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REVIEW

Herbal teas for gastritis: A narrative review and bibliometric analysis of *Acorus calamus, Curcuma longa, Zingiber officinale, and Piper betle*

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ABSTRACT

Introduction: Medicinal herbs *Acorus calamus, Curcuma longa, Zingiber officinale,* and *Piper betle* have been traditionally used for treating stomach-related conditions such as irregular bowel movement, bloating, and gastric ulcers. The present study aimed to explore current status, research trends, and future directions of these herbs as functional herbal teas in prevention and treatment of gastritis. **Methods**: A total of 80 articles from Scopus database were retrieved and reviewed. Research trends were quantitatively analysed using VOSviewer software, focusing on the keywords, authors, countries, journals, and documents. A narrative review was integrated to provide comprehensive insights into the study. **Results**: Analysis revealed China and India as driving forces of this specific area of research, with the Journal of Ethnopharmacology emerging as a prominent source for publications in this field. “Curcumin”, “ginger”, and “*Helicobacter pylori*” were the main keywords of the study. Several gastroprotective mechanisms, including stimulation of mucosal proliferation, regulation of gastric acid production, reduction of inflammation in the gastric mucosa, protection of the gastric mucosa from oxidative damage, and inhibition of the growth of *H. pylori*, were associated with these herbs. Active compounds, such as α-asarone, curcumin, gingerol, and piperbetol, were found to be responsible for these effects. **Conclusion**: This study highlights various gastroprotective properties of *A. calamus, C. longa, Z. officinale,* and *P. betle*, providing researchers with a deeper understanding of the subject matter and opening new avenues for potential development into a functional herbal tea formulation known as “Lega Tea” (Relief Tea).

Keywords: bibliometric, gastritis, gastroprotective, herbal tea, *Helicobacter pylori*, VOSviewer

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INTRODUCTION

Gastrointestinal disorders, such as gastritis, gastric ulcer, acid reflux, and indigestion, have generated increasing interest in the development of effective and safe treatments. Current treatments rely primarily on synthetic drugs, including antibiotics, proton pump inhibitors (PPIs), and gastric acid neutralising agents, which can cause adverse side effects, such as allergies, arrhythmia, and haematopoietic dysfunction (Wang *et al.*, 2023). Consequently, the search and application of herbal remedies with low toxicity and good biological activity for the prevention of gastric-related conditions have become an increasing focus of research (Sharangi & Das, 2022).

Acorus calamus, Curcuma longa, Zingiber officinale, and *Piper betle* have been traditionally combined as ingredients in a polyherbal tea, which is believed to alleviate stomach discomfort (Fazal *et al.*, 2014; Sharangi & Das, 2022; Singh & Easwari, 2022). However, a comprehensive review and quantitative analysis of the existing literature regarding the therapeutic potential of these herbal remedies, specifically in gastritis and gastric ulcer, are currently lacking. Therefore, a review and bibliometric analysis are needed to assess the current state of evidence and elucidate the therapeutic potential, mechanisms of action, and research trends associated with these plants in gastric-related conditions.

In this review, the therapeutic potentials of *A. calamus, C. longa, Z. officinale,* and *P. betle* in treating gastric-related conditions, such as gastritis, gastric ulcer, acid reflux, and indigestion, are addressed. *A. calamus*, commonly known as a sweet flag or myrtle flag, is an aromatic herb with creeping rhizomes. Its rhizome, root, and leaf yield a volatile aromatic oil called calamus oil, which contains bioactive compounds such as terpineol, azulene, eugenol, limonene, β-asarone, and α-asarone (Bhat *et al.*, 2012). These compounds exhibit antimicrobial, antioxidant, anti-inflammatory, anticonvulsant, and wound-healing properties. Traditional uses of *A. calamus* include aiding digestion, stimulating the digestive system, and reducing stomach discomfort. Its rhizomes have also demonstrated great efficacy as a topical treatment for various skin conditions (Berganayeva *et al.*, 2023).

Turmeric, a rhizomatous plant known as *C. longa*, is a perennial member of the Zingiberaceae family, primarily grown in India and Southeast Asia. Its major polyphenolic yellow pigment, curcumin, has been extensively studied for its various beneficial properties, including anti-inflammatory, antioxidant, anti-cancer, anti-proliferative, anti-fungal, and anti-microbial effects (Aggarwal, Chacko & Kuruvilla, 2016). Turmeric has traditionally been utilised to alleviate inflammation, provide pain relief, aid in wound healing, stimulate bile production, enhance gut function, and address stomach issues such as bloating, indigestion, and acid reflux. Additionally, its antioxidant and anti-inflammatory properties have made it a common ingredient in nutraceutical supplements (Varma *et al.*, 2022).

Ginger, also belonging to the Zingiberaceae family, is widely used in Asian countries as a traditional medicine for several conditions, including nausea, vomiting, colds, fever, and rheumatic disorders (Mao *et al.*, 2019). It possesses analgesic properties that are beneficial for pain relief, including menstrual cramps and headaches. Ginger contains important constituents such as gingerols, shogaols, paradols, and zingerone, which are responsible for its therapeutic effects. Numerous studies have reported its antimicrobial, antioxidant, and anti-inflammatory properties. Ginger extract and its active compounds have also demonstrated anti-ulcerative activity in various gastric ulcer animal models,

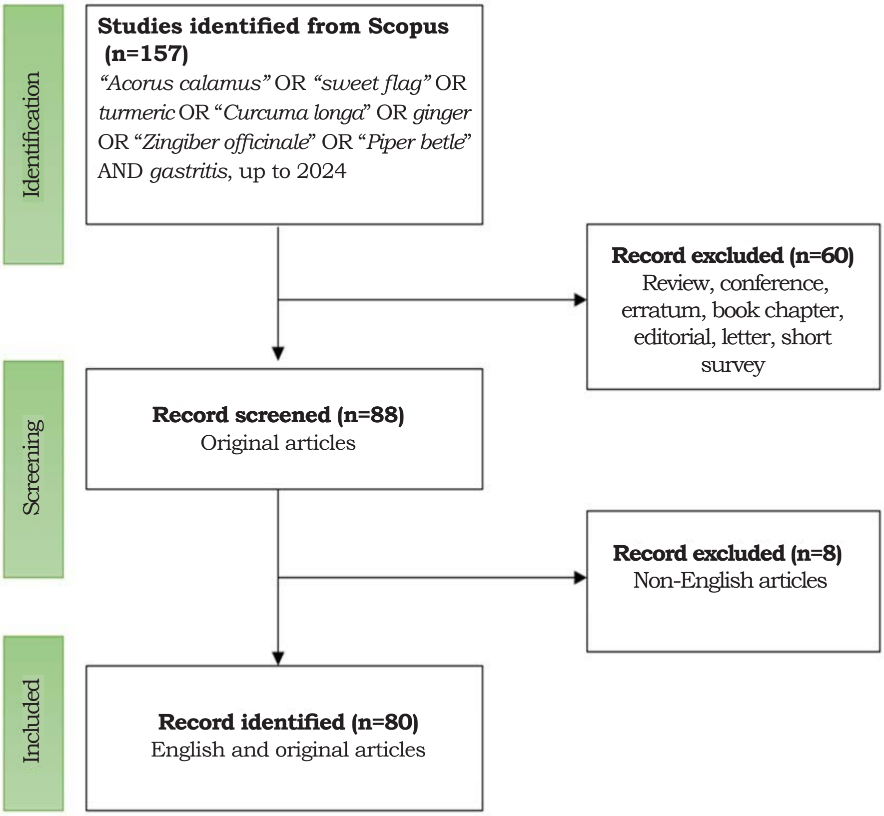


Figure 1. Flowchart of search strategy

regulating inflammatory cytokine release and antioxidant enzyme activity (Shahrajabian, Sun & Cheng, 2019).

Piper betle, belonging to the Piperaceae family, is regarded as a medicinal plant in the Southeast Asia region. Betel leaf, often chewed with other ingredients like areca nut and slaked lime, is commonly used for its oral health benefits (Toprani & Patel, 2013). Externally, the leaves are used as poultices or in oil form to alleviate joint pain, swelling, and inflammation. Betel leaf contains bioactive compounds, including chavibetol, hydroxychavicol, eugenols, tannins, flavonoids (quercetin), and polyphenols. These compounds possess antimicrobial, antioxidant, anti-inflammatory, analgesic, gastroprotective, hepatoprotective, and wound-healing properties (Nayaka *et al.*, 2021).

Given the important role of herbal medicine in the prevention and treatment of gastritis, this article employed bibliometric analysis to present the existing research outcomes of four selected herbs, namely *A. calamus, C. longa, Z. officinale*, and *P. betle*, and discuss their current research trends and focal points. The combination of these herbs may also provide the basis for the development of a functional herbal tea formulation, referred to as "Lega Tea" (Relief Tea), which could serve as a reference for future studies in this field.

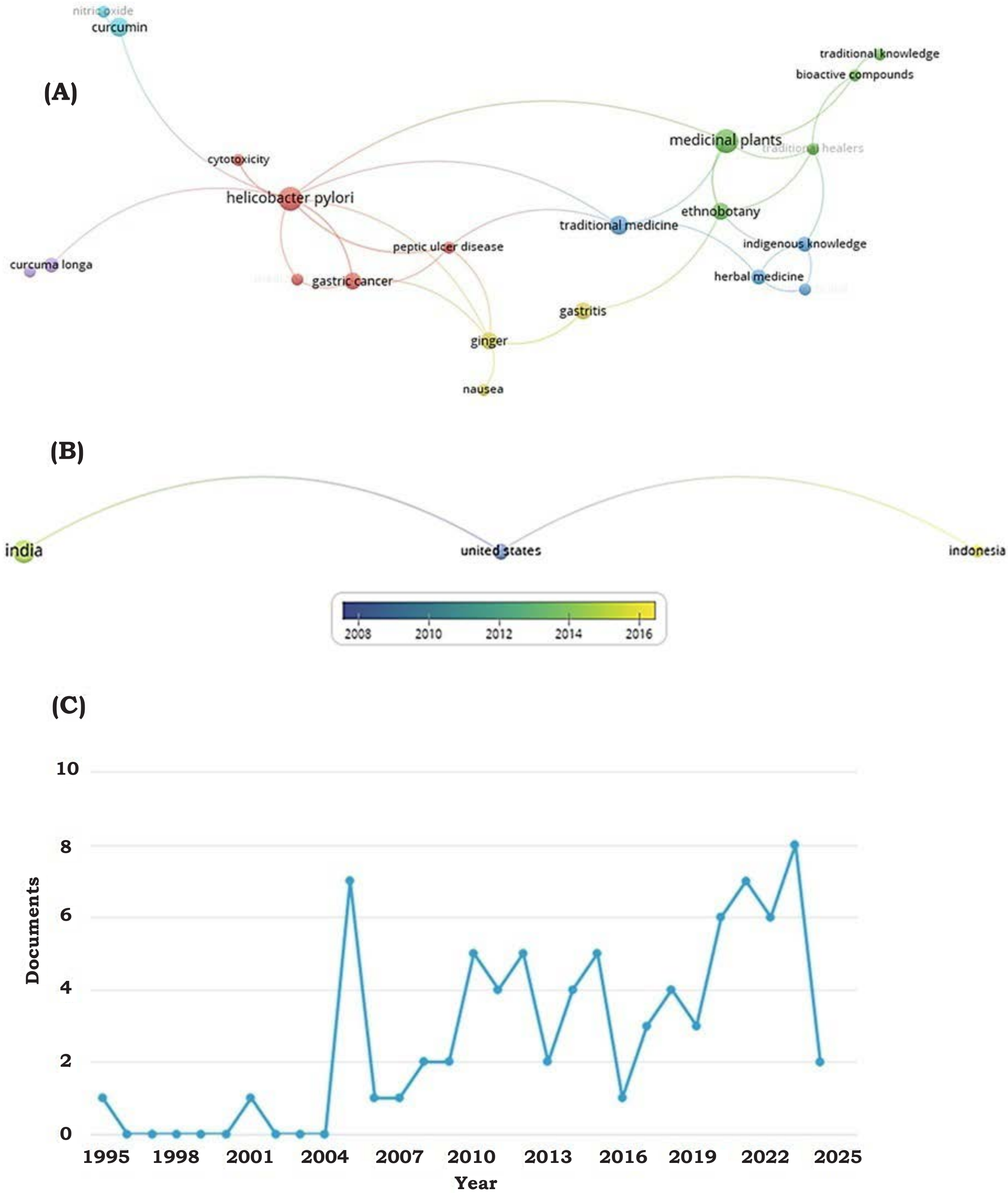


Figure 2. Overlay visualisation of (A) keyword analysis, (B) country analysis, and (C) research publications over the years. Distinct colours in (A) and (B) represent different clusters across the years.

METHODOLOGY

Publications were retrieved from the Scopus database using selected keywords – *"Acorus calamus"* OR "sweet flag" OR turmeric OR *"Curcuma longa"* OR ginger OR *"Zingiber officinale"* OR *"Piper betle"* AND gastritis – covering all four herbs. This study only employed the Scopus database, as it offers comprehensive coverage, with approximately 99% of journals indexed in the Web of Science already indexed in Scopus.

Publications were retrieved up to 31st December 2024. A total of 157 articles were initially identified from the database. The inclusion criteria involved literature with the plant's scientific or common name and gastritis mentioned in the title, abstract, and keywords. The exclusion criteria comprised any document types other than research articles and publications not in English (Zakaria *et al.*, 2023). Upon applying these criteria, a total of 80 articles were selected for the subsequent bibliometric analysis, as depicted in Figure 1.

Bibliometric analysis of the selected articles was conducted using VOSviewer (version 1.6.19), according to Fadhlina *et al.* (2023). The analysis included authors, countries, keywords, sources, and documents. Data were visualised using network and overlay maps. The reviewed plants in this study were cross-checked against the World Flora Online Plant List (https://wfoplantlist.org/plant-list/) for accurate identification (Hairani *et al.*, 2023). To complement the bibliometric findings, a narrative review was also conducted to provide an in-depth discussion of the pharmacological and therapeutic roles of the four species in gastritis, with additional relevant studies to ensure a more comprehensive synthesis of evidence.

RESULTS AND DISCUSSION

Research keyword

In literature, keywords serve as the central summary of research content, making it crucial to analyse their co-occurrence for a more comprehensive understanding. Based on keyword analysis, a total of eleven keywords appeared at least three times throughout the years of studies. "*Helicobacter pylori*" was observed to have the highest occurrence (8), indicating a focus on the role of this bacterium in gastritis. The appearance of such keywords as "curcumin" (5), "*Curcuma longa*" (5), and "ginger" (4) suggests an interest in the therapeutic potential of these plants for gastritis treatment. The inclusion of such keywords as "medicinal plants", "herbal medicine", and "traditional medicine" suggests increasing interest in the broader field of medicinal plants, herbal medicine, and traditional medicine for gastritis treatment. Additionally, the appearance of keywords "ethnobotany" and "indigenous knowledge" in more recent studies (2018-2019) indicates a growing recognition of the value of indigenous knowledge and ethnobotanical research in identifying new plant-based remedies and therapeutic approaches for gastritis (Figure 2A). The keyword "gastric cancer" indicates a focus on understanding the relationship between gastritis and gastric cancer.

Country, author, source, and document analysis

Figure 2B demonstrates the visualisation map of country analysis. The size of the node corresponds to the number of articles published by countries, while the distance between countries indicates how closely they collaborate. The visualisation map highlights the collaboration network between India, the United States, and Indonesia. China emerged as the country with the highest number of published documents (Table

1). Researchers from India have also conducted numerous studies, reflecting a significant interest and expertise in the research area. The long history of traditional medicines in China and India, with their rich resources and numerous scientific research institutions, might explain their prolific contributions (Pandey, Subha & Rawat, 2013). Similarly, the United States, Thailand, and Indonesia have also made significant contributions, each contributing seven publications, reflecting their involvement in researching the therapeutic potential of these plants for gastritis.

Author analysis further supports these trends, revealing the involvement of prolific authors affiliated with prolific countries (Table 1), such as Liu, Y. and Qin, X. from China. Their contributions indicate expertise and active engagement in this field of research. For source analysis, the Journal of Ethnopharmacology was the most prolific source for publications (Table 1) and has been a preferred platform for researchers to share their findings in this field. Evidence-Based Complementary and Alternative Medicine and Phytotherapy Research were also notable sources for studies on the therapeutic value of these plants in gastritis. Document analysis (Table 2) showed that an article on the antimicrobial activity of curcumin against *H. pylori* isolates from India received significant attention and citations (388), indicating the interest in curcumin's potential for combating *H. pylori*. The remaining prolific publications also contributed to the field by investigating

Table 1. List of prolific authors, countries, and sources

	Author	*TP*	*Country*	*TP*	*Source*	*TP*
1.	Liu, Y. (China)	2	China	17	Journal of Ethnopharmacology	10
2.	Mahady, G.B. (USA)	1	India	13	Evidence-Based Complementary and	4
3.	Neamsuvan, O. (Thailand)	1	United States	7	Phytotherapy Research	4
4.	Pendland, S.L. (USA)	1	Thailand	7	American Family Physician	2
5.	Qin, X. (China)	1	Indonesia	4	Journal of Alternative and Complimentary Medicine	2

TP= Total of publication

Table 2. Top 10 prolific documents

No.	*Document title*	*Citation*
1.	Antimicrobial activity of curcumin against *Helicobacter pylori* isolates from India and during infections in mice.	388
2.	*In Vitro* susceptibility of *Helicobacter pylori* to botanical extracts used traditionally for the treatment of gastrointestinal disorders	215
3.	Herbal medications commonly used in the practice of rheumatology: mechanisms of action, efficacy, and side effects.	206
4.	Efficacy and safety of curcumin in major depressive disorder: a randomized controlled trial.	165
5.	Ethnobotanical study of medicinal plants used by Ribeirinhos in the North Araguaia microregion, Mato Grosso, Brazil.	165
6.	Ethnobotanical survey of traditionally used plants in human therapy of east, north and north-east Bosnia and Herzegovina.	134
7.	Medicinal plants from Riau province, Sumatra, Indonesia. Part 1: Uses	130
8.	Phase II clinical trial on effect of the long turmeric (*Curcuma longa* Linn) on healing of peptic ulcer.	120
9.	A curcumin-based 1-week triple therapy for eradication of *Helicobacter pylori* infection: something to learn from failure?	112
10.	Medicinal plant activity on *Helicobacter pylori* related diseases	111

various aspects.

Overall, the trends reflect a strong interest in identifying medicinal plants for gastritis and its related conditions, specifically in managing *H. pylori* infections. In terms of the number of publications across the years, the overall trend indicates a growing research interest in studying the therapeutic potentials of *A. calamus*, *C. longa*, *Z. officinale*, and *P. betle* in managing gastritis. There was a notable increase in publications in 2005, possibly indicating initial research findings that sparked more attention. While there were fluctuations in research activity, particularly in the earlier years, the trend has generally been positive, with increasing attention and publications in recent years, especially in 2023 (Figure 2C).

Functional and nutraceutical roles of herbal tea in treating gastritis

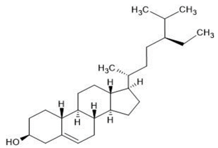
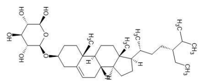
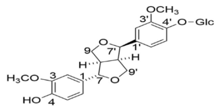
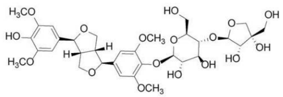
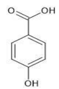
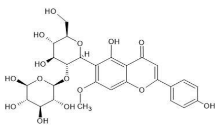
Herbal teas play a dual role as both functional foods and nutraceuticals in the management of gastritis. Functional foods are designed to promote overall well-being and reduce the risk of chronic diseases, while nutraceutical products derived from food sources offer medicinal benefits through bioactive compounds such as antioxidants, anti-inflammatory agents, vitamins, minerals, probiotics, and phytochemicals (Varma *et al.*, 2022; Singh & Easwari, 2022). Functional herbal teas, in particular, are selected for their targeted health benefits, including digestive support, immune modulation, stress relief, and gastroprotective effects (Ekor, 2014; Srivastava, Shankar & Gupta, 2010). Of specific interest are herbal extracts from *A. calamus, C. longa, Z. officinale*, and *P. betle*, which are rich in bioactive compounds with therapeutic potential. These include eugenol (Bhat *et al.*, 2012), curcumin (Aggarwal *et al.*, 2016), gingerol (Shahrajabian *et al.*, 2019), and chavibetol (Nayaka *et al.*, 2021). These constituents exhibit anti-inflammatory, antioxidant, and anti-*H. pylori* properties that can help mitigate gastric inflammation and protect the stomach lining from oxidative stress (Wang *et al.*, 2023).

For instance, ginger tea is widely recognised for its antimicrobial effects, particularly against *H. pylori;* it is often used to alleviate nausea, digestive discomfort, and inflammation (Mao *et al.*, 2019). Turmeric tea, another popular remedy, is noted for its curcumin content, which has been extensively studied for its effectiveness against *H. pylori* and its capacity to soothe gastric irritation (De *et al.*, 2009; Aggarwal *et al.*, 2016). These teas are available in various forms, such as tea bags, loose-leaf preparations, and blended infusions. They are also often combined (e.g., turmeric-ginger tea) to enhance both palatability and therapeutic potential. Together, these herbal teas represent a promising complementary approach to gastritis prevention and treatment, addressing both symptom relief and underlying pathophysiology.

Research advancement in the validation of *A. calamus, C. longa, Z. officinale*, and *P. betle* for gastritis treatment

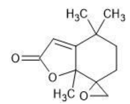
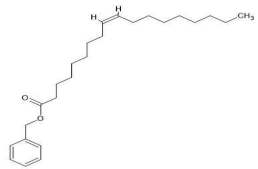
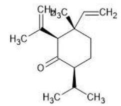
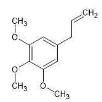
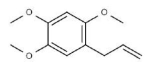
Gastritis is an inflammation of the gastric mucosa, the lining of the stomach responsible for producing mucus and substances that protect it from stomach acid and digestive enzymes (Wang *et al.*, 2023). Gastritis can arise through various factors, including infection, autoimmune response, and exposure to chemical irritants. The primary cause of gastritis is often the presence of *H. pylori*, which erodes the protective mucus layer and triggers inflammation. *H. pylori* infection is a prevalent cause of chronic gastritis globally, affecting more than half of the world's population, although not all infected individuals will experience symptoms or complications. Autoimmune gastritis occurs when the immune system mistakenly attacks the gastric mucosa cells, leading to chronic

Table 3. Identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus, C. longa, Z. officinale*, and *P. betle*

Compounds	*Class*	*Chemical structure*	*Molecular formula*	*Bioactivities*	*References*
Acorus calamus					
β-sitosterol	Phytosterol		$C_{29}H_{50}O$	Anti-inflammatory and antioxidant activities	Huang *et al.*, 2024
Daucosterol	Steroid saponin		$C_{35}H_{60}O_6$	Antioxidant, anti-inflammatory, immunomodulatory and neuroprotective properties.	Huang *et al.*, 2024
(+)-pinoresinol-β-D-glucoside	phenylpropanoid		$C_{26}H_{32}O_{11}$	Antioxidant and anti-inflammatory activities	Huang *et al.*, 2024
(-)-syringaresinol 4-O-β-D-apiofuranosyl-(1→2)- β-D-glucopyranoside	Lignin		$C_{33}H_{44}O_{17}$	Antioxidant and anti-inflammatory activities	Huang *et al.*, 2024
4-hydroxybenzoic acid	Benzoic acid		$C_7H_6O_3$	Antioxidant and anti-inflammatory activities	Huang *et al.*, 2024
Spinosin	C-glycoside flavonoid		$C_{28}H_{32}O_{15}$	Anti-inflammatory activity	Huang *et al.*, 2024

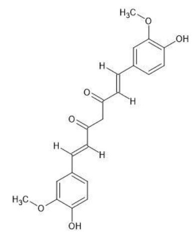
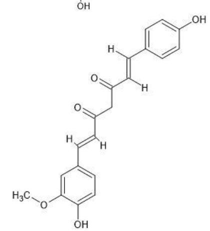
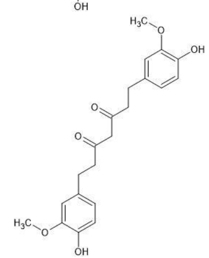
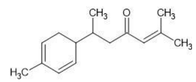
To be continued...

Table 3. Identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus, C. longa, Z. officinale*, and *P. betle (continued)*

Compounds	*Class*	*Chemical structure*	*Molecular formula*	*Bioactivities*	*References*
Spiro [2,4,5,6,7,7a-hexahydro-2oxo-4,4,7a-trimethyl-benzofuran]-7,2' -(oxirane)	-		$C_{12}H_{16}O_3$	Antimicrobial activity	Prabha & Kumar, 2021
9-octadecenoic acid (Z), phenylmethyl ester	Oleic acid		$C_{25}H_{40}O_2$	Antimicrobial activity	Prabha & Kumar, 2021
Shyobunone	Sesquiterpene		$C_{15}H_{24}O$	Antioxidant activity	Parki, Chaubey & Prakash, 2017
α-asarone	phenylpropanoid		$C_{12}H_{16}O_3$	Antioxidant and anti-inflammatory activities	Parki *et al.*, 2017; Saldanha *et al.*, 2020
Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- or γ asarone	Phenyl propene		$C_{12}H_{16}O_3$	Antimicrobial, antioxidant, and anti-inflammatory activities	Prabha & Kumar, 2021

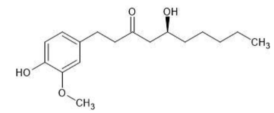
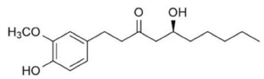
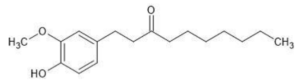
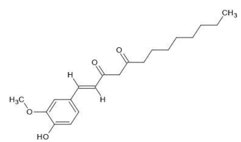
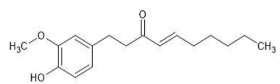
To be continued...

Table 3. Identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus, C. longa, Z. officinale*, and *P. betle (continued)*

Compounds	*Class*	*Chemical structure*	*Molecular formula*	*Bioactivities*	*References*
Curcuma longa Curcumin	Polyphenol		$C_{21}H_{20}O_6$	Antimicrobial, antioxidant, anti-inflammatory, antiulcer, and gastroprotective properties	Yadav *et al.*, 2013
Tetrahydrocurcumin	Polyphenol		$C_{21}H_{24}O_6$	Anti-inflammatory and antioxidant activities	Sandur *et al.*, 2007; Yadav *et al.*, 2013
Demethoxycurcumin	Polyphenol		$C_{20}H_{18}O_5$	Anti-inflammatory and antioxidant activities	Sandur *et al.*, 2007; Yadav *et al.*, 2013
Turmerones	Sesquiterpene		$C_{20}H_{18}O_5$	Anti-inflammatory and antioxidant activities	Guo *et al.*, 2008

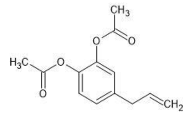
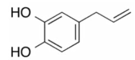
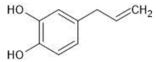
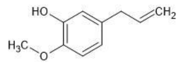
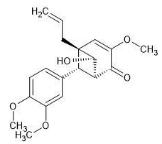
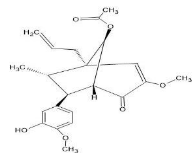
To be continued...

Table 3. Identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus, C. longa, Z. officinale*, and *P. betle (continued)*

Compounds	*Class*	*Chemical structure*	*Molecular formula*	*Bioactivities*	*References*
Bisdemethoxycurcumin	Polyphenol		$C_{19}H_{16}O_4$	Anti-inflammatory and antioxidant activities	Sandur *et al.*, 2007
Zingiber officinale					
6-gingerol	Phenylpropanoid		$C_{17}H_{26}O_4$	Analgesic, anti-inflammatory, antioxidant and intestinal protective effects	Promdam & Panichayupakaranant, 2022
6-shogaol	Phenylpropanoid		$C_{17}H_{24}O_3$	Anti-inflammatory, antioxidant and antiulcer effects	Wang *et al.*, 2011
6-paradol	Phenolic ketone		$C_{17}H_{26}O_3$	Anti-inflammatory, antioxidant and antiulcer effects	Rafeeq *et al.*, 2021
Dehydro-10-gingerdione	Hydrocinnamic acid		$C_{21}H_{30}O_4$	Anti-inflammatory activity	Ullah *et al.*, 2022

To be continued...

Table 3. Identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus, C. longa, Z. officinale*, and *P. betle (continued)*

Compounds	*Class*	*Chemical structure*	*Molecular formula*	*Bioactivities*	*References*
Piper betle					
4-Allyl-1,2 Diacetoxybenzene	Cinnamic acid		$C_{13}H_{14}O_4$	Antimicrobial and antioxidant activities	Jantorn *et al.*, 2023
Hydrochavicol	Allylbenzene		$C_9H_{10}O_2$	Antimicrobial, antioxidant, and anti-inflammatory	Singh *et al.*, 2018
Allypyrocatechol	Polyphenol		$C_9H_{10}O_2$	Hepatoprotective, anti-inflammatory, anti-thyroid, antioxidative, and antiulcer activities	Panda *et al.*, 2019b
Chavibetol or eugenol	Terpenoid		$C_{10}H_{12}O_2$	Antioxidant, anti-thyroid and anti-carcinogenic activities	Alam *et al.*, 2013; Panda *et al.*, 2019a
Piperbetol	Polyphenol		$C_{22}H_{26}O_6$	Anti-inflammatory and cardioprotective activities	Ahmad, Wani & Ahmed, 2023
Piperol A	Polyphenol		$C_{20}H_{24}O_5$	Antioxidant and antimicrobial activities	Murugesan *et al.*, 2020

inflammation (El-Zimaity & Riddell, 2013). Additionally, prolonged use of non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin or ibuprofen, as well as excessive alcohol consumption, can irritate the stomach lining and contribute to gastritis (Glickman & Antonioli, 2001).

Phytochemical studies of sweet flag have revealed a diverse array of compounds, including glycosides, flavonoids, saponins, tannins, and polyphenolic compounds. In addition to these, reports indicate the presence of glucosides, alkaloids, and essential oils containing calamen, clamenol, calameon, asarone, and sesquiterpenes. Notably, a bitter glycoside named acorine, along with eugenol, pinene, and camphene, can also be found in sweet flag (Bhat *et al.*, 2012). Meanwhile, turmeric's most significant bioactive component is curcumin, a phenolic compound representing 70-75% of its total composition. It is accompanied by demethoxycurcumin (10-25%) and bisdemethoxycurcumin (5-10%) (Varma *et al.*, 2022). Ginger, rich in active constituents, boasts a variety of phenolic and terpene compounds. The principal phenolic compounds in ginger are gingerols, shogaols, and paradols, with 6-gingerol, 8-gingerol, and 10-gingerol being the major polyphenols found in fresh ginger (Shahrajabian *et al.*, 2019). On the other hand, betel leaf is composed of a multitude of bioactive compounds, with tannins, flavonoids (including quercetin), eugenol, hydroxychavicol, and chavibetol being the primary constituents of this plant (Nayaka *et al.*, 2021). The identified bioactive compounds that are responsible for the anti-gastritis activity of *A. calamus*, *C. longa*, *Z. officinale*, and *P. betle* are summarised in Table 3.

Based on a previous study involving *A. calamus, C. longa, Z. officinale,* and *P. betle*, several mechanisms of action are suggested for the treatment of gastritis. These plants possess anti-inflammatory properties attributed to bioactive compounds such as curcumin in *C. longa* and gingerol in *Z. officinale* (Azeez & Lunghar, 2021), which inhibit pro-inflammatory cytokines and enzymes, effectively reducing inflammation in the gastric mucosa (Mao *et al.*, 2019). These plants also exhibit antioxidant activities, containing antioxidant compounds that scavenge free radicals and mitigate oxidative stress (Kausalya *et al.*, 2017). By protecting the gastric mucosa from oxidative damage, these plants contribute to the prevention and management of gastritis. Aside from that, compounds like curcumin and gingerol found in these plants demonstrate anti-*H. pylori* activity, which is a bacterium commonly associated with gastritis (Prasad, Devi & Prasad, 2019), potentially aiding in combating the infection and reducing gastritis symptoms (Guerra-Valle, Orellana-Palma & Petzold, 2022).

Additionally, the mentioned plants possess cytoprotective properties that help maintain the integrity and function of the gastric mucosa. This effect involves enhancing mucus production, increasing the secretion of protective prostaglandins, and promoting gastric mucosal healing. These plants may also regulate gastric acid secretion, potentially reducing excessive acid production that can contribute to gastritis symptoms (Shu *et al.*, 2018). Moreover, certain compounds present in these plants, such as gingerol, have gastroprokinetic effects, improving gastric motility. This aids in the emptying of the stomach and alleviates symptoms of dyspepsia associated with gastritis (Czigle *et al.*, 2022). It is important to emphasise that while these mechanisms have been studied and are associated with the mentioned plants, further research is necessary to fully understand their effects on gastritis and establish their clinical efficacy.

Toxicity and safety concerns

Several studies on the toxicity of *A. calamus* have been conducted, but no conclusive evidence is yet available. No significant changes were noticed in rats exposed to acute and subacute toxicity of the hydro-alcoholic extract of *A. calamus* at the maximum dose level of 10 g/kg, and the lethal dose (LD_{50}) was discovered to be 5 g/kg (Muthurahman & Singh, 2012). Bhat *et al.* (2012) found that 2000 mg/kg of raw and purified *A. calamus* did not cause any toxic effects within 14 days of oral administration in albino rats. Liu *et al.* (2013) reported that β-asarone from *A. calamus* showed no behavioural changes in BALB/c mice within 24 hours of treatment. The LD_{50} of β-asarone was 1.56 g/kg, while 5-FU's was 250 mg/kg, indicating that it might be safe for clinical application. In addition, they conducted a 90-day long-term toxicity test at doses of 10, 20, and 50 mg/kg/d, and the findings revealed a dose-dependent toxicity with an increase in the number of white blood cells (WBC) and a reduction in the number of red blood cells (RBC) at 10 mg/kg.

Toxicity evaluations of turmeric were done in several investigations. Aggarwal *et al.* (2016) did not observe any toxic effects in rats receiving turmeric at 5000 mg/kg. In a clinical trial with 207 irritable bowel syndrome (IBS) patients, daily doses of 72 or 144 mg of turmeric extract for 8 weeks caused no serious side effects, though ~25% reported mild symptoms like flatulence and dry mouth (EFSA ANS Panel, 2010). A recent study examining a polyherbal formulation containing five herbs, including two *Curcuma* species, revealed that this formulation demonstrated promising anti-inflammatory properties without any toxic effects in the acute and subacute oral toxicity tests on female Sprague-Dawley rats (Mohamad *et al.*, 2022). Furthermore, an additional study involving the inclusion of a *Curcuma* species in the polyherbal formulation demonstrated the absence of toxicity, specifically in terms of cardiotoxicity, neurotoxicity, and mutagenicity effects (Abdul Majid *et al.*, 2022; Zainol *et al.*, 2021).

Ginger is also generally considered a safe herbal medicine with a dosage of below 1500 mg per day, but excess intake (>6 g) can cause stomach discomfort, acid reflux, and diarrhoea (Rong *et al.*, 2009; Sheikh *et al.*, 2023). In a previous research, ginger extract was given to pregnant rats for 10 days at dosages of 100, 333, and 1000 mg/kg throughout the organogenesis phase. The results showed no maternal or developmental defects, supporting the claim that modest consumption among pregnant women is normally safe (Weidner & Sigwart, 2001). In a separate 13-week study, Wistar rats showed no adverse effects from daily oral doses of ginger oil up to 500 mg/kg (Idang *et al.*, 2019). However, long-term use may pose risks, as continuous exposure in mice led to organ toxicity and oxidative stress (Jeena, Liju VB & Kuttan, 2011), highlighting the need for caution with prolonged or high-dose use.

Betel leaf extract was administered to guinea pigs at dosages of 100 and 200 mg/kg during an acute toxicity test. The results revealed that the extract did not induce death within 24 hours; however, dosages of more than 300 mg/kg exhibited 50% mortality, suggesting that doses between 100 and 200 mg/kg are safe (Hajare *et al.*, 2011). In another investigation, the extract also did not cause mortality after 24 hours, even when taken orally in doses up to 3200 mg/kg. On the other hand, when *P. betle* extract was administered to mice's livers, Choudhary and Kale found no evidence of toxicity, which was corroborated by the absence of any potentiation of lipid peroxidation (Choudhary & Kale, 2002). Although *P. betle* and its derivatives are "generally recognised as safe" (GRAS) (Weidner & Sigwart, 2001) and the 21-day trial showed no harm to organs like the liver or kidneys, caution is still advised for pregnant and breastfeeding women.

Limitations

Current evidence shows limited clinical studies, which might be due to small sample sizes and short study periods, highlighting the need for more robust clinical trials in the future. This study acknowledges several limitations inherent to bibliometric analyses. Firstly, the use of a single database (Scopus) may have resulted in the omission of relevant publications indexed elsewhere. However, Scopus was selected for its broad coverage and comprehensive indexing of journals across disciplines. Secondly, the analysis was also limited to English-language articles to maintain consistency and avoid translation bias, which may have excluded studies published in other languages, particularly from regions where these herbs are traditionally used. In addition, the search strategy focused specifically on the term "gastritis" to ensure specificity, though this may have excluded research on related gastric disorders that were described using broader terminologies. Lastly, while bibliometric analysis provides valuable insights into publication trends and research collaborations, it does not evaluate the methodological quality or clinical significance of individual studies.

CONCLUSION

The exploration of *A. calamus*, *C. longa*, *Z. officinale*, and *P. betle* as potential therapeutic agents for gastritis treatment through herbal teas presents a promising avenue in the field of natural medicine. The utilisation of bibliometric analysis provides a comprehensive understanding of the historical and recent advancements of these plants for gastritis treatment. Notably, publications in journals like the Journal of Ethnopharmacology have served as vital platforms for disseminating research findings in this field. The collaborative efforts among researchers from various countries signify the global interest in understanding the therapeutic potential of these herbs. The identified gastroprotective mechanisms, including anti-inflammatory, antioxidant, and anti-*H. pylori* activities, highlight the potential efficacy of these herbal remedies in alleviating gastritis symptoms. Nonetheless, while the findings suggest promising therapeutic benefits, it is essential to address potential herb-drug interactions and safety concerns associated with prolonged use. Given the numerous health benefits of these plants, further research is warranted, particularly on exploring the potential of combining these plants into a herbal tea formulation known as "Lega Tea" (Relief Tea).

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Authors' contributions

Fadhlina A, prepared the draft of the manuscript and reviewed the manuscript; Zakaria NH, data interpretation and reviewed the manuscript; Abdul Majid FA, conceptualised and designed the study; Sheikh HI, assisted in data analysis and drafting of the manuscript; Hairani MAS, assisted in drafting of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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