

A Thorough Analysis of Herbal and Synthetic Methods for Treating Peptic Ulcers

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Abstract

Many people are afflicted with ulcers, a common gastrointestinal disorder. In essence, they are inflammatory lesions that form in the digestive tract's skin or mucous membrane lining. An imbalance between preventive and damaging factors – either from reduced mucosal defences or from increased aggressive elements – leads to ulcer development. Their development is influenced by several variables, including as stress, poor eating habits, and long-term pharmaceutical use. The word “peptic ulcers” refers to ulcers that mostly occur in the digestive system, specifically in the stomach or duodenum. Pepsin activity, the breakdown of mucosal defences, and the presence of stomach acid all affect their growth. Although there are several synthetic medications available to treat ulcers, they are frequently expensive and linked to possible negative effects, making herbal remedies a more appealing choice. Reducing discomfort, encouraging ulcer healing, and avoiding recurrence should be the main goals of the best peptic ulcer management strategy. This article examines typical medicinal plants used to treat and prevent ulcers in both modern and ayurvedic medicine. Furthermore, it emphasizes easy and natural ways to use these herbs to effectively treat ulcers.

Keywords: Peptic ulcer, medicinal plants, antiulcer activity, herbal drugs, medicinal herbs, patents

INTRODUCTION

The *Helicobacter pylori* bacterium is the main culprit behind stomach ulcers. Furthermore, it has been determined that a major contributing factor to ulcer development is the overuse of painkillers, such as aspirin and non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen and naproxen [1]. In essence, a peptic ulcer is an open sore that affects the digestive tract's mucosal lining. Ulcers are classified according to where they develop; ulcers in the stomach lining are called gastric ulcers, while ulcers in the duodenum are called duodenal ulcers. According to clinical observations, ulcer formation is frequently significantly influenced by a lack of digestive enzymes. An imbalance in the gut environment caused by this enzyme deficiency encourages the growth of *H. pylori*. It then spreads to the mucosal membrane [2].

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Peptic ulcer disease is caused by an imbalance between preventive mechanisms (such mucin, prostaglandins, bicarbonate, nitric oxide, and growth hormones) and aggressive forces (like stomach acid, pepsin, and *H. pylori*). Even though spicy meals and psychological strain were long thought to be the main causes of ulcers, additional study has shown that these factors only make the problem worse rather than directly causing it. Instead, an *H. pylori* infection has been found to be a significant contributing factor [3]. This gram-negative bacterium adapts to the acidic environment of the stomach by staying in the

space between the mucus layer and the gastric epithelium. *H. pylori* first colonizes the antral region before progressively moving to closer locations.

H. pylori first colonizes the antral region before progressively moving to the stomach's more proximal regions. A considerable number of individuals worldwide suffer from peptic ulcers, one of the most frequent gastrointestinal disorders [4]. There are two main types of drugs used to treat peptic ulcers: those that strengthen the gastro-duodenal mucosal barrier and those that neutralize stomach acid [5]. However, as recurrence is still a widespread problem, none of the therapeutic approaches that are currently available are completely effective [6]. As a result, efforts to find safer and more effective therapeutic alternatives are still ongoing (Tables 1–7).

Herbal medicines, which are derived from natural sources, have long been studied for their medicinal properties. Numerous substances derived from plants have shown notable anti-ulcer effects in recent decades [7]. To find possible herbal medicines that could be safer and more successful than traditional ulcer treatments, researchers have looked to ayurvedic scriptures [8]. New and promising approaches to treating and managing peptic ulcers are being revealed by current research on natural products (Figure 1) [9].

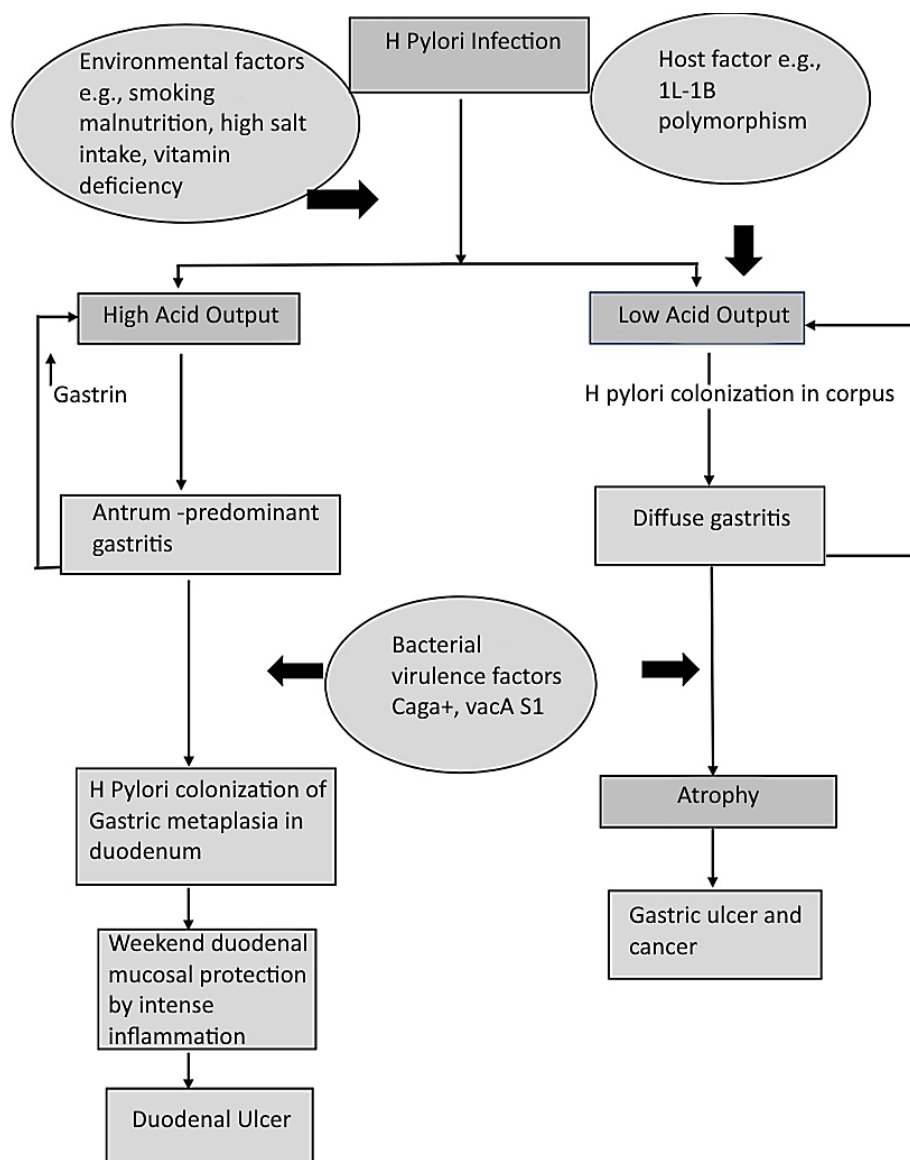


Figure 1. Mechanism of action of peptic ulcer.

Symptoms

Ulcers often cause sharp, burning pain that can vary depending on their location [10–14]. The common symptoms of peptic and duodenal ulcers include:

- Pain occurring anywhere between the belly button and the breastbone, sometimes radiating to the back [15].
- Discomfort lasting from a few minutes to several hours [16].
- Increased pain from a duodenal ulcer when the stomach is empty, which temporarily subsides after eating [17].
- Worsening of peptic ulcer symptoms at night or while lying down [18].
- Symptoms varying based on the ulcer’s location and the patient’s age [19].
- Abdominal discomfort and nausea [20].
- Waterbrash (excessive saliva production [21].
- Loss of appetite and unintended weight loss [22].
- Hematemesis (vomiting blood) [23].
- Peak acid secretion occurring between 11 PM and 2 AM [24].

Prevention

To reduce the risk of ulcers and prevent worsening symptoms, the following precautions are recommended:

- Quit smoking [15].
- Maintain a high-fiber diet [16].
- Avoid foods that trigger stomach irritation [17].
- Limit caffeine intake [18].
- Refrain from using aspirin [19].
- Avoid non-steroidal anti-inflammatory drugs (NSAIDs), including:
 1. Ibuprofen [20].
 2. Naproxen [21].
 3. Ketoprofen [22].
- Eat small, frequent meals [23].
- Exercise often to properly manage stress [24].

Diagnosis Test for Peptic Ulcer

1. *Routine*: The diagnosis of simple PUD cannot be made with routine lab testing. To find bleeding, stool hemocult, HgB, and Hct are helpful.
2. *H. pylori test*: Histology, culture, biopsy/CLO test.
3. *Urea breathe test*
4. *Serology*

Table 1. Synthetic drugs available in market for the treatment of peptic ulcer.

S. N.	Drug Class	Action Mechanism	Utilize	Adverse Effects	References
1.	Cimetidine, Ranitidine, Famotidine, Nizatidine, Roxatidine, and H2 Receptor Antagonist	By inhibiting the H2 receptor, H2 blockers lower stomach acid. These drugs are a reasonably safe therapy choice since they reduce acid secretion.	Because PPIs are better at suppressing acid, they have supplanted <i>H. pylori</i> -negative peptic ulcers.	A headache, Depression and Anxiety, Light-headedness, Heart-related incidents, Thrombocytopenia.	[4]
2.	Proton Pump Inhibitor <ul style="list-style-type: none"> • Omeprazole • Pantoprazole • Lansoprazole • Rabeprazole • Esomeprazole 	Strongest acid inhibition It works by permanently inhibiting the gastric parietal cells’ hydrogen/potassium	Aspirin or NSAID ulcer prophylaxis is a crucial part of the eradication protocol for all <i>H. pylori</i> -negative peptic	Headache, Abdominal pain, Diarrhea, Nausea, Vomiting, Constipation, Flatulence, Vitamin B12 deficiency, Osteoporosis.	[5, 6]

		adenosine triphosphate enzyme pathway.	ulcers; it is administered when traveling with bleeding ulcers.		
3.	Cytoprotective Agent • Misoprostol sucralfate	Increase mucosal resistance weak acid inhibition	<i>H. pylori</i> resistance weak acid inhibition.	Diarrhea, Abdominal pain, Headache, Constipation.	[7, 8]
4.	Anticholinergics • Pirenzepine • Propantheline	It is a class of drug that block the neurotransmitter acetylcholine in CNS and PNS Block transmission of nauseating stimuli to CTZ	Parkinsonism, Motion sickness, Bronchial asthma, Intestinal renal biliary colic.		
5.	Agents that compete for potassium: Vonoprazan	Inhibits the stomach parietal cells' H ⁺ , K ⁺ -ATPase at the last phase of the acid secretory process.	When using quadrupole treatment to eradicate <i>H. pylori</i> .	Fall-related constipation, eczema, and upper respiratory tract irritation might result in a nasopharyngitis contusion.	[9–11]
6.	Agents that neutralize acids: Antacids	By neutralizing the stomach's acid, it lessens the amount of acid that reaches the duodenum.	Lessening discomfort to lessen Piroplasm's.	Undefined frequency: Feeling queasy, throwing up Low phosphate levels, Constipation with a chalky taste, Cramping in the abdomen, Diarrhea, Unbalanced electrolytes.	[12]

Table 2. Category of herbs for peptic ulcer treatment.

Sr N.	Category of Herbs for Peptic Ulcer Treatment	Examples	Use
1.	Herbs that are soothing	Liquorice, marshmallow, cornsilk, flaxseed, Mullen, and slippery elm.	Help to soothe and coat the mucous membranes that are inflamed. These can swiftly alleviate symptoms.
2.	Herbs that are astringent	Blackberry Root and Leaf, Agrimony, Rose, White Oak, Black Tea, and Green Tea.	Able to treat wound infection. When a peptic ulcer occurs, we want to use helicobacter herbs that are particular to <i>H. pylori</i> , such garlic or goldenseal.
3.	Herbs that are vulnerable	Comfrey, Calendula, Arnica, Fenugreek, and Aloe.	Aid in the healing of wounds.
4.	Bitter plants	Mint, chamomile, mugwort, and coriander.	Encourage the production of digestive secretions [13].

Table 3. Some herbal drugs used for treatment of peptic ulcer.

Sr N.	Drug	Part of the Plant Used	Chemical Composition	Method of Use	Mechanism of Action	References
1.	Cabbage (<i>Brassica oleracea</i> Var. <i>Capitata</i>)	Cabbage	<ul style="list-style-type: none"> • Betacarotene • Lutein • DL tocopherl • Phenolics 	To extract the juice, chop two carrots and half of a raw head of cabbage into small pieces and place them in a blender. Before every meal and right before bed, take half of this juice. For several weeks, repeat	The best treatment for a stomach ulcer is cabbage, being a lactic acid food; cabbage helps to produce secretion of amino acid that stimulates blood flow to the stomach lining. This in turn helps strengthen the stomach lining and heal the ulcer. Plug cabbage	[14, 15]

				every day. Make sure you always utilize fresh juice.	contains a good amount of vitamin C which has been found to be particularly beneficial for patient with <i>H. pylori</i> infection.	
2.	Bananas (<i>Musa acuminata</i>)	Ripe Fruit	<ul style="list-style-type: none"> Banana thaumatin Banana Lectin Banana endo-β1,3-glucanase Kaempferol Saponins Tannin Sterpenes flavonoids Anthraquinones Cardiac Glycosides 	Eat at least three ripe bananas per day to treat ulcers; if you can't eat bananas, you can create banana milk shakes. As an alternative, cut two or three bananas into thin slices after peeling them. The slices should be placed in the sun to dry the dried banana pieces. Dried banana pieces should be ground into a fine powder. Add two-teaspoons of honey and mix. For approximately a week, take this mixture three times daily.	Both ripe and unripe bananas work wonders for treating stomach ulcers. Bananas have antimicrobial chemicals that prevent <i>H. pylori</i> , the bacteria that causes ulcers, from growing. By neutralizing the acidity of stomach juice, bananas also shield the system. The stomach lining is strengthened, and inflammation is lessened as a result.	[16–18]
3.	(<i>COCOS nucifera</i> L.) Coconut	A fruit	Indole-3-acetic acid, kinetin, auxin, ortho-topolin, and dihydrozeatin	Eat the delicate coconut kernel and drink a few cups of fresh, tender coconut water each day for at least a week to get the desired effect. Another option is to take a spoonful of coconut oil every morning and night for a week. This is because medium-chain fatty acids, which are readily absorbed, make up most of the coconut oil.	It gets rid of bacteria that cause ulcers. Additionally, coconut milk and water have anti-ulcer properties.	[19, 20]
4.	Liquorice (<i>Glycyrrhiza glabra</i> L.)	Root	<ul style="list-style-type: none"> Triterpene saponin Glabridin Hispaglabridin Is prenylchalcone Formononetin 	In one cup of water, combine half a teaspoon of powdered licorice root. The following morning, add one cup of cooked broken white rice to this infusion and consume it after covering it and letting it sit overnight. For a week, repeat every day to achieve a positive outcome.	Stomach ulcers can be efficiently prevented and treated with licorice. It facilitates the production of more productive mucus by the gut and stomach, which coats the stomach walls. As a result, ulcer discomfort is reduced, and the healing process is accelerated.	[21, 22]
5.	Apis honey	Unprocessed honey	C-prenylated, propolis C, abyssinoflavanone	On an empty stomach, take two teaspoons of	Hydrogen peroxide, which is produced by an enzyme	[23]

			VII, pentacyclic triterpenoids, and nypphaeol C.	raw honey every day in the morning. In addition to treating stomach ulcers, it will help clean the bowl and strengthen the stomach lining.	called glucose oxides in honey, destroys the dangerous germs that cause ulcers. Pius calms and lessens stomach lining inflammation.	
6.	<i>Allium sativum</i> L. or garlic	A vegetable	Allicin, saponins, ethyl linoleate, and the 14-kDa protein found in garlic	During the day, just consume two to three smashed garlic cloves and a glass of water. To reduce stomach inflammation and avoid stomach ulcers, do this every day.	Garlic's antibacterial and antimicrobial qualities can help control <i>Helicobacter pylori</i> levels, which are linked to stomach ulcer formation.	[24, 25]
7.	<i>Limonia acidissima</i> or wood apple	The leaves	Coumarins, lignans, phenols, methanol, acetone, and diclofenac sodium	In a copper jar, soak two to three wood apple leaves in one cup of water for the entire night. Strain the mixture and consume it on an empty stomach the next morning. For a few weeks, follow this therapy every day.	Beal, another name for wood apple leaves, is also a very effective therapy for stomach ulcers. The leaves' tannins aid in shielding the stomach's agents from harm caused by stomach acid. Because of its mucilage content, Jiu's released from wood apple fruit also helps to alleviate pain and inflammation.	[26, 27]
8.	TULSI (<i>Osmium sanctum</i> Linn)	Leaves	<ul style="list-style-type: none"> • Carvacrol • Eugenol • Oleanolic • Ursolic • Rosmarinic • Linalool 	Chew tulsi leaves and wash your mouth with rinse water twice a day for pain relief of mouth ulcer.	The fixed oil significantly possessed antiulcer activity due to its lipoxigenase inhibitory, histamine antagonist and antisecretory effect.	[28]
9.	Cayenne pepper (an annual capsicum)	Powdered cayenne pepper	Vitamin C; capsaicin	For the first two to three days, mix one-eighth teaspoon of cayenne pepper with a glass of cold water and drink it twice daily.	The component capsaicin, which is found in cayenne pepper, prevents and cures ulcers by inhibiting the secretion of stomach acid, inhibiting the creation of alkali, and stimulating mucosal secretion and gastric mucosal blood flow.	[29]
10.	Peepal tree (<i>Ficus religiosa</i>)	Stem bark	<ul style="list-style-type: none"> • Bergapten • Lanosterol • Lupeol • Lupeol acetate • Alpha amyirin acetate 	It was only done only in animals which contain Ethanolic extract of bark (200 and 400 mg/kg of body weight) showed antiulcer effects in male albino wistar rats.	Volume of gastric juice and free acidity were reduced.	[30, 31]
11	Aloe vera (<i>Aloe barbadensis</i>)	Leaves	<ul style="list-style-type: none"> • Barbaloin • Isobarbaloin • Saponins 	Take one branch of the aloe vera plant and wash it well. Then cut it take jelly like substance out from the leave and wash it then take jelly like substance and mix it with butter milk.	Aloe vera has ulcer-healing property comparable to omeprazole a common ulcer medication. It reduces the amount of stomach acid produced from suffering with ulcer.	[32, 33]

12.	Carica papaya or papaya	The whole fruit and the seed	<ul style="list-style-type: none"> Papain Chymopapain 	Consume half a glass of the pawpaw water each morning, afternoon, and night. It will mend the inside wound that is causing the discomfort.	Papaya's cytoprotective action is what gives it its anti-ulcerogenic properties, and a methanolic extract of the plant's seed has gastroprotective and ulcer-healing properties.	[34, 35]
13.	Rhinax		Withania Somniferous (Roots), Asparagus Racemases (Roots), Mucuna Prurience (Roots), Phyllanthus Emblica (Fruits), Terminalia Ache bulla (Fruits), Myristica Fragrance (Seed), Glycyrrhiza (Roots)	Oral dose of 25–100 mg twice a day.	Exhibited hepatoprotective function.	[36]
14.	Cauvery 100		Curran Carvic (Fruits), Emblica Officinalis (Fruits), Withania Osmonifera (Roots), Glycyrrhiza Giabra (Roots), Unimum Cynimum (Roots), Trema Orientalis (Roots),	Oral dose taken once a day and shows effect in 48 hrs.	Used to treat indomethacin induced ulcers in rats. The level of hexosamine and sialic acid showed marked increase in ulcer on treating with Cauvery 100 for 15 days the hexosamine and sialic acid level were brought back to normal.	[37]
15.	Satavari Mandhur		Asparagus Racemases and other constituents	Sm, 125–500 mg/kg given orally, twice daily for three, five and seven days.	It is a Herbo-mineral preparation containing Asparagus racemases. Used for the treatment of digestion problems.	[38]

Some Herbal Plants and Their Therapeutic Uses (Tables 2 & 3)

- Brassica oleracea var. capitata, or Cabbage***

Cabbage is mostly found in the northern extratropical region of the earth and belongs to the Brassicaceae family. It was once grown wild over Europe's Atlantic and Mediterranean shores. The leaves of these headless plants were probably consumed by the Stone Age population. The domestication of cabbage coincided with the development of human culture and civilization in ancient Egypt and the Roman Empire [39, 40].

- Action mechanism:** Since cabbage contains lactic acid, it aids in the production of amino acid secretion, which increases blood flow to the stomach lining, fortifies it, and heals ulcers. Cabbages are the greatest treatment for stomach ulcers because they are high in vitamin C, which has been shown to be particularly beneficial for individuals with *H. pylori* infections [14].
 - Therapeutic Application:**
 - Cabbage is used to treat intestinal and stomach ulcers, excessive stomach acid, and Roemheld syndrome, a disorder affecting the stomach.
 - Cabbage is also used to alleviate morning sickness and asthma. Additionally, it is used to prevent cancer of the breast, colon, stomach, lung, and other cancers, as well as osteoporosis, or weak bones.
 - To reduce discomfort and swelling in their breasts, nursing mothers occasionally apply cabbage leaves and extracts to their breasts.

- One plant that is frequently consumed as a vegetable is cabbage. The leaves are sometimes used as medication.
- ***Musa acuminata, or Bananas***

The banana species *Musa acuminata* is indigenous to Southern Asia, which includes the Indian Subcontinent and Southeast Asia. Although some are hybrids with *Musa balbisiana*, this species is the source of many of the edible bananas grown today. The Italian botanist Luigi Aloysius Colla first described *Musa acuminata* in his work *Memorie della Reale Accademia delle Scienze di Torino* (1820) [41].

 - *The mechanism of operation:* *Musa acuminata* stimulates the formation of the gastrointestinal mucosa by raising mucosal proteins including hexosamine and sialic acid, which in turn boost mucus production and stop ulcer erosion. These noticeably elevated amounts of sialic acid and hexosamine were associated with the increased bulk of mucosa in the stomach of animals given bananas. By encouraging the growth of mucosal cells, the banana's mechanism of action seems to differ from that of traditional anti-ulcerogenic medications. This would enable damaged areas to be promptly sealed with a secretory layer of mucus and prevent additional erosions brought on by gastric HCl and pepsin [42].
 - *Therapeutic use:* Bananas are a very nutrient-dense fruit, but do they have any therapeutic uses in addition to their nutritional value? Perdue University asserts boldly that every portion of the banana plant has medical qualities, which may surprise those of us used to using bananas for baking and banana splits and little more. Among the listed properties are
 - *Flowers:* Used to heal diarrhea, ulcers, and bronchitis. Cooked, flowers are considered a nutritious diet for diabetics.
 - *The Sap:* Banana sap has astringent properties chemically. Numerous conditions, including leprosy, hysteria, fever, digestive issues, bleeding, epilepsy, hemorrhoids, and insect stings, are treated with the sap in traditional medicine.
 - *Seeds and Roots:* Address gastrointestinal issues.
 - *Pulp and Peel:* Demonstrated by science to have both antibiotic and antifungal ingredients. The neurotransmitters dopamine, serotonin, and norepinephrine have also been found to be present in these structures.
- ***Cocos nucifera L., or Coconut***

In male Wistar albino rats, the antiulcerogenic properties of a coconut milk crude extract, coconut oil, and a coconut water dispersion were examined in warm water. Using conventional methods, indomethacin (40 mg/kg) was administered subcutaneously to the male rats to cause ulcers. The cytoprotection provided by test compounds was measured using the ulcer inhibition rate (UIR). Compared to coconut water (39%), coconut milk (2 ml daily oral feeding) resulted in a greater percentage (54%) decrease in the mean ulcer area. Coconut milk had a comparable impact to sucralfate, which in this trial decreased the mean ulcer area by 56%. One common cytoprotective agent is sucralfate. According to the findings, the ulcerated stomach mucosa was protected by coconut milk and water when seen under a microscope. It was determined that coconut milk protected rats against indomethacin-induced ulceration more effectively than coconut water did [43].

 - *Mechanism Action:* Coconut oil may have antioxidant qualities that help regulate prostaglandin production, guard against damage from reactive oxygen species, and cure ulcers [44].
 - *Therapeutic Use:* Its fruit components, such as the coconut kernel and soft coconut water, have a variety of therapeutic uses, including antimicrobial, antifungal, antiviral, antiparasitic, and antioxidant.
- ***Glycyrrhiza glabra L., or licorice***

Native to Western Asia and the Mediterranean, licorice (*Glycyrrhiza glabra* L.) is a plant. The roots of the licorice plant have been used as medicine for thousands of years. Chinese medicine has

historically utilized licorice root to treat gastrointestinal disorders, infections, malaria, and insomnia.

- **Mechanism action:** *Triterpenoid saponins* (4–20%), mostly glycyrrhizin, a combination of potassium and calcium salts of glycyrrhizic acid, are found in licorice root. It makes the stomach produce more mucus, which calms the lining of the stomach. Additionally, it improves the stomach's blood flow, which aids in healing.
- **Therapeutic use:** *Glabra* extracts have been shown to possess lot of medicinal properties like
 - Antitussive.
 - Antimicrobial.
 - Antioxidant.
 - Anti-Inflammatory.
 - Antiulcer.
 - Anticancer [21].
- **Honey (*Apis*)**

One naturally occurring non-plant food is honey. When honey and fenugreek seeds were given orally to rats in an ethanol-induced ulcer model, the amount of stomach acid was dramatically decreased. Through antisecretory, antioxidant, and cellular defence mechanisms, honey and turmeric were found to exhibit anti-ulcer efficacy in rats [45].

 - **The mechanism of operation:** The gastrointestinal tract was protected by honey polyphenols. Honey showed anti-ulcer properties.
 - **Therapeutic Use:**
 - A good source of antioxidants.
 - Raw honey nutrition.
 - Antibacterial and antifungal properties.
 - Heals wounds.
 - Phytonutrient powerhouse.
 - Help for digestive issues.
 - Soothe a sore throat and cough.
 - Brain benefits.
- **Garlic (*Allium sativum* L.)**

Allium sativum L., often referred to as “garlic” and locally termed “vellapundu,” is a member of the Liliaceae family. It is grown throughout India. This plant's chemical components include sugar, mucilage, albumen, starch, and an acrid volatile oil that serves as its active ingredient. Aromatic oil is produced from seeds [48]. In addition to significant nutritious and complementing elements containing vitamins, the juice, and especially its oil constituents, are rich in organically bound sulfur, iodine, and salicylic acid combinations [47].

 - **Mechanism of Action:** Rats were given oral dosages of 250 and 500 mg/kg of *A. sativum* bulb juice to prevent stomach ulcers caused by cysteamine. The extract stops rats from developing experimentally produced duodenal and stomach ulcers and dramatically speeds up the healing of gastric ulcers [48].
 - **Therapeutic Use:** In terms of therapeutic applications, garlic soup helps prevent colds and the flu, cures hypertension, strengthens the immune system, lowers cholesterol, prevents heart disease, is good for your eyes, is high in antioxidants, and helps prevent cancer.
- **Wood Apple (*Limonia acidissima*)**

The fruit of the wood apple, *Limonia acidissima*, is edible and utilized in a relatively small number of culinary recipes. In addition to being used as a traditional medicine to treat a variety of illnesses, this fruit and other portions of the *L. acidissima* plant are said to have anti-hyperglycemic and anti-hyperlipidemic properties. Beal, another name for wood apple leaves, is also a very effective

therapy for stomach ulcers. The leave's tannins aid in shielding the stomach's agents from harm caused by stomach acid. Because wood apple fruit contains mucilage, its juices also aid in reducing pain and inflammation [49].

- *Mechanism of Action:* Phenolic and tannin compounds can be found in wood apples. Because of their strong antioxidant qualities, these substances can help prevent piles and ulcers. Numerous studies have been conducted on the fruit pulp's active ingredients to support the traditional usage of herbal remedies [50].
- *Therapeutic Use:* In India, the fruit is widely used as a liver and heart tonic. When it is not mature, it may be used as an astringent to stop diarrhea and dysentery and is a useful cure for gum disease, hiccups, and sore throats.

- ***Ocimum Sanctum Linn., Or Tulsi***

The Lamiaceae plant *Ocimum sanctum* is often referred to as "holy basil." "Tulsi" is the local term for it. It spreads over India. Tulsi's name translates to "the incomparable one." In the Indian subcontinent, it is considered a sacred herb by Hindus. This plant contains alkaloids, flavonoids, saponins, tannins, and sterols as chemical components [16].

- *Mechanism of Action:* Rats with ulcers caused by aspirin, indomethacin, alcohol, and stress-induced ulceration were given intraperitoneal injections of *O. sanctum* fixed oil in dosages of 1, 2, and 3 ml/kg. In a dose-dependent way, it lowers the ulcer index [51].
- *Therapeutic Application:* Fever and heart problems can also be treated with tulsi. Respiratory issues can also be treated with tulsi. Tulsi is used to treat kidney stones, headaches, sore throats, fevers, and the common cold. Tulsi aids in the treatment of asthma. Oral health and anti-inflammatory properties.
 - Digestive tract.
 - Diabetes.

- ***Cayenne Pepper or Capsicum annum***

In addition to sending digestive enzymes to the stomach to aid in digestion, pepper may help boost the synthesis of digestive fluid and provide the stomach additional defence against infections. Capsaicin may lower high blood pressure, which lowers the risk of heart disease, according to research on animals [29].

- *Mechanism of Action:* Cayenne pepper's capsaicin component prevents and cures ulcers by inhibiting the production of stomach acids and promoting mucus secretions and gastric mucosal blood flow [40].
- *Therapeutic Use:* A typical remedy for nerve pain and other unpleasant ailments is capsicum. It is also used for a wide range of other illnesses, such as heart and blood vessel disorders, digestive issues, and many more, however many of them have no solid scientific support.

- ***The Peepal (Ficus Religiosa) Tree***

A popular name for *Ficus religiosa* (Urticaceae) is "sacred fig." Locals refer to it as "arashamaram." Hindus grow this sacred peepul, a huge, spherical, natural tree, all throughout India. This plant's chemical components include tannin-containing bark, caoutchouc (cochtone), and wax [52].

- *Mechanism of Action:* Volume of gastric juice and free acidity were reduced [31].
- *Therapeutic Use:* The leaves of peepal trees have long been used to treat conditions like jaundice, fever, constipation, diabetes, nose bleeding, and heart problems.

- ***Aloe Vera***

Aloe vera, which resembles a cactus and grows in arid locations, has been used for thousands of years. It contains vitamins, amino acids, saponins, enzymes, anthraquinones, flavonoids, and gallic acid [53].

- *Mechanism of Action:* The anti-ulcer activity of leaf gel extract of Aloe was shown in indomethacin-induced ulcer model with the doses of 50, 100, and 150 mg/kg by mucus-

secreting mechanism. As a result, Aloe vera reduced gastric secretion, total acid output, and ulcerative index and increased mucus production [56].

- *Therapeutic Use:*
 - Used to improve skin integrity.
 - Anti-inflammatory.
 - Skin protection.
 - Antiseptic.

- **Papaya Caricature**
 The Carica papaya, sometimes called “papaya,” is a member of the Caricaceae family. Locals refer to it as “papali-pazham.” It may be seen growing in many subtropical areas and all tropical nations. Papain, chymopapain, pectin, carposide, carpaine, carotenoids, and antheraxanthin are among the chemical components of this plant [55].
 - *The Method of Action:* The seed extract in water of C. papaya was administered at the doses of 50 and 100 mg/kg orally, in rats against ethanol induced gastric ulcer. The extract protected the gastric mucosa against ethanol effect. C. papaya extract significantly reduced the gastric juice volume and gastric acidity [56, 57].
 - *Therapeutic Use:* It has strong medicinal properties, such as antibacterial, antiviral, antitumor, and anti-inflammatory.

Table 4. Mucoadhesive formulation as anti-ulcer agent.

S. N.	Extract/Compound	Particle Size	Zeta Potential	Entrance Efficiency	Reference
1.	Thiolate polyacrylic acid	25.2 ± 1.87nm	-26.68mV	67.20%	[58]
2.	Carbopol-934P	109 nm	-318mV	50%-80%	[59]
3.	Ranitidine/alginate	815.5 to 901.3nm	3.02 ± 0.18mV	97.62 ± 0.42 to 98.16 ± 0.45	[60]

Table 5. Noisome formulation as anti-ulcer agent.

S. N	Extract/Compound	Particle Size	Zeta Potential	Entrance Efficiency	Reference
1.	OLM-NIO	159.3 ± 6.8nm	-35.3 ± 1.2 mV	93 ± 2%	[61]
2.	Ondansetron HCL	1067,55 ± 175 nm	-58.05mv	76.13 ± 1.2%	[62]

Table 6. Phytosomes as an antiulcer agent.

S. N.	Natural Sources	Phytoconstituents Complexed	Phytosomal Products	Dose and Dosage Form	Mechanism of Action	Utilization	References
1.	<i>Silybium maranium</i> (Milk Thistle)	Silybin, Silycristin, Isosilbin, silydianin.	Silybin Phytosome (Siliphos)	120-200 mg Emulsion, gel, lotion and cream	Prevents the destruction of glutathione in liver.	Hepatoprotective, hepatitis, cirrhosis and inflammation.	[63]
2.	<i>Panax ginseng</i> (Ginseng)	Ginsenosides	Ginseng Phytosome	150 mg	Increases catalase, superoxide dismutase, glutathione peroxidase and glutathione reductase activities and prevent depletion	Nutraceutical, Immunomodulator.	[63]

					of these antioxidant enzymes.		
3.	<i>Ginkgo biloba</i> , or the dominant hair tree	Bilobalide, ginkgo flavonoids, ginkgoic acids of ginkgo flavoglucoisides, and ginkgolides	Phytosome select Ginkgo pick of Terpene of ginkgo biloba The phytosome Dimeric flavonoids from ginkgo biloba The phytosome	Shampoo, conditioner, solution, and emulsion (120 mg). Gel, emulsion massage oils, 20–25 mg 1.5%. 100–200 mg	Inhibits MAO and catechol-O-methyl transferase and increases the release of neurotransmitters, such as catecholamines. Capillary and arteriole dilatation enhances the skin's ability to absorb nutrients. Ginkgolides prevent platelet activating factor from attaching to its receptor on the platelet membrane. Ginkgo flavanoids enhance capillary blood flow and lipolysis in fat cells via inhibiting the cAMP phosphodiesterase enzyme.	Anti-aging, anti-asthmatic, anti-amnestic, antidepressant, cardioprotective, dermatitis, calming, anti-inflammatory, and cognitive enhancer Raynaud's illness.	[64]
4.	<i>Vitis vinifera</i> (Grapes)	Resveratrol, quercetin, catechin, procyanidins, epicatechin.	Biovin and leucoselect Phytosome™ Masquillier's Phytosome™	50–100 mg	Protects endothelial cells from peroxynitrite induced damage and increased the endothelium-dependent NO release. Reduce the oxidant level and increases antioxidant level and enhance the resistance of LDLs and as a result causes oxidative modification.	Cardioprotective, systemic antioxidant, nutraceutical.	[64]
5.	<i>Camellia sinensis</i> (Tea)	Epigallocatechin, catechin, epicatechin-3-O-gallate, Epigallocatechin-3-O-gallate.	Green tea Phytosome	400 mg	Inhibits urokinase enzyme which is responsible for increase in tumour size. Enhances the antioxidant.	Nutraceutical, Anticancer, Antioxidant, Hepatoprotective, Atherosclerosis, Antidiabetic, Anti-inflammatory.	[65–66]

Table 7. Patents an antiulcer formulation.

S. N.	Class of Drug	Patent No.	Patent Filed	Date of Patent	Assigner	Inventors	Type	Reference
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1.	4,5,6,7 Tetrahydroimidazole [4-5-c] pyridine compound	9493457	April 13, 2015	Nov. 15, 2016	Proximagen limited	Edward Savoury, Michael Higginbottom, Kathryn Oliver, Viet Anne re Organ	Grant	[67]
2.	Hypochlorous	863283	Dec 21,2007	Jan 21, 2014	Puricore Inc.	Joe B, Seldom	Grant	[68]
3.	Carbonyl amino	8455549	Aug. 21,2007	June 4, 2013	Aniona aps.	Lars Siim Madsen Pale Christopherson	Grant	[69]
4.	1–3 Glucans	8912165	July 2, 2013	Dec. 16, 2014	Biotech pharmakon ASA	Rolf Engstad, Rolf Sejelid	Grant	[70]
5.	Hydroxy omeprazole	6294586	Oct.30, 2000	Sep. 25 ,2001	Sepracor inc.	William E. Yelle, Dean A. Handley	Grant	[71]
6.	Antiulcer agent	8372429	Dec. 4, 2008	Feb, 2013	Kyowa Chemical Industry Co., Ltd.	Keiko Katsuki, Akira Okada	Grant	[72]
7.	Gastric Antacid Hydrotalcite	8216608	Dec 14,2007	July 10, 2012	Kyowa Chemical Industry Co., Ltd	Keiko Katsuki, Akira Okada	Grant [69]	[76]

CONCLUSIONS

This study shows that research using plant sources can lead to new and efficient treatment patterns. Traditional medicine is becoming more popular because of contemporary medicine's current dead ends in treating a variety of illnesses. Regarding this, conventional medicine has established effective treatment methods for a range of gastrointestinal conditions. The effectiveness of each of the treatments offered here in treating ulcers was sufficiently supported by traditional or scientific sources. The previous theory held that the only factor contributing to ulcer development was acid secretion, and the main therapeutic strategy was to reduce acid production. However, this idea has evolved in light of new information. These days, the major goals of ulcer treatment are to reduce acid secretion and strengthen the defences. Since the beginning of medicine, chemicals made from plants have been employed to cure human illnesses. Natural products account for around half of the novel chemical entities that have been created in the last 20 years. Natural products are now again of interest in medication development due to recent technical advancements. As a result, efforts ought to focus on identifying and characterizing the active principles as well as clarifying the connection between structure and activity. In vivo tests on animal models have shown that several medicinal plants and their extracts – which include active chemical elements including flavonoids and tannins – had strong antiulcer properties. Additionally, thorough examination of natural medications' active ingredients ought to focus on clinical.

The Significance

Some active ingredients extracted from herbal medications have a preventive effect against ulcers. Therefore, to separate, describe, and standardize the active ingredients from herbal sources for antiulcer action, ayurveda expertise backed by contemporary science is required. Better medications with fewer adverse effects can be created by combining traditional and contemporary knowledge to treat peptic ulcers. Although the experimental assessment of herbal medications for the treatment of stomach ulcers is rather outstanding, only a small number of them have advanced to clinical trials and are already on the market. Demonstrates that time, labor, and resources are not being used effectively since the benefits of medical research are not reaching the intended audience. Pharmacologists must, therefore, be more involved in evaluating herbal medications for possible antiulcer action and standardizing them to make them clinically efficacious and competitive on a worldwide scale. Additionally, we concluded that the

above-mentioned plants are effective in preventing or treating peptic ulcers, which can be brought on by several substances, including alcohol, aspirin, indomethacin, and *H. pylori*. These plants can be used as an alternate source of ulcer treatment because they have been shown to have anti-ulcer activity both in vitro and in vivo. Nowadays, reducing acid secretion and strengthening the defences are the primary goals of ulcer therapy. Many medicinal plants have strong antiulcer properties, as do their extracts, which include active chemical elements like flavonoids and tannins. Drugs made from plants are better than those made from allopathic sources. It's inexpensive, effective, readily available, and has few adverse effects. We have written about polymers, mucoadhesives, niosomes, phytosomes, and the exosomal research of cagA. We have also written about the patents that have been filed for antiulcer formulations.

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