



## REVIEW ARTICLE

# Phytotherapy for Peptic-ulcer: An overview on important Indian herbal plants having flavonoid as antiulcer activity

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## ARTICLE HISTORY

Received: 24 June 2021

Accepted: 03 October 2021

Available online: 14 November 2021

## KEYWORDS

Peptic ulcer  
Herbal plants  
Gastroprotective  
Flavonoids  
Mechanism of action

## ABSTRACT

Peptic ulcers are described by erosions of the gastrointestinal mucosa that can reach the muscular layer. Peptic ulcers are a widespread health condition that affects millions of individuals and has a high recurrence rate. "No gastric acid, no peptic ulcer" is a flawed assumption. Excessive gastric acid secretion is only one factor in the pathogenesis of peptic ulcer disease. Their etiology is multifactorial and develops when the balance of offensive and protective components is disrupted. Its treatment faces great difficulties due to the limited effectiveness and severe side effects of the currently available drugs. Natural products such as herbal plants and their isolated compounds have been widely used in experimental models of peptic ulcers. Flavonoids strengthened defensive factors had cytoprotective and rehabilitative actions. Flavonoids are among the molecules of greatest interest in biological assays due to their anti-inflammatory, antioxidant properties. The present study is a literature review of herbal plants having flavonoid that have been reported to show peptic ulcer activity in experimental models using the divergent mechanism of action.

## Introduction

Peptic ulcer disease is a major health complication of the digestive tract. Every year, some 500000 new cases have been reported, affecting 5 million individuals in the United States alone. Surprisingly, persons born around the mid-twentieth century have the maximum risk of developing peptic ulcer complications. Peptic ulcers are tiny holes that appear on the mucosa of the oesophagus, stomach, or duodenum, indicated by an eroded membrane with a lesion persisting into the submucosa or muscularis propria deep inside the wall of the stomach and duodenum (1). According to the research, peptic ulcer disease is triggered by a conflict amongst supportive mucosa-protective determinants (such as mucus, bicarbonate barrier, prostaglandin, cell renewal and migration, surface-active phospholipids, optimal blood supply and some growth factors) and violent determinants (such as HCl, pepsin, reactive oxygen species (ROS), refluxed bile, leukotrienes) (2). Based on their severity of occurrence peptic ulcers can be categorised as acute ulcers and chronic ulcers. Acute peptic ulcers are characterized as the injury or hole which penetrates the mucosa of the lamina muscularis but does not affect further more than the submucosa. Stress is the primary cause, as it includes brain damage (Cushing's ulcer) linked with high intracranial pressure and severe burns

(Curling's ulcer). On the other hand, chronic ulcers extend the length of the muscularis propria and have their roots in the organ's serosal layer or outside the gut itself. It includes ulcers of the stomach and duodenum (3). Gastric ulcers (GU) appear to be chiefly prominent in those around the age of 50, particularly among women (4). Various causes for the occurrence of Gastric ulcers have been reported, including impairment of mucosal barrier get unable to protect the lining of the stomach from hydrochloric acid and pepsin. Pyloro-duodenal reflux is considered to be another cause of pre-ulcerative superficial gastritis in which bile and other duodenal secretions regurgitated into the stomach. A high majority of stomach ulcer cases could be due to biliary reflux (5). Duodenal Ulcers (DU) are more common in younger people. Acid hypersecretion is the major cause of a duodenal ulcer various studies have reported being an obvious link to the stomach's excess production of hydrochloric acid with duodenal ulcers. Various kind of endocrine organ dysfunctions leads to indirect elevation of gastric acids such as a parathyroid tumour, Cushing's syndrome and Zollinger-Ellison syndrome. In Zollinger-Ellison syndrome secretion of a large amount of hormone gastrin secreted by tumours in the pancreas and duodenum due to which too much production of acid takes place leads to an indirect effect in the formation

of duodenal ulcer (6). Liver disease –Gastric ulcer and duodenum ulcer have been associated with liver disease, especially cirrhosis. It could be caused by an elevation in blood flow to the gastric mucosa, as well as an overproduction of histamine in the stomach wall, which stimulates parietal cells (7). Ulcers smaller in size do not show any serious symptoms while larger size ulcers sometimes may cause heavy bleeding. Some of the common symptoms include Epigastric pain, Epigastric burning sensation, postprandial fullness, bloating, Unexplained weight loss, Vomiting, Blood in stools, Appetite changes.

It could be excruciating when the condition worsens due to haemorrhage, penetration, perforation and pyloric stenosis. A surgical emergency is required when perforation of a duodenal peptic ulcer occurs (8). Traditionally all ulcers of the upper digestive tract were thought to be caused by the detrimental activity of HCl and pepsin on the mucosa. While other factors including alcohol consumption, smoking, usage of steroidal and non-steroidal anti-inflammatory medicines (NSAIDs) (9), *Helicobacter pylori* infections (10), a stressful lifestyle and genetic are all linked to the development of peptic ulcers. These are a serious human illness that affects about 8% to 10% of the world's population, so presently managing or curing them is one of the foremost critical concerns of every healthcare pharma industry (11). Despite recent breakthroughs in our understanding of the complex pathophysiology of peptic ulcers, stomach acid secretion is still acknowledged being a key factor of the disease as a result, the primary therapeutic goal is to regulate this secretion using multiple currently available drugs like antacids, proton pump inhibitors, cytoprotective, histamine H<sub>2</sub>-blocker and anticholinergics. However, this therapy does not show their result up to the mark and facing major drawbacks due to their limited efficacy, high re-occurrence rate of gastric ulcer after therapy and severe side effects (12) Table 1 (13-16).

Anti-ulcer medicines have adverse effects however, medicinal plants are well-known for their safety and availability in natural sources. Chemical

components from a single plant or diverse portions of numerous plants are used in traditional medicine to make synthetic drugs (17). Medicinal plants have been successfully used with fewer consequences since prehistoric times and be a good alternative for the treatment of ailments. Scintigraphy revealed that these natural plant compounds posed no significant risk (18). The availability of different active constituents mainly flavonoids are associated with antiulcer activity (19). As a result, this review helps to identify plants having flavonoid as active constituents that can be used as ulcers remedy potentially contribute to the development of antiulcer herbal medicines. The current review focuses on the foremost essential indigenous medicinal herbs utilized in the management of ulcers.

## Methodology

The information for this review article came from articles indexed in databases such as Scopus, Scientific Information Database, Google Scholar, PubMed, Indian Ayurvedic booklet *Materia Medica*. The appropriate article related to Medicinal plants with antiulcer effects was further reviewed.

## Indian Plants with flavonoids showing antiulcer potentiality

### *Myristica malabarica*

The plant, *Myristica malabarica* Linn. is a perennial tree of a height of 25 m. It comes under the family *Myristicaceae* (English name: Malabar nutmeg). India is one of the richest sources of this plant where it is commonly seen in the Western Ghats. *Myristica malabarica* is traditionally used for anti-ulcer, anti-inflammatory, antimicrobial and sedative-hypnotics. Large no. of phytoconstituents such as diarylnonanoids, tannins, isoflavones are present in it (20). The result after evaluation from ulcer indices and histopathological parameters showed that methanolic extract of *Myristica malabarica* (40 mg/kg), when given orally for each consecutive 3 days, could

**Table 1.** Modern therapy uses for ulcer treatment and their side effects.

Class of drugs	Mechanism involved	Types	Side effects	References
Ulcer protective	Lessen gastric mucosal impairment	Colloidal bismuth subcitrate, Sucralfate	Diarrhea, edema, dizziness and hypophosphatemia.	(13)
		Anticholinergic Pirenzepine Oxyphenonium	Dry mouth, blurred vision, urinary retention, constipation and xerostomia.	(14)
Gastric acid secretion Inhibitors.	Decrease the production of HCl, alleviate gastric pain, encourage ulcer healing.	Proton pump inhibitor Omeprazole Lansoprazole	Atrophic gastritis, hypergastrinemia and dizziness.	(14)
		H <sub>2</sub> Antihistamine Cimetidine Roxatidine Ranitidine	Skin rash, Headache, arrhythmias, loss of libido and impotence.	(14)
		Prostaglandin analogue Misoprostol	Abdominal cramps, uterine bleeding, abortion and Diarrhea.	(14)
		Anti <i>H. pylori</i>	Inhibition of Pylori growth and proliferation	Amoxicillin, Metronidazole
Antacid	Neutralize gastric acid by inhibiting pepsin	Systemic Sod.citrate Nonsystemic Mag.hydroxide Magaldrate	Stomach distension, belching, renal stone and constipation.	(16)

significantly heal the ulcers of the stomach against indomethacin-induced ulcer model in mouse. On comparing with a positive control group, the treated group showed a reduced macroscopic damaged score of around 72% ( $P < 0.001$ ). Healing of ulcers was observed faster with a treated group for 3 days than with the natural healing of 5 to 7 days ( $P < 0.05$ ). The possible mechanism behind the ulcer healing ability could be their antioxidant activity along with their potential to increase the mucin content of stomach tissues. The extract decreased lipid peroxidation (42–44%) and protein carbonyl content (34%) while increasing non-protein thiol levels above normal limits (21).

### ***Bryophyllum pinnatum***

The fleshy herb *Bryophyllum pinnatum* (Lam.) Kurz. pertains to the *Crassulaceae* family (English name: Life plant). It thrives best in subtropical and mild temperate climate zones and has been utilized as a medicine in India, tropical America, Africa, China and Australia (22). The leaves of this herb offer a wide range of therapeutic properties and can be used both internally and externally. The pulp or juice of the leaves is applied topically to physical injuries to cease bleeding by constricting the small arterioles (23). Various studies revealed that methanolic extracts delivered intraperitoneally to rats (250 and 500 mg/kg) showed a major reduction in free acidity, total acidity and total volume of gastric content in the ulcer model induced via ethanol when compared with the untreated group. Kaempferol is considered as the active constituent of the plant and the possible mechanism of extract in this pharmacological model could involve inhibition of lipoxygenase pathways (24).

### ***Piper betle***

*Piper betle* Linn. in the local language called 'paan' belongs to the family Piperaceae. *Piper betle* (English name: Betel leaf) is an annual creeper that rises to several meters in height. It is often seen easily where the temperature and humidity of any part of the country are high disseminated in India and other South-East Asian nations such as China and Vietnam. Various states in India cultivate it including Uttar Pradesh, Tamil Nadu, Bihar, Andhra Pradesh Bengal, Orissa (25). A study of gastric ulcer models induced by indomethacin proclaimed that ethanolic leaf extract of *Piper betle* had a significant role in ulcer healing. Isolated compound allyl pyrocatechol (APC) from the extract was administered orally for 7 days stabilized basal acid output with similar adequacy to misoprostol. Treatment with *Piper betle* extract not only restored MDA levels but also persistently improved CAT and SOD levels with performance identical to misoprostol. The possible mechanism responsible for the healing of ulcers could be attributed to an increase in mucus production by APC (26).

### ***Asparagus racemosus***

*Asparagus racemosus* (English name: Satavari) is popularly known as Satavari, Satawar and Satamuli, widely grown in low-lying areas of India. Taxonomically it comes under *Liliaceae* family. The

dried roots are utilized as a medicine. According to reports, *A. racemosus* root extract has antioxidant, antiulcer, antidiabetic, antidiarrheal and immunomodulatory activity. Whereas other parts too contain active constituent like Flavonoids, rutin, quercetin showed a beneficial role in ulcer therapy (27). The result of a study claimed that crude extract of *Asparagus racemosus* (100 mg/kg/day orally) prominently decreased ulcer index when indomethacin plus pylorus ligation induced model was used. Besides, other parameters like gastric secretion, free acidity and total acidity are reduced in contrast with the ulcer group. Along with it, Gastric juice had a considerable rise in total carbohydrate (TC) and TC/total protein (TP) ratios. All these indicated that inhibition of the release of HCl could be the significant mechanism responsible for the healing of ulcer (28).

### ***Alstonia scholaris***

*Alstonia scholaris* Linn., (English name: Blackboard), a member of the *Apocynaceae* family. It is a huge evergreen tree that can reach a height of 17 to 20 meters. This plant has different names as Shaitan wood, Lava, Milky pine, White cheese wood and Devil tree. It is claimed to include a variety of alkaloids, flavonoids, phenolic acids and other compounds. The phytochemicals suggest that they could be used to treat cancer, antioxidants, asthma, diabetes, antibacterial, ulcers and rheumatic pain (29). Experiment with rats showed that *Alstonia scholaris* has a Gastroprotective effect at 200 mg/kg and 400 mg/kg against ulcers induced by the pylorus ligation model. The hydro-alcoholic extract of *Alstonia scholaris* only was found to be effective in treating stomach ulcers by minimizing oxidative stress and reducing mucosal erosion when compared to a control group. The antioxidant activity of *Alstonia scholaris* may mediate gastroprotection through activation of prostaglandin production. The extract's potential to minimize stomach mucosal damage confirms its cytoprotective impact and shows that prostaglandins may be involved in the extract's antiulcer activity (30).

### ***Solanum nigrum***

It is popularly known as "black nightshade berries" and belongs to Solanaceae family. It grows anywhere in cultivated fields, in shaded areas, on wasteland, near roads, therefore known as a volunteer crop. Secondary metabolites present in this plant are flavonoids, alkaloids, saponins and phytosterols (31). In an era of folk medicine tribals in Tamil Nadu, ingest fresh leaves to treat duodenal ulcers. In the result of one study, *Solanum nigrum* ethanolic fruit extract (SNE) revealed its antisecretory action. After 7 days of treatment, SNE (200 and 400 mg/kg) hastened the healing of ulcers induced by acetic acid. In ulcerated rats, SNE reduced pepsin secretion, stomach secretory content, acidity, simultaneously. The action of SNE on  $H^+K^+ATPase$  and plasma concentrations of gastrin hormone in ulcerated rats were also examined and showed that SNE blocks  $H^+K^+ATPase$  activity and lowers gastrin secretion. Histological data revealed the intensity of ulcerogen and reduction of ulcer size in the treated group (32).

### ***Acacia arabica***

It belongs to the Mimosaceae family and is found in wasteland areas throughout India. This plant is also called the "babool tree", kikar or Indian gum Arabic tree. English name: Gum Arabic tree. Gum including Arabic acid mixed with calcium, potassium and magnesium, as well as a minor amount of malic acid, 14 % moisture, and 3-4 % ash, are described as chemical ingredients in this plant. Tannin can be found in abundance in the bark. In Ayurvedic medicine, it can be used as a gargle or a wash for haemorrhagic ulcers and wounds. Tender leaves that have been crushed made into a cataplasm and placed against ulcers work as a stimulant and antiseptic (33). Besides, research has shown that other acacia species, such as *Acacia senegal* gum, can protect rats from acquiring stomach ulcers induced by cold restraint stress. Gum Arabic (GA) derived from the stem of *Acacia senegal* in the form of dried exudate was used and given to rats (7.5 g/kg/day) via an orogastric tube in a stress-induced model. The result of the experiment revealed that pre-treated with GA reduced stomach lesions considerably. Significant reduction in ulcer score and severity has been observed (39.58 % and 32.8 %) in comparing with the stress-untreated group (34).

### ***Rhus coriaria***

*Rhus coriaria* called as "sumach" is a very essential plant of Anacardiaceae family. It is a tiny shrub or tree that can reach a height of 1-3 m. It is indigenous to southern Europe. Isoquercitrin, tannic acid, ellagic acid, gallic acid and myricitrin, are chemical components of this plant. In Ayurvedic medicine, it is usually taken as a powder or an extract, with a dose of 10 to 30 grains. Traditionally the charcoal-based paste was applied over ulcers (35). In an experiment with rats, the hydroalcoholic extract of *R. coriaria* showed antisecretory action. In which the ulcer was induced by ethanol and extract was administered (145 and 248 mg/kg) orally to the ulcer group as a treatment. The extract has been shown to speed up the healing of stomach ulcers due to the presence of flavonoid quercetin in the plant which could be responsible for the elevation of prostaglandin E2 (36).

### ***Momordica charantia***

"Bitter gourd" is the common name for *Momordica charantia* of the family Cucurbitaceae. This climbing shrub is grown for its medicinal property in gardens all over India. This plant contains bitter glycosides that are miscible in aqueous but immiscible in a solvent like ether. Fresh vegetables include moisture 88.75 %, 85.41 % soluble carbohydrates, 1.51 % woody fibre, 1.62 % albuminoids and 8.53 % ash (37). Traditionally the powdered herb is used to dust over leprous and other stubborn ulcers, as well as to treat wounds. One study found that aqueous and alcoholic extracts of *M. Charantia* fruit (200 and 400 mg/kg) were effective in treating ulcers induced by different inducers like aspirin, stress and pylorus ligation demonstrated a considerable decrease in ulcer index in contrast with a control group (38).

### ***Anogeissus latifolia***

The common name of *Anogeissus latifolia* is Axlewood in English. Researchers reported that ethanolic *A. latifolia* extract (ALE) revealed remarkable

gastroprotective activity. By using ALE (100 and 200 mg/kg body weight) in rats against different ulcer models induced by aspirin, ethanol, cold restraint stress (CRS) and pylorus ligation (PL), found that ALE had a considerable gastroprotective effect in CRS rat model. In CRS-induced ulcers, ALE increasing catalase (CAT) activity and reduced lipid peroxidation (LPO), superoxide dismutase (SOD) activity. ALE (200 mg/kg) inhibit 5-lipoxygenase which was believed to be a reason behind protective action in aspirin-induced ulcer rats (39), Table 2, (40-52).

### **Mechanism of action**

According to various studies, the medicinal plant may protect against gastric ulcers through a variety of mechanisms involving antioxidant action, control of acid generation and secretion stimulation of mucosal proliferation, enhanced mucus formation and inflammatory suppression.

### **Antioxidant activity**

The connection between oxidative stress and stomach ulcer is universally acknowledged. It's conceivable that the antioxidant capabilities of several herbal remedies help with stomach ulcers. The gastrointestinal levels of malondialdehyde (MDA) were elevated in indomethacin-induced gastric ulcer models, whereas the level of superoxide dismutase (SOD) and catalase (CAT) were reduced (53). Oral dosing of rutin (200 mg/kg) reduced ulcer area and MDA levels while dramatically increasing the activities of glutathione peroxidase, mucosal SOD, CAT against lesions induced by 50% ethanol was observed (54). The results were mixed when it came to the role of NO (a reactive oxygen species). Herbs that help with stomach ulcers have been shown to enhance NO levels in gastrointestinal tissue (55), whereas herbal extracts have been shown to inhibit intracellular NO synthase and NO production (56).

### **Suppression of acid production**

Gastric ulcers can be managed by suppressing acid production (57). Gastric acid production is reduced by various medicinal plants with anti-gastric ulcer action. For instance, after three days of consuming *Ocimum sanctum* extract, total stomach acidity was lowered by more than half (58). The reduction in acid formation caused by herbal extracts could be attributable to (1) restriction of H<sup>+</sup>K<sup>+</sup>-ATPase ability, as seen in animal models of the gastric ulcer; or (2) activation of prostaglandin E2 (59).

### **Elevation of mucosal proliferation**

Ulcer healing involves the proliferation of mucosa. Various herbal remedies that help to heal ulcers work by stimulating cell proliferation. *Centella asiatica* when given orally for consecutive 3 days enhanced basic growth factor expression of fibroblast and encouraged cell proliferation and angiogenesis (60). Furthermore, a 7-day alcoholic extract of *Tabebuia avellanedae* enhanced cell proliferation in rats when administered orally in a chronic ulcer model (61). Increased level of epidermal growth factor (62) and its receptor expression (63) could be ascribed to herbal medicine's stimulation of cell proliferation.

**Table 2.** Flavonoid with antiulcer activity

Compound	Plant source and family	Ulcer inducer	Effect or mechanism	Reference
Myricetin	<i>Alchornea glandulosa</i> Euphorbiaceae	Ethanol, indomethacin	↑ PGE <sub>2</sub> , SOD	(40)
	<i>Urtica dioica</i> Urticaceae	Pylorus ligation, ethanol and indomethacin	↓ histamine-induced gastric acid secretion	(41)
Quercetin	<i>Solidago chilensis</i> Asteraceae	Ethanol	↑ GSH ↑ MPO	(42)
	<i>Citrus paradise</i> Rutaceae	Pylorus ligation, indomethacin and ethanol	↑ levels of hexosamine	(43)
Vexibinol	<i>Sophora flavescens</i> Fabaceae	Stress, pylorus ligation and ethanol	↓ gastric acid production	(44)
Kaempferol	<i>Syzygium aromaticum</i> Myrtaceae	Restraint, ethanol and pylorus ligation	↑ PGE <sub>2</sub> , SOD	(45)
Silymarin	<i>Silybum marianum</i> Asteraceae	Cold restraint stress and pylorus ligation	↓ peroxidation	(46)
Mangiferin	<i>Mangifera indica</i> Anacardiaceae	Indomethacin and ethanol	↓ 5-HT <sub>3</sub> receptors	(47)
7-hydroxycoumarin	<i>Mikania laevigata</i> Asteraceae	Stress, indomethacin and ethanol	↑ Glandular secretion	(48)
Wogonin	<i>Scutellaria baicalensis</i> <i>Georgi</i> Lamiaceae	Ethanol	↑ apoptosis in the stomach	(49)
Leucocyanidin	<i>Musa sapientum</i> Musaceae	Indomethacin	↑ secretion of mucus	(50)
Baicalein	<i>Scutellaria baicalensis</i> Lamiaceae	Ethanol	↑ SHs, NO, GSH, mucus ↓ MPO	(51)
	<i>Boesenbergia rotunda</i> Zingiberaceae	Ethanol	↓ COX <sub>2</sub>	(52)

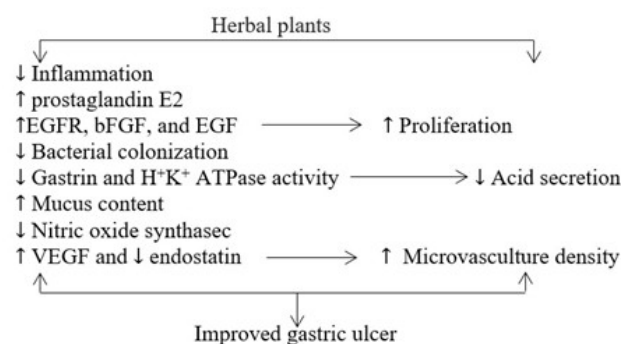
COX–Cyclooxygenase; GSH–Glutathione; MPO–Myeloperoxidase; NO–nitric oxide; PGE<sub>2</sub>–ProstaglandinE<sub>2</sub>; SHs–Sulphydryl compounds; SOD–Superoxide dismutase

### Other mechanisms

Peptic ulcers are frequently connected to *H. pylori* infection (64). The antibacterial properties of several herbal medications can be related, to their ability to treat gastrointestinal ulcers. As a result of one study, *Croton lechleri* extract was given orally for 1 week, showed notably reduction in bacterial colony-forming units by around 30% (65). Mucus, which contains mucin, acts as a protective membrane towards acid and pepsin (66, 67). Some herbal remedies work by enhancing mucus formation to treat gastric ulcers. An animal model in which gastric ulcers were induced by ethanol showed normal gastric mucus volume following 5 hrs introduction of chitosan (250 mg/kg) (68). Pepsin is implicated in the development of stomach ulcers by degrading mucus, which is relevant to mucus (69). In pyloric ligation-induced stomach ulcers, anti-gastric ulcer herbs reduced pepsin content (70). These findings suggest that medicinal plants can help people with peptic ulcers through different mechanisms Fig. 1.

### Some important Flavonoid as antiulcer agent

One of the most widely distributed polyphenolic compounds throughout the plant kingdom is flavonoid. Till today about 3000 varieties of flavonoid has been screened (71). For the maintenance of capillary integrity in mammals, flavonoids are commonly used in medicine (72). Flavonoids' gastro protective effects have been due to a variety of mechanisms, including an increase in mucosal prostaglandin content (73), suppression of *Helicobacter pylori* growth (74) and inhibition of histidine decarboxylase to reduce histamine secretion



**Fig. 1.** Schematic diagram showing mechanism responsible to cure of gastric ulcer. bFGF: Basic fibroblast growth factor; EGFR: Epidermal growth factor receptor; VEGF: Vascular endothelial growth factor.

from mast cells (75). Free radical scavengers are present in flavonoid. For ulcerative and erosive bowel disease radicals have tremendous effect (76). According to the flavylum nucleus, it is comprised of three phenolic rings (A, B, and C) having a basic 15-carbon skeleton (C6-C3-C6) (77) Fig. 2.

### Quercetin

Quercetin is an essential bioflavonoid that scientists have widely documented throughout the last 40 years. Flavonoids are widely distributed in nature has phenolic structure that can be seen in root, bark, fruits, grains, stems, bulbs, wine and tea. The most common plant source of quercetin is *Allium cepa* L. (78). It belongs to the flavanol class of flavonoids and help to obtain many other flavonoids, including citrus flavonoids such as naringenin, rutin, tangeritin and hesperidin (79). Several studies have shown that

Cyclooxygenase activity is stimulated by quercetin. As a result, local prostaglandin output enhancement may

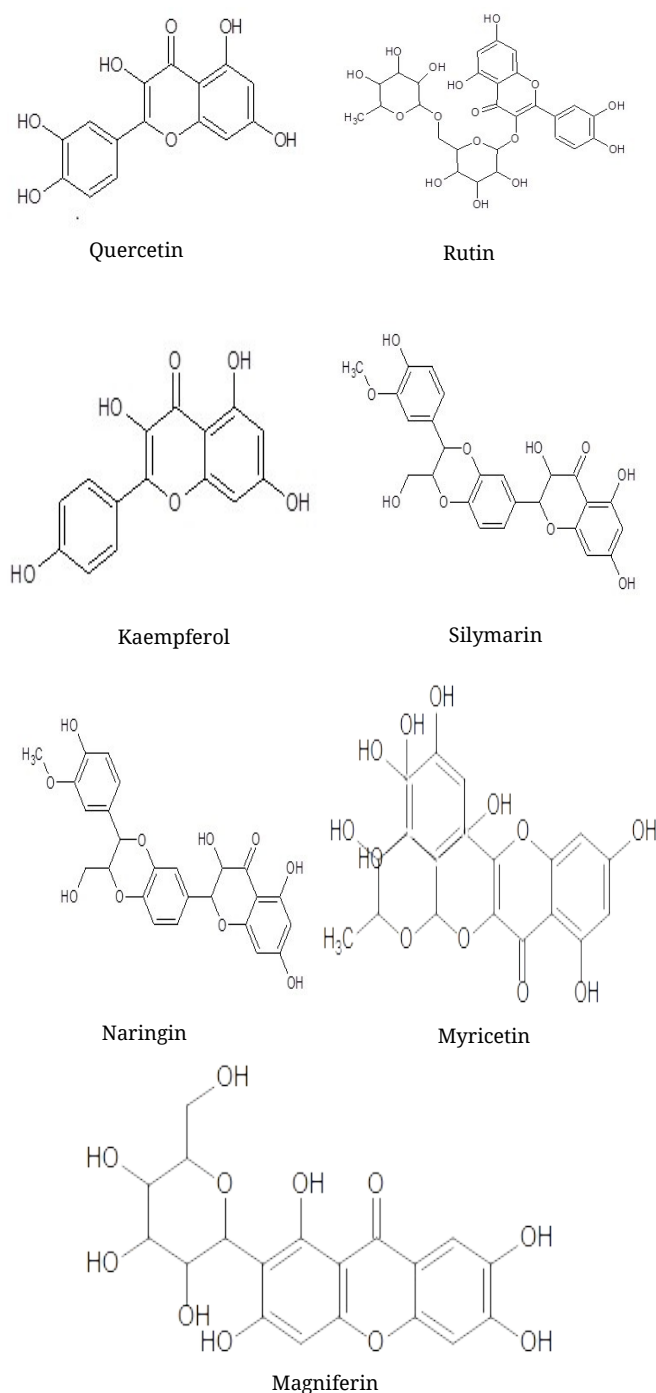


Fig. 2. Chemical constituents of Flavonoids.

be one of the protective mechanisms (80).

### Rutin

Rutin is a one the crucial flavonoid obtained from passion flower, buckwheat, tea and apple. Chemically it is known as (3,30,40,5,7-pentahydroxyflavone-3-rhamnoglucoside). It is also known as quercetin-3-Orutinoside and vitamin P. Several studies have shown that rutin has cytoprotective effects, including gastroprotective properties (81). Rutin is named after the *Ruta graveolent* L., which produces *rutin* as well. Endogenous platelet-activating factor (PAF) may be involved in this flavonoids cytoprotective impact. PAF mucosal content was inhibited dose-dependently (82).

### Kaempferol

It is a yellow compound mostly found in foods obtained from plant origin and traditional medicinal plants. Kaempferol has a low molecular weight (MW: 286.2 g/mol) with chemical name 3,5,7-trihydroxy-2-(4-hydroxyphenyl)-4H-(benzopyran-4-one). The various plant sources of kaempferol are *Bryophyllum pinnatum* L., *Aloe veera* etc. The absorption of kaempferol is done by the small intestine. Kaempferol's lipophilicity aids passive diffusion absorption, but various studies proved that active transport or facilitated diffusion may also be used to absorb kaempferol (83). The role of kaempferol for exhibiting antiulcer activity is due to its ability to reduce Platelet Aggregation Factor (PAF) formation by gastric mucosa (84).

### Silymarin

Silymarin is a distinctive flavonoid derived from the milk thistle, which contains silybin, silydianin and silicristin. It can also be found in plant source like *Silybum marianum*. Recently several studies have proved tremendous role of oxidative free radicals in gastric ulceration animal model induced by cold restraint stress. In rats, silymarin dosage was found to be successful in preventing ulcers in stomach caused by cold restraint stress (85). The role of silymarin as antiulcer activity is due to its inhibitory mechanism of enzymatic peroxidation by the lipoxygenase pathway (86).

### Naringin

Naringin are found in citrus fruits like tomato that gives them their bitter taste. It has anti-inflammatory, anticancer and anti-microbial properties, as well as metabolic syndrome, oxidative stress, bone regeneration effects (86). In rats, naringin (100 and 200 mg/kg) administered orally was tested against ulcers induced by ethanol and found to reduce gastric MDA levels, mucosal damage and gastric expression of caspase-3, IL-6 with a substantial reduction in mucosal damage (87).

### Conclusion

We can conclude from this data that studies including plant sources can result in unique and successful treatment patterns. Western medicine's ongoing stalemates in the treatment of numerous disorders are leading to a shift in study toward traditional medicine. In this regard, plant-derived medicine has developed effective treatment methods for a variety of gastrointestinal ailments. All of the medicinal plants described here have sufficient evidence of achievement in the treatment of ulcers. As earlier, it was believed that Acid production was to be a single cause of ulcer growth and lowering acid secretion was supposed to be the main therapeutic method. Yet, current findings have led to a shift in this belief. The potentiations of the defensive system, as well as the reduction of acid secretion are presently the key goals of ulcer management. Phytochemicals like flavonoid derived from various medicinal plants were utilized in rural or remote places for the treatment of peptic ulcers are far apart from the modern world. In a

conclusion, pharmacologists must invest significant time and resources in evaluating herbal remedies for antiulcer activity and standardization of such herbal therapies for them to be clinically and financially effective.

### Acknowledgements

The authors deeply acknowledge the support of management of Noida Institute of Engineering and Technology (Pharmacy Institute) Greater Noida to carry out this screening work.

### Authors' contributions

All the authors contributed equally to the works presented in paper.

### Compliance with ethical standards

**Conflict of interest:** The authors declare that they have no conflicts of interest.

**Ethical issues:** None.

### References

- Malferttheiner P, Chan FK, McColl KE. Peptic ulcer disease. The lancet. 2009;374:1449-61. [https://doi.org/10.1016/S0140-6736\(09\)60938-7](https://doi.org/10.1016/S0140-6736(09)60938-7)
- Umamaheswari M, Asokkumar K, Rathidevi R, Sivashanmugam A, Subhadradevi V, Ravi TJJoe. Antiulcer and *in vitro* antioxidant activities of *Jasminum grandiflorum* L. J. ethnopharmacol. 2007;110: 464-70. <https://doi.org/10.1016/j.jep.2006.10.017>
- R.M.N. McSween, K. Whaley, Muir's Textbook of Pathology, 13th Ed, (ELBS Arnold, London, 1992) pp. 695-96.
- Vyawahare N, Deshmukh V, Gadkari M, Kagathara V. Plants with antiulcer activity. Pharmacogn Rev. 2009;3(5):118.
- Fox M, Barr C, Nolan S, Lomer M, Anggiansah A, Wong T. The effects of dietary fat and calorie density on esophageal acid exposure and reflux symptoms. Clinical Gastroenterology and Hepatology. 2007 Apr 1;5(4):439-44. <https://doi.org/10.1016/j.cgh.2006.12.013>
- Waxman I, Gardner JD, Jensen RT, Maton PN. Peptic ulcer perforation as the presentation of Zollinger-Ellison syndrome. Digestive Diseases and Sciences. 1991 Jan 1;36(1):19-24. <https://doi.org/10.1007/BF01300081>
- Bhowmik D, Chiranjib TK, Pankaj KS. Recent trends of treatment and medication peptic ulcerative disorder. Int J Pharm Tech Research. 2010;2(1):970-80.
- Hunt RH, Tytgat Guido N J. Basic Mechanisms to Clinical Cure 1996. London (UK): Kluwer Academic publisher; 1996.
- Soll AH, Weinstein WM, Kurata J, McCarthy, DJAoim. Nonsteroidal anti-inflammatory drugs and peptic ulcer disease. Ann. Intern. Med. 1991;114:307-19. <https://doi.org/10.7326/0003-4819-114-4-307>
- De Vries AC, Kuipers EJ. Helicobacter pylori infection and nonmalignant diseases. Helicobacter. 2010; 15:29-33. <https://doi.org/10.1111/j.1523-5378.2010.00775.x>
- Calam J, Baron JH. Pathophysiology of duodenal and gastric ulcer and gastric cancer. Brit Med J. 2001;323:980-83.
- Zimmerman TW, Problems associated with medical treatment of peptic ulcer disease. The Am J Med. 1984; 77:51-56.
- Tarnawski A. Cytoprotective drugs. Drug Investig. 1990;2:1-6.
- Howden CW, Jones DB, Peace KE, Burget DW, Hunt RH. The treatment of gastric ulcer with antisecretory drugs. Dig Dis and Sci. 1988;33:619-24. <https://doi.org/10.1007/BF01798367>
- K.D. Tripathi, Essentials of Medical Pharmacology, 5th Ed, (Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2003) pp.589-95.
- Morrissey JF, Barreras RF. Drug therapy. Antacid therapy. N Engl J Med. 1974 Mar 7;290(10):550-4. <https://doi.org/10.1056/NEJM197403072901007>
- Kuna L, Jakab J, Smolic R, Raguz-Lucic N, Vcev A, Smolic M. Peptic ulcer disease: a brief review of conventional therapy and herbal treatment options. J of Clinical Med. 2019; 8:179. <https://doi.org/10.3390/jcm8020179>
- Bone K, Simon Mills MC, FNIMH M. Principle and Practice of Phytotherapy: Modern Herbal Medicine[e-book]. 2<sup>nd</sup> ed London (UK): Churching levington Elsevier; 2013;45-82.
- Borrelli F, Izzo AA. The Plant Kingdom as a Source of Anti-ulcer. Phytother Res. 2000;14:581-91. [https://doi.org/10.1002/1099-1573\(200012\)14:8<581](https://doi.org/10.1002/1099-1573(200012)14:8<581)
- Chelladurai PK, Ramalingam R. *Myristica malabarica*: A comprehensive review. J Pharmacogn Phytochem. 2017;6(2):255-58.
- Banerjee D, Maity B, Bauri AK, Bandyopadhyay SK, Chattopadhyay S. Gastroprotective properties of *Myristica malabarica* against indometacin-induced stomach ulceration: a mechanistic exploration. J Pharm Pharmacogn. 2007 Nov;59(11):1555-65. <https://doi.org/10.1211/jpp.59.11.0014>
- Nagaratna A, Hegde PL. A comprehensive review on Parnabeeja [*Bryophyllum pinnatum* (Lam.) Oken]. J Med Plants Stud. 2015;3(5):166-71.
- Radwan-Pragłowska J, Janus Ł, Piątkowski M, Sierakowska A, Galek T, Szajna E, Bogdał D, Tupaj M. Fungal Chitosan-Derived Biomaterials Modified with *Kalanchoe pinnata* as Potential Hemostatic Agents—Development and Characterization. Polymers. 2021 Jan;13(8):1300. <https://doi.org/10.3390/polym13081300>
- Kamboj A, Saluja A. *Bryophyllum pinnatum* (Lam.) Kurz.: Phytochemical and pharmacological profile: A review. Pharmacognosy Reviews. 2009 Jul 1;3(6):364. Available Online : [www.phcogrev.com](http://www.phcogrev.com)
- Dwivedi V, Tripathi S. Review study on potential activity of *Piper betle*. J Pharmacogn Phytochem. 2014;3(4):93-98.
- Bhattacharya S, Banerjee D, Bauri AK, Chattopadhyay S, Bandyopadhyay SK. Healing property of the *Piper betel* phenol, allylpyrocatechol against indomethacin-induced stomach ulceration and mechanism of action. World J Gastroenterol 2007; 13: 3705-13. <https://doi.org/10.3748/wjg.v13.i27.3705> [PMID: 17659730]
- Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of *Asparagus racemosus* (Shatavari): A review. Asian Pac J Trop Dis. 2013 Apr 1;3(3):242-51. [https://doi.org/10.1016/S2222-1808\(13\)60049-3](https://doi.org/10.1016/S2222-1808(13)60049-3)
- Bhatnagar M, Sisodia SS. Antisecretory and antiulcer activity of *Asparagus racemosus* Willd. against indomethacin plus pyloric ligation-induced gastric ulcer in rats. J Herb Pharmacother. 2006; 6:13-20. [https://doi.org/10.1080/J157v06n01\\_02](https://doi.org/10.1080/J157v06n01_02)
- Arulmozhi S, Mazumder PM, Ashok P, Narayanan LS. Pharmacological activities of *Alstonia scholaris* Linn. (Apocynaceae)-A review. Pharmacog Reviews. 2007;1(1).
- Chavan GM, Ranalkar MD, Bagul SK, Patil SG, Patil SA, Pawar SP. Evaluation of Anti-ulcer Activity of leaves of *Alstonia scholaris* [L.] R. Br. by using Pylorus Ligation Method. Journal of Seybold Report. ISSN 1533:9211.
- Mayilsamy M, Rajendran A. Ethnomedicinal plants used by paliyar tribals in Dindigul district of Tamil Nadu, India. The International Journal of Science Innovations and Discoveries. 2013;3(1):146-52.
- Shree GK, Parvathi S, Ramkumar PS, Priya SS. Pharmacological and phytochemical evaluation of anti-ulcerogenic potential of *Solanum nigrum*. Int J Pharm Sci Res. 2012 Aug 1;3(8):2837.
- K. M. Nadkarni's, Indian Materia Medica, Volume 1, pp. 9-10.

34. Helal OK, Yousef MM, Elnaa M. Possible protective effect of gum arabic on experimentally induced gastric ulcer in adult male albino rats: a histological and immunohistochemical study. *Egypt. J Histol.* 2011 Sep 1;34(3):546-50. <https://doi.org/10.1097/EHX.0000399971.18980.f6>
35. Shabbir A. *Rhus coriaria* Linn., a plant of medicinal, nutritional and industrial importance: a review. *J Anim Plant Sci.* 2012 Jan 1;22(2):505-12.
36. Ahmad H, Wadud A, Jahan N, Khazir M, Sofi G. Evaluation of anti-ulcer activity of hydro alcoholic extract of Post Sumaq (*Rhus coriaria* Linn.) in Ethanol induced Gastric ulcer in experimental rats. *Int J Res Med Sci.*2013;1(10):7-12. Available online at: [www.isca.in](http://www.isca.in), [www.isca.me](http://www.isca.me)
37. K. M. Nadkarni's, *Indian Materia Medica*, Volume 1, pp. 805–07, Popular Prakashan, Mumbai, India, 1976.
38. Rao NV, Venu K, Sowmya U, Gangadi JR, Anirudh K. Evaluation of antiulcer activity of *Momordica charantia* in rats. *Int J Pharm Biol Sci.* 2011;1(1):1-6.
39. Govindarajan R, Vijayakumar M, Singh M, Rao CV, Shirwaikar A, Rawat AK, Pushpangadan P. Antiulcer and antimicrobial activity of *Anogeissus latifolia*. *J Ethnopharmacol.* 2006 Jun 15;106(1):57-61. <https://doi.org/10.1016/j.jep.2005.12.002>
40. Hiruma-Lima CA, Calvo TR, Rodrigues CM, Andrade FD, Vilegas W, Brito AR. Antiulcerogenic activity of *Achornea castaneafolia*: effects on somatostatin, gastrin and prostaglandin. *J Ethnopharmacol.* 2006 Mar 8;104(1-2):215-24. <https://doi.org/10.1016/j.jep.2005.09.007>
41. Gorelick J, Bernstein N. Elicitation: an underutilized tool in the development of medicinal plants as a source of therapeutic secondary metabolites. *Advances in Agronomy.* 2014 Jan 1;124:201-30. <https://doi.org/10.1016/B978-0-12-800138-7.00005-X>
42. de Barros M, Da Silva LM, Boeing T, Somensi LB, Cury BJ, de Moura Burci L, Santin JR, de Andrade SF, Delle Monache F, Cechinel-Filho V. Pharmacological reports about gastroprotective effects of methanolic extract from leaves of *Solidago chilensis* (Brazilian arnica) and its components quercitrin and afzelin in rodents. *Naunyn Schmiedebergs Arch Pharmacol.* 2016 Apr 1;389(4):403-17. <https://doi.org/10.1007/s00210-015-1208-0>
43. Martin MJ, Marhuenda E, Perez-Guerrero C, Franco JM. Antiulcer effect of naringin on gastric lesions induced by ethanol in rats. *Pharmacology.* 1994;49(3):144-50. <https://doi.org/10.1159/000139228>
44. Yamahara J, Mochizuki M, Fujimura H, Takaishi Y, Yoshida M, Tomimatsu T, Tamai Y. Antiulcer action of *Sophora flavescens* root and an active constituent. *I J ethnopharmacol.* 1990 May 1;29(2):173-77. [https://doi.org/10.1016/0378-8741\(90\)90053-V](https://doi.org/10.1016/0378-8741(90)90053-V)
45. Calderon-Montan˜o JM, Burgos-Moron E, Perez-Guerrero C, Lopez-Lazaro M. 2011. A review on the dietary flavonoid kaempferol. *Mini Rev Med Chem.* 11:298-34. <https://doi.org/10.2174/138955711795305335>
46. De La Lastra CA, Martin MJ, Marhuenda E. Gastric anti-ulcer activity of silymarin, a lipoxygenase inhibitor, in rats. *J Pharm Pharmacol.* 1992 Nov;44(11):929-31. <https://doi.org/10.1111/j.2042-7158.1992.tb03239.x>
47. Carvalho AC, Guedes MM, de Souza AL, Trevisan MT, Lima AF, Santos FA, Rao VS. Gastroprotective effect of mangiferin, a xanthone from *Mangifera indica*, against gastric injury induced by ethanol and indomethacin in rodents. *Planta Medica.* 2007 Oct;73(13):1372-76. <https://doi.org/10.1055/s-2007-993751>
48. Bighetti AE, Antonio MA, Kohn LK, Rehder VL, Foglio MA, Possenti A, Vilela L, Carvalho JE. Antiulcerogenic activity of a crude hydroalcoholic extract and coumarin isolated from *Mikania laevigata* Schultz Bip. *Phytomedicine.* 2005 Jan 10;12(1-2):72-77. <https://doi.org/10.1016/j.phymed.2003.09.006>
49. da Silva MA, Oliveira AP, Sannomiya M, Sano PT, Varanda EA, Vilegas W, dos Santos LC. Flavonoids and a naphthopyranone from *Eriocaulon ligulatum* and their mutagenic activity. *Chem Pharm Bull.* 2007 Nov 1;55(11):1635-39. <https://doi.org/10.1023/B:DDAS.0000020490.34220.6d>
50. Prabha P, Karpagam T, Varalakshmi B, Packiavathy AS. Indigenous anti-ulcer activity of *Musa sapientum* on peptic ulcer. *Pharmacognosy Res.* 2011 Oct;3(4):232. <https://doi.org/10.4103/0974-8490.89742>
51. Ribeiro AR, do Nascimento Valença JD, da Silva Santos J, Boeing T, da Silva LM, de Andrade SF, Albuquerque-Júnior RL, Thomazzi SM. The effects of baicalein on gastric mucosal ulcerations in mice: Protective pathways and anti-secretory mechanisms. *Chem Biol Interact.* 2016 Dec 25;260:33-41. <https://doi.org/10.1016/j.cbi.2016.10.016>
52. Abdelwahab SI, Mohan S, Abdulla MA, Sukari MA, Abdul AB, Taha MM, Syam S, Ahmad S, Lee KH. The methanolic extract of *Boesenbergia rotunda* (L.) Mansf. and its major compound pinostrobin induces anti-ulcerogenic property *in vivo*: possible involvement of indirect antioxidant action. *J Ethnopharmacol.* 2011 Sep 2;137(2):963-70. <https://doi.org/10.1016/j.jep.2011.07.010>
53. Repetto MG, Llesuy SF. Antioxidant properties of natural compounds used in popular medicine for gastric ulcers. *Braz J Med Biol Res.* 2002 May;35(5):523-34. <https://doi.org/10.1590/S0100-879X2002000500003>
54. La Casa C, Villegas I, De La Lastra CA, Motilva V, Calero MM. Evidence for protective and antioxidant properties of rutin, a natural flavone, against ethanol induced gastric lesions. *J Ethnopharmacol.* 2000 Jul 1;71(1-2):45-53. [https://doi.org/10.1016/S0378-8741\(99\)00174-9](https://doi.org/10.1016/S0378-8741(99)00174-9)
55. Dai XP, Li JB, Liu ZQ, Ding X, Huang CH, Zhou B. Effect of Jianweiyuyang granule on gastric ulcer recurrence and expression of VEGF mRNA in the healing process of gastric ulcer in rats. *World J Gastroenterol.* 2005 Sep 21;11(35):5480. <https://doi.org/10.3748/wjg.v11.i35.5480>
56. Melese E, Asres K, Asad M, Engidawork E. Evaluation of the antipeptic ulcer activity of the leaf extract of *Plantago lanceolata* L. in rodents. *Phytother Res.* 2011 Aug;25(8):1174-80. <https://doi.org/10.1002/ptr.3411>
57. Feldman M. Suppression of acid secretion in peptic ulcer disease. *J Clin Gastroenterol.* 1995 Jan 1;20:S1-6. <https://doi.org/10.1097/00004836-199506001-00002>
58. Dharmani P, Kuchibhotla VK, Maurya R, Srivastava S, Sharma S, Palit G. Evaluation of anti-ulcerogenic and ulcer-healing properties of *Ocimum sanctum* Linn. *J Ethnopharmacol.* 2004 Aug 1;93(2-3):197-206. <https://doi.org/10.1016/j.jep.2004.02.029>
59. Wang CH, Wang YH, Zhou Y. Clinical and experimental study on effect of Chinese herbal drugs on producing prostaglandin in gastric mucosa. *Chin Jintegr Trad West Med.* 1994 Sep 1;14(9):528-30. [PMID: 7865999]
60. Cheng CL, Guo JS, Luk J, Koo MW. The healing effects of *Centella* extract and asiaticoside on acetic acid induced gastric ulcers in rats. *Life Sciences.* 2004 Mar 19;74(18):2237-49. <https://doi.org/10.1016/j.lfs.2003.09.055>
61. Pereira IT, Burci LM, da Silva LM, Baggio CH, Heller M, Mücke GA, Pizzolatti MG, Marques MC, de Paula Werner MF. Antiulcer effect of bark extract of *Tabebuia avellanae*: activation of cell proliferation in gastric mucosa during the healing process. *Phytother Res.* 2013 Jul;27(7):1067-73. <https://doi.org/10.1002/ptr.4835>
62. Xu X, Xie B, Pan S, Liu L, Wang Y, Chen C. Effects of sea buckthorn procyanidins on healing of acetic acid-induced lesions in the rat stomach. *Asia Pac J Clin Nutr.* 2007 Jan 1;16(1):234-38.
63. Tao XL, Li GC, Luo SX, Yi P. Mechanism of prescription of strengthening spleen and replenishing Qi on promoting renovation of stomach mucosa. *Chin J Integr Trad West Med.* 2005;13:387-89.
64. Malfertheiner P. The intriguing relationship of *Helicobacter pylori* infection and acid secretion in peptic ulcer disease and gastric cancer. *Dig Dis.* 2011;29(5):459-64. <https://doi.org/10.1159/000332213>
65. Miller MJ, MacNaughton WK, Zhang XJ, Thompson JH, Charbonnet RM, Bobrowski P, Lao J, Trentacosti AM, Sandoval M. Treatment of gastric ulcers and diarrhea with the Amazonian herbal medicine sangre de grado. *Am J PhysiolGastrointest Liver Physiol.* 2000 Jul 1;279(1):G192-200. <https://doi.org/10.1152/ajpgi.2000.279.1.G192>
66. Venables CW. Mucus, pepsin and peptic ulcer. *Gut.* 1986 Mar;27(3):233. <https://doi.org/10.1136/gut.27.3.233>



67. Allen A, Flemström G. Gastroduodenal mucus bicarbonate barrier: protection against acid and pepsin. *Am J Physiol Cell Physiol.* 2005 Jan;288(1):C1-9. <https://doi.org/10.1152/ajpcell.00102.2004>
68. Ito M, Ban A, Ishihara M. Anti-ulcer effects of chitin and chitosan, healthy foods, in rats. *Jpn J Pharmacol.* 2000;82(3):218-25. <https://doi.org/10.1254/jjp.82.218>
69. Allen A, Pearson JP, Blackburn A, Coan RM, Hutton DA, Mall AS. Pepsins and the mucus barrier in peptic ulcer disease. *Scand J Gastroenterol Suppl.* 1988 Jan 1;23(sup146):50-57. <https://doi.org/10.3109/00365528809099130>
70. Ge Y, Cui JC, Zhou RL, Chen YX, Sun L, Ling FM, Chen LL. Clinical and experimental study on separately decocted and mingly decocted jianweishu granule. *Chin J Integr Trad West Med.* 2002 Sep 1;8(3):199. <https://doi.org/10.1007/BF02934309>
71. Kuhnau J. Flavonoids. A class of semi-essential food components: Their role in human nutrition. *World Rev Nutr Diet.* 1976.
72. Cesarone MR, Laurora G, Ricci A, Belcaro G, Pomante P, Candiani C, Leon M, Nicolaidis AN. Acute effects of hydroxyethylrutinosides on capillary filtration in normal volunteers, patients with venous hypertension and in patients with diabetic microangiopathy (a dose comparison study). *VASA. Zeitschrift für Gefasskrankheiten.* 1992 Jan 1;21(1):76-80.
73. Attaguile G, Caruso A, Pennisi G, Savoca F. Gastroprotective effect of aqueous extract of *Cistus incanus* L. in rats. *Pharmacol Res.* 1995 Jan 1;31(1):29-32. [https://doi.org/10.1016/1043-6618\(95\)80043-3](https://doi.org/10.1016/1043-6618(95)80043-3)
74. Beil W, Birkholz C, Sewing KF. Effects of flavonoids on parietal cell acid secretion, gastric mucosal prostaglandin production and *Helicobacter pylori* growth. *Arzneimittel-Forschung.* 1995 Jun 1;45(6):697-700. PMID: 7646573
75. Amellal M, Bronner C, Briancon F, Haag M, Anton R, Landry Y. Inhibition of mast cell histamine release by flavonoids and biflavonoids. *Planta Medica.* 1985 Feb;51(01):16-20. <https://doi.org/10.1055/s-2007-969381>
76. Borrelli F, Izzo AA. The plant kingdom as a source of anti-ulcer remedies. *Phytother Res.* 2000 Dec;14(8):581-91. [https://doi.org/10.1002/1099-1573\(200012\)14](https://doi.org/10.1002/1099-1573(200012)14)
77. Kumar S, Pandey AK. Chemistry and biological activities of flavonoids: an overview. *Sci World J.* 2013 Oct;2013. <https://doi.org/10.1155/2013/162750>
78. Modaresi M, AlasvandZaravand M, Madani M. The effects of hydro-alcoholic extract of *Artemisia dracunculus* L. (Tarragon) on hematological parameters in mice. *J Basic Res Med Sci.* 2018 Jan 10;5(1):10-14. <https://doi.org/10.29252/jbrms.5.1.10>
79. Martín MJ, Motilva V. Antiulcer and gastroprotective effects of quercetin: a gross and histologic study. *Pharmacology.* 1994 Jan 1;48(1):56-62. <https://doi.org/10.1159/000139162>
80. Hosseinzadeh H, Nassiri-Asl M. Review of the protective effects of rutin on the metabolic function as an important dietary flavonoid. *J Endocrinol Invest.* 2014 Sep;37(9):783-88. <https://doi.org/10.1007/s40618-014-0096-3>
81. Tapas AR, Sakarkar DM, Kakde RB. Flavonoids as nutraceuticals: a review. *Trop J Pharm Res.* 2008;7(3):1089-99. <https://doi.org/10.4314/tjpr.v7i3.14693>
82. M Calderon-Montano J, Burgos-Morón E, Pérez-Guerrero C, López-Lázaro M. A review on the dietary flavonoid kaempferol. *Mini Reviews in Medicinal Chemistry.* 2011 Apr 1;11(4):298-344. <https://doi.org/10.2174/138955711795305335>
83. Majee C, Mazumder R, Choudhary AN. Medicinal plants with anti-ulcer and hepatoprotective activity: A review. *Int J Pharm Sci Res.* 2019 Jan 1;1:1-1.
84. Izzo AA, Carlo GD, Mascolo N, Capasso F, Autore G. Antiulcer effect of flavonoids. Role of endogenous PAF. *Phytotherapy Research.* 1994 May;8(3):179-81. <https://doi.org/10.1002/ptr.2650080313>
85. Bhia M, Motallebi M, Abadi B, Zarepour A, Pereira-Silva M, Saremnejad F, Santos AC, Zarrabi A, Melero A, Jafari SM, Shakibaei M. Naringenin nano-delivery systems and their therapeutic applications. *Pharmaceutics.* 2021Feb;13(2):291. <https://doi.org/10.3390/pharmaceutics13020291>
86. De La Lastra CA, Martín MJ, Marhuenda E. Gastric anti-ulcer activity of silymarin, a lipoxygenase inhibitor, in rats. *Journal of Pharmacy and Pharmacology.* 1992 Nov;44(11):929-31. <https://doi.org/10.1111/j.2042-7158.1992.tb03239.x>
87. Motilva V, De La Lastra CA, Martín MJ. Ulcer-protecting effects of naringenin on gastric lesions induced by ethanol in rat: Role of endogenous prostaglandins. *J Pharm Pharmacol.* 1994 Feb;46(2):91-94. <https://doi.org/10.1111/j.2042-7158.1994.tb03747.x>

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**To cite this article:** Mazumder A, Yadav B, Sharma H. Phytotherapy for Peptic-ulcer: An overview on important Indian herbal plants having flavonoid as antiulcer activity. *Plant Science Today.* 2021;8(4):1006–1014. <https://doi.org/10.14719/pst.1350>

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