AN OVERVIEW OF THE PHARMACOLOGICAL AND THERAPEUTIC POTENTIAL OF CURCUMA LONGA (TURMERIC)

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ABSTRACT
"Curcuma longa" Linn. (C. longa), popularly known as turmeric, lies into the Zingiberaceae family and has a long liberal trade background of having restorative holding against numerous conditions. In Unani and Ayurveda drugs, C. longa has been used for liver inhibition and hostility, and has been applied externally for ulcers and inflammation. Also, it's employed in several other affections similar as cough, cold, dental issues, indigestion, skin infections, blood sanctification, asthma, piles, bronchitis, excrecence, injuries, and hepatic diseases, and is used as an antiseptic. Curcumin, a major portion of C. longa, is well known for its remedial eventuality in multitudinous diseases. Still, there's a lack of literature on the remedial eventuality of C. longa in comparison to curcumin. Hence, the present review aimed to give in-depth information by pressing knowledge gaps in traditional and scientific substantiation about C. longa in relation to curcumin. The relationship to one another in terms of natural state includes their antioxidant, anti-inflammatory, neuroprotective, anticancer, hepatoprotective, cardioprotective, immunomodulatory, antifertility, antimicrobial, antiallergic, antidermatophytic, and antidepressant activity. Likewise, in-depth discussion of C. longa on its taxonomic categorization, traditional uses, botanical description, phytochemical constituents, pharmacology, morbidity, and guard aspects in relation to its commanding emulsion curcumin is needed to diagnose the trends and perspectives for unborn exploration. Considering all of the promising substantiation to date, there's still a lack of probative suggestion especially from clinical trials on the peripheral use of C. longa and curcumin. This prompts further preclinical and clinical inquiry on curcumin.

KEYWORDS: Curcuma longa, Phytochemicals, Pharmacological activities, Traditional uses, Ayurveda, Herbal Medicine.
INTRODUCTION

*Curcuma longa*, or turmeric is a imperishable condiment and member of the Zingiberaceae family and is cultivated considerably in Asia substantially in India and China. The rhizome, the portion of the factory used medicinally, yields unheroic greasepaint. Dried *Curcuma longa* is the source of turmeric, the component that gives curry greasepaint its characteristic unheroic color. It has numerous names similar as Curcum in the Arab region, Indian saffron, Haridra (Sanskrit, Ayurvedic), Jianghuang (unheroic gusto in Chinese), Kyoo or Ukon (Japanese).[1]

Turmeric has been used in Asian cookeries for both its flavor and color and in the Chinese and Ayurvedic drug particularly as an anti-inflammatory and for the treatment of hostility, menstrual difficulties, hematuria, hemorrhage, and bellyache. It's sanctioned in the Pharmacopoeia of China as well as in other Asian countries similar as Japan and Korea and its operation covers a wide range of wellness suggestions. In China it's ingested orally and applied topically for urticaria and skin mislike, viral hepatitis, seditious conditions of joints, sore throat and injuries.[2]

*Curcuma longa* has been used in different dosage forms depending on the type of aid. Mostly oral administration was seen for *curcuma longa*. Now a days it can be used topically and via inhalation (Ayurvedic tradition) or applied topically for the treatment of acne, injuries, boils, bruises, blistering, ulcers, eczema, nonentity mouthfuls, parasitic infections, hemorrhages and skin conditions like herpes zoster and pemphigus.[3]

The active ingredients of turmeric are the flavonoid Curcuminoids which is a admixture of curcumin (diferuloylmethane), monodexmethoxy curcumin and bisdesmethoxy curcumin Curcumin makes up approximately 90 of the curcuminoid content in turmeric. Other ingredients include sugars, proteins, and resins. The stylish delved active element is curcumin, whichcomprises0.3-5.4 of raw turmeric.[4]

Curcuminoids curcumin (diferuloylmethane), demethoxy curcumin, and bisdemethoxy curcumin combine to form Turmeric., as well as unpredictable canvases (tumerone, at lantone, and zingiberone), sugars, proteins, and resins. The Curcumin is a lipophilic polyphenol that's nearly undoable in water but is relatively stable in the acidic pH of the stomach.[5]
Description
Common Turmeric is an upright imperishable condiment with rhizomes that grow about 40 elevation altitudinous. The rhizomes are the source of a bright unheroic orange culinary spice. The bright orange color in the rhizomes is constantly used in food coloring, fabrics, and maquillages. People in India, Pakistan and Bangladesh have used it for medicinal purposes. The factory is a member of the Zingiberaceae or gusto family. Common Turmeric is the main component in curry greasepaint.

TAXONOMICAL CLASSIFICATION[8]

- **Kingdom:** Plantae
- **Subkingdom:** Tracheobionta
- **Superdivision:** Spermatophyta
- **Division:** Magnoliophyta
- **Subclass:** Zingiberidae
- **Order:** Zingiberales
- **Family:** Zingiberaceae
- **Genus:** Curcuma
- **Species:** longa
- **Scientific name:** *Curcuma longa*
- **Family Name:** Ginger family
- **Useful Parts:** Roots, Leaves

**NAMES IN DIFFERENT LANGUAGES (VERNACULAR NAME)**[9]
- **Sanskrit:** Ameshta, bahula, bhadra,
Hindi: Haldi  
English: Indian saffron, Turmeric  
Gujarati: Halad, Haldar Marathi: Halad  
French: Safran pays, safran des Indes  
Indonesian: Kunyit, Kunyèt  
German: Kurkuma  
Portuguese: Curcuma, rizoma dos Índios, açafroeira da Índia, terra merita  
Bengali: Halud  
Arabic: Kurkum, Uqdah safra  
Japanese: Ukon, Tamerikku  
Greek: Kitrinoriza, Kourkoumi, Kourkoumas  
Kannada: Arishina, Arisina

Table No. 1: Plant Characteristics.[13]

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Life Cycle</th>
<th>Annual: Perennial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binomial name</td>
<td>Curcuma longa L.</td>
<td></td>
</tr>
</tbody>
</table>
| Dimensions       | Height: 3 ft. 0 in. - 4 ft. 0 in.  
Width: 3 ft. 0 in. - 4 ft. 0 in. |
| Cultural Conditions | Light               | Full sun (6 or more hours of direct sunlight a day)  
Partially Shade (Direct sunlight only part of the day, 2-6 hours) |
| Soil Texture     | High Organic Matter |
| Soil pH          | Acid (<6.0); Neutral (6.0-8.0) |
| Soil Drainage    | Good Drainage Moist Occasionally Wet |
| Available Space to Plant | 6-feet-12 feet  |
| USDA Plant Hardiness Zone | 8a, 8b, 9a, 9b, 10a, 10b, 11a, 11b |
| Fruit            | Color               | Brown/Copper      |
|                  | Description         | The seeds are brown in color, small, and ovoid in shape.  
The seeds are not viable. |
| Flowers          | Color               | Gold/Yellow  
White |
|                  | Inflorescence       | Spike            |
|                  | Bloom Time          | Summer           |
|                  | Size                | 3-6 inches       |
|                  | Description         | The flower is yellowish-white and grows on a spike-like stalk measuring 4-6 inches long. They bloom from July to August. The flowers are sterile. |
| Leaves           | Color               | Green            |
|                  | Type                | Sheath           |
Shape | Lanceolate  
Margin | Entire  
Hairs Present | No  
Dimension | Leaf Length: > 6 inches  
Leaf Width: 3-6 inches  
Description | The leaves are dark green on the upper surface and pale green on the undersides. The leaves are large, pleated, lanceolate to elliptical in shape, and measure up to 40 inches in length. They resemble Canna leaves.

| Stem | Stem Is Aromatic | No  
| Landscape | Location | Container; Houseplants  
| Resistance to Challenges | Humidity; Wet Soil  
| Problems | Contact Dermatitis  
| Synonyms | Curcuma domestica Valeton  

**Geographical Distribution and Habitat**

Family Zingiberaceae forms a pivotal group with an Effective implicit yield of sweet imperishable sauces with creeping vertical or tuberous rhizomes distributed throughout different corridor of the world similar as Asia, Africa, and America. The rich reserve of factory species grip tremendous eventuality for treating colorful conditions, one similar treasured source of medicinal and culinary factory is “turmeric” which belongs to the family Zingiberaceae.\(^{10}\) Turmeric has been employed in Asia for thousands of times and is a leading part of Ayurveda, Siddha, Traditional Chinese, and Unani medicinal system. It's generally set up in the tropical regions of India, Indonesia, China, Australia, Africa, Philippines, Taiwan, Haiti, Jamaica, Sri Lanka, Cambodia, Malaysia, Indochina, West Indies, and Peru. Because of its brilliant unheroic color and pleiotropic medicinal activity, turmeric is also known as “Indian saffron or Indian Solid gold”.\(^{11-12}\)

**Plant Morphological Profile**

The leaves are large, floundered, green, lanceolate shaped, and measure up to 40 elevations in length. Each shoot has 8-12 leaves. The flowers are heroically and appear as thick, short harpoons measuring 4-6 elevation long. The flowers are sterile and don't produce feasible seeds. The seeds are small, elliptical, and brown in color. The rhizomes are thick and fanned.\(^{13}\)
Table No. 2: Phytoconstituent.

<table>
<thead>
<tr>
<th>Phytoconstituent</th>
<th>Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curcumin I</td>
<td>94%</td>
</tr>
<tr>
<td>Curcumin II</td>
<td>6%</td>
</tr>
<tr>
<td>Curcumin III</td>
<td>0.3%</td>
</tr>
<tr>
<td>Protein</td>
<td>6.3%</td>
</tr>
<tr>
<td>Moisture</td>
<td>13.1%</td>
</tr>
<tr>
<td>Minerals</td>
<td>3.5%</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>69.4%</td>
</tr>
<tr>
<td>Fat</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

Some important chemicals for it medicinal classification are Bis-desmethoxycurcumin, Bisabolene, Borneol, Boron, Bixin, Calcium, Caprylic-acid, Caryophyllene, Chromium, Cineole, Cinnamic-acid, Caffeic-acid, Cuminyl-alcohol, Curcumene, Curcumenol, Curcumin, Curdione, Cobalt, Copper.

Some exploration in chain compounds which makes their presence in curcuma longa Eugenol, Epiprocurcumenol; Eucalyptol; Eugenol; Gamma-atlantone, Germacrone, Feruloyl-p-coumaroyl-methane, Isoborneol, Germacrone13-al; Guaiacol, L-alpha curcumene.

L-beta-curcumene, Limonene, Manganese, Monodesmethoxycurcumin, Niacin, Nickel, norbixin; O-coumaric-acid, P-coumaric-acid, P-methoxyccinnamic-acid, Pcmene, Ptlymethylicarbinol, Phosphorus, Protocatechuic-acid, Procurcumadiol. Acidic polysaccharides: utonan A, B, C, D. In case of Volatile Oil (4.2%) turmerone, arturmerone, curcumene, germacrone, ar-curcumene are the main contents.

The CHMM (Chinese Herbal Materia Medica) which is an herbal classic is also the part of it classification.

Turmeric contains some chemicals which fall under other category which are protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). Phenolic diketone, curcumin (diferuloylmethane) (3-4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%). There are some basic chemical compound’s who’s presence is studied in many researches which are campesterol, betasitosterol, stigmasterol, fatty acids, cholesterol and metallic elements potassium, sodium, magnesium, calcium, manganese, iron, copper/zinc.\textsuperscript{14}
PHARMACOLOGICAL ACTIVITY

Antioxidant Activity: Water and fat-answerable excerpts of turmeric and its curcumin factors parade important antioxidant exertion, resemblant to vitamins C and E. A check of ischemia positive that curcumin pretreatment reduced ischemia- convinced revision in the heart.[15] An in vitro study measuring the effect of curcumin on endothelial brim oxygenase 1, an stimulate pressure protein, was conducted utilizing bovine aortic endothelial cells. Incubation with curcumin resulted in enhanced cellular resistance to oxidative damage.[16]

Antidiabetic Activity: A hexane infusion (containing arturmerone), ethanolic excerpt (incorporate arturmerone, curcumin, desmethoxycurcumin and bisdemethoxycurcumin) and ethanolic excerpt from the residue of the hexane birth (Containing curcumin, desmethoxycurcumin and bisdemethoxycurcumin) were set up to cure dependently induce adipocyte isolation. The results indicate that turmeric ethanolic excerpt include both curcuminoids and sesquiterpenoids are more forcefully hypoglycemic than either curcuminoids or sesquiterpenoids.[17]

Wickenberg et al. 2010 studied the goods of turmeric on postprandial tube glucose and insulin in healthy subjects; they set up out that the ingestion of 6g C. longa had no significant effect on the glucose effect. The revision in insulin was significantly advanced 30 min and 60 min after the OGTT including C. longa. The insulin AUCs were also, significantly advanced after the input of C. longa after the OGTT.[18]

Hepatoprotective Activity: Turmeric is known to have a hepatoprotective characteristic analogous to silymarin. Studies have demonstrated turmeric’s hepatoprotective activity from a variety of hepatotoxic injuries, including carbon tetrachloride (CCl4)[19] galactosamine and acetaminophen (paracetamol).[20] Turmeric’s hepatoprotective effect is substantially a result of its antioxidant activity, as well as its capability to drop the conformation of proinflammatory cytokines. Curcumin administration significantly dropped liver injury.[21]

Turmeric reduced infection with Aspergillus parasiticus and inhibited fungal aflatoxin product by 90. Turmeric and curcumin also reversed biliary hyperplasia, adipose changes, and necrosis convinced by aflatoxin product. Sodium curcuminate, a swab of curcumin, also exerts choleretic activity by adding biliary excretion of corrosiveness mariners, cholesterol, and bilirubin, as well as adding corrosiveness solubility, thus, conceivably precluding and treating cholelithiasis. Curcumin also protects cells against lipid peroxidation convinced by
paracetamol. This may be due to the anti-oxidative activity of the phenolic groups of curcumin.\[22\]

Curcumin was set up to drop serum aspartate transaminase and alkaline phosphatase exertion, and free adipose acid, cholesterol and phospholipid situations. Tacrine is known for its T-cell destructive exertion and hepatotoxicity. In a study with societies of mortal hepatocytes, which had been destroyed by tacrine, curcumin showed to be nearly ten times further effective than the regular treatment, ascorbic acid.\[23\]

The effect of curcumin on alcohol convinced hepatotoxicity in alcoholic rats was studied by Rajakrishnan et al. 1998.\[24\] Curcumin administration redounded in a drop of serum aspartate transaminase and alkaline phosphatase exertion. The situations of serum free adipose acids, cholesterol and phospholipids dropped as well.

**Cardiovascular Conditions:** Turmeric’s defensive activity on the cardiovascular system includes lowering cholesterol and triglyceride situations, dwindling vulnerability of low-viscosity lipoprotein (LDL) to lipid peroxidation and inhibiting platelet aggregation.\[25\] Turmeric excerpt demonstrated dropped vulnerability of LDL to lipid peroxidation, in addition to lower tube cholesterol and triglyceride situations. Turmeric excerpt’s effect on cholesterol situations may be due to dropped cholesterol uptake in the bowel and increased conversion of cholesterol to corrosiveness acids in the liver. Inhibition of platelet aggregation by C. longa ingredients is allowed to be via potentiation of prostacyclin conflation and inhibition of thromboxane conflation.\[25\]

Curcumin mobilizes α-tocopherol from adipose towel, this results in protection against oxidative damage produced during atherosclerosis development. Curcumin increases VLDL cholesterol transport in tube, which results in adding situations of α-tocopherol. Curcumin has been shown to rally α-tocopherol from adipose towel, therefore guarding their body against oxidative damage produced during the development of atherosclerosis. Also, further LDL cholesterol could be transported in tube, adding situations of αtocopherol. Overall, the adipose acids in the creatures were less susceptible to oxidation in the vessel wall.\[26\] It was observed that oral input of 500mg/d curcumin for 7 days redounded in a significant drop in the position of serum lipid peroxides (33\%) and an increase in HDL cholesterol (29\%) and a drop in position of total serum cholesterol (12\%).\[27\]
Gastrointestinal Diseases: Curcumin’s anti-inflammatory activity and remedial benefit have been demonstrated for a variety of gastrointestinal diseases, including dyspepsia, Helicobacter pylori infection, peptic ulcer, perverse bowel pattern, Crohn’s complaint, and ulcerative colitis.

Irritable Bowel Pattern: Cases with Irritable bowel pattern (IBS) have the most common symptoms that are abdominal pain, bloating, altered bowel habits, and increased coprolite ratio. In an eight-week airman study of IBS cases. After four weeks, those groups endured a 53 and 60 reduction in IBS frequency. Impost-study analysis, abdominal painful sensation and irritation scores were weakened by 22 and 25.[28]

Inflammatory Bowel Disease: Crohn’s disease (CD) and ulcerative colitis (UC) are the two primary forms of seditious bowel complaint (IBD). Medicinal and pharmacological activity of Turmeric Holt et al., 2005.[29] conducted a airman study to examine the effect of curcumin remedy in cases with IBD who had preliminarily entered standard UC or CD remedy. Hematological and biochemical blood analysis, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) (the ultimate two seditious pointers), sigmoidoscopy, and vivisection were all performed at standard and at the end study. Crohn’s Disease Activity Index (CDAI), CRP, ESR, hematological blood disquisition, and order part were assessed in all cases at birth and end of study. In the proctitis group all five cases developed by study’s end as indicated by a global score, and all five subjects demonstrated normal ESR, CRP, and serologic indicators of inflammation after two months. In the CD group, CDAI scores reduced by an normal of 55 points, and CRP and ESR dropped in four of five cases. The authors concluded that curcumin plus standard remedy was important effective in maintaining absolution than placebo plus standard UC treatment.[30]

Neurological Disorders: Survey in animal models of Alzheimer’s disease (AD) indicates a direct effect of curcumin in cheapening the amyloid pathology of AD.[31] Grounded on numerous examinations, outgrowth has shown that curcumin held aggregate conduct in brain. Curcumin can be an arising medicine of remedy for the treatment of different neurological diseases similar as leading depression, tardive dyskinesia and diabetic neuropathy.[32]

Pregnancy/neonates: Singh and Aggarwal 1995[33] studied curcumin on hepatic biotransformation system enzymes. Turmeric and curcumin convinced a significant gain in hepatic situations of glutathione S-transferase (GST) and sulfhydryl (SH) situations.
Cytochrome b5 and cytochrome P450 situations were significantly raised as well. These show that turmeric and/ or curcumin metabolites can be transported through lactation.

**Anticancer Activity:** Annapurna et al. (2011)\[34\] estimated the knowledge of *C. longa* prophylactically and remedial, i.e., pre-induction treatment and post- induction aid via oral and topical operation to modulate the N- methyl- N- nitrosourea convinced mammary cancer in rats for 24 weeks. Precautionary topical application given at 200 mg/ kg of *C. longa* has significantly reduced the mean excrescence volume compared with remedial topical operation. This was the first report to display the anticancer exertion of *C. longa* with topical operation in a bone cancer model. In an in vivo exploration involving the topical operation of curcumin in CD- 1 mice and salutary administration of 1 *C. longa*,0.05 of its ethanol excerpt significantly reduced excrescence prevalence, excrescence burden, and excrescence volume in dimethyl Benz (a) anthracene (DMBA) - initiated and 12, O- tetradecanoylphorbal-13-acetate( TPA) promoted skin excrescences.\[35\]

Kuttan and his coworker’s work was the first to demonstrate curcumin’s anti-cancer eventuality in both in vitro and in vivo experimental models. Curcumin activates DNA damage response, laying the foundation for the remedial use of these nutraceuticals in prostate cancer chemoprevention.\[36\]

The general anti-carcinogenic effect of curcumin involves mechanisms like induction of apoptosis and inhibition of cell- cycle progression in rat aortic smooth muscle cells. The antiproliferative effect is regulated incompletely through interference of protein tyrosine kinase exertion and c- myc mRNA expression, while the apoptotic effect may incompletely be intermediated via precluding the functioning of protein tyrosine kinase, protein kinase C, and expressions of c- myc mRNA and bcl- 2 mRNA.\[37\]

Curcumin inhibits the recap factor NF- κB and colorful downstream gene products like c- myc, Bcl- 2, COX- 2, nitric oxide synthase( NOS), Cyclin D1, TNF- α, ILs, and matrix metallopeptidase 9(MMP- 9) and has anti-proliferative conditioning in a diversity of malice. Curcumin could be used to avoid colorectal cancer (CRC) in diabetics with type 2 diabetes by reduction of leptin blood situations and growing adiponectin situations. Poloxamer 407 can be employed as a polymer to enlarge the colorectal drug emancipation medium for curcuminoids in CRC treatment, according to the examination of Chen.\[38,39\]
Future Prospect and Current importance of Herbal Medicine

It's estimated that there are about 350,000 species of alive plants (including seed plant, bryophytes, and ferns), among which 287,655 species have been linked as of 2004. Fairly small probabilities (1 to 10) of these are employed as foods by both humans and other beast species. It's doable that indeed further are employed for medicinal purposes. 30 World Health Organization (WHO) has shown great curiosity in representing the use of medicinal shops used by lines from different corridor of the world. Numerous processing countries have boosted their attempt in establishing ethno-medical data on medicinal shops. Exploration to find out scientific overload for claims by ethnical healers on Indian sauces has been boosted. Once these original ethno-medical medications are scientifically estimated and circulated duly; people will be better advised regarding efficient medicine treatment and corroborated health status.[6]

The traditional knowledge system needs to be studied, proved, saved and used for the benefit of humankind, before it's lost ever. This will bear a holistic approach, and involvement and participation of original occupants. The Associated Chambers of Commerce and Industry of India (ASSOCHAM) has projected that the request size of herbal assiduity which is presently estimated at Rs. 7,500 crores (Rs. 75 billion) will double to situations at Rs. 15,000 crore by 2015 since this assiduity would be growing at a compounded periodic growth rate of over 20 hereafter. In a study brought out by ASSOCHAM on Herbal Industry and Global Market 2015, it's refocused out that India’s rich resource of medicinal shops and traditional treasure of knowledge in this area, its share at present is considered veritably stingy. A quick estimate of the implicit reveals that India can induce raw stock of around Rs. 300 billion and fluently achieve around Rs. 150 billion values added products. Therefore, India is hardly suitable to exploit lower than 50 of its eventuality. Interestingly both raw accoutrements (sauces) and herbal products have ready request encyclopedic-ally.[7]

CONCLUSION

"Curcuma longa" (Turmeric) is a drug of choice for the generation as it can be used to treat a wide variety of diseases. It has quite eye-catching phytochemical, experiments and clinical investigations. Different experimental studies are demonstrated in past and going on in the present era for it effectiveness in gastric ulcer antioxidant activity, anti-diabetic activity, hepatoprotective activity, cardiovascular conditions, inflammatory bowel disease, neurological disorders, pregnancy/neonates & anticancer Activity which are discussed in this
paper. The clinical study for the drugs will show a way to explore the therapeutic potential of this plant in order to give this drug a standard form. The future prospect of this plant claims that it is worthwhile to cultivate the plant at large scale which will not only help the people to explore the therapeutic, but it will help the country in its economic growth as we as farmers land.

REFERENCES


