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Recent trends in *Curcuma Longa* Linn.

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ABSTRACT

Plants have been one of the important sources of medicines even since the dawn of human civilization. In spite of tremendous development in the field of allopathy during the 20th century, plants still remain one of the major sources of drug in the modern as well as traditional system of medicine throughout the world. Over 60% of all pharmaceuticals are plant-based. *Curcuma longa* Linn. commonly known as Haldi, family Zingiberaceae is an important cultivated medicinal crop of India. It is well known throughout the country. Turmeric is a holistic gift of nature. Its use in medication, culinary and cosmetics is well known since centuries. Its constituents, especially curcumin has been found to possess tremendous therapeutic potency to the extent of incorporating the curcumin nucleus in many other compounds. It is official in various pharmacopoeias. The present study is a review on a description of its various pharmacological actions studied earlier and in the recent times. It has been found to posses a myriad therapeutic activities ranging from anti-inflammatory, anti-oxidant, anti-hepatotoxic, anti-microbial, anti-depressant etc. to the more recent chemo-preventive, anti-fertility, neuroprotective, HIV-1 & HIV-2 protease inhibitor, and many more. More stress needs to be given for the application of various techniques to enhance the yield of such phytoconstituents. Tissue culture techniques lead to the improvement in therapeutically active constituents of *Curcuma longa*. Although these studies can exploit therapeutic potential of drug but further studies are required to get its maximum utility.

KEY WORDS: Anti-depressant, anti-oxidant, anti-inflammatory, *Curcuma longa*, curcumin, chemo-preventive.

INTRODUCTION

Curcuma longa Linn., is commonly known as Haldi, Turmeric or Indian saffron belongs to family Zingiberaceae. It is cultivated mostly in Ceylon, Belgium, Indonesia, France and in many parts of India, especially in Bengal, Tamil Nadu and Andhra Pradesh. India accounts for more than 90% of the total output of the world. *Curcuma longa* is a perennial herb with simple and large leaves. Its tubers, rhizomes and oil have great importance. Its rhizomes are oblong, ovate or cylindrical. Externally the drug is yellowish brown in color with characteristic odor and slightly pungent bitter taste. Root scars and annulations are present on the surface of the rhizome. The fracture is horny and internal surface is orange in color.

Curcuma longa is used as a household remedy as anti-inflammatory, antiseptic and irritant in the form of lepas on skin and dyestuff for dye silk and wool. It is one of the important ingredients of pooja in Hindu mythology. Curcuma genera has about 70 species, some medicinally important species are *C. zanthorrhiza, C. zedoria, C. arometica, C. caesia and C. amada.* In Ayurveda, it is recommended in condition of kapha and pitta.

Curcuma longa contains an essential oil (5%), an alkaloid, starch grains, yellow matter curcumins and other curcuminoids, turmeric oil (5-8%), turmerol, a coporioc acid (0.1%) as a free acid, and veleric acid (0.1%) as combined acid. Distillation of oil yields 2% d-sallinene, 1% ∝-phellandrene and 3% cineol from the lower-fraction. The middle fraction yields 30.5% zingiberene and higher fraction shows mixture of sesquiterpene hydrocarbons and sequiterpene alcohol (50.5%). The oil contains small amount of sequiterpenes, ∝- and β-pinene, camphor, camphene and ∝- and β- curcumins. Some commonly found constituents are shown in fig.1.

Indian Vaidyas, Hakims as well as tribal people have developed and recorded the knowledge of the various uses. Various scientists and research workers reported a lot of scientific work on this drug. Some important properties, uses and formulations are summarized in Tables no. 1, 2, 3.

RECENT STUDIES ON *CURCUMA LONGA*

Anti-inflammatory activity

Anti-inflammatory activity of turmeric oil has been reported by Ramchandran *et al.*, (1) on pepper's model. Mishra *et al.*, (2) reported that the volatile oil of *Curcuma longa* was effective in anti-inflammatory and anti-hyaluronidase action. They suggested the antioxidative effect as evidenced by inhibition of diffusion capability of the hyaluronidase enzyme by the oil.

Further the cytotoxic, anti-inflammatory and antioxidant activity of curcumin I, II and III from *Curcuma longa* was studied by Ramsewk *et al.*, (3). They observed cytotoxic activity against leukemia, colon cancer, CNS melanoma, renal and breast cancer. Leaf oil of *Curcuma longa* also shown potent anti-inflammatory activity (as shown by phenylbutazone) in carranngenin induced paw edema and cotton pellet method in male albino rats as reported by lyengar *et al.*, (4). Anto *et al.*, (5) reported that curcumin III as a most potent anti-inflammatory agent amongst present

natural curcuminoids (I, II, III) and other B-synthetic curcuminoids. Lantz *et al.,* (6) reported the effect of turmeric extracts on inflammatory mediator production. Ammon *et al.,* (7) suggested mechanism of anti-inflammatory actions of curcumine. Kulkarni *et al.,* (8) proposed treatment of osteoarthritis with a herbomineral formulation: a double-blind, placebo-controlled, cross-over study. Huang *et al.,* (9) demonstrated the inhibitory effect of curcumin, an anti-inflammatory agent, on vascular smooth muscle cell proliferation.

Antioxidant activity

A lot of scientific work narrates that *Curcuma longa* and its isolates possess significant antioxidant activity. Subramaniam *et al.,* (10) isolated turmeric antioxidant protein (TAP) and found that this antioxidant principle (TAP) is a heat stable substance. A comparative study on the pharmacological properties of curcuminoids I, II and III was undertaken by Anto *et al.,* (11) for evaluating cytotoxic tumour reducing and antioxidant activities. They found that the curcuminoid III was more active than other two. Further Rao *et al.,* (12) showed curcumin has potent scavenger activity and has ability to protect lipid, heamoglobin and DNA against oxidative degradation. Its phenolic and methoxy group contribute significantly to its free scavenger activity. Sugiyama *et al.,* (13) observed the involvement of diketone moiety in the antioxidative mechanism of tetrahydrocurcumin. Significant anti-tumour and antioxidant activity of natural curcuminoids were determined by Ruby *et al.,* (14). Scartezzini *et al.,* (15) reviewed on some plants of Indian traditional medicine with antioxidant activity. They showed that *Curcuma longa* is used in number of Ayurvedic preparation for thousands of years. Chatterjee *et al.,* (16) studied effect of irradiation on the antioxidant activity of turmeric (*Curcuma longa*) extracts. Bernd *et al.,* (17) suggested the pharmacological effects and prospects for future clinical use of curcuma antioxidants. Ramos *et al.,* (18) reported screening of antimutagenicity via antioxidant activity in Cuban medicinal plants (*Curcuma longa*). Mohanty *et al.,* (19) studied protective effects of *Curcuma longa* on ischemia-reperfusion induced myocardial injuries and their mechanisms. Srinivas *et al.,* (20) reported turmerin: a water-soluble antioxidant peptide from turmeric (*Curcuma longa*). Selvam *et al.,* (21) proposed the anti-oxidant activity of turmeric (*Curcuma longa*). Reddy *et al.,* (22) proposed effect of dietary turmeric (*Curcuma longa*) on iron-induced lipid peroxidation in the rat liver. Srivastava (23) identified extracts from two frequently consumed spices - Cumin (*Cuminum cyminum*) and turmeric (*Curcuma longa*) that inhibit platelet aggregation and alter eicosanoid biosynthesis in human blood platelets. Mesa *et al.,* (24) reported that oral administration of a turmeric extract inhibits erythrocyte and liver microsome membrane oxidation in rabbits fed with an atherogenic diet. Jang *et al.,* (25) investigated principal phenolic phytochemicals and antioxidant activities of three Chinese medicinal plants. The principal antioxidant components and content of cinnamon (*Cinnamomum cassia*), turmeric (*Curcuma longa*) and golden thread (*Coptidis rhizoma*) extracts were determined using high performance liquid chromatography (HPLC) with UV detection. Karmakar *et al.,* (26) reported that curcumin activate both receptor-mediated and mitochondria-mediated proteolytic pathways for apoptosis in human glioblastoma T98G cells. Lee (27) investigated antiplatelet property of *Curcuma longa* L. rhizome-derived *ar*-turmerone. The antiplatelet activities of *Curcuma longa* L. rhizome-derived materials were measured using a platelet aggregometer and compared with those of aspirin as antiplatelet agent. The active constituent from the rhizome of *Curcuma longa* L. was isolated and characterized as *ar*-turmerone by various spectral analyses. At 50% inhibitory concentration (IC_{50}) value, *ar*-turmerone was effective in inhibiting platelet aggregation induced by collagen (IC_{50}, 14.4 μM) and arachidonic acid (IC_{50}, 43.6 μM). Kumar *et al.,* (28) reported free and bound phenolic antioxidants in amla (*Emblica officinalis*) and turmeric (*Curcuma longa*). Cousins *et al.,* (29) revealed antioxidant capacity of methanolic extract of fresh and dried rhizomes from four clones of turmeric (*Curcuma longa* L.) grown *in-vitro*. Tognolini *et al.,* (30) studied comparative screening of plant essential oils: Phenylpropanoid moiety as basic core for antiplatelet activity in guinea pig and rat plasma in order to assess antiplatelet activity and inhibition of clot retraction. Jayaprakasha *et al.,* (31) reported antioxidant activities of curcumin, demethoxycurcumin and bisdemethoxycurcumin by *in-vitro* model systems, such as the phosphomolybdenum and linoleic acid peroxidation methods.

Hepatoprotective and hepatatoxic activity

Another group of scientists demonstrated action of curcuma on liver. Deshpande *et al.,* (32) carried out a study on hepatoprotective activity in rats. They reported that pre-treatment of *Curcuma longa* shows reduction in bilirubin, cholesterol, AST and alkaline phosphatase activity in CCl_4 induced liver toxicity in animal model. Another report by Rajsekharan *et al.,* (33) showed the protective effect of curcumin in ethanol induced liver toxicity. Kandarkar *et al.,* (34) reported that dietary administration of turmeric or ethanolic extract of turmeric for 14 days at cancer preventive doses was found to be hepatotoxic in mice as observed by histopathologic and ultrastructural studies. Soni *et al.,* (35) showed protective effect of food additives on aflatoxin-induced mutagenicity and hepatocarcinogenicity. Singh *et al.,* (36) reported that postnatal modulation of hepatic biotransformation system enzymes via translactational exposure of F_1 mouse pups to turmeric and curcumin. Prevention of CCl_4 - Induced hepatotoxicity by aqueous extract of turmeric were proposed by Subramanian *et al.,* (37).

Hypolipidemic action

Significant hypolipidemic action of turmeric also has been reported. Darka (38) reported hypolipidemic action of 50% ethanolic extract of turmeric in rabbit. Deshpande *et al.,* (39) demonstrated remarkable reduction in lipid profile of *Curcuma longa*. In their classical experiment they gave 1gm turmeric extract (t.i.d) for the span of 15 days. This caused 55 to 40% reductions in total cholesterol, triglycerides and LDL content in animals. Some other studies (40, 41) on *Curcuma longa* extract on lipid profile showed the efficacy of turmeric in lowering the risk of arteriosclerosis. Tortosa *et*

al., (42) proposed that an oral administration of a turmeric extract inhibits LDL oxidation and has hypocholesterolemic effects in rabbits with experimental atherosclerosis. Ashraf *et al.,* (43) proposed antiatherosclerotic effects of dietary supplementations of garlic and turmeric. A notable restoration of arterial blood pressure was seen in animals on garlic and turmeric supplemented diet.

Anti-allergic and wound healing activities

Turmeric was found to be effective in treatment of allergy. Studies on anti-allergic activity (44, 45) were carried out on various extract of *Curcuma longa* rhizome. The ethyl acetate fraction was found to be most potent anti-allergic agent amongst all extracts. This causes potent inhibition of histamine release from mast cells. Crude extract of fresh rhizome of *Curcuma longa* found to posses good cycloxygenase (COX) inhibitory action (46) in an *in-vitro* bioassay test. Turmeric is established as an excellent remedy for wound healing since antiquity. The local application of *Curcuma longa* powder efficiently heals septic wounds in diabetic patient, reported by Pandya *et al.,* (47).

Anti-microbial activity

Turmeric shows significant anti-microbial activity (48). Negi *et al.,* (49) demonstrated that turmerone and curlone components of turmeric oil possess excellent antibacterial action against a wide range of microbes, such as *B. cereus, B. coagulans, B. subtills, S. aereus, E. coli,* and *Pseudomonas aeruginosa*. Other studies on *Curcuma longa* and it's leaf oil extract reveals that curcuma oils has significant antibacterial activity (50, 51) against various species of Shigella and most pathogenic gram positive bacteria. Turmeric also induct predominant anti-fungal activity as reported by Grisanapan *et al.,* (52). Kapoor *et al.,* (53) reported that fresh juice and extract of curcuma arrest the growth of *A. nigar* and *Penicillium digitatum* in usual concentration.

In one study, it was observed that its extract has fungicidal action against *C. albicans* MTCC-183 and *Cryptocus neoformans* MTCC-1347 strains. Behura *et al.,* (54) reported that essential oil of *Curcuma longa* leaf has anti-fungal action as similar as standard fungicides like cabendazim and manocozeb. Venugopal *et al.,* (55) reported that curcuma oil exhibits excellent insect repellent property even at 1% concentration in water. Apisariyakul *et al.,* (56) showed significant antifungal activity of turmeric oil extracted from *Curcuma longa* (Zingiberaceae). Rafatullah *et al.,* (57) proposed evaluation of turmeric (*Curcuma longa*) for gastric and duodenal antiulcer activity in rats.

Anti-cancerous activity

Studies by Kim *et al.,* (58) showed it's chemo-protective action. They reported, curcumin a dietary pigment present in turmeric, possess anti-carcinogenic and anti-metastatic properties. Another study (59) reported that turmeric significantly inhibits tumour burden and tumour incident in experimental model. Oral administration of curcumin, due to its antioxidants and hypolipidemic action play a neuroprotective role against ethanol-induced brain injury as reported by Rajshekharan *et al.,* (60). Other studies done by Duvoix *et al.,* (61) showed chemopreventive and therapeutic effects of curcumin a natural compound extracted from *Curcuma longa*. Pillai *et al.,* (62) demonstrated induction of apoptosis in human lung cancer cells by curcumin. Khar *et al.,* (63) carried out a study on antitumor activity of curcumin is mediated through the induction of apoptosis in AK-5 tumour cells. Joon Surh (64) determined anti-tumour promoting potential of selected spice ingredients with antioxidative and anti-inflammatory activities. Anto *et al.,* (65) screened antimutagenic and anticarcinogenic activity of natural and synthetic curcuminoids. The natural curcuminoids, curcumin I (diferuloylmethane), curcumin II (feruloyl-*p*-hydroxycinnamoylmethane) and curcumin III (bis-(*p*-hydroxycinnamoyl)methane) isolated from *Curcuma longa* were found to be potent inhibitors of mutagenesis and crotean oil-induced tumor promotion in animals. Shenouda *et al.,* (66) studied that phytoestrogens in common herbs regulate prostate cancer cell growth *in-vitro*. Shukla (67) proposed antimutagenic potential of curcumin on chromosomal aberrations in wistar rats. Kuttan *et al.,* (68) reported potential anticancer activity of turmeric (*Curcuma longa*). Chan (69) studied the inhibition of tumour necrosis factor by curcumin, a phytochemical. Nagabhushan *et al.,* (70) showed *in-vitro* antimutagenicity of curcumin against environmental mutagens. Azuine *et al.,* (71) proposed adjuvant chemoprevention of experimental cancer: catechin and dietary turmeric in forestomach and oral cancer models. Pal *et al.,* (72) proposed mechanisms of curcumin-induced apoptosis of ehrlich's ascites carcinoma cells. Singhal *et al.,* (73) studied the effect of curcumin on glutathione-linked enzymes in K562 human leukemia cells. Limtrakul *et al.,* (74) studied inhibitory effect of dietary curcumin on skin carcinogenesis in mice. Donatus *et al.,* (75) reported cytotoxic and cytoprotective activities of curcumin. They evaluated effects of curcumin on paracetamol-induced cytotoxicity, lipid peroxidation and glutathione depletion in rat hepatocytes. Wahl *et al.,* (76) proposed that curcumin enhances Apo2L/TRAIL-induced apoptosis in chemoresistant ovarian cancer cells. Chan *et al.,* (77) studied effects of different dosage of curcumin on cell death types in a human osteoblast cell line. Curcumin can induce apoptotic changes, including JNK activation, caspase-3 activation, and cleavage of PARP and PAK2, at treatment concentrations lower than 25 μM in human osteoblast cells. In contrast, treatment with 50–200 μM of curcumin does not induce apoptosis, but rather triggers necrotic cell death in human osteoblasts. Chakraborty *et al.,* (78) confirmed inhibition of telomerase activity and induction of apoptosis by curcumin in K-562 cells. Curcumin, a phenolic compound isolated from the rhizome of the plant *Curcuma longa* Linn., has been reported to possess anti-tumor, apoptotic and anti-angiogenic properties. Apoptosis has emerged as the major mechanism by which anti-tumor agents eliminate pre-neoplastic cells or cells progressed to malignancy. Shi *et al.,* (79) demonstrated antiproliferation and apoptosis induced by curcumin in human ovarian cancer cells. It has recently been demonstrated that the chemopreventive activities of curcumin might be due to its ability to inhibit cell growth and induce apoptosis. Sreepriya and Bali (80) proposed chemopreventive effects of embelin and curcumin against *N*-nitrosodiethylamine/phenobarbital-

Table 1: Properties of Curcuma longa

Sl. No.	Name of properties	Published literature
1.	Anti-inflammatory activity	Ramachandran (1) *et al.,* Ramsewk (3) *et al.,* Ammon (7) *et al.*
2.	Anti-hyaluronidase activity	Mishra (2) *et al.*
3.	Antioxidant activity	Subramaniam (10) *et al.,* Anto (11) *et al.,* Ruby (14) *et al.,* Scartezzini (15) *et al.,* Selvam (21) *et al.*
4.	Hepatoprotective activity	Deshpande (32) *et al.,* Rajsekharan (33) *et al.*
5.	Hypolipidemic activity	Darka (38), Deshpande (39) *et al.*
6.	Anti-allergic activity	Yano (44, 45) *et al.*
7.	Wound healing activity	Pandey (47) *et al.*
8.	Antimicrobial activity	Negi (49) *et al.*
9.	Anti-fungal activity	Grisanpan (52) *et al.,*Behura (54), Apisariyakul (56) *et al.,*
10.	Antibacterial activity	Rath (50) *et al.*, Singh (51) *et al.*
11.	Insect-repellant activity	Venugopal (55)
12.	Antiulcer activity	Rafatullah (57) *et al.*
13.	Antitumor activity	Duvoix (61) *et al.,* Kim (58) *et al.,* Khar (63) *et al.,* Kuttan (68) *et al.*
14.	Antifertility and antispermatic activity	Bhagat (84) *et al.*
15.	Anti-venom activity	Ferreira (88) *et al.*
16.	Anti-emetic activity	Dietrelhoft (91) *et al.*
17.	G.I.T. disorder	Gilani (94) *et al.*
18.	Antidepressant activity	Kon (95) *et al.,* Xu (96) *et al.*

induced hepatocarcinogenesis in Wistar rats. Su *et al.,* (81) studied curcumin-induced apoptosis of human colon cancer colon 205 cells through the production of ROS, Ca2+ and the activation of caspase-3. These observations suggest that curcumin may have a possible therapeutic potential in colon cancer patients. Tan *et al.,* (82) reported curcumin-induced cell cycle arrest and apoptosis in human acute promyelocytic leukemia HL-60 cells via MMP changes and caspase-3 activation. Curcumin has been shown to inhibit cell proliferation, cell cycle arrest, COX-1 and -2 expression and apoptosis in several human cancer cell lines. Cui *et al.,* (83) reported that curcumin inhibits telomerase activity in human cancer cell lines. Curcumin could suppress telomerase activity in the cancer cell lines and that the decrease of telomerase expression followed by induction of apoptosis might be involved in the anti-proliferating effect of curcumin.

Anti-fertility activity

Bhagat *et al.,* (84) reported that curcuma extract possess significant anti-fertility and anti-spermatic activity in albino rats upon long-term administration (500mg/kg/ bodywt/rat/ day for 60 day). Another study (85) postulates the anti-androgenic efficacy of curcuma longa (50% oil extract) with special emphasis on testicular cell preparation. Maligalig *et al.,* (86) reported significant estrogenic action of curcumin. It is found to be effective in glucocorticoid therapy employed for treating chronic anterior uvetis (CAU) patient.

Miscellaneous actions

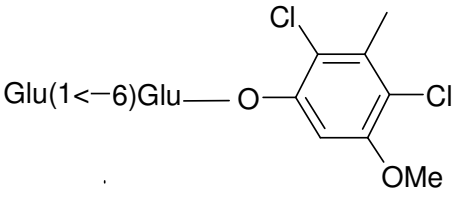
Numbers of attempts have been made to explore its other possible actions. Deters *et al.,* (87) demonstrated that bis-demethoxy-curcumin has much more influence on bile flow and bile acid excretion for prolong time (180 min.) in bile fistula model. Significant antivenom and biological effects (it include anti-inflammatory, antioxidant, anticarcinogenic, antiviral, antiinfectious activities, wound healing and detoxifying properties) of ar-turmerone isolated from *Curcuma longa* (Zingiberaceae) were shown by Ferreira *et al.,* (88). The isolated fraction from *Curcuma longa* consisting of ar-turmerone neutralized both the hemorrhagic activity present in *Bothrops jararaca* venom, and the lethal effect of *Crotalus durissus terrificus* venom in mice. Joe *et al.,* (89) investigated biological properties of curcumin-cellular and molecular mechanisms of action. Eigner *et al.,* (90) showed that *Ferula asafoetida* and *Curcuma longa* in traditional medical treatment and diet in Nepal. Food and eating have powerful symbolic value among the hinduistically-influenced ethnic groups of Nepal. In addition, food plays a major role in the concepts of illness and curing and constitutes an integral part of traditional medical prescriptions. Materials that are consumed in 0.5–1.5 g amounts in the daily diet (e.g. the spices turmeric and asafoetida) are used in minute amounts for medical purposes.

In rats, it is also found to be effective in reducing the cyclosoporin-induced colitis. While, Dietrelhoft *et al.,* (91) was reported turmeric root extract (TRE) possess anti-emetic, carminative and spasmolytic effect and provide relief from constipation. The report from American society on chemistry and industry (92) strongly recommended curcumin as an excellent radical scavenger and is effective in fighting against cancer. Turmeric was found to be effective in treatment of antidepressant. Khattak *et al.,* (93) suggested biological effects of indigenous medicinal plants *Curcuma longa* and *Alpinia galangal*. The ethanolic extracts of *Curcuma longa* and *Alpinia galanga* exhibited excellent (100%) phytotoxic activity

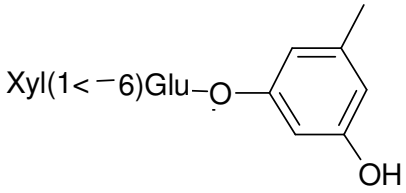
Table 2: Marketed Preparation with their action of Curcuma longa

S. No.	Marketed preparation	Action	Manufacturer's
1.	Dantobhedgadantak Ras	In diarrhoea, dysentery, fever	Baidyanath Ayurved Pvt. Ltd.
2.	Chandanbalalak	Antipyretic, antispasmodic	Baidyanath Ayurved Pvt. Ltd.
3.	Jatyadi Tel	Antiseptic, fungicidal	Baidyanath Ayurved Pvt. Ltd.
4.	Shankhapusphpi Tel	In general disability	Baidyanath Ayurved Pvt. Ltd.
5.	Samraji Tel	Antileucodermic, antiseptic	Baidyanath Ayurved Pvt. Ltd.
6.	Uritone	In burning micturition and in urogenital symptoms	Baidyanath Ayurved Pvt. Ltd.
7.	Mahalakshadi Tel	Use as massage oil in fever and general disability	Baidyanath Ayurved Pvt. Ltd.
8.	Fair Care Powder	For curing pimples and other skin disorder	Sure Cure Remedies (P) Ltd.
9.	Nimbadi Churna	For skin diseases	Sure Cure Remedies (P) Ltd.
10.	Mahasudarshan Churna	In different types of fever	Sure Cure Remedies (P) Ltd.
11.	Naturofit	Provides physical efficiency, mental alertness	Jiwadaya Healthcare Pvt. Ltd
12.	Diabecon	In diabetes mellitus	Himalaya Herbal Healthcare
13.	Geriforte	In stress care	Himalaya Herbal Healthcare
14.	Anti-wrinkle cream	For skin care	Himalaya Herbal Healthcare
15.	Blood purifier capsule & syrup	For purification of blood	Himalaya Herbal Healthcare
16.	Fem care gel	For skin care	Himalaya Herbal Healthcare
17.	Vijaya Churna	In ameobiasis & piles	Vindhya Herbals
18.	Vindhya Vat Capsule	In fever and diarrhoea	Vindhya Herbals
19.	Vindhya Cough-6 capsule	In respiratoy tract infection	Vindhya Herbals
20.	Pachak Buknu Churna	In flatulence, cough & cold	Vindhya Herbals

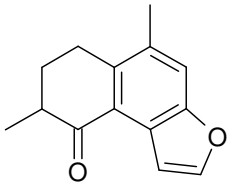
Fig. 1 Common phytoconstituents of Curcuma longa



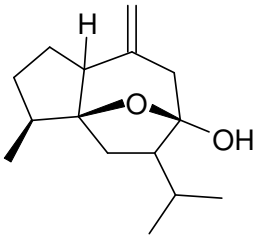
Curculigine A



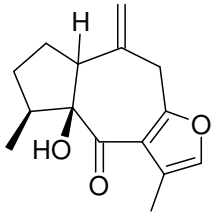
Corchioside A



Curzeone



Curcumol



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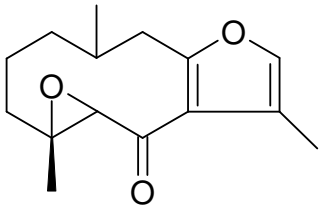

Zederone

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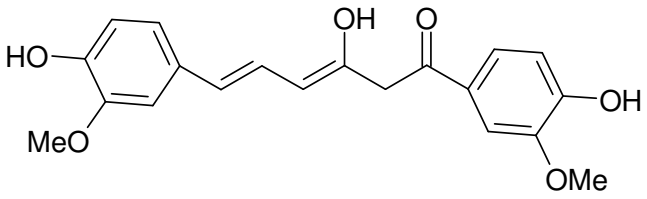

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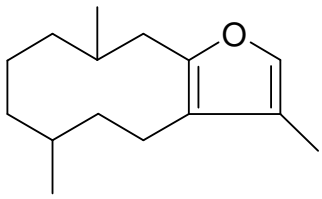
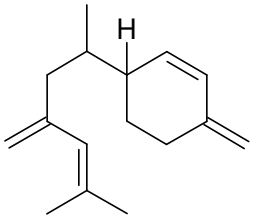
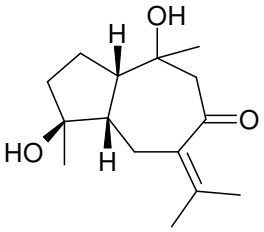


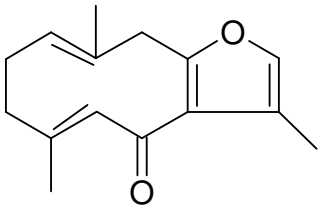
Furanodiene



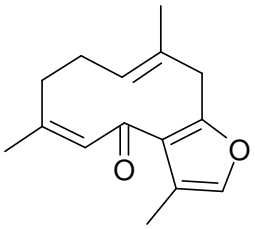
Curlone



Isozedoarondiol



Furanodienone



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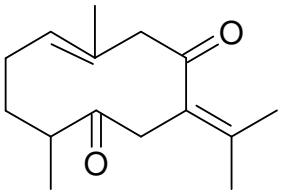

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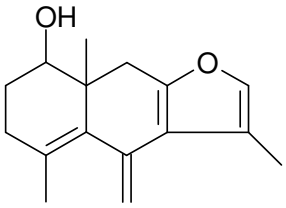
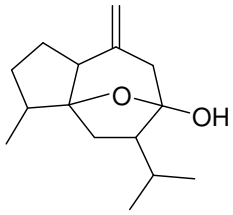


Curculone



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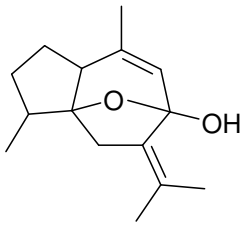

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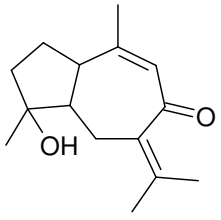

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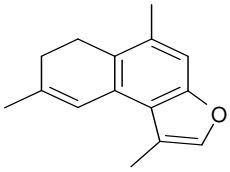
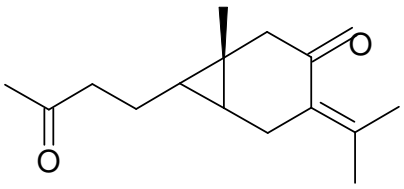
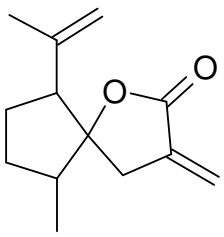


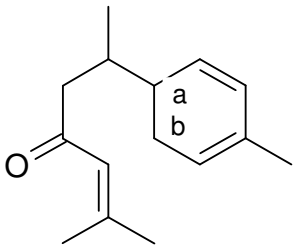
Pyrocurzerenone



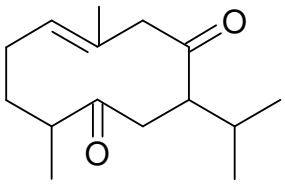
(-) Curcumenone



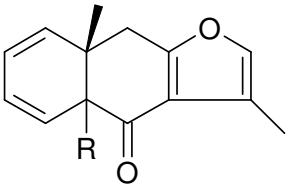
Curcumanolide A & B



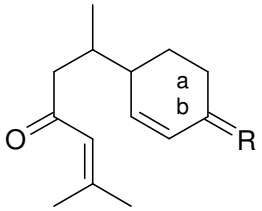
Sesquiterpenes (I & II)



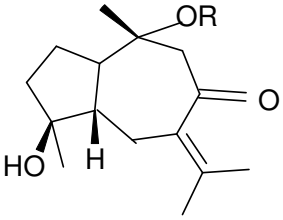
Neocurdione



Curzerenone
R = alpha – H
Epicurzerenone
R = beta – H



Alpha Turmerone
a,b, R = Me, H
Beta Turmerone
R = CH 2



Zedoarondiol
R = H
Methylzedoarondiol
R = H

against *Lemna minor*. These extracts were also found to possess good antifungal activities against *Trichophyton longifusus* (65% and 60%, respectively). Pharmacological basis for the use of turmeric in gastrointestinal and respiratory disorders were given by Gilani *et al.,* (94). Kon *et al.,* (95) studied antidepressant activity of aqueous extracts of *Curcuma longa* in mice. Xu *et al.,* (96) showed the effects of curcumin on depressive-like behaviors in mice. Xia *et al.,* (97) indicated behavioral, neurochemical and neuroendocrine effects of the ethanolic extract from *Curcuma longa* L. in the mouse forced swimming test. *Curcuma longa* L. (turmeric) has been used for centuries in traditional Chinese medicine as a treatment for mental disorders including depression. This study was undertaken to determine the behavioral, neurochemical and neuroendocrine effects of the ethanolic extract from *Curcuma longa* using the forced swimming test (FST) in male ICR strain of mice. Xu *et al.,* (98) reported antidepressant effects of curcumin in the forced swim test and olfactory bulbectomy models of depression in rats.

Lal *et al.,* (99) reported that prolong use of curcumin gives symptomatic relief form idiopathic inflammatory orbital pseudo-tumors. Lee *et al.,* (100) reported that the formation of the aflatoxin B, reduced product of affitoxicol, by chicken liver cytosol was strongly inhibited by *Curcuma longa*. Suresh *et al.,* (101) formulated a herbal preparation from *Curcuma longa* and studied the release pattern, in order to optimize the efficacy of product. While another study reflects the possible protective role of curcuminoid on epidermal skin due to the condition arising by the oxygen free radical stress. Yang *et al.,* (102) investigated that curcumin inhibits formation of abeta oligomers and fibrils and binds plaques and reduces amyloid *in-vivo*. Ono (103) reported that curcumin has potent anti-amyloidogenic effects for alzheimer's beta-amyloidfibrils *in-vitro*.

Another important study reveals the effect of piperine like substance on pharmacokinetics profile of curcumin. The result of study shows, the dose of piperine enhances the absorption and bioavailability of curcumin in both rats and human beings. While, Choudhary *et al.,* (104) reported that the use of curcumin play radio-protective role in glycoxylase system which is vital for various biological function. *Curcuma longa* also possesses a sound inhibitory action of DOPA oxidase and tyrosinase enzyme, responsible for degradation of neurotransmitters (105) at synapse. Sattayasai *et al.,* (106) have studied screening of plants containing Naja naja siamensis cobra venom inhibitory activity using modified ELISA technique. Sui *et al.,* (107) reported inhibition of the HIV-1 and HIV-2 proteases by curcumin and curcumin boron complexes. Mazumder *et al.,* (108) studied inhibition of human immunodeficiency virus type-1 integrase by curcumin. Significant effect of turmeric oil and turmeric oleoresin on cytogenetic damage in patients suffering from oral submucous fibrosis was showed by Hastak *et al.,* (109). Sakui *et al.,* (110) demonstrated biotransformation of sesquiterpenes by cultured cells of *Curcuma zedoaria*. Barquero *et al.,* (111) studied that curcumin, a *Curcuma longa* constituent, acts on MAPK p38 pathway modulating COX-2 and iNOS expression in chronic experimental colitis in rats. Kumar *et al.,* (112) investigated antidiabetic property of fenugreek seed mucilage and spent turmeric in streptozotocin-induced diabetic rats. Diabetic rats lost weight but body weights were improved by feeding spent turmeric than fenugreek seed mucilage. In diabetic rats, a 30% improvement in urine sugar and urine volume profiles was observed with feeding fenugreek seed mucilage and spent turmeric. Sangvanich *et al.,* (113)

investigated hemagglutinating activity of Curcuma plants. Crude proteins obtained extraction from Thai medicinal plants of the Curcuma species exhibited agglutination activity against rabbit erythrocytes.

CONCLUSION

Present article highlight the recent researches on *Curcuma longa*. It is a universal accepted herbal drug used to treat various diversified physiological conditions. Although, India is a largest producer of *Curcuma longa*, still there is a scope to improve its cultivation and export potential because the climatic condition of India is much favorable to maximize its production. Application of tissue culture techniques can play an important role to increase the percentage of its therapeutically active phyto-constituents. Recent researches and market report reveals that the maximum potential of *Curcuma longa* is utilized as spice, in external applications and for the treatment of some common disease. Preliminary report in experimental studies says it is significantly effective in disease related to liver, heart, cancer and immunological disorders. It is required to carryout pinpoint study related to such type of dangerous diseases. There is a need to exploit its maximum potential in the field of medicinal and pharmaceutical sciences for novel and fruitful application, because *Curcuma longa* is a holistic gift nature.

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