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RESEARCH ARTICLE

Anti-ulcer effect of extract of rhizome of *Curcuma longa*. L against aspirin-induced peptic ulcer in rats

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ABSTRACT

Background: Rhizome of *Curcuma longa* has many therapeutic implications in traditional Indian medicine. It is used in traditional medicine for flatulence, dyspepsia, and other gastric problems. There is conflicting reports regarding its anti-ulcer and ulcerogenic potential. **Aims and Objectives:** The study is with the aim of determining the gastoprotective effect of *C. longa* extract on aspirin-induced gastric ulcer in rats. **Materials and Methods:** *C. longa* rhizomes were collected locally. Preparation of extract was done with 50% ethanol using Soxhlet extraction. Albino rats of Wistar strain were used for the study. Aspirin was purchased from Sigma Labs, Mumbai. Anti-ulcer effect of the extract was studied in rats after inducing mucosal damage by aspirin. **Results:** It was found that **e**xtract of *C. longa* exhibited significant protection against aspirin-induced ulcer at dose levels of 250-mg/kg, 500-mg/kg, and 1000 mg/kg body weight. There is a dose-dependent increase in the ulcer protective action of the extract. **Conclusion**: The present study with extract of *C. longa* revealed its anti-ulcer activity.

KEY WORDS: *Curcuma longa*; Anti-ulcer; Aspirin; Ulcer Index

INTRODUCTION

Gastric ulcer is an important health problem affecting a large number of population worldwide. In spite of extensive research, it still remains as an important cause of morbidity. It is a major target for devising newer therapeutic strategies due to its prevalence and complications.

Peptic ulcer can be considered as a multifactorial disease. Factors such as increased stress, impaired mucosal resistance, genetic factors, infection with *Helicobacter pylori*, and anti-inflammatory drugs including nonsteroidal anti-inflammatory drugs (NSAID's) can damage gastric mucosa. Anti-inflammatory drugs including NSAID's are an important proven cause for gastric ulcer, ulcer perforation, gastric, and duodenal bleeding and in ulcer death.[1] Highly selective COX-2 inhibitors were a breakthrough discovery with less incidence of gastric mucosal damage, but soon retracted many of them due to serious cardiovascular adverse events. In the present study, *Curcuma longa*, a plant belonging to the *Zingiberaceae* family was chosen for investigating its anti-ulcer property which has potent anti-inflammatory[2] activity also. Considering the morbidity caused by peptic ulcer disease and dyspepsia over the world, cheap and easily available treatments with less adverse effects will always be beneficial, especially for the people in less developed and developing countries.

C. longa has a prominent place and is considered auspicious in all religious observations in Indian households. Rhizomes of turmeric are an integral part of Indian diet used as flavoring and coloring agent. In Indian system of medicine, *C. longa* has

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a prominent place, and it is subjected to extensive research for its medicinal properties. In Indian system of medicine, it is used for diabetes, edema, as a germicidal, for anorexia, leprosy and intermittent fever and for healing wounds, and bruises and leech bites. It also used in traditional medicine for flatulence, dyspepsia, and other gastric problems.

Ulcers are lesions on the mucous membrane of the stomach or duodenum characterized by superficial loss of tissues with loss of mucosal integrity. There is a local defect with active inflammation. Peptic ulcer is considered as one of most common disease in man leading to human sufferings affecting nearly 5% of the global population. Since in majority of cases it is aggravated due to pepsin and hydrochloric acid, it is termed as peptic ulcer. Usual course of the peptic ulcer is characterized by many cycles of healing, relapses and occasional complications.[3]

Imbalances between damaging and protective factors are the major contributing factor for the pathophysiology of peptic ulcer. Pepsin, acid, *H. pylori* infection, bile acids, impaired mobility, NSAID's, corticosteroids, nicotine, etc., are some of the damaging factors and protective factors include prostaglandins, mucus, epidermal growth factors, intact microcirculation, epithelial renewal, alkaline tide, nitrous oxide, phospholipids, and bicarbonate.

Increased gastrin secretion and acid output with defective gastric emptying mechanism predispose to gastric ulcer. Lower post prandial pepsin secretion, raised serum PG2 and low PGI/PG2 ratios are considered as risk factors for developing a peptic ulcer.[2]

In hypo motility at antropyloric region, there is increased chance for reflex of duodenal contents into stomach which can cause chronic inflammation and ulceration. Reactive oxygen species (ROS), refluxed bile acids, cytokines such as tumor necrosis factors and exogenous agents such as *H. pylori*, NSAID's, alcohol abuse, emotional stress, and smoking can damage gastric mucosa leading to a gastric ulcer.[4]

Mucous bicarbonate barrier, prostaglandins mucosal blood flow, cell renewal and migration, and antioxidants, growth factors are all act as gastroprotective factors preventing the gastric mucosal injury. Gastric mucosal barrier will block the back diffusion of (H^+). NSAID's can disrupt this barrier, and H^+ can damage it resulting in mucosal injury.[3,4]

The first line of defense is a mucus-bicarbonate layer, which serves as a physicochemical barrier to multiple molecules including hydrogen ions. Surface epithelial cells provide the next line of defense through several factors, including mucus production and epithelial cell ionic transporters that maintain intracellular pH and bicarbonate production, and intracellular tight junctions. There are certain mediators, which play an important role in cytoprotection. Epithelial cells in the surface produce bicarbonate, which diffuses up from the mucosa to accumulate beneath the mucous layer, creating a thin layer of alkalinity between the mucus and epithelial surface.[3] Epithelial cells also secrete mucus, which forms a gel that covers the mucosal surface and physically protects the mucosa.

Various studies have shown that extract of *C. longa* possesses anti-ulcer actions[5] in addition to its anti *H. pylori*,[6] antioxidant,[7] and anti-inflammatory[2] actions. There are some conflicting reports showing its ulcerogenic potential also.[8] Anti-inflammatory drugs such as NSAID's and glucocorticoids are deleterious to gastric mucosa and can cause peptic ulcer and gastritis. Extract of *C. longa* which already found to have anti-inflammatory actions if found to have anti-ulcer activity, it will be beneficial in the management of peptic ulcer and related disorders and also can be used as anti-inflammatory agents with gastroprotective action. Since peptic ulcer is a major health problem, having an alternative therapeutic modalities with lesser adverse effects and diverse favorable biological properties will be beneficial in its management.

MATERIALS AND METHODS

Plant material: Locally collected rhizomes of *C. longa* were identified pharmacognostically before use, and its botanical identity was confirmed and certified by pharmacognosy unit Ayurvedic Research Institute, Poojappura, Thiruvananthapuram.

Washed and air dried rhizomes were used for preparing extract with 50% ethanol using Soxhlet extraction method with percentage yield of 4.3. Albino rats of Wistar strain (150–200 g) and Swiss albino mice obtained from the animal house of medical college Thiruvananthapuram were used. They were fed a standard diet and maintained under standard laboratory conditions.

Drugs

Ranitidine was collected from Kerala State Drugs and Pharmaceutical Ltd., Alapuzha. Aspirin was purchased from Sigma Labs, Mumbai.

Phytochemical Screening[9]

A preliminary phytochemical screening was done to determine the presence of various chemical constituents in the alcoholic extract of *C. longa* [Table 1].

Acute Toxicity Study[10,11]

Determination of LD_{50}

Acute toxicity study was done using albino mice of both sexes weighing 20–25 g. After selecting them randomly and dividing them into 8 groups with each group having 6 animals,

Table 1: Preliminary phytochemical screening of 50% ethanol extract of *C. longa*[5,6]

Chemical substance tested	Method	Result
Alkaloid	Mayer's test	+
	Dragendorff's test	+
	Hagers test	+
	Wagner's test	+
Tannins present	Ferric chloride test	+
	Gelatin test	+
	Lead acetate test	+
Flavonoids	Ferric chloride test	+
	Magnesium hydrochloride test	+
	Sodium hydroxide test	+
	Mineral acid test	+
Carbohydrates	Molisch's test	+
	Benedict's test	+
	Fehling's test	+
	Barfoed's test	−
Phytosterols	Liebermann-burchard test	+
Proteins and amino acids	Millions test	−
	Biuret test	−
	Ninhydrin test	−
Lactones	Acetic anhydride test	+
	Alkaline nitroprusside test	+
Triterpenes	Salkowski test	+
	Liebermann-storch mora sky test	+
	Hirshhorn test	+
Anthraquinone glycosides	Borntrager's test	+

C. longa: Curcuma longa

they were subjected to fasting for 18 h before the experiment without giving any food but allowed water *ad libitum*. For the Group 1, which was considered as control, 1% carbxy methyl cellulose (CMC) was given orally. To Groups 2, 3, 4, 5, 6, 7, and 8 extract of *C. longa* were given orally as a suspension in 1% CMC in the doses 100, 200, 400, 800, 1600, 2000, and 2200 mg/kg body weight, respectively. All mice received a constant volume of 1 ml/100 g body weight.

Anti-ulcer study in rats using aspirin-induced ulcer[12,13]

Albino rats weighing 150–200 of both sexes were used for the study. They were randomized into 5 groups, each group having 6 animals. They were starved for 36 h having access to drinking water *ad libitum*. During this time they were housed in single cages with raised bottoms of wide wire mesh to avoid cannibalism and coprophagy. Aqueous preparation of extract of *C. longa* and other compounds were given orally 30 min before aspirin administration in the following manner. Group I (control): Distilled water (1 ml/100 g body weight), Group II (standard): Ranitidine in a dose of 50 mg/kg body weight suspended in distilled water,[14] Group III (test Group I): Ethanolic extract of *C. longa* in a dose of 250-mg/kg body weight suspended in distilled water, Group IV (test Group 2): Ethanolic extract of *C. longa* in a dose of 500-mg/kg body weight suspended in distilled water, and Group V (test Group 3): Ethanolic extract of *C. longa* in a dose of 1000 mg/kg body weight suspended in distilled water.

Aspirin dissolved in water was administered orally in a dose of 500 mg/kg body weight to all animals.[13] 4 h later, the animals were sacrificed by giving heavy dose of ether. Stomach was removed and opened along the greater curvature. Mucosa was examined for total number of ulcers in each stomach and for their severity. Histopathological study was also done. Severity of each ulcer was recorded in the following manner.[15]

0-No ulcer, 1-pinpoint ulcer. Histological changes limited to superficial layers of mucosa. No congestion, 2-ulcer size <1 mm congestion present. 3-Ulcer size 1–2 mm deeper involvement of mucosa. Necrosis and congestion present. 4-Ulcer size more than 2 mm in size or perforated with complete destruction of mucosa. Ulcer index was calculated by following formula[16] $Ui = UN + Us + Up \times 10^{-1}$

Ui - Ulcer index, Un - Average number of ulcers per animal, Us - Average of severity score, Up - Percentage of animals with ulcer.

Specimens were collected in formalin-filled bottles for histopathological study.

Statistical Analysis

Comparing the means in the experimental groups was done by one-way analysis of variance. Mean and standard deviation was found out. Significance of tests results was done by Duncan's multiple range (DMR) test (*post hoc* analysis using DMR test).

RESULTS

Acute Toxicity Study

Acute toxicity study was carried out to determine the LD_{50} of the extract by oral route. Doses up to 1600 mg/kg caused no mortality at 24 h.

Anti-ulcer Study in Rats Using Aspirin-induced Ulcer

Extract of *C. longa* exhibited significant protection against aspirin-induced ulcer at dose levels of 250-mg/kg, 500-mg/kg, and 1000 mg/kg body weight. However, at all these doses, the extract was less effective comparing to that of standard drug

used ranitidine. Ulcer index was 17.69 ± 0.12, 16.18 ± 0.10, and 10.42 ± 0.49 in dose levels of 250 mg/kg, 500 mg/kg, and 1000 mg/kg body weight, respectively. Ulcer index was 8.42 ± 0.61 in the ranitidine treated group whereas 18.33 ± 0.15 in the control group. In this model, extract of *C. longa* in all dose levels showed a significant protection against aspirin-induced gastric ulceration. There is a dose-dependent increase in the ulcer protective action of the extract. Ulcer index was 10.42 ± 0.49 and 8.42 ± 0.61 in case of test drug in a dose of 1000 mg/kg and ranitidine administered group, respectively [Tables 2-4 and Figure 1].

Histopathology showed marked congestion, superficial layer of fibrinoid debris and inflammatory infiltrate with neutrophilic predominance in the mucosa. There was eosinophilic infiltration in some sections with abundant red blood cells suggestive of hemorrhage. The lamina propria of mucosa surrounding the gastric ulcer was infiltrated by plasma cells, lymphocytes and few neutrophils in the control group. There was inflammatory infiltrate in the submucosa also. Similar changes were seen in extract treated groups in the doses of 250-mg/kg and 500-mg/kg body weight. Extract-treated group in the dose of 1000-mg/kg, and ranitidine treated group showed minimum inflammatory infiltrate with mild congestion. Gastric mucosal erosion was absent or minimal. There was a dose-dependent reduction in the inflammatory changes, congestion, and gastric erosion in extract treated groups [Figure 2-9].

DISCUSSION

The present study shows that the extract of *C. longa* exhibited significant protection against aspirin-induced ulcer at dose levels of 250-mg/kg, 500-mg/kg, and 1000 mg/kg body weight. However, it was less effective comparing to ranitidine in all these doses of extract. Ulcer index was 10.42 ± 0.49 at dose of 1000 mg/kg body weight of extract of *C. longa* and 8.42 ± 0.61 in the ranitidine treated group whereas 18.33 ± 0.15 in the control group. Extract of *C. longa* showed significant protection against aspirin-induced gastric ulcer in all dose levels. There is a dose-dependent increase in anti-ulcer effect of extract of *C. longa*. Histopathology study shows minimum inflammatory infiltrate with mild congestion and absent or minimal gastric mucosal erosion with extract treated group in the dose of 1000-mg/kg and ranitidine treated group. There was a dose-dependent decrease in inflammatory changes, gastric erosion, hemorrhage, and congestion in extract treated group.

Curcumin, a diacetyl heptanoid is the principal curcuminoid present in the rhizome of *C. longa.* curcumin, desmethoxy curcumin, and bisdesmethoxy curcumin are natural phenols present in rhizome of *C. longa* which impart yellow color to turmeric. *C. longa* has been used in traditional medicine for treating various diseases. The present study supports the traditional use of this plant against gastric problems. Extensive

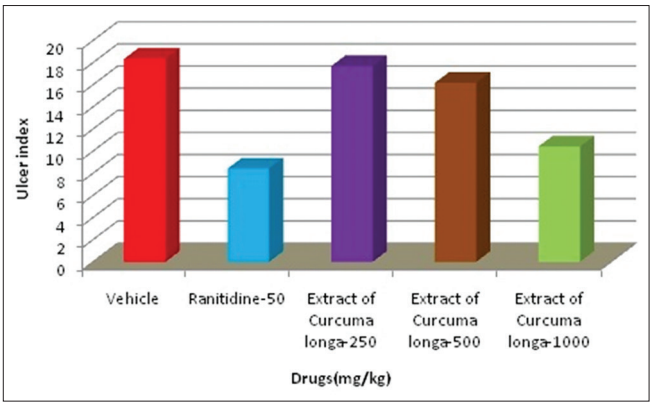

Figure 1: Graph showing the effect of ethanolic extract of Curcuma longa and ranitidine on anti-ulcer study by aspirin-induced gastric ulcer in rats

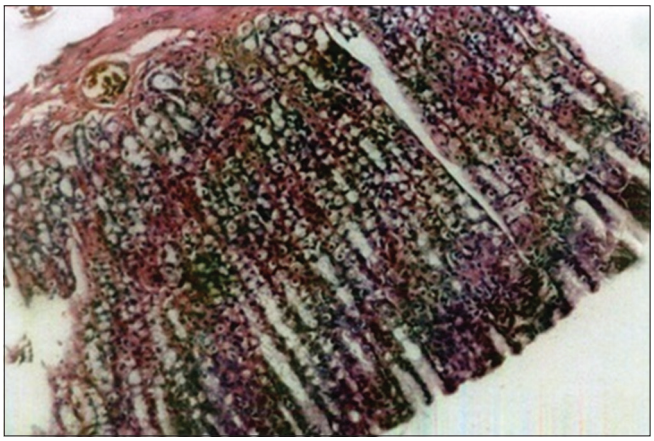

Figure 2: Section of the stomach of rat showing normal mucosa (Group II-aspirin-induced ulcer)

Table 2: Effect of ethanolic extract of *C. longa* on aspirin-induced ulcer in rat

Group	Drug	Dose (per kg body weight)	% of animals with ulcer	Number of gastric ulcer mean±SE	Ulcer score mean±SE	Ulcer index mean±SE
I	Vehicle		100	6.83±1.17	1.83±0.15	18.328±0.150
II	Ranitidine	50	66.67	1.00±0.89	0.75±0.61	8.420±0.612
III	Extract of *C. longa*	250	100	6.00±0.89	1.69±0.12	17.690±0.119
IV	Extract of *C. longa*	500	100	4.83±1.17	1.35±0.10	16.178±0.099
V	Extract of *C. longa*	1000	83.33	1.17±0.75	0.92±0.49	10.417±0.492

C. longa: Curcuma longa, SE: Standard error

Table 3: ANOVA for ulcer index in aspirin-induced gastric ulcer

Group	Ulcer index-mean	Standard deviation	F
Control	18.328	0.150	914.610***
Standard	8.420	0.612	
Drug 250	17.690	0.119	
Drug 500	16.178	0.099	
Drug 1000	10.417	0.492	

n=6, **P*<0.05, ***P*<0.01, ****P*<0.001. ANOVA: Analysis of variance

Table 4: DMR test for aspirin-induced gastric ulcer

Group	Subset of alpha=0.05				
	1	2	3	4	5
Standard	8.420				
Drug 1000		10.4167			
Drug 500			16.1783		
Drug 250				17.6900	
Control					18.3283

Means for groups in homogeneous subset are displayed, uses harmonic sample size=6.000. DMR: Duncan's multiple range

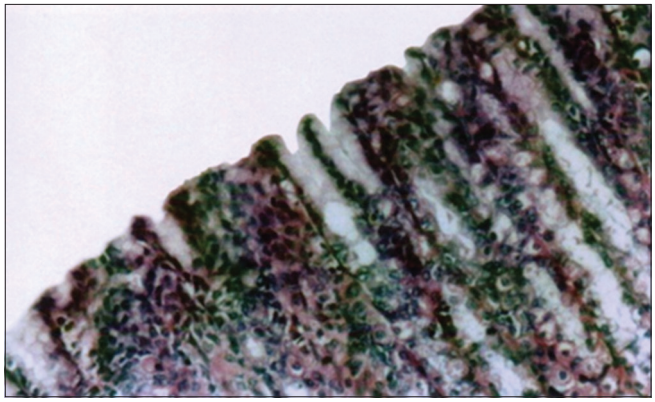

Figure 3: Section of the stomach of rat showing normal mucosa (Group II-aspirin-induced ulcer)

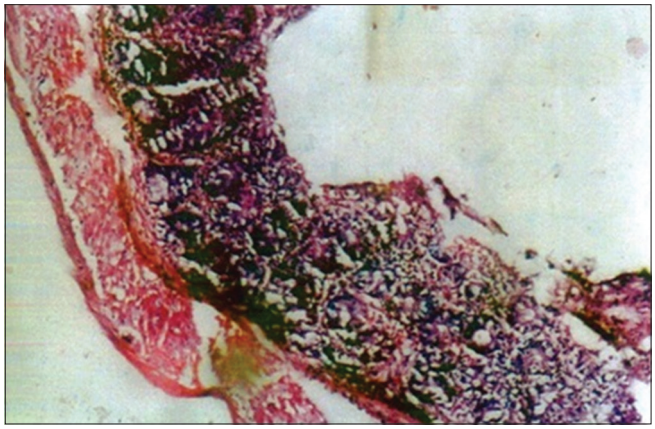

Figure 4: Section of the stomach of rat showing ulcerated mucosa with inflammatory infiltrate (Group III-aspirin-induced ulcer)

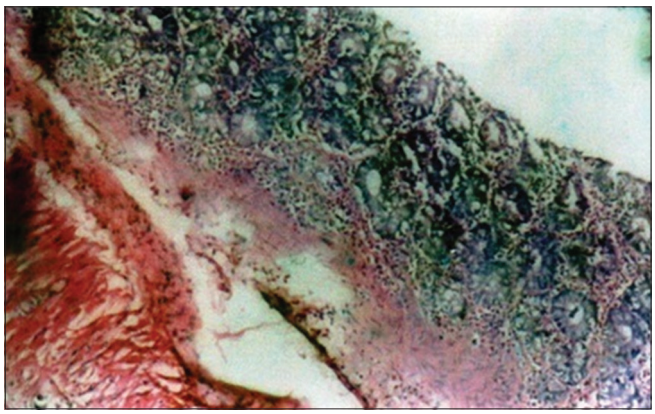

Figure 5: Section of the stomach of rat showing mucosal erosion and inflammatory infiltrate predominantly neutrophilic with eosinophils (Group III-aspirin-induced ulcer)

review regarding the protective and therapeutic uses of curcumin by Agarwal and Goel describes both the anti-ulcer and ulcerogenic potential of curcumin.[17] Salt of curcumin, sodium curcuminate, was found to inhibit intestinal spasm, and p-tolymethylcarbinol, a turmeric component, was found capable of increasing bicarbonate, and pancreatic enzyme secretion.[18] *Curcuma* powder has been reported to increase gastric wall mucus, in a study conducted by Rafatullah *et al.*[5] Curcumin was found to increase mucin secretion in rabbits and may act as a gastroprotective agent against irritants.[19] Ulcerogenic potential of curcumin was shown by Dasgupta *et al.*[8] Preliminary phytochemical screening of extract of *C. longa* showed the presence of triterpines. In a study conducted by Faber *et al.* it was found that anti-ulcer activity of dill (*Anethum graveolens* L seed) is due to the presence of terpenes.[20] Terpenes were associated with anti-ulcer activity in other plants.[21-23] Muscle spasm induced by electrical vagal stimulation has been shown experimentally to produce acute gastric ulcers.[24] A salt of curcumin, sodium curcuminate, was found to inhibit intestinal spasm.[18]

Different studies give highlights to various causes for the development of peptic ulcer. Ulcers caused by aspirin could be due to their direct effect or release of noxious substances including free radicals.[25] Disruption of prostanoid synthesis is another contributing factor for aspirin-induced ulcers. It appears that the development of gastric mucosal damage by aspirin, and possibly other ulcerogenic NSAIDs, involves hypersecretion of tissue-destructive free radicals which may come from (a) enhanced conversion of hydroperoxy to hydroxy fatty acids in the lipooxygenase pathway, (b) accelerated xanthine-oxidase activity in the mucosa, and (c) possibly from the drugs themselves. The inhibition of gastric mucosal prostaglandin production occurs rapidly following oral administration of ulcerogenic drugs. This is correlated with the rapid absorption of these drugs through the mucosa. Inhibition of prostglandin coincides with the earlier stages of injury to the cell membranes of the mucosa

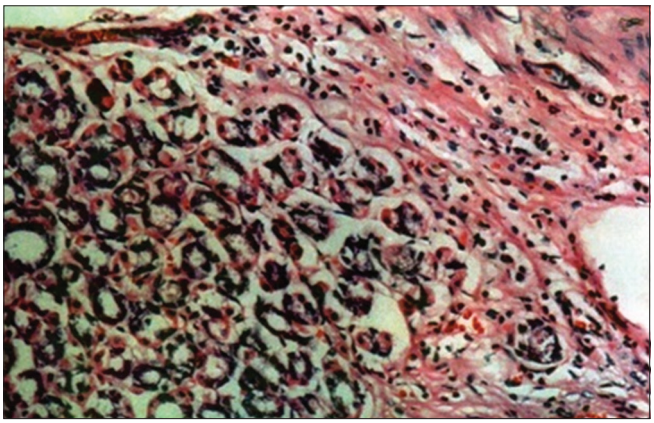

Figure 6: Section of the stomach of rat showing inflammatory infiltrate predominantly neutrophilic (Group IV-aspirin-induced ulcer)

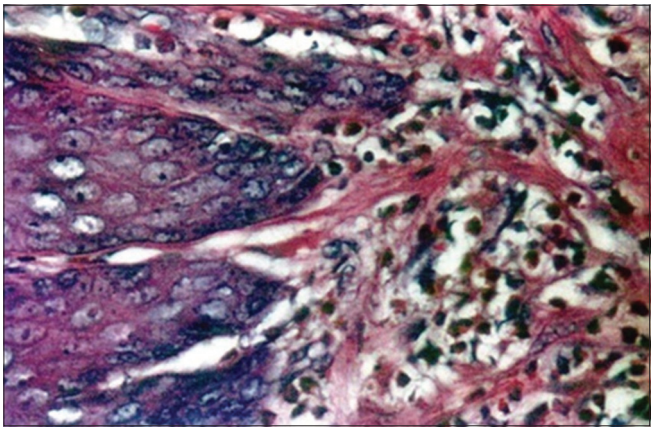

Figure 7: Section of the stomach of rat showing inflammatory infiltrate and congestion (Group IV-aspirin-induced ulcer)

with the concomitant loss of the permeability characteristics of the mucus and electron microscopic evidence of damage to mucosal, parietal, and endothelial cells. The later changes also reflect rapid ischemia which appears to develop in the mucosa during aspirin injury.[26] NSAID's such as aspirin and indomethacin are known to induce gastric ulceration. The reason being attributed principally to inhibition of biosynthesis of cytoprotective prostaglandins such as prostaglandin E and prostacyclin by inhibition of cyclooxygenase pathway of arachidonic acid metabolism, resulting in overproduction of leukotrienes and other products of 5-lipoxygenase pathway.[27] Role of cytoprotection in preventing ulcer generation is clearly shown.[28] Different studies show role of ROS, for the genesis of gastric ulcer.[29] A small part of oxygen used is converted to ROS, i.e., the superoxide anion radical (O_2-), hydrogen peroxide (H_2O_2), and the hydroxyl radical (•OH). They are highly toxic to cells and can cause oxidative damage. Ischemia-reoxygenation-induced gastric mucosal injury shows role of ROS in pathogenesis of gastric ulcer.[30] *H. pylori* is an important causative agent leading to chronic Type B gastritis, peptic ulcer, adenocarcinoma, and mucosa associated lymphoid tissue lymphoma affecting stomach.[31] Various studies show the role of ROS in NSAID's[26] and

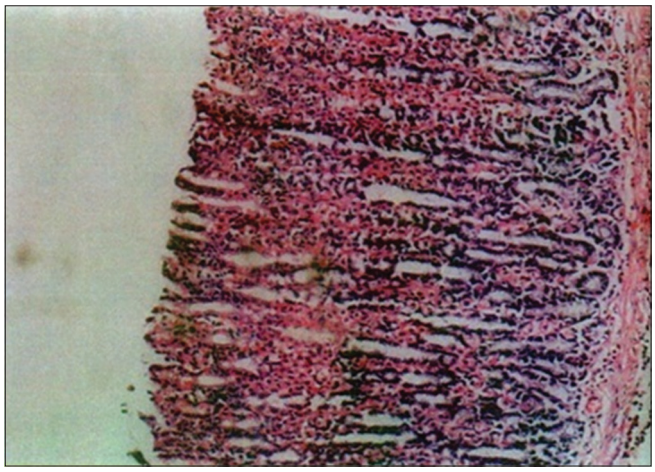

Figure 8: Section of the stomach of rat showing normal mucosa (Group V-aspirin-induced ulcer)

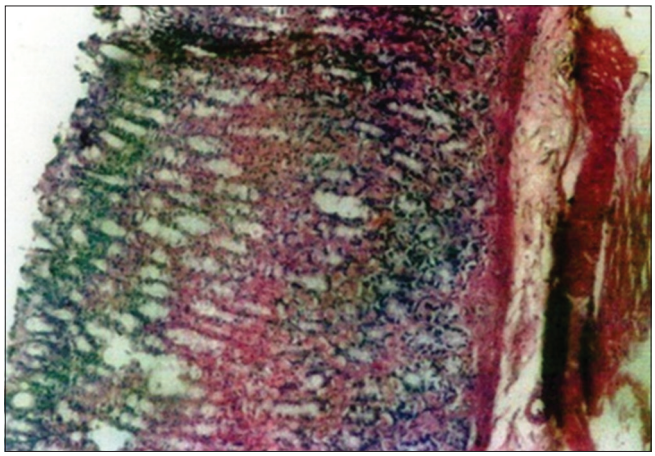

Figure 9: Section of the stomach of rat showing normal mucosa (Group V-aspirin-induced ulcer)

H. pylori[32] induced gastric mucosal injury. These ROS decreases the level of endogenous antioxidants such as α tocopherol, glutathione and ascorbate, and augment oxidative mucosal damage. Ulcers induced by aspirin could be due to their direct effect or release of noxious substances including free radicals.[33] A specific •OH scavenger, dimethyl sulfoxide found to inhibit gastric ulceration produced by ischemia,[30] stress,[34] or ethanol[35] showing the role of •OH in causing mucosal ulceration. Antioxidant potential of melatonin was found to be the reason for its anti-ulcer property by scavenging ROS.[36]

Even though the present study shows significant ulcero-protective action of the extract of *C. longa*, its precise mechanism of action is not clear. Further studies are required to find out the actual mechanisms which leading to its anti-ulcer action. Some of the probable mechanisms which may contribute to its anti-ulcer activity are worth mentioning here. Potent anti-inflammatory effect of curcumin analogs was shown by Srihari *et al.*[2] Factors causing inflammation such as phospholipase inducible tumor necrosis factor, lipooxygenase,

leukotrienes, thromboxane, elastase, and collagenase were found to be inhibited by curcumin the active ingredient of *C. longa*.[25] Hence, the protective action of extract of *C. longa* against aspirin-induced gastric lesions could possibly due to its 5-lipoxygenase inhibitory effect in addition to its probable selective inhibitory action on COX-2 enzymes. It has also been reported that leukotriene antagonist and 5-lipoxygenase inhibitors are capable of inhibiting NSAID's-induced gastric ulceration in rats,[37] so the protection afforded by the extract of *C. longa* against NSAID's-induced gastric ulceration could also be due to inhibition of 5-lipoxygenase pathway or leukotriene antagonistic activity. Further studies are necessary to confirm these findings. By activating cellular protection, inhibiting prostaglandin metabolism, decreasing gastric vascular permeability, and cytoprotective action some triterpines are found to have anti-ulcer property.[38]

In another study oral administration of curcumin in rats caused, a significant reversal of lipid peroxidation, in brain lipids, and produced enhancement of glutathione; a non-enzymatic antioxidant.[34] Potent antioxidant action of *C. longa* was demonstrated by an integrated metabolomic approach by Dall' Acqua *et al*.[39] In case of peptic ulcer, inflammatory mediators play an important role along with involvement of free radical injury and lipid peroxidation. The anti-ulcer effects of turmeric and curcumin may be due in part to direct antioxidant and free radical scavenging effect. However, it also enhances the body's natural antioxidant system, increasing glutathione levels that also may be contributing to its anti-ulcer effect.[40] Powerful antioxidant property of turmeric, comparable to Vitamin E and Vitamin C was shown by Toda *et al*.[41] Electron paramagnetic resonance spectroscopic techniques were used to show the ability of curcumin to quench oxygen radical at very low concentration.[42] Diarylheptanoids separated from ethanolic extract of *C. longa* found to have free radical scavenging activity *in vitro*.[7] *H. pylori* which is a Gram-negative spiral bacterium found in gastric epithelium is found to have inhibited by *C. longa*.[6] All these findings favor the involvement of reactive free radicals in gastric mucosal damage and the role of antioxidants in preventing gastric ulceration. Thus, the powerful anti-inflammatory and antioxidant properties may contribute to anti-ulcer activity of *C. longa* against aspirin-induced gastric ulcer.

Diverse role of *C. longa* in protecting gastric mucosal damage may be due to its effect on wound healing,[43] anti-inflammatory, and antioxidant activity. Peptic ulcers are reported to be due to an imbalance between offensive acid-pepsin secretion and defensive mucosal factors such as mucin secretion and cell shedding.[44] For the long-term management of peptic ulcer, extract of *C. longa* and curcumin can be used due to its anti-inflammatory, anti *H. pylori,* and antioxidant effect. Anticancer actions also is beneficial since *H. pylori* infection is considered as a risk factor for gastric malignancies.[31].Curcumin is also found to increase gastric wall mucus.[24] It may, thus, be beneficial in protecting the gastric mucosa from irritants.[45] Probably presence of triterpenes in the *C. longa* extract may be contributing to its beneficial ulcero-protective activity.

CONCLUSION

The present study with extract of *C. longa* revealed that it has significant anti-ulcer activity. Usually, NSAIDs and corticosteroids are widely used in clinical practice as anti-inflammatory agents. With the exception of newer highly selective COX-2 inhibitors, NSAID's and corticosteroids produce significant gastric irritation resulting in gastritis and gastric ulceration, especially on long-term treatment. Present study revealed that alcoholic extract of *C. longa* has ulcer protective properties. Previous studies showed its potent anti-inflammatory activity.[2] Therefore, it can be consider as an ideal substitute for conventional NSAIDs and glucocotricoids. Further studies have to be conducted to explain precisely the mechanism of action of this drug.

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