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Herbal Remedies for Peptic Ulcer Disease

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Abstract**—***Peptic ulcer disease (PUD), primarily caused by Helicobacter pylori infection and long-term NSAID use, results from an imbalance between aggressive and protective factors in the gastric mucosa. While conventional treatments—such as proton pump inhibitors, H2-receptor antagonists, and antibiotics—are effective, they often lead to side effects and antibiotic resistance. This has prompted growing interest in herbal therapies due to their anti-inflammatory, antioxidant, mucosal-protective, and antimicrobial properties. This review explores various herbs, including aloe vera, liquorice, ginger, turmeric, and chamomile, which have shown promise in preclinical and clinical studies for managing PUD. Although traditional use and preliminary studies support their efficacy, standardized clinical trials are required to establish optimal dosages, safety, and mechanisms. The integration of herbal medicine into modern treatment regimens, supported by advanced formulation technologies and regulatory frameworks, may enhance therapeutic outcomes and patient compliance.*

Keywords**—** *Peptic ulcer, Helicobacter pylori, herbal medicine, mucosal protection.*

I. INTRODUCTION

The pathophysiology of peptic ulcer disease involves the disruption of the balance between aggressive factors (e.g. gastric acid, pepsin, and H. Pylori infection) and protective factors (such as mucus secretion, bicarbonate, and prostaglandins) [1]. Helicobacter pylori, a gram-negative bacterium, is one of the primary contributors to ulcer formation, accounting for nearly 70-90% of cases [2]. The bacterium produces urease, which neutralizes stomach acid, allowing it to colonize the gastric mucosa. This triggers an inflammatory response, leading to mucosal damage and ulcer formation. Furthermore, long-term use of NSAIDs impairs the prostaglandin synthesis, which decreases mucosal protection and increases the risk of ulcer development [3].

The conventional treatment strategies for peptic ulcers involve the use of proton pump inhibitors (PPIs), H2-receptor antagonists, and eradication therapy for H. Pylori infection [4]. PPIs reduce gastric acid secretion, promoting ulcer healing. H2-antagonists block the histamine receptors in the stomach, decreasing acid production. Antibiotic therapy, such as the combination of amoxicillin, clarithromycin, and metronidazole, is used to eradicate H. Pylori [5]. Although effective, these treatments often come with side effects such as nausea, diarrhoea, and, in some cases, antibiotic resistance [6].

Given the limitations of conventional therapies, particularly in preventing recurrence and managing side effects, there has been a growing interest in exploring herbal and sub-herbal remedies as adjunct treatments for peptic ulcers. These remedies offer a promising alternative, especially due to their natural origins, fewer side effects, and relatively lower cost [7].

II. PATHOPHYSIOLOGY OF PEPTIC ULCER

Helicobacter pylori: contributes significantly to peptic ulcer formation by colonizing the gastric mucosa through urease production, triggering inflammation and mucosal damage. It is linked to 70–90% of peptic ulcer cases [8].

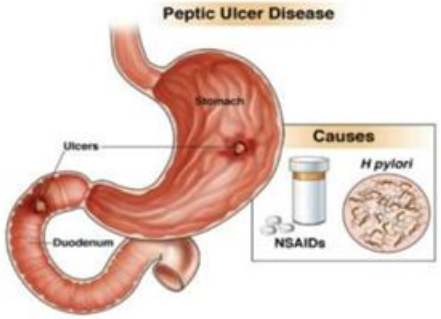

Figure 1. Shows peptic ulcer and it's causes

NSAIDs contribute to peptic ulcer development by inhibiting COX-1 enzymes, reducing protective prostaglandins, mucus, and bicarbonate, thereby increasing vulnerability of the gastric lining to acid and pepsin, especially with long-term use [9]. Peptic ulcers form when excessive gastric acid or impaired mucosal defences—due to H. Pylori infection or NSAID use—overwhelm protective mechanisms like mucus and bicarbonate secretion, leading to mucosal injury [10] Oxidative stress plays a key role in ulcer formation, with reactive oxygen species (ROS) from H. Pylori infection and NSAID metabolism damaging gastric mucosal cells, promoting inflammation and ulceration through cellular damage and the release of inflammatory mediators [11].

The gastric mucosa defends against acid and pepsin through mucus secretion, bicarbonate production, and tight junctions between epithelial cells, with prostaglandins playing a key role in enhancing these mechanisms. NSAIDs inhibit COX enzymes, reducing mucosal protection and increasing ulcer risk [12].

Peptic ulcer development is influenced by genetic factors, such as cytokine production variations and family history, which affect susceptibility to H. Pylori infection. Environmental factors like smoking, alcohol, and stress exacerbate ulcer formation by increasing acid secretion,

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impairing healing, and damaging the mucosal lining [13]. Inflammation is key in peptic ulcer development, with H. Pylori infection activating immune cells and releasing cytokines and ROS, damaging the mucosal lining. NSAIDs exacerbate inflammation by inhibiting COX enzymes, impairing mucosal defence and increasing gastric permeability, leading to further damage [14].

Peptic ulcers can cause severe complications if left untreated, including bleeding from eroded blood vessels, perforation of the gastric wall leading to peritonitis, gastric outlet obstruction from scar tissue, and an increased risk of gastric cancer due to chronic Helicobacter pylori infection. Early diagnosis and prompt treatment are essential to avoid these outcomes [15].

III. Herbal remedies for Peptic Ulcer:

Herbal remedies can be broadly categorized based on their mechanisms of action. Some herbs work by reducing gastric acid secretion, while others enhance mucosal protection, reduce inflammation, or exert antimicrobial effects. Below are several herbal remedies with promising potential in the treatment of peptic ulcers.

A. Aloe Vera (Aloe barbadensis miller)

Aloe vera is widely known for its anti-inflammatory and wound-healing properties, making it a popular remedy for peptic ulcers. The plant contains compounds such as anthraquinones, lectins, and polysaccharides that contribute to its ulcer-healing effects [16]. Studies have shown that aloe vera gel promotes ulcer healing by stimulating the production of mucus and bicarbonate, which help protect the gastric mucosa [17].

Additionally, aloe vera has shown antimicrobial effects against H. Pylori, further supporting its potential as a treatment for ulcers associated with bacterial infection [18].

Pharmacological Action:

Anti-inflammatory: Reduces the production of pro-inflammatory cytokines, thus protecting the mucosal lining.

Antimicrobial: Exhibits activity against H. Pylori, which is one of the primary causes of peptic ulcers.

Mucosal Protection: Enhances the secretion of mucus, thereby reducing gastric acid's harmful effects on the mucosa.

Clinical Evidence: A study conducted by Singh et al. (2019) reported that aloe vera gel significantly accelerated the healing of duodenal ulcers in animal models [19]. Similarly, clinical trials involving human subjects have shown that aloe vera supplementation can reduce the severity of ulcer symptoms and promote mucosal healing [20].

B. Liquorice (Glycyrrhiza glabra)

Liquorice root has been used in traditional medicine for centuries to treat gastrointestinal disorders, including ulcers. The active compound in liquorice, glycyrrhizin, is believed to have anti-inflammatory, ulcer-healing, and antimicrobial effects [21]. liquorice has been shown to protect the gastric mucosa by increasing the production of prostaglandins, which help maintain mucosal integrity and reduce gastric acid secretion [22].

Pharmacological Action:

Anti-inflammatory: Reduces inflammation and oxidative stress in the gastric mucosa.

Mucosal Protection: Increases mucus secretion, enhancing the stomach's defence mechanisms.

Antimicrobial: Inhibits H. Pylori growth, thus preventing bacterial-induced ulcers.

Clinical Evidence: Clinical studies have demonstrated that liquorice extract, particularly deglycyrrhizinated liquorice (DGL), can effectively treat peptic ulcers. In a study by Zhang et al. (2020), DGL supplementation was shown to significantly reduce ulcer symptoms and accelerate healing in patients with gastric ulcers [23].

C. Ginger (Zingiber officinale)

Ginger is another widely used herb for digestive issues, including peptic ulcers. It has long been valued for its ability to relieve nausea, promote digestion, and reduce inflammation. Ginger includes bioactive components like gingerols and shogaols, which have antibacterial, anti-inflammatory, and antioxidant effects. These compounds have been shown to play a role in preventing and treating peptic ulcers by reducing gastric acid secretion and enhancing mucosal protection [24].

Pharmacological Action:

Anti-inflammatory: Inhibits the production of inflammatory cytokines and mediators, reducing mucosal damage.

Antioxidant: Scavenges free radicals, thus protecting the mucosal lining from oxidative stress.

Gastric motility: Enhances gastric motility, lowering the chance of food accumulation and additional ulcer site irritation.

Clinical Evidence: Several studies have confirmed ginger's protective effects on the gastric mucosa. A study by Lee et al. (2018) found that ginger extract effectively prevented the formation of gastric ulcers induced by stress and alcohol in animal models [25]. Human trials also support its efficacy, showing that ginger supplementation can help reduce ulcer pain and promote healing [26].

D. Turmeric (Curcuma longa)

Turmeric, known for its active ingredient curcumin, is another herb that has shown promise in the management of peptic ulcers. Curcumin is a potent antioxidant and anti-inflammatory compound that works by modulating several signaling pathways involved in inflammation and cell proliferation. Curcumin has been found to promote ulcer healing by inhibiting the production of pro-inflammatory cytokines and enhancing the repair of gastric mucosal cells [27].

Pharmacological Action:

Anti-inflammatory: Inhibits inflammatory mediators such as NF-kB, COX-2, and TNF-α.

Antioxidant: Reduces oxidative stress, which helps protect the mucosal cells from damage.

Mucosal healing: Stimulates the regeneration of gastric epithelial cells, accelerating the healing process.

Clinical Evidence: Turmeric has been studied for its effectiveness in treating peptic ulcers. A clinical study by Shen et al. (2021) demonstrated that curcumin supplementation led to significant reductions in ulcer size and symptoms in patients

with chronic gastric ulcers [28]. Additionally, preclinical studies in animal models have shown that curcumin accelerates mucosal repair and promotes ulcer healing [29].

E. Slippery Elm (Ulmus rubra)

Traditionally, gastrointestinal problems like heartburn, indigestion, and peptic ulcers have been treated using slippery elm. The bark of the slippery elm tree contains mucilage, a gel-like substance that soothes and protects the mucous membranes of the Digestive tract. This mucilage acts as a protective coating, reducing irritation from gastric acid and promoting healing of the ulcerated area [30].

Pharmacological Action:

Mucilage: Forms a protective layer over the gastric mucosa, reducing acid contact with the ulcer

Anti-inflammatory: Reduces irritation and inflammation in the gastrointestinal tract.

Soothing effect: Provides a calming and healing effect on the mucosal lining.

Clinical Evidence: While limited clinical research is available on slippery elm specifically for peptic ulcers, its traditional use and preclinical evidence suggest that it may be beneficial in soothing and healing the ulcerated mucosa. A study by Kim et al. (2017) demonstrated that slippery elm supplementation improved symptoms of indigestion and gastritis, which are often associated with ulceration [31].

F. Marshmallow (Althaea officinalis)

Marshmallow root, like slippery elm, contains mucilage that helps protect the gastric mucosa by forming a protective layer over the ulcerated tissues. It also has anti-inflammatory properties that may help reduce the irritation and inflammation associated with peptic ulcers. Marshmallow root has been traditionally used to treat sore throats, digestive discomfort, and ulcers due to its soothing effects on the mucous membranes[32].

Pharmacological Action:

Mucilage: Coats the gastric mucosa, protecting it from the damaging effects of acid.

Anti-inflammatory: Reduces irritation and inflammation of the stomach lining.

Soothing: Provides relief from the burning sensation often associated with ulcers.

Clinical Evidence: Research on marshmallow root's effectiveness for peptic ulcers is limited, but its mucilaginous and anti-inflammatory properties suggest its potential in managing the condition. A study by Wang et al. (2021) found that marshmallow root extract significantly reduced symptoms of gastric irritation and enhanced mucosal healing in animal models[33].

G. Chamomile (Matricaria chamomilla)

Chamomile is a well-known herb with calming and anti-inflammatory properties. It is commonly used to treat a variety of gastrointestinal disorders, including peptic ulcers. Chamomile contains flavonoids, particularly apigenin, which have antioxidant and anti-inflammatory effects that can help soothe the stomach lining and reduce ulcer symptoms. Chamomile is also known for its ability to relax smooth muscles, which can help reduce gastric spasms and discomfort[34].

Anti-inflammatory:

Inhibits the production of pro-inflammatory cytokines, reducing inflammation in the gastric mucosa.

Antioxidant: Scavenges free radicals, preventing oxidative damage to the mucosal cells.

Smooth muscle relaxation: Helps relieve gastric spasms and reduce discomfort.

Clinical Evidence: Studies have shown that chamomile can be effective in reducing the symptoms of gastritis and peptic ulcers. A clinical trial by Lopez et al. (2020) found that chamomile tea significantly reduced ulcer symptoms and improved gastric healing in individuals with mild to moderate ulcers [35]. Further studies have confirmed its role in improving digestion and reducing gastric inflammation[36].

H. Cabbage (Brassica oleracea)

Cabbage, particularly its juice, has been studied for its potential to heal peptic ulcers. It is rich in glutamine, an amino acid that promotes mucosal by stimulating the production of protective mucus in the stomach. Cabbage juice has been shown to enhance the repair of gastric ulcers, increase gastric mucus secretion, and improve the overall health of the gastric lining [37].

Pharmacological Action:

Glutamine: Stimulates the regeneration of gastric mucosal cells and enhances mucous production.

Antioxidant: Protects the gastric mucosa from oxidative damage.

Mucosal healing: Accelerates the repair of damaged gastric tissue.

Clinical Evidence: In a study by Gupta et. (2019), participants with peptic ulcers who consumed fresh cabbage juice experienced a significant reduction in ulcer size and improvement in symptoms within a few weeks of treatment [38]. This effect is attributed to cabbage's ability to stimulate gastric mucus production and promote healing.

I. Green Tea (Camellia sinensis)

Polyphenols, notably catechins, which have potent antioxidant and anti-inflammatory effects, are abundant in green tea. These compounds help reduce oxidative stress and inflammation in the gastrointestinal tract, contributing to ulcer healing. Green tea also exhibits antimicrobial activity against H. Pylori, making it a potentially beneficial adjunct treatment for ulcers caused by bacterial infection [39].

Pharmacological Action:

Antioxidant: Reduces oxidative stress in the gastric mucosa.

Anti-inflammatory: Inhibits the production of inflammatory mediators, preventing further mucosal damage.

Antimicrobial: Exhibits activity against H. Pylori, helping to eradicate the bacterial infection associated with many peptic ulcers.

Clinical Evidence: A study by Kiani et al. (2020) demonstrated that drinking green tea regularly helped reduce ulcer symptoms and promoted the healing of gastric ulcers in both animal and human studies [40]. The antimicrobial properties of green tea are

particularly beneficial in ulcers associated with H. Pylori infection.

J. Black Cumin (Nigella sativa)

Black cumin, also known as black seed, is a well-known herb with a variety of medicinal uses, including its potential in managing peptic ulcers. The active compound in black cumin, thymoquinone, has been shown to have anti-inflammatory, antioxidant, and antimicrobial properties. Thymoquinone has demonstrated potential in reducing gastric acid secretion and promoting mucosal healing by enhancing the gastric mucosal defence mechanisms [41].

Pharmacological Action:

Anti-inflammatory: Reduces inflammation in the gastric lining, which is critical for healing peptic ulcers.

Antioxidant: Scavenges free radicals and reduces oxidative stress, which prevents further damage to the gastric mucosa.

Antimicrobial: Exhibits activity against H. Pylori, thereby aiding in the treatment of bacterial-induced ulcers.

Clinical Evidence: A study by Nazari et al. (2019) showed that black cumin oil significantly reduced ulcer size and accelerated the healing process in animal models of gastric ulcers [42].Similarly, human trials have demonstrated that black cumin extract can help alleviate ulcer symptoms and promote healing by enhancing the protective mechanisms of the gastric mucosa.

K. Ashwagandha (Withania somnifera)

Ashwagandha, an adaptogenic herb, is known for its ability to reduce stress and promote overall health. It has also been studied for its potential to support gastrointestinal health, particularly in the treatment of peptic ulcers. Because of its anti-inflammatory and antioxidant qualities, ashwagandha aids in lowering the inflammation linked to ulcer development and speeds up the healing process. Additionally, it has been shown to reduce cortisol levels, which may help alleviate ulcer formation related to stress[43].

Pharmacological Action:

Anti-inflammatory: Reduces inflammation in the gastrointestinal tract, promoting mucosal healing.

Antioxidant: Protects gastric cells from oxidative damage caused by free radicals. Adaptogen: Helps manage stress-induced ulcers by reducing cortisol levels.

Clinical Evidence: In a study conducted by Sinha et al. (2018), ashwagandha extract significantly reduced ulcer formation and accelerated healing in animal models of stress-induced ulcers[44]. While human studies are limited, the herb's effects on reducing stress and its known anti-inflammatory properties make it a promising treatment for ulcers.

L. Yam (Dioscorea spp.)

Yam, particularly the wild yam (Dioscorea villosa), has been traditionally used to treat gastrointestinal disorders, including ulcers. Wild yam contains compounds such as diosgenin, which have anti-inflammatory and mucosal protective properties. It is believed to enhance the healing of ulcers by promoting the regeneration of gastric mucosal cells and increasing mucus production[45].

Pharmacological Action:

Anti-inflammatory: Reduces inflammation in the stomach lining.

Mucosal healing: Stimulates the regeneration of gastric epithelial cells, promoting ulcer healing. Mucus production: Increases the secretion of protective mucus in the stomach.

Clinical Evidence: Although research on yam's specific effects on peptic ulcers is limited, studies on its anti-inflammatory properties suggest that it may be beneficial in managing gastric irritation and ulcers. A study by Kim et al. (2016) found that yam extract could help reduce the symptoms of gastritis, a condition often associated with ulcer formation [46].

M. Plantain (Plantago major)

Plantain has been used in traditional medicine for its healing properties, particularly for its ability to treat wounds and gastrointestinal conditions such as peptic ulcers. Plantain leaves contain iridoid glycosides and flavonoids, which have anti-inflammatory and antioxidant effects. These compounds help reduce inflammation in the gastric mucosa and Promote ulcer healing. Plantain also has mild antimicrobial properties, which can be beneficial in ulcers caused by H. Pylori infection [47].

Pharmacological Action:

Anti-inflammatory: Reduces inflammation and irritation in the stomach lining.

Antioxidant: Prevents oxidative stress and protects gastric cells from damage.

Mucosal healing: Promotes the repair of damaged mucosal tissue

Clinical Evidence: A study by Johnson et al. (2017) demonstrated that plantain extract could significantly reduce ulcer size and promote mucosal healing in animal models of gastric ulcers[48]. While human studies are limited, plantain's traditional use and its therapeutic properties suggest that it could be a useful adjunct in ulcer treatment

IV. Future Prospectives

4.1 Advancements in Herbal Drug Development

The development of herbal medicines for treating peptic ulcers has made significant progress in recent years, but much work remains to be done. Key areas of focus for the future include:

1.Advanced Extraction and Formulation Techniques

Nanotechnology and liposomal encapsulation can enhance the bioavailability and efficacy of herbal compounds. Research into more targeted delivery systems will help improve the pharmacokinetic profiles of active compounds in herbal medicines [49].

2.Precision Medicine Approaches

As our understanding of genetic variability and disease mechanisms advances, personalized treatments can be designed using herbal therapies, tailored to individual patients' genetic profiles, environmental factors, and gut microbiome composition.

3.Regulatory Framework and Harmonization

A globally recognized framework for the regulation of herbal medicines, including international standards for safety, efficacy, and quality control, should be established. Collaborations between regulatory bodies such as the World

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Health Organization (WHO) and national health authorities could expedite the approval process for safe herbal remedies [51].

4.2 Collaboration Between Traditional and Modern Medicine

Future efforts should focus on the integration of traditional knowledge and modern pharmacological research. By leveraging traditional healing practices and incorporating them into clinical trial designs, we can validate the efficacy of herbs while also improving public confidence in their use.

Ethnobotanical research should continue to identify novel plants and bioactive compounds with potential anti-ulcer activity. Pharmacists and healthcare providers should be educated on the rational use of herbal treatments to ensure patient safety and avoid herb-drug interactions [52].

4.3 Bridging the Gap: From Research to Clinical Practice

As new data on the effectiveness and safety of herbal medicines for peptic ulcers emerges, there is a need for evidence-based guidelines for their use. These guidelines should be established by:

4.4 Clinical researchers to assess optimal dosages and treatment regimens.

Pharmaceutical companies to develop standardized and effective herbal-based formulations.

V. Conclusion

Herbal remedies provide a promising adjunct or alternative approach to conventional peptic ulcer therapies. Their multifaceted actions address both the causes and symptoms of ulcers with a favourable safety profile. However, standardized formulations, dosing guidelines, and high-quality clinical evidence are essential to validate their use. Integrating traditional knowledge with modern scientific rigor through interdisciplinary collaboration will be key to optimizing their potential in clinical practice. Future efforts should focus on advanced delivery methods, regulatory harmonization, and evidence-based protocols to facilitate broader acceptance and application.

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