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REVIEW OF PHARMACOLOGICAL ACTIVITIES OF *HARIDRA* (*CURCUMA LONGA L.*)

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ABSTRACT

Haridra is widely used medicinal plant by every *Hindu* individual. The medicinal uses of *Haridra* are of utmost important. In the *Ayurvedic* literature also it is one of the most commanaly used herb. A review of research work done regarding ancient and ayurvedic properties of haridra i.e Curcuma longifolia is mentioned here.the studies showed that, haridra is possessing various pharmacological properties,according to Ayurveda, *Kushthaghna, Pramehaha, Krimighna, Raktadoshanashak, Shothahar, Apachihar, Kamala ,Medhya ,lekhana, Vranaropan, Panduhar, Pinasahar, Aruchihar, Twakdoshahar, Varnya, Balya, Kandughna and Vishaghna And according to modern are* anticancer activity, anti-inflammatory activity, antihepatotoxic activity,anti-oxidant activity,antidepressant activity,inhibition of aggregation of human blood platelets,topoisomerase i and ii enzyme inhibition activity, antifungal activity and mosquitocidal activity,neuroprotective activity,hypoglycemic activity,hypolipidaemic activity,antifungal activity,wound healing activity,anti allergic and anti histamine activity and complexion promoting activity.

KEY WORDS: *Haridra, Curcuma longa, Curcuma domestica.*

INTRODUCTION

Haridra is widely used medicinal plant by every *Hindu* individual. Every *Hindu* female apply *Kumkum* on forehead which is made up of *Haridra* and *Nimbuk Swarasa* as a symbol of *Saubhagya*. It is integral part of *Hindu* religious ceremonies, marriages and cooking.The medicinal uses of *Haridra* are of utmost important, right from *Vedic* era to till date. In the

vedic literature *Haridra* is extensively described. *Sayana* claimed it as *Medhya* when administered with honey and *Ghee*.It is indicated for *Shvitra* and *Palita* when used with *Brigaraja,Indravaruni* and *Nili* according to *Atharvaveda*. it was also used externally in *Hridroga* and *Kamala. Koushika Sutra* delineated *Haridra* as an antidote for snake venom. [1]

In the *Ayurvedic* literature also it is one of the most commanaly used herb(both internally as well as externally). *Sushruta* high-lighted its importance in the management of *Pittaja* and *Kaphaja Pramehas*.*Vaghbhata* quoted it as the best for *Prameha*. [1] A review of research work done regarding ancient and *ayurvedic* properties of *haridra* i.e Curcuma longifolia is mentioned here.

Properties mentioned in *Nighantu*

Sr.No	*Nighantu*	Properties
1	*Dhanvantari Nighantu* [2]	*Vishaghna,Kushthaghna,Kandughna,Pramehahar, Vrana,Varnya,Balya,Krimighna,Pinasahar,Aruchihar*
2	*Bhavaprakash Nighantu* [3]	*Kaphanashan,Pittanashan,Varnya,Twakdoshahar,Pramehanashan,Raktadoshanashak,Shothahar,Panduhar,Vranaropan*
3	*Madanpala* [4]	*Kaphanashan,Pittanashan,Varnya,Twakdoshahar,Pramehanashan,Raktadoshanashak,Shothahar,Panduhar,Vranaropan*
4	*Raja Nighantu* [5]	*Kaphanashan,Pittanashan,Varnya,Twakdoshahar,Pramehanashan,Raktadoshanashak,Shothahar,Panduhar,Vranaropan Vishaghna,Kushthaghna,Kandughna,Pramehahar, Vrana,Varnya,Balya,Krimighna,Pinasahar,Aruchihar*
6	*Kaiyadev Nighantu* [6]	*Kaphanashan,Pittanashan,Varnya,Twakdoshahar,Pramehanashan,Raktadoshanashak,Shothahar,Panduhar,Vranaropan And Apachihar*

Vernacular Names [7]

English: Indian Saffron/Turmeric

Hindi: *Haldi*

Sanskrit: *Haridra*

Latin: *Curcuma longa syn : Curcuma domestica*

Family: *Zinziberaceae.*

Botanical Description

A tall herb.rootstock large,ovoid,with sessile cylindric tubers orange coloured inside.leaves very large,in tufts upto 1.2 meters or more long,including petiole which is about as long as the blade,oblong-lanceolate,tapering to the base.flowers in autumnal spikes,10-15 cm

long;peduncle 15 cm.or more,conceled by the sheathy petiole; flowering bracts pale green;bracts of coma tinged with pink. [7]

Pharmacological actions:

Anticancer activity

Anticancer activity of the rhizomes of turmeric was evaluated in vitro using tissue culture methods and in vivo in mice using Dalton's lymphoma cells grown as ascites form. Turmeric extract inhibited the cell growth in Chinese Hamster Ovary (CHO) cells at a concentration of 0.4 mg/ml and was cytotoxic to lymphocytes and Dalton's lymphoma cells at the same concentration. Cytotoxic effect was found within 30 min at room temperature (30°C). The active constituent was found to be 'curcumin' which showed cytotoxicity to lymphocytes and Dalton's lymphoma cells at a concentration of 4 µg/ml. Initial experiments indicated that turmeric extract and curcumin reduced the development of animal tumours.[8]

Anti-Inflammatory Activity

A large number of studies on curcumin were identified. These included studies on the antioxidant, anti-inflammatory, antiviral, and antifungal properties of curcuminoids. Studies on the toxicity and anti-inflammatory properties of curcumin have included *in vitro*, animal, and human studies. A phase 1 human trial with 25 subjects using up to 8000 mg of curcumin per day for 3 months found no toxicity from curcumin. Five other human trials using 1125-2500 mg of curcumin per day have also found it to be safe. These human studies have found some evidence of anti-inflammatory activity of curcumin. The laboratory studies have identified a number of different molecules involved in inflammation that are inhibited by curcumin including phospholipase, lipooxygenase, cyclooxygenase 2, leukotrienes, thromboxane, prostaglandins, nitric oxide, collagenase, elastase, hyaluronidase, monocyte chemoattractant protein-1 (MCP-1), interferon-inducible protein, tumor necrosis factor (TNF), and interleukin-12 (IL-12).[9]

Identification of non-steroidal anti-inflammatory small molecules is very important for the development of anti-inflammatory drugs,viz diferuloylmethane, *p*-coumaroylferuloylmethane and di-*p*-coumaroylmethane, present in the ethyl acetate extract of *Curcuma longa*, diferuloylmethane is most potent in inhibiting TNF-α induced expression of ICAM-1, VCAM-1 and E-selectin on human umbilical vein endothelial cells. The inhibition by diferuloylmethane is time dependent and is reversible. By using RT-PCR, we demonstrate that it inhibits the induction of steady state transcript levels of ICAM-1, VCAM-1 and E-

selectin, and therefore it may interfere with the transcription of their genes. As diferuloylmethane significantly blocks the cytokine induced transcript levels for the leukocyte adhesion molecules, it may be interfering at an early stage of signalling event induced by TNF-α.[10]

Antihepatotoxic Activity

An extract of the rhizomes of *Curcuma longa*, exhibited intense preventive activity against carbon tetrachloride-induced liver injury *in vivo* and *in vitro*. The extract was subjected to fractionation by monitoring the activity by the *in vitro* assay methods employing carbon tetrachloride- and galactosamine-produced cytotoxicity in primary cultured rat hepatocytes. Curcuminoids were shown to possess significant antihepatotoxic action. The liver protective effects of some analogues of ferulic acid and p-coumaric acid, probable metabolites of the curcuminoids, were also evaluated.[11]

Anti-oxidant activity

The turmeric anti-oxidant protein (TAP) had been isolated from the aqueous extract of turmeric. The anti-oxidant principle was found to be a heat stable protein. Trypsin treatment abolished the anti-oxidant activity. The anti-oxidant principle had an absorbance maximum at 280 nm. After gel filtration, the protein showed a 2-fold increase in antioxidant activity and showed 2 bands in the SDS-PAGE with approximate molecular weight range of 24 000 Da. The protein showed a concentration-dependent inhibitory effect on the promoter induced lipid peroxidation. A 50% inhibitory activity of lipid peroxidation was observed at a protein concentration of 50 µg/ml. Ca^{2+}-ATPase of rat brain homogenate was protected to nearly 50% of the initial activity from the lipid peroxidant induced inactivation by this protein. This protection of Ca^{2+}-ATPase activity was found to be associated with the prevention of loss of -SH groups.[12]

Antidepressant activity

The aqueous extracts of C*urcuma longa* when administered orally to the mice from 140 to 560 mg/kg for 14 days, were able to elicit dose-dependent relation of immobility reduction in the tail suspension test and the forced swimming test in mice. The effects of the extracts at the dose of 560 mg/kg were more potent than that of reference antidepressant fluoxetine. The extracts, at the dose of 140 mg/kg or above for 14 days, significantly inhibited the monoamine oxidize A (MAO) activity in mouse whole brain at a dose-dependent manner, however, oral administration of the extract only at a dose of 560 mg/kg produced observable

MAO B inhibitory activity in animal brain. Fluoxetine showed only a tendency to inhibit MAO A and B activity in animal brain in the study. Neither the extracts of *C. longa* nor fluoxetine, at the doses tested, produced significant effects on locomotor activity. These results demonstrated that *C. longa* had specifically antidepressant effects in vivo. The activity of *C. longa* in antidepression may mediated in part through MAO A inhibition in mouse brain.[13]

Inhibition of aggregation of human blood platelets

Earlier it is reported that extracts from several spices, including turmeric, inhibit platelet aggregation and modulate eicosanoid biosynthesis. Due to their eicosanoid-modulating property, it was suggested that the spices may serve to provide clues to drugs directed to arachidonic acid (AA) pathway enzymes as pharmacological targets. Curcumin, a major component of turmeric, inhibited platelet aggregation induced by arachidonate, adrenaline and collagen. This compound inhibited thromboxane B_2 (TXB_2) production from exogenous [^{14}C] arachidonate in washed platelets with a concomitant increase in the formation of 12-lipoxygenase products. Moreover, curcumin inhibited the incorporation of [^{14}C]AA into platelet phospholipids and inhibited the deacylation of AA-labelled phospholipids (liberation of free AA) on stimulation with calcium ionophore A23187. Curcumin's anti-inflammatory property may, in part, be explained by its effects on eicosanoid biosynthesis.[14]

Topoisomerase I and II enzyme inhibition activity, antifungal activity and mosquitocidal activity

Bioassay-directed fractionation of ethyl acetate extract from *Curcuma longa* Linn. rhizomes yielded three curcuminoids, which displayed topoisomerase I and II enzyme inhibition activity. Curcumin III was the most active curcuminoid, inhibiting topoisomerase at 25 µg mL^{-1}. Curcumin I and curcumin II inhibited the topoisomerases at 50 µg mL^{-1}. Fractionation of the volatile oil from the rhizomes afforded *ar*-turmerone , which displayed mosquitocidal activity with an LD_{100} of 50 µg mL^{-1} on *Aedes aegyptii* larvae. Bioassay-directed fractionation of hexane extract from the turmeric leaves yielded labda-8(17),12-diene-15,16 dial with antifungal activity against *Candida albicans* at 1 µg mL^{-1} and inhibited the growth of *Candida kruseii* and *Candida parapsilosis* at 25 µg mL^{-1}. In addition, displayed 100% mosquitocidal activity on *A. aegyptii* larvae at 10 µg mL^{-1}. [15]

Neuroprotective Activity

Curcumin from *Curcuma longa* was screened for neuroprotective activity using ethanol as a model of brain injury. Oral administration of curcumin to rats caused a significant reversal in lipid peroxidation, brain lipids and produced enhancement of glutathione, a non-enzymic antioxidant in ethanol intoxicated rats, revealing that the antioxidative and hypolipidaemic action of curcumin isresponsible for its protective role against ethanol induced brain injury.[16]

Hypoglycemic Activity

The chemistry includes curcuminoids and sesquiterpenoids as components, which are known to have antioxidative, anticarcinogenic, and antiinflammatory activities. the effects of three turmeric extracts on blood glucose levels in type 2 diabetic KK-A^y mice (6 weeks old, n = 5/group). These turmeric extracts were obtained by ethanol extraction (E-ext) to yield both curcuminoids and sesquiterpenoids, hexane extraction (H-ext) to yield sesquiterpenoids, and ethanol extraction from hexane−extraction residue (HE-ext) to yield curcuminoids. The control group was fed a basal diet, while the other groups were fed a diet containing 0.1 or 0.5 g of H-ext or HE-ext/100 g of diet or 0.2 or 1.0 g of E-ext/100 g of diet for 4 weeks. Although blood glucose levels in the control group significantly increased ($P < 0.01$) after 4 weeks, feeding of 0.2 or 1.0 g of E-ext, 0.5 g of H-ext, and 0.5 g of HE-ext/100 g of diet suppressed the significant increase in blood glucose levels. Furthermore, E-ext stimulated human adipocyte differentiation, and these turmeric extracts had human peroxisome proliferator-activated receptor-γ (PPAR-γ) ligand-binding activity in a GAL4-PPAR-γ chimera assay. Also, curcumin, demethoxycurcumin, bisdemethoxycurcumin, and ar-turmerone had PPAR-γ ligand-binding activity. These results indicate that both curcuminoids and sesquiterpenoids in turmeric exhibit hypoglycemic effects via PPAR-γ activation as one of the mechanisms, and suggest that E-ext including curcuminoids and sesquiterpenoids has the additive or synergistic effects of both components.[17]

Hypolipidaemic Activity

Fifty per cent ethanolic extract of Curcuma longa (tuber) and Nardostachys jatamansi (whole plant) feeding elevates HDL-cholesterol/total cholesterol ratio. The extracts also caused a significant reduction in the ratio of total cholesterol/phospholipids. Curcuma longa exhibited better cholesterol and triglyceride lowering activity [Ch = -85%; Tg = -88%] as compared to

N. jatamansi in triton-induced hyperlipidaemic rats. In view of the protective action of HDL against heart disease and atherogenecity, C. longa consumption is recommended.[18]

Antifungal activity

Curcuma longa Linn. or turmeric (Zingiberaceae) is a medicinal plant widely used and cultivated in tropical regions. According to Thai traditional texts, fresh and dried rhizomes are used as peptic ulcer treatment, carminatives, wound treatment and anti-inflammatory agent. Using hydro distillation, 1.88% and 7.02% (v/w) volatile oils were extracted from fresh and dried rhizomes, respectively, and 6.95% (w/w)crude curcuminoids were extracted from dried rhizomes. Dried powder was extracted with 95% ethanol and yielded 29.52% (w/w) crude ethanol extract composed of curcumin (11.6%), demethoxycurcumin (10.32%) and bisdemethoxycurcumin (10.77%). These extracts were tested for antifungal activity by agar disc diffusion method against 29 clinical strains of dermatophytes. It was found that crude ethanol extract exhibited an inhibition zone range of 6.1 to 26.0 mm. There was no inhibition activity from crude curcuminoids while curcumin, demethoxycurcumin and bisdemethoxycutcumin gave different inhibition zone diameters ranging from 6.1 to 16.0 mm. Although antifungal activity of undiluted freshly distilled oil and 18-month-old oil revealed some differences, the inhibition zone diameters for both extracts varied within 26.1 to 46.0 mm. With 200 mg/ml ketoconazole, the activities of the standard agent were similar to the oil, both freshly distilled and 18-month-old, but were significantly different from those of curcuminoid compounds and crude ethanol extracts ($p < 0.01$). Turmeric oil was also tested for its minimum inhibitory concentration (MIC) by broth dilution method. The MICs of freshly distilled and 18-month-old oils were 7.8 and 7.2 mg/ml respectively. [19]

Wound healing Activity

Tissue repair and wound healing are complex processes that involve inflammation, granulation and tissue remodeling. Interactions of different cells, extracellular matrix proteins and their receptors are involved in wound healing, and are mediated by cytokines and growth factors. Previous studies from our laboratory have shown that curcumin (diferuloylmethane), a natural product obtained from the rhizomes of *Curcuma longa*, enhanced cutaneous wound healing in rats and guinea pigs. In this study, we have evaluated the efficacy of curcumin treatment by oral and topical applications on impaired wound healing in diabetic rats and genetically diabetic mice using a full thickness cutaneous punch wound model. Wounds of animals treated with curcumin showed earlier re-epithelialization, improved

neovascularization, increased migration of various cells including dermal myofibroblasts, fibroblasts, and macrophages into the wound bed, and a higher collagen content. Immunohistochemical localization showed an increase in transforming growth factor-β1 in curcumin-treated wounds compared to controls. Enhanced transforming growth factor-β1 mRNA expression in treated wounds was confirmed by in situ hybridization, and laser scan cytometry. A delay in the apoptosis patterns was seen in diabetic wounds compared to curcumin treated wounds as shown by terminal deoxynucleotidyl transferase–mediated deoxyuridyl triphosphate nick end labeling analysis. Curcumin was effective both orally and topically. These results show that curcumin enhanced wound repair in diabetic impaired healing, and could be developed as a pharmacological agent in such clinical settings.[20]

Anti allergic and anti histamine activity

The anti-allergic and anti-oxidative activities of curcumin-related compounds (glycosides, reductants and *bis*-demethoxy analogs) were investigated to elucidate the underlying active mechanisms and structural features of curcumin in exerting these activities. The anti-allergic activities were assessed by measurement of histamine release from rat basophilic leukemia cells, RBL-2H3. Curcumin and tetrahydrocurcumin (THC) caused a marked decrease in histamine release. Glycosides of curcumin, *bis*-demethoxycurcumin and THC also inhibited the release of histamine, though less potently than curcumin did. The anti-oxidative activities were assessed by measurement of cell-free or cellular radical scavenging. All compounds but diglycosides or *bis*-demethoxycurcumin analogs distinctly exerted anti-oxidative effects. The relationship between both of these activities revealed that all compounds with potent radical scavenging activities caused a definite decrease in histamine release, but some compounds with non-potent radical scavenging activities also inhibited the histamine release. These results suggest that the hydroxy groups of curcumin play a significant role in exerting both the anti-oxidative and anti-allergic activities, and that most of the compounds develop the anti-allergic activities through mechanisms related to anti-oxidative activities, but some through mechanisms unrelated to anti-oxidation activity.[21]

Complexion promoting activity

Evaluation of tyrosinase inhibitory activity of spices. Materials and methods: Ten different spices considered as usual commodity in Indian food habits was screened for their inhibitory activity against tyrosinase. The mushroom tyrosinase inhibitory activity was determined by dopachrome method using L-DOPA as the substrate. Results: Amongst the spices tested four

spices viz. Turmeric (*Curcuma longa*), cumin (*Cuminum cyminum*), black pepper (*Piper nigrum*), pipal (*Ficus religiosa*) showed the specific inhibitory activity against tryrosinase above 50% and out of them turmeric showed maximum inhibition which can be further explored for the characterization of the phytoconstituents. Other spices showed potential inhibition of tyrosinase activity. This finding could lead to the design and discovery of new tyrosinase inhibitors from Indian spices.[22]

DISCUSSION

The vedic and ayurvedic refrences shows that the plant haridra is possessing *Kushthaghna,Pramehaha,Krimighna,Raktadoshanashak,Shothahar,Apachihar,Kamala,Medhya,lekhana,Vranaropan,Panduhar,Pinasahar,Aruchihar,Twakdoshahar,Varnya,Balya,Kandughna and Vishaghna* properties. while the properties according studies regarding haridra in modern era are anticancer activity,anti-inflammatory activity,antihepatotoxic activity,anti-oxidant activity,antidepressant activity,inhibition of aggregation of human blood platelets,topoisomerase i and ii enzyme inhibition activity, antifungal activity and mosquitocidal activity,neuroprotective activity,hypoglycemic activity,hypolipidaemic activity,antifungal activity,wound healing activity,anti allergic and anti histamine activity and complexion promoting activity.

These properties can be compared with each other as follows

Sr No	Ayurvedic properties	Modern Properties
	Apachihar	Anticancer Activity
	Kamala	Antihepatotoxic Activity,Anti-Oxidant Activity
	Kandughna	Anti Histamine Activity
	Krimighna	Mosquitocidal Activity and antifungal Activity
	Kushthaghna	Antifungal Activity
	lekhana	Hypolipidaemic Activity
	Medhya	Antidepressant Activity Neuroprotective Activity
	Panduhar	Anti Oxidant Activity
	Pinasahar	Anti Allergic Activity
	Pramehaghna	Hypoglycemic Activity
	Raktadoshanashak	Inhibition Of Aggregation Of Human Blood Platelets
	Shothahar	Anti-Inflammatory Activity
	Twakdoshahar	Anti Fungal Activity
	Varnya	Complexion Promoting Activity
	Vishaghna	Anti Histamine Activity
	Vranaropan	Wound Healing Activity

CONCLUSION

The literary study of haridra from ayurvedic texts and modern researches concludes that Haridra i.e. Curcuma longa has following properties according to ayurveda *Kushthaghna,Pramehaha,Krimighna,Raktadoshanashak,Shothahar,Apachihar,Kamala,Medhya,lekhana,Vranaropan,Panduhar,Pinasahar,Aruchihar,Twakdoshahar,Varnya,Balya,Kandughna and Vishaghna And according to modern are* anticancer activity,anti-inflammatory activity,antihepatotoxic activity,anti-oxidant activity,antidepressant activity,inhibition of aggregation of human blood platelets,topoisomerase i and ii enzyme inhibition activity, antifungal activity and mosquitocidal activity,neuroprotective activity,hypoglycemic activity,hypolipidaemic activity,antifungal activity,wound healing activity,anti allergic and anti histamine activity and complexion promoting activity.

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