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Antimicrobial Effects of Medicinal Plants on *Helicobacter pylori*

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ABSTRACT

Background: This review thoroughly investigates the antimicrobial properties of medicinal plants against *Helicobacter pylori* (*H. pylori*) and highlights their potential to address the issue of drug resistance. The review highlights the significance of exploring compounds derived from plants that can efficiently suppress bacterial growth through distinct mechanisms, and it also examines the combined effects of using multiple compounds from plant extracts. The rising antibiotic resistance of *H. pylori* has sparked increased interest in alternative treatments, including medicinal plants, which may offer effective and safer methods for preventing and managing diseases caused by this bacterium. Currently,

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there is heightened interest in medicinal plants due to their lower side effects, ease of use, availability, and generally lower cost.
Conclusion: In light of the escalating antibiotic resistance of *H. pylori*, this study explores the inhibitory effects of medicinal plants on this pathogen. The study underscores the vital importance of herbal medicines in tackling resistant strains of *H. pylori* and emphasizes the need for additional research to create new treatment strategies.

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Introduction

H. pylori infection affects around 50% of the world population. *H. pylori* infection causes bacteria to colonize the stomach, resulting in the generation of inflammatory cytokines, chronic inflammation, and tissue damage. The symptoms of an *H. pylori* infection include stomach discomfort, bloating, nausea, vomiting, and lack of appetite. Untreated *H. pylori* infection may cause consequences such as peptic ulcers, stomach cancer, and lymphoma (1). Due to safety concerns, antimicrobial therapy is not recommended for the elderly, children, pregnant, or nursing women, creating a growing desire for alternative therapies for *H. pylori* Phototherapy and probiotics are less likely to cause resistant strains and have fewer negative effects than antibiotics. Phytotherapy and probiotics are effective dietary therapies, according to Mozaffarian et al. Emphasize that eating is medicine (2). Phytotherapy, commonly referred to as herbal therapy, is a therapeutic approach that utilizes whole plants or their extracts in medical treatment. Herbal remedies have been employed to address a range of gastrointestinal disorders, mitigate antibiotic resistance and associated adverse effects, and enhance the eradication rates of *Helicobacter pylori* infections (3).

Helicobacter pylori

Helicobacter pylori (*H. pylori*) is a spiral-shaped, microaerophilic, Gram-negative bacteria that lives in the stomach mucosa and is associated with a variety of gastrointestinal disorders, including chronic gastritis, peptic ulcers, and gastric cancer(4).

Prevalence

The prevalence of *Helicobacter pylori* infection is notably high on a global scale, with rates ranging from 85% to 95% in developing countries and between 30% and 50% in developed nations. Furthermore, various factors—including health status, socio-economic conditions, ethnicity, and population density—contribute to a higher incidence of this bacterium in economically disadvantaged regions compared to their developed counterparts (5).The existing data indicates that the highest prevalence of *Helicobacter pylori* is observed in Africa, followed by Asia and Europe, while the Americas and Oceania exhibit the lowest prevalence rates (6). The incidence of *Helicobacter pylori* infection across different nations is declining over time, attributed to enhancements in living standards and dietary practices (7).

Pathogenesis

Upon entering the host's stomach, *Helicobacter pylori* employs its urease activity to counteract the harsh acidic environment present at the onset of infection. Subsequently, motility facilitated by flagella is essential for *H. pylori* to navigate towards the gastric epithelial cells of the host. This is followed by specific interactions between bacterial adhesins and host cell receptors, which ultimately facilitate successful colonization and the establishment of a persistent infection. Additionally, *H. pylori* secretes various effector

proteins and toxins, such as cytotoxin-associated gene A (*CagA*) and vacuolating cytotoxin A (VacA), which contribute to the damage of host tissues (8).

Treatment

The typical therapy for *H. pylori* infection consists of proton pump inhibitors (PPIs), two antibiotics, and bismuth. Antibiotic resistance in *H. pylori* has emerged as a result of widespread usage, complicating therapy. Long-term PPI usage increases the risk of infection, renal problems, and bone fractures (9).

Non-antibiotic treatment

This research paper Emphasize the growing Concern of antibiotic resistance, which poses a significant threat to the treatment of *Helicobacter pylori* infections. In light of this challenge, the study emphasizes the need to explore alternative strategies beyond traditional antibiotic therapies. It suggests that non-antibiotic or non-pharmacological interventions could provide innovative solutions for managing *H. pylori* infections, potentially improving treatment outcomes and addressing the limitations posed by antibiotic resistance (10).

Probiotics

Probiotics are living microorganisms that provide a variety of health advantages, notably for the gastrointestinal tract. Many probiotics colonize the intestinal tract, and some, such as *Lactobacillus*, are also found in the stomach, where they fight *H. pylori*. Probiotics prevent both urease activity and *H. pylori* adhesion. Probiotics are effective in treating *H. pylori* infections by targeting host cell attachment (11-14). Probiotics may be useful in avoiding *H. pylori* infection. The findings suggest that *H. pylori* infection may be managed with diet. Probiotics are important in treating *H. pylori*, and further advancements may improve their usage (15). Sun et al. discovered that four *Lactobacillus* strains obtained from fermented meals in northeastern China inhibited the development of *H. pylori* (16). Furthermore, in a randomized double-blind placebo-controlled experiment, *Saccharomyces boulardii* substantially decreased mean *H. pylori* stool antigen titer compared to the control group. Boulardii may diminish *H. pylori* colonization in the human gastrointestinal tract, but it cannot completely remove it (17).

Bacteriophages

Bacteriophages (phages) are viruses that infect bacteria and are classed as virulent (lytic) or temperate (lysogenic) according to their interaction with host bacteria. Virulent phages attack bacterial surfaces, inject nucleic acids, reproduce inside host cells, and finally lyse them, releasing new phage offspring that infect other bacteria (18). Traditional phage treatment employs virulent phages or their proteins to lyse and eradicate bacterial infections, which is successful even in chronic instances (19, 20).There are few investigations on *H. pylori*-specific phages. Abdel-Haliem and Askora (21) found that anti-*H. pylori* phages φHPE1 and φHPE2, isolated from wastewater, can adapt to the acidic environment of the human stomach and have great thermal stability. Physiological circumstances in the stomach may limit most phages' capacity to attack *H. pylori*. Gastric juice acidity and digesting enzymes change the makeup of phages, limiting their growth and concentration at the site of infection (22, 23). The phages were categorized into the Podoviridae and Siphoviridae families, with titers of 10^9 PFU/ml for φHPE1 and 10^{10} PFU/ml for φHPE2. These research lacked data on the phages' latent time, burst size, and antibacterial activity. The first findings of phage-like intracellular particles in histological preparations were reported. Pylori was detected shortly after the bacteria was discovered (24-26).

Photodynamic treatment

Antimicrobial photodynamic therapy is a non-invasive treatment that has shown effective in dermatology, oncology, gynecology, and urology. Photodynamic treatment employs a photosensitizer that accumulates in sick tissues to efficiently kill germs while avoiding medication resistance. Current research suggests that *H. pylori* may manufacture endogenous photosensitizers, particularly protoporphyrin IX (PPIX) and coproporphyrins I and III (CPI and CPIII), which have a distinct absorption peak at 415 nm (27-29).

Nanomaterials

Nanomaterials have unique qualities, such as tiny size and biocompatibility, which enable them to cross physiological boundaries. Their high surface area-to-volume ratio promotes contact with pathogen biofilms while ensuring stability. Nano emulsions are being investigated as a possible therapy for *H. pylori* infection. These emulsions, which include oil droplets in water, efficiently transport antimicrobial agents to infection sites. Nano emulsions are biocompatible and stable, which increases medication stability, solubility, and bioavailability. Tran et al. created a Nano emulsion delivery method that encapsulates erythromycin, significantly increasing its stability for *H. pylori* elimination (30).

Lactoferrin

Lactoferrin, an iron-binding glycoprotein found in bovine milk, was initially identified by Sorensen et al. in 1940. The concentration of LF in human colostrum ranges from 5 to 8 mg/mL, whereas mature milk has 1-3 mg/dL. Despite histological evidence of LF expression in the stomach mucosa, its role during histological is unclear. We discovered that LF concentrations in gastric juice and mucosa rose dramatically after *H. pylori* infection for the first time. *H. pylori* infection is directly related to the amount of stomach mucosal inflammation (31-36). LF has 260 times the iron-binding ability of transferrin (37). Thirteen clinical isolates of *H. pylori* were seeded onto Brain Heart Infusion Agar containing 7% fresh horse blood and cultured under microaerobic conditions. Human LF showed time- and dose-dependent activity against 8 of the 13 *H. pylori* isolates tested in vitro at a dosage of 1.5 mg/mL. Furthermore, we demonstrated the antibacterial activity of LF and lactoferrin-derived peptide (LFcin, generated by pepsin digestion) against *H. pylori* in vitro (38).

Postbiotics

A unique biotherapeutic strategy comprises the use of microbial bioactive substances (postbiotics) that demonstrate optimum compatibility and close contact with the host's immune system (39). Postbiotics may compete with infections for adhesion sites if their adhesions are still functional after pretreatment. *Lactobacillus acidophilus*, lyophilized and inactivated, dramatically improves *H. pylori* eradication rates when added to a regular anti-*H. pylori* regimen owing to its high adherence to intestinal cells. Because of its safety and great patient compliance, it is an excellent addition to standard anti-*H. pylori* medications (40). Canducci et al. discovered that treating *H. pylori* patients with clarithromycin, rabeprazole, and amoxicillin with inactivated *Lactobacillus acidophilus* enhanced the rate of eradication (41).

Antimicrobial peptides (*AMPs*)

Antimicrobial peptides (AMPs) are synthesized by diverse species and have a role in innate immunity, defending host cells against infections. Amphipathic peptides are generally made up of less than 50 amino acids. AMPs contain a positive charge that interacts with the negative charge on microbial cell membranes, causing enhanced permeability, pore development, and cell lysis. They may also permeate the membrane, preventing the formation of the cell wall, DNA, RNA, proteins, and cell division. AMPs have great selectivity for bacterial cells, wide range action, and inexpensive synthesis costs (42-45).

Various AMPs, such as defensins, in gastric epithelial cells are critical for the innate immune response to *H. pylori* infection. Despite the fact that stomach epithelial cell AMPs are protective, *H. pylori* continue to colonize. *H. pylori* demonstrates specific drug resistance to host AMPs (46-48). Human neutrophil peptide 1 is a small cationic peptide (3.44 kDa) that is part of the defensin family. Its recombinant version, created using the *Pichia pastoris* expression system, demonstrates significant effectiveness against antibiotic-resistant *H. pylori* in laboratory settings and also notably decreases the colonization of *H. pylori*, suggesting its potential for treating *H. pylori* infections (49). According to Jiang et al. (2020), Cbf-K16 demonstrated effective antibacterial properties against *H. pylori* SS1 that is resistant to clarithromycin and amoxicillin, both in laboratory settings and in living organisms. Additionally, Zhang et al. created a recombinant version of PGLa-AM1 (rPGLa-AM1), which is characterized by its low toxicity, high stability, and effective anti-*H. pylori* activity in both in vitro and in vivo studies (50). The peptide Tilapia Piscidin 4 (TP4) has been demonstrated to suppress the growth of *H. pylori*, regardless of its sensitivity to antibiotics, by forming membrane micelles. This process results in membrane depolarization and the leakage of cellular components. TP4 is suggested as a promising and safe standalone treatment for infections caused by multidrug-resistant *H. pylori* (51). Bicarinalin has proven to be effective in treating patients with *H. pylori* that are resistant to clarithromycin and levofloxacin, yet sensitive to metronidazole. Additionally, it has been proposed that using bicarinalin as a new food preservative could help prevent certain gastric diseases by combating *H. pylori* after consumption (52).

Herbal medicine

Herbal medicine also called phytotherapy, uses plants or plant extracts to prevent and treat different diseases (53). Herbal remedies have played a key role in traditional medicine systems across the world for ages (54). In the past few years, people have shown renewed interest in herbal medicine in its ability to fight bacteria that resist antibiotics (55).

Herbal medicine can be derived from various parts of plants, including leaves, roots, flowers, seeds, and bark because these plant components are often rich in beneficial compounds (56). These plant parts have active ingredients such as alkaloids, flavonoids, tannins, and terpenes that give them healing powers (57). Scientists have found many plants with germ-fighting abilities making them good options to treat bacterial infections (58). Lots of research shows that herbal medicines can affect various types of bacteria, including those that cause common and serious infections (59). Here are some key examples:

Streptococcus Species

Streptococcus is a type of bacteria that causes various infections such as Streptococcal throat scarlet fever, and pneumonia (60). Studies indicate that some herbal extracts have a strong impact on Streptococcus species (61). To illustrate essential oils from *Origanum vulgare* (oregano) and *Thymus vulgaris* (thyme) show powerful antibacterial effects against *Streptococcus pyogenes* stopping both floating cells and the formation of biofilms (62).

Staphylococcus aureus

Staphylococcus aureus is a type of bacteria that can cause a range of infections in humans, including skin infections, pneumonia, and food poisoning in humans. This pathogen is commonly found on the skin and in the nose of healthy people (63). This pathogen has become resistant to methicillin leading to methicillin-resistant *Staphylococcus aureus* (MRSA) strains (64). Research indicates that some herbal extracts can stop *S. aureus* from growing (65). For example, *Allium sativum* (garlic) and *Camellia sinensis* (green tea) extracts have a strong impact on *S. aureus* blocking its growth and preventing biofilm formation (66). These plants have an effect on

resistant strains by breaking through bacterial cell walls and disrupting biofilm creation (67).

Escherichia coli

Escherichia coli lives in the guts of humans and animals (68). Most strains don't cause harm, but some can lead to serious food poisoning (69). Plant oils from *Cinnamomum verum* (cinnamon) and *Mentha piperita* (peppermint) have an impact on *E. coli* killing many of these bacteria (70). These oils contain substances like cinnamaldehyde and menthol, which break down bacterial cell walls (71).

Pseudomonas aeruginosa

Pseudomonas aeruginosa infects people with weak immune systems (72). It also creates biofilms, which makes treatment tough (73). Research indicates that *Eucalyptus globulus* (eucalyptus) extracts can cut down biofilm growth and boost how well standard antibiotics work against *P. aeruginosa* (74).

Mechanisms of Action Herbal medicines fight bacteria in several ways, including:

Breaking Down Cell Walls and Membranes

Many plant compounds, like terpenes and alkaloids, can break through bacterial cell walls and membranes. This causes damage to the structure and allows cell contents to leak out (75).

Stopping Biofilm Growth

Biofilms shield bacteria from antibiotics and immune system attacks (76). Some herbal extracts such as those from *Ginkgo biloba*, have shown they can stop biofilms from forming. This makes bacteria easier to treat (77).

Interference with Quorum Sensing

Quorum sensing allows bacteria to communicate and coordinate their actions, including how they form biofilms and become virulent (78). Some plants, like rosemary (*Rosmarinus officinalis*), contain compounds that block quorum sensing. This has an impact on bacterial virulence by reducing it (79).

Herbal medicine gives us promising options instead of regular antibiotics as more bacteria resist antibiotics (80). Plants such as oregano, garlic, and cinnamon have shown strong antibacterial effects against many germs, including *Streptococcus* and *Staphylococcus* types (81). These natural substances work in different ways, like breaking down bacterial structures stopping biofilm growth, and messing with how bacteria talk to each other (82). As we keep studying this field herbal medicine could help us to create new ways to fight infections (83).

Different effects of Medicinal plants on Helicobacter pylori

Medicinal plants show promise to treat *Helicobacter pylori* infections. Extracts from plants like *Allium sativum* (garlic) and *Zingiber officinale* (ginger) have an influence on bacteria and inflammation. These properties help stop *H. pylori* from growing and cut down on stomach inflammation (84, 85). Research also points out that compounds in these plants can reduce the number of bacteria and make symptoms better for people with *H. pylori* infections (86, 87).

Aqueous Extracts from Medicinal Plants Have an Impact on Helicobacter pylori

Helicobacter pylori, a gram-negative bacterium, has a link to stomach problems like peptic ulcers and stomach cancer. Antibiotics don't work as well as they used to so researchers are looking for new ways to treat it. Plant based medicines show promise. Water-based extracts from these plants pack a punch against *H. pylori* (88).

Thyme (*Thymus vulgaris*)

Thyme has an influence on bacteria due to substances like thymol and carvacrol. New research shows that water-based thyme extracts stop *H. pylori* from growing. A study in 2019 found that thyme extracts made *H. pylori* less active in lab tests hinting at their use to help treat stomach infections (89).

Turmeric (*Curcuma longa*)

Turmeric, which contains curcumin as its active ingredient, has an impact on bacteria. Research from 2021 showed that water-based turmeric extracts stopped *H. pylori* from growing and cut down its presence in stomach tissues. Curcumin breaks bacterial cell walls and blocks urease, which *H. pylori* needs to live (90).

Rosemary (*Rosmarinus officinalis*)

Rosemary contains active compounds, including rosmarinic acid, which have an impact on bacteria. Research from 2022 showed that water-based rosemary extracts cut down *H. pylori* growth and stopped it from forming biofilms. This means rosemary might help to treat *H. pylori* infections (91).

Aloe Vera (*Aloe barbadensis* miller): Aloe vera known for its healing abilities, has an influence on fighting bacteria like *H. pylori*. A study in 2023 showed that water-based aloe vera extracts stopped *H. pylori* from growing and lowered its urease activity. This suggests it could help treat stomach issues (92).

The antibacterial effects of these herbal extracts target various functions of the bacterial cell (Table 1), including;

Breaking Cell Walls

The active parts can get through and harm bacterial cell walls (93). Stopping Urease: These extracts can block urease making it harder for *H. pylori* to live in acid environments (94).

Reduction of Biofilm Formation

Some extracts have an impact on biofilm formation making treatments more effective (95).

Aqueous extracts from medicinal plants like thyme, turmeric, rosemary, and aloe vera show promising antibacterial effects against *H. pylori*. These extracts can work as effective complementary treatments to manage *H. pylori*-related conditions. They can stop bacterial growth, break up biofilm formation, and mess with essential bacterial functions (96, 97).

Antibacterial Effects of Alcoholic Extracts from Various Medicinal Plants on Helicobacter pylori

Helicobacter pylori, a gram-negative bacterium, has an influence on chronic gastritis peptic ulcers, and even gastric cancer. The rise of antibiotic-resistant strains and side effects linked to standard treatments have led researchers to look into other options such as using medicinal plants. Alcohol-based extracts from these plants have shown strong antibacterial effects against *H. pylori* (98).

Alcohol-Based Extracts of Ginger (Zingiber officinale)

Zingiber officinale, or ginger as it's called, has an influence on reducing inflammation and fighting microbes. Research from 2018 showed that ginger extracts in alcohol stop *H. pylori* from growing in lab tests. This happens because of active ingredients like gingerol and shogaol. These substances can break bacterial cell walls and mess with how the bacteria work (99).

Alcoholic Extracts of Garlic (Allium sativum)

Allium sativum, or garlic, has been the subject of extensive research regarding its germ-fighting abilities. A study from 2020 found that garlic extracts in alcohol have a strong antibacterial

Table 1. The effect of various plant extracts on *H.pylori*.

Plant	Bacterial Target	Using Part	Extraction	Mechanism of Action	Inhibition Zone (IZ)	References
Zingiber officinale **(Ginger)**	*Helicobacter pylori*	Rhizome	Alcoholic extract	Disruption of cell Membrane	Significant inhibition observed	(119)
Allium sativum **(Garlic)**	*Staphylococcus aureus*, *Helicobacter pylori*	Bulb	Alcoholic extract	Inhibition of bacterial enzyme activity	Effective inhibition against *H. pylori*	(120)
Punica granatum **(Pomegranate)**	*Streptococcus mutans*, *Helicobacter pylori*	Fruit peel	Alcoholic extract	Inhibition of biofilm formation	Strong inhibition observed	(121)
Azadirachta indica **(Neem)**	*Escherichia coli*, *Helicobacter pylori*	Leaves	Alcoholic extract	Disruption of bacterial cell wall	Effective against *H. pylori*	(122)
Melaleuca alternifolia **(Tea Tree)**	*Staphylococcus aureus*, *Helicobacter pylori*	Leaves	Essential oil	Disruption of bacterial cell membrane	Significant inhibition observed	(123)
Origanum vulgare **(Oregano)**	*Helicobacter pylori*, *Escherichia coli*	Leaves	Essential oil	Disruption of cell membrane integrity	Strong inhibition observed	(124)
Syzygium aromaticum **(Clove)**	*Helicobacter pylori*, *Streptococcus mutans*	Flower buds	Essential oil	Inhibition of urease activity	Significant inhibition observed	(125)
Lavandula angustifolia **(Lavender)**	*Helicobacter pylori*, *Escherichia coli*	Flowers	Essential oil	Disruption of bacterial cell wall and biofilm formation	Significant inhibition observed	(126)

effect on *H. pylori* (100). This happens because of allicin, a sulfur compound in garlic, which stops bacteria from growing and forming films. The research points out that garlic extracts could be useful as an extra treatment for *H. pylori* infections (101).

Alcoholic Extracts of Pomegranate (Punica granatum)

Punica granatum also called pomegranate, has polyphenolic compounds that have a strong influence on fighting microbes. Research from 2021 showed that alcohol-based pomegranate extracts cut down *H. pylori* survival and stopped its urease from working. The high levels of ellagic acid and punicalagins in these extracts cause the antimicrobial effects. They break down bacterial

cell walls and stop key enzymes from working (102).

Alcoholic Extracts of Neem (Azadirachta indica)

Azadirachta indica also known as neem, has strong germ fighting abilities. A study from 2022 showed that alcohol-based neem extracts had a big impact on *H. pylori* bacteria. The researchers think neem works so well because it's full of flavonoids and terpenoids. These substances can harm bacterial membranes and stop key bacterial processes (103).

These alcohol-based extracts fight bacteria in several ways

The extracts can get through bacterial cell walls. This causes the cell's insides to leak out killing the bacteria (104).

Certain extracts have an impact on urease, an enzyme vital to *H. pylori*'s ability to survive in acidic conditions (105).

Alcohol-based extracts can lower biofilm production, which shields *H. pylori* from the host's immune defenses and antibiotic treatments (106).

Alcoholic extracts from medicinal plants like ginger, garlic, pomegranate, and *Azadirachta indica* show promising effects to fight bacteria against *H. pylori*. These extracts could work well as add-on treatments because they stop bacteria from growing, break up biofilms, and mess with key bacterial processes (107, 108).

How Essential Oils from Different Medicinal Plants Kill Helicobacter pylori Bacteria

Helicobacter pylori, a gram-negative bacterium, has an influence on gastric diseases such as peptic ulcers and gastric cancer. As conventional antibiotics lose their effectiveness essential oils from medicinal plants are showing up as possible alternatives. New research points to their encouraging antibacterial effects on *H. pylori* (109).

Tea Tree Oil (*Melaleuca alternifolia*)

Tea tree oil has a reputation for killing many types of microbes. A study in 2020 showed that tea tree oil stops *H. pylori* from growing in lab tests. The researchers found that terpinen-4-ol, a main ingredient in tea tree oil causes this effect. It damages bacterial cell membranes and prevents cells from multiplying (110).

Oregano Oil (*Origanum vulgare*)

Oregano oil contains plenty of phenolic compounds carvacrol and thymol. These compounds have a strong impact on bacteria. Research from 2021 showed that oregano essential oil can stop *H. pylori* from growing. The study pointed out that carvacrol breaks down the bacteria's cell membrane and stops its enzymes from working (111).

Clove Oil (*Syzygium aromaticum*)

Clove oil, which contains eugenol, has an impact on microbes. A study in 2019 found that clove oil kills *H. pylori* and stops urease, an enzyme that helps bacteria live in acidic conditions. Eugenol fights microbes by breaking bacterial cell walls and messing up how they work (112).

Lavender Oil (*Lavandula angustifolia*)

Lavender oil has an influence on microbes because of its antimicrobial qualities, which stem from linalool and linalyl acetate. Research from 2022 in the case that lavender oil fights bacteria like *H. pylori* cutting down on how much they grow and form biofilms (113).

Essential oils fight bacteria in several ways

Breaking Cell Walls

These oils can get into and break bacterial cell walls causing the cell's insides to leak out and the bacteria to die (114).

Stopping Urease

Some of these oils stop urease from working. This enzyme helps *H. pylori* stay alive in acid (115).

Reduction of Biofilm Formation

Essential oils can hamper biofilm formation making treatments work better (116).

Essential oils from plants like tea tree oregano, clove, and lavender show strong antibacterial action against *H. pylori*. These oils could help manage *H. pylori* infections because they stop bacteria from growing, break down cell membranes, and cut down on biofilm formation (117). We need more studies to figure out how to best use them in clinics and check if they're safe and effective.

Conclusion

In the investigation of medicinal plants as effective treatments for *H. pylori*, it is clear that these natural remedies provide considerable advantages. The combination of traditional knowledge and modern scientific research has created new opportunities for developing therapies that successfully target antibiotic-resistant strains of *H. pylori*. Utilizing herbal medicines not only complements existing antibiotic treatments but also offers potential preventive strategies against the colonization and transmission of this pathogen. The increasing significance of medicinal plants in treating bacterial infections has emerged due to the escalating issue of antimicrobial resistance. As bacteria become resistant to standard antibiotics, the demand for alternative treatment options has intensified. For centuries, medicinal plants have been utilized to address various health issues, including bacterial infections. By continually connecting traditional herbal practices with contemporary medical research, it is possible to expand the range of treatments available for *H. pylori*, thus alleviating the global impact of infections caused by this difficult pathogen. In this study, a variety of effective medicinal plants against *H. pylori* were gathered, and the effects of each were documented.

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Conflict of interest

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