizome is often short-branched long turmeric; the round form is about half as broad as long; the long form is from 2–5cm long, 1–1.8cm thick; externally yellowish to yellowish brown, with root scars and annulations, the latter from the scars of leaf bases; fracture horny; internally orange yellow to orange; waxy, showing a cortex separated from a central cylinder by a distinct endodermis.[4,10]

Organoleptic properties: Odour, aromatic; taste, warmly aromatic and bitter [4]. Drug when chewed colours the saliva yellow.

Microscopic characteristics: The transverse section of the rhizome is characterized by the presence of mostly thin-walled rounded parenchyma cells, scattered vascular bundles, definite endodermis, a few layers of cork developed under the epidermis and scattered oleoresin cells with brownish contents. The cells of the ground tissue are also filled with many starch grains. Epidermis is thin walled and consists of cubical cells of various dimensions. The cork cambium is developed from the subepidermal layers and even after the formation of the cork, the epidermis is retained. Cork is usually composed of 4–6 layers of thin-walled brick shaped parenchymatous cells. The parenchyma of the pith and cortex contains curcumin and is filled with starch grains. Cortical vascular bundles are scattered and are of collateral type. The vascular bundles in the pith region are almost scattered and form discontinuous rings just under the endodermis. The vessels have mainly spiral thickening and only a few have reticulate and annular structure.[4,11,12]

Powdered plant material: Coloured deep yellow. Fragments of parenchymatous cells contain numerous altered, pasty masses of starch grains coloured yellow by curcumin, fragments of vessels; cork fragments of cells in sectional view; scattered unicellular trichomes; abundant starch grains; fragments of epidermal and cork cells in surface view; and scattered oil droplets, rarely seen.[4,10]

Geographical distribution: Cambodia, China, India, Indonesia, Lao People's Democratic Republic, Madagascar, Malaysia, the Philippines, and Viet Nam.[4] It is extensively cultivated in China, India, Indonesia, Thailand and throughout the tropics, including tropical regions of Africa.[4,7]

Chemical composition of turmeric: Turmeric is chemically diverse in composition. The qualitative and quantitative compositions of turmeric varies often with varieties, locations, sources, and cultivation conditions. To date, around 235 compounds, primarily phenolic com-pounds and terpenoids, have been identified from this magical spice. Of these compounds, 22 are diarylheptanoids and diarylpentanoids, 8 phenylpropene and other phenoliccompounds, 68 monoterpenes, 109 sesquiterpenes, 5 diterpenes, 3 triterpenoids, 4 sterols, 2 alkaloids, and 14 other compounds. The curcuminoids belonging to the group of diaryl-heptanoids are the major bioactive ingredients of turmeric. The most common curcuminoid present in turmeric is cur-cumin, which has been utilized for medicinal purposes for thousands of years. Commercial curcumin is usually a mixture of three curcuminoids: curcumin (71.5%), demethoxy-curcumin (19.4%), and bisdemethoxycurcumin (9.1%).Three diarylpentanoids with a five-carbon chain between two phenyl groups have also been identified from turmeric. Calebin-A, vanillic acid, and vanillin are other phenylpropene and phenolic compounds identified from turmeric. The es-sential oils from leaves and flowers are usually dominated by monoterpenes. The most common monoterpenes present in turmeric are p-cymene, phellandrene, terpinolene (terpenoline),p-cymen-8-ol, cineole, and myrcene. Dried turmeric rhizomes usually yield 1.5–5% essential oils, in which sesquiterpenes are the major ones and are responsible for its aromatic taste and smell. The most common sesquiterpenes identified from turmeric are turmerone, turmerone, turmeronol A, and turmeronol B.

Pharmacological actions

Curcuma longa Linn. is known for its various medical properties. Rhizome of *Haridra* is known to possess therapeutic activities and has been used by medical practitioners as an anti-diabetic,[13-15] hypolipidemic,[13-14] anti-inflammatory,[15,16] anti-diarrhoeal,[14] hepatoprotective,[13,14] anti-asthmatic[15] and anti-cancerous drug. *Haridra* is widely used in cosmetology.

Medicinal uses

Gastrointestinal disorders: The fresh juice of *Haridra* is considered to be anthelmintic.[17] The Curcumin acts through nuclear factor (NF)-κB inhibition and it reduces the production of adhesion molecules and inflammatory cytokines, thus resulting in the amelioration of gastric injury in NSAIDs-induced gastropathy in rats. It also improves gastric mucosal damage and causes a decrease in leukocyte adhesions, and intercellular adhesion molecule 1 and tumor necrosis factor (TNF)-α production after curcumin administration.[18] Curcuma longa extract tablet decreased IBS prevalence and abdominal pain/discomfort score significantly between baseline and after treatment of eight-week. There were significant improvements in the IBS quality of life (QOL) scales.[19] In liver injury of male mice Curcumin prevents APAP induced hepatitis through the improvement of liver histopathology by decreased oxidative stress, reduced liver inflammation, and restoration of GSH.[20]

Inflammatory disorders: Curcumin has been shown to inhibit a number of different molecules involved in inflammation including phospholipase, lipooxygenase, COX-2, leukotrienes, thromboxane, prostaglandins, nitric oxide, collagenase, elastase, hyaluronidase, MCP-1, interferon-inducible protein, tumor necrosis factor, and interleukin-12.[21] Studies has proven bisdemethylcurcumin (BDC) is more potent as an anti-inflammatory agent as indicated by suppression of TNF induced NF-κB activation, more potent as an anti-proliferative agent, and more potent in inducing reactive oxygen species(ROS). Hispolon analogues, which lacks one aromatic unit in relation to curcumin, also exhibited enhanced anti-inflammatory and anti-proliferative activities.[22] The beneficial effect of curcumin(anti inflammatory compound) in sepsis appears to be mediated by the upregulation of PPAR-γ, leading to the suppression of pro inflammatory cytokine, TNF-α expression and release.[23]

Hepatic Disorders: Turmeric has been found to have a hepatoprotective characteristic similar to silymarin. Animal studies have demonstrated turmeric's hepatoprotective effects from a variety of hepatotoxic insults, including carbon tetrachloride (CCl4), galactosamine, acetaminophen (paracetamol), and Aspergillus aflatoxin. Turmeric's hepatoprotective effect is because of its antioxidant properties, as well as its ability to decrease the formation of pro-inflammatory cytokines. In rats with CCl4-induced acute and subacute liver injury, curcumin administration significantly decreased liver injury in test animals compared to controls. Turmeric extract inhibited fungal aflatoxin production by 90 percent when given to ducklings infected with Aspergillus parasiticus. Turmeric and curcumin also reversed biliary hyperplasia, fatty changes, and necrosis induced by aflatoxin production. Sodium curcuminate, a salt of curcumin, also exerts choleretic effects by increasing biliary excretion of bile salts, cholesterol, and bilirubin, as well as increasing bile solubility, therefore possibly preventing and treating cholelithiasis.

Cardiovascular disorders: The antioxidants in turmeric also help in preventing damage due to cholesterol, thereby useful in protecting against atherosclerosis. In fact, the ability of the antioxidants in turmeric to decrease free radicals is similar to that in vitamins C and E. Since the antioxidant activities of turmeric are not degraded by heat (unlike most vitamins), even using the spice in cooking provides benefits. Animal studies have shown that curcumin lowers cholesterol and triglycerides, another fat that circulates in the blood stream and is a risk factor for cardiovascular disease.[24] In a recent study of atherosclerosis, mice were fed a standard American diet, rich in refined carbohydrates and saturated fat, but low in fiber. Some of the mice, however, received this diet plus turmeric mixed in with their food. After four months on these diets, the mice that consumed the turmeric with their food had 20 percent less blockage of the arteries than the mice fed the diet without the turmeric.[24] In another study, rabbits were fed turmeric plus a diet designed to cause atherosclerosis. Several risk factors for the disease were improved, including a decrease in cholesterol, triglycerides, and free-radical damage.[25]

Anti-cancer properties: Curcumin has been shown to mediate anti-inflammatory effects through the suppression of nuclear factor-κB (NF-κB) activation, anti-proliferative effects through suppression of cyclin D1 and anti-apoptotic gene products, induce cytochrome C release, activate caspases and p53 and have anti-angiogenic effects through the down-regulation of vascular endothelial growth factor (VEGF). On the basis of the results from these studies, curcumin is currently in clinical trials for treatment of various cancers.[26,27]

Anti-diabetic activity: Turmeric exerts cardio-protective effects mainly by antioxidant activity, lowering lipid peroxidation, anti-diabetic activity and inhibiting platelet aggregation. A study of 18 atherosclerotic rabbits given 1.6-3.2 mg/kg/day of turmeric extract demonstrated decreased susceptibility of LDL to lipid peroxidation, in addition to lower plasma cholesterol and triglyceride levels. The effect of turmeric on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increased conversion of cholesterol to bile acids in the liver. Inhibition of platelet aggregation by turmeric constituents is thought to be via potentiation of

prostacyclin's synthesis and inhibition of thromboxane synthesis. Both turmeric decreases blood glucose level in diabetic rats. Turmeric also decreases complications arising because of diabetes mellitus. Further clinical studies need to be done in this area to discover optimal dosages for cardiovascular protection and lipid or glucose lowering activities.[28]

Antioxidant activity: Curcumin has been proved to be a powerful scavenger of oxygen free radicals. Its antioxidant activity is comparable to vitamins C and E.[29] It can protect lipids or hemoglobin from oxidation. It can significantly inhibit the generation of reactive oxygen species (ROS) such as H_2O_2, superoxide anions and nitrite radical generation by activated macrophages. Its derivatives, bis-demethoxycurcumin and demethoxycurcumin have antioxidant activities. Curcumin pre-treatment has been shown to decrease ischemia-induced oxidative stress and changes in the heart.[30] An in vitro study measuring the effect of curcumin on an inducible stress protein, resulted in enhanced cellular resistance to oxidative damage.[31]

Anti-asthmatic activity: Curcumin is also found to be a potent blocker of nuclear transcription factor (NF)-kB, which is linked to a variety of diseases including allergy and asthma.[32]

Other activities: In addition to the activities discussed above, turmeric exhibits numerous other activities by in vitro studies. For instance, in one study turmeric exhibited chemoprotective activity against benzo[a]pyrene-induced chromosomal damage in human lymphocytes.[33] In another study, cisplatin-induced nephrotoxicity in HEK 293 cells was recovered by turmeric treatment.[34] Psoriasis is a chronic inflammatory skin disorder which is characterized by rapid proliferation of keratinocytes and incomplete keratinization. The ethanolic extract from turmeric was shown to possess antipsoriatic activity in a keratinocyte cell line.[35] At the molecular level, the extract decreased the expression of colony stimulating factor (CSF)-1,interleukin (IL)-8, NF-B1, and NF-B2. The authors of this study suggested that turmeric might exert antipsoriatic activity by controlling the expression of NF-B signaling biomarkers. Within in vitro tissue culture conditions, turmeric possesses insulin-releasing actions.[36] Turmeric also inhibits human pancreatic amylase activity[37] and exhibits immune-stimulatory activities in human peripheral blood mononuclear cells.

CONCLUSION

Turmeric is the unique source of various types of chemical compounds, which are responsible for a variety of activities. Although, a lot of experiments have been done on turmeric, however, more investigations are needed to exploit other therapeutic utility to combat diseases. A drug development programme should be undertaken to develop more effective drugs. Although crude extracts from leaves or rhizomes of the plant have medicinal applications, modern drugs can be developed after extensive investigation of its pharmacotherapeutics, bioactivity, mechanism of action, and toxicities, after proper standardization and clinical trials. As the global scenario is now changing towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs from Curcuma longa should be emphasized for the control of various diseases. Further evaluation needs to be carried out on Curcuma longa in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of mankind.

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