UJMR, Conference Special Issue Vol. 9 No. 3. June, 2024, pp. 518 - 549
E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

https://doi.org/10.47430/ujmr.2493.059

Received: 12 March 2024 Accepted: 24 June 2024

Phytochemistry and Biological Activities of Ethnopharmacological Plants Widely Used in the Treatment of Pectic Ulcer Diseases

Abdullahi Ibrahim Dalhatu[1], *Bahauddeen Salisu Dandashire[2], Mukhtar Gambo Lawal[3] and Ibrahim Lawal[4]

[1,4]Department of Microbiology, Al-Qalam University Katsina, Katsina, Nigeria
[2,3]Department of Microbiology, Umaru Musa Yaradua University, Katsina, Nigeria
*Correspondence author: bahauddeen.salisu@umyu.edu.ng,

Abstract

The common gastrointestinal ailment known as peptic ulcer is characterized by damage to the stomach and duodenum's mucosal integrity, mostly as a result of an unbalanced interaction between mucus production and other defensive systems and aggressive elements like gastric acid. Pain, loss of appetite, bloating, nausea, perforations, weight loss, bloody stools, or vomiting are some of the signs that identify the condition. The necessity for efficient treatment plans is highlighted by the rising incidence of peptic ulcers, which is made worse by conditions including Helicobacter pylori infection and NSAID use. Herbal drugs are emerging as alternative remedies for various health conditions. With an emphasis on the bioactive chemicals and pharmacological properties of these plants, this review investigates the therapeutic potential of medicinal plants in the management of peptic ulcers. A PRISMA-compliant systematic review was carried out to evaluate the anti-ulcerogenic qualities of a variety of medicinal plants. We looked through scientific databases, including PubMed, Scopus, and Google Scholar, to find pertinent research that was published between 2010 and 2024. Terms like "peptic ulcer," "anti-ulcer plants," "plant-derived drugs for peptic ulcer," "herbal drugs," and "phytomedicine for peptic ulcer" were used in the search. Thirty-three (33) full-text articles out of 2,650 entries that were examined and found to match the inclusion criteria were included. Plant species, bioactive chemicals, and their proven effects on peptic ulcers in preclinical research were the main topics of data extraction. This review highlights the many modes of action and therapeutic applications of the several medicinal plant extracts that have been connected to anti-ulcer properties. The ethnobotanical plants were discovered to be a rich source of phytochemicals, including flavonoids, alkaloids, tannins, simple phenols, and saponins. Numerous therapeutic plants with potent anti-ulcerogenic, anti-inflammatory, and antibacterial qualities have been found to exist, such as Curcuma longa, Moringa oleifera, and Allium sativum. These plants improve mucosal defence systems, lower stomach acid output, control inflammatory mediators, and inhibit H. pylori, offering considerable therapeutic potential. More research is required to fully understand the medical potential of these natural medicines, as the findings show that they can successfully complement current treatments for peptic ulcers, lowering dependency on synthetic pharmaceuticals and minimizing associated adverse effects.

Key words: Peptic ulcer; Medicinal Plants, Bioactive compounds, Anti-ulcer activity

INTRODUCTION

According to Khanpara and Mavani (2022), ulcers are lesions on the skin or mucous membrane that are characterized by the shedding of inflammatory dead tissue; although they can form anywhere, they usually first appear on the skin of the lower limbs or within the gastrointestinal system (Sari and Suryawati, 2023). While bigger ulcers may cause substantial bleeding, smaller ulcers usually show few symptoms (Laine *et al.*, 2021). Typical warning signs include upper abdominal burning, bloating, vomiting, blood in the stools, weight loss that doesn't make sense, and changes in appetite (Paul *et al.*, 2021). There are known to be several different kinds of ulcers, including peptic, vaginal, esophageal, and oral ulcers (Jaiswal *et al.*, 2021).

The term "peptic ulcer," or "PU," refers to a group of long-term illnesses that impact the stomach and/or duodenal lining's mucosal integrity (Gad *et al*., 2023). According to Yang *et al*. (2021), it is still a common cause of gastrointestinal morbidity and mortality. A peptic ulcer is characterized as a lesion of the stomach, duodenum, and occasionally the lower esophagus's mucosal lining (Sisay *et al*., 2021). Epigastric pain, perforations, bloating, nausea, blood in the stool or vomit, decreased appetite, and weight loss are some of the symptoms that characterize this illness (Anaemene and Ochogu, 2022). It was once thought that the damaging effects of pepsin and hydrochloric acid (HCl) on the mucosa were the main cause of ulcers in the upper digestive tract (Beiranvand, 2022). However, a number of variables are now known to be predisposing factors for the development of peptic ulcers, including alcohol consumption, smoking, the use of NSAIDs and non-NSAIDs, Helicobacter pylori infections, a stressful lifestyle, and genetic factors (Jaiswal *et al*., 2021; Singh and Easwari, 2022). Peptic ulcer disease is thought to be caused by an imbalance between factors that act aggressively, like hydrochloric acid (HC), pepsin, reactive oxygen species (ROS), refluxed bile, leukotriene, and cell renewal and migration, and factors that support and protect the mucosa, like mucus, bicarbonate barrier, prostaglandin, cell renewal and migration, surface-active phospholipids, optimal blood supply, and certain growth factors (Asali *et al*., 2018; Abd_Elhamid *et al*., 2021).

"Gastric ulcer" and "duodenal ulcer," so termed because of where the ulcers occur, are the two main forms of peptic ulcers (Jaiswal *et al*., 2021). Duodenal and stomach ulcers can occur in the same person at the same time (Abbass *et al*., 2020). Painful lesions called gastric ulcers develop in the stomach, and they are particularly prevalent among individuals around the aged of 50, especially women; contrary to easing the pain, eating might exacerbate it (Elbeltagi *et al*., 2023). Additional symptoms include nausea, vomiting, and weight lost (Bereda, 2020). Despite normal or decreased acid production in patients with stomach ulcers, ulcers can still develop in the absence of acid (Jaiswal *et al*., 2021). Duodenal ulcers tend to be more prevalent among younger individuals; the primary factor contributing to the development of duodenal ulcers is excessive acid production (Kim, 2022), as several studies have indicated a clear association between the development of duodenal ulcers and the stomach's increased production of hydrochloric acid. (Herszényi *et al*., 2020). Peptic ulcers can also be classified into two main types based on their severity: acute peptic ulcers and chronic peptic ulcers (Saidovich, 2023). Acute peptic ulcers involve damage or perforation that extends through thelamina muscularis mucosa, without progressing beyond the submucosa (Kővári *et al*., 2022). Stress, such as brain damage (Cushing's ulcer) associated with severe burns and increased intracranial pressure (Curling's ulcer), is the primary cause of acute ulcers (Kumaria *et al*., 2023). In contrast, chronic ulcers affect a larger area, extending through the muscularis propria and originating in the organ's serosal layer or beyond the gastrointestinal tract itself (Aljezani *et al*., 2023); this category includes ulcers found in the stomach and duodenum (Bereda, 2022).

Peptic ulcer disease poses a global health challenge as a result of its significant impact on health, mortality rates, and economic consequences, in addition to a high incidence of *Helicobacter pylori* infection (Shatila and Thomas, 2022). It stands as one of the most commonly widespread gastrointestinal disorders in the globe, affecting approximately 10–15% of the population (Roy *et al*., 2023). Duodenal ulcers make up the majority, accounting for 95% of all peptic ulcers (Lin *et al*., 2022). The yearly toll from peptic ulcers includes an estimated 15,000 deaths (Li *et al*., 2023). Incidence rates for peptic ulcer bleeding and perforation range from 19.4 to 57 and 3.8 to 14 per 100,000 people, respectively (Srivastav *et al*., 2023). The long-term perforation recurrence rate is 12.2% on average, whereas the seven-day bleeding recurrence rate is 13.9% on average (Danilo and Leanza, 2022). Notably, surgical interventions in Sub-Saharan Africa revealed that 86% of patients had duodenal ulcers, with the remaining 14% having gastric ulcers. Surgery was indicated for significant side effects such as bleeding (7%), chronic instances (28%), blockage (30%), and perforation (35%), resulting in an overall fatality rate of 5.7% (Shivachi, 2022).

Herbal medicines are increasingly used in situations where long-term drug use is required, as they are cost-effective, efficient, and readily available (Putra *et al*., 2023). It is acknowledged that extracts from natural goods, such as medicinal herbs, are excellent sources of therapeutic agents for treating peptic ulcers, with numerous studies supporting their antiulcer activity (Beiranvand, 2022; Mazumder *et al*., 2021). Presently, numerous individual components extracted from plant materials have been identified, and their pharmacological activity has been assessed; among these components, natural polyisoprenoids, carotenoids, various terpenoids, saponins, phenolic compounds, flavonoids, and alkaloids have been identified as possessing antiulcer properties through pharmacological tests (Djanaev *et al.*, 2022). The transmission of ethnopharmacological and botanical insights through oral traditions has been a longstanding practice in Africa. This traditional knowledge passed down across successive generations, holds invaluable information about the therapeutic uses of medicinal plants. However, the reliance on oral traditions poses a risk of loss over time. Systematic documentation is crucial to preserve this rich traditional knowledge for the benefit of current and future generations (Courric *et al.*, 2023).

The present review aims to summarize the bioactive principles of different therapeutic plants that are frequently employed in the ethno-pharmacological management of peptic ulcer disorders, providing evidence for their effectiveness and pharmacological activities in various preclinical studies.

METHODOLOGY

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were followed in this comprehensive review, as adopted by Salisu *et al.* (2021), and followed the protocol unanimously approved by all contributors. The scope encompassed scientific publications that presented information on the use of traditional medicinal plants for peptic ulcer disease treatment. Exclusions comprised non-English studies abstracts lacking full text, and no limitations were imposed on sample size. The study included both in vitro and in vivo models to evaluate the anti-peptic ulcer effectiveness of medicinal plants. Additionally, investigations carried out on related pharmacological activities that did not align with the specified in vivo or in vitro models mentioned earlier were also included. A total of fourteen years' (2010 to 2024) worth of relevant publications that satisfied the review paper's inclusion requirements were obtained from a number of databases, including Scopus, PubMed, Google Scholar, Scientific Information Database, Research Gate, Science Direct, PubMed and Elsevier. The primary search phrases employed included "Plant names and *Helicobacter pylori*", Plant names and peptic ulcer", Plant names and anti-peptic ulcer", "Plant names and gastric ulcer," and "Plant names and duodenal ulcer". The gathered data was subjected to thorough filtration to ensure its relevance to the specified topic. The systematic "snowballing" technique guidelines adopted by Ziogas *et al.* (2021) were used to manually search for papers that were missing in the reference lists of the research included in the systematic review.

Record Selection and Inclusion Strategy

The present review followed a systematic approach for database search, selection, and inclusion. A total of 2,650 records were gathered from diverse sources. Research articles from different databases were initially organized and screened for duplicates based on titles. Subsequently, titles and abstracts were scrutinized to eliminate records with incorrect subjects or outcomes. Finally, the full-text articles were further screened to exclude irrelevant data, resulting in the inclusion of 33 full-text records in this review.

Data Extraction and Tabulation

Data extraction and tabulation, along with quality assessment of eligible studies, were conducted using standardized, pre-tested forms as adopted by Ziogas *et al.* (2021). The extracted information from the included studies encompassed information on plant name, family, global cultivation and distribution, extracts, phytochemical constituents, pharmacological activities, and anti-ulcer activities. All the information extracted was recorded and summarized in Tables 1, 2, and 3.

RESULT

Medicinal Plants used in the Conventional Treatment of Peptic Ulcer

Over 1.5 million traditional medicine practitioners use medicinal plants for preventative, promotional, and curative purposes; they are essential to the production of effective therapeutic substances (Walia *et al.*, 2020). In developing and underdeveloped societies, there is a considerable demand for plant-based medicines as a primary healthcare resource, given their extensive biological and medicinal properties, high safety profiles, and cost-effectiveness (Ahmed *et al.*, 2021). A total of twenty (20) medicinal plants documented in the past 14 years (2010 to 2024) have been identified in this review. The recognized plants, along with their phytochemical constituents and biological activities, are as follows:

Curcuma longa

Turmeric, or *Curcumalonga*, is an annual herb with big oblong leaves and a tiny stem. The rhizomes of the plant can be oval, elliptical, or pyriform; they can branch periodically and have a brownish-yellow color (Jyotirmayee and Mahalik, 2022). The plant belonging to *Zingiberaceae* family contains curcumin (sometimes referred to as diferuloylmethane), the principal naturally occurring polyphenol found in its rhizome (Rahaman *et al.*, 2020). *Curcuma longa* is cultivated primarily in countries such as Nigeria, Australia, Taiwan, Myanmar, China, Sri Lanka, Jamaica, Peru, Bangladesh, the West Indies, and other Caribbean and Latin American nations (Jyotirmayee and Mahalik, 2022).

Research result indicates that turmeric, whetherin the form of extract, isolated compound, or powder, exhibits a diverse range of pharmacological activities (Umar *et al.*, 2020). In traditional and herbal medicine, turmeric finds applications in addressing various health issues, such as urinary tract infections, chronic anterior uveitis, skin cancer, smallpox, chickenpox, rheumatoid arthritis, wound healing, liver ailments, conjunctivitis, overall body energy enhancement, gallstone dissolution, menstruation regulation, wound cleansing, worm expulsion, and digestive disorders (Rathore *et al.*, 2020).

Diverse animal models, including cysteamine-induced ulcers, stress, indomethacin, ethanol, and pyloric ligation, were employed in some preclinical studies to extensively assess the anti-ulcer properties of *curcumin* (Gupta *et al.*, 2021). Prior administration of the *curcumin* extract has demonstrated significant protection against agents causing cysto-destructive effects (Günbatan, 2022). It is expected that a significant rise in stomach wall mucus and the restoration of glutathione levels and non-protein sulfhydryl content in rats will provide gastro-protective effects (Fayez *et al.*, 2023). The inhibition of the cyclooxygenase enzyme and the reduction in levels of inflammatory mediators (ILs and TNF) have been identified to contribute to the anti-inflammatory properties of turmeric (Gandhi *et al.*, 2022).

Figure 1: *Curcuma longa* root

Figure 2: *Curcuma longa* plant

Trema orientalis

Trema orientalis, a perennial shrub from the *Ulmaceae* family, is indigenous to South Africa, tropical Asia, and Australia, with a widespread global distribution (Al-Robai *et al.*, 2022). The generic term originates from the Greek word "Trema", signifying hole, puncture, or pitted seeds, while the species name finds its roots in the Latin word "orientalis," meaning eastern (Niranjan *et al.*, 2023). *Trema orientalis* thrived in lowland humid tropics; it is one of the early trees to develop on nutrient-starved, flood-prone, and arid terrain (Niranjan *et al.*, 2023). The plant is widely referred to by a number of names, including Indian nettle tree, gunpowder tree, pigeon wood, hop out, and nettle tree (Appau *et al.*, 2023). The leaves and roots of this shrub contain a variety of phytochemicals, such as flavonoids, phenolics, alkaloids, cardiac glycosides, steroids, terpenoids, tannins, coumarins, and flavonoids (Chowdhury *et al.*, 2018). After analyzing the plant's stem bark, identified chemicals like trematol, scopoletin, methylswertianin, 2α, 3ß-dihydroxyurs-12-en-28-oic acid, and p-hydroxybenzoic acid were found (Kumadoh *et al.*, 2021).

Flavonoids from*Trema orientalis*, identified as cytoprotective agents, have been extensively verified for their antiulcerogenic efficacy; these active substances produce more mucus, stimulate the secretion of prostaglandin and bicarbonate, have antioxidant qualities, and prevent the growth of *H. pylori*, protecting the gastrointestinal mucosa against a variety of ulcerogenic agents (Kanase *et al.*, 2019). Research has shown that plant phytosterols, particularly a fraction containing β-sitosterol as a major component, exhibit gastroprotective effects and demonstrate anti-peptic ulcer activity (Ahmed *et al.*, 2021).

In a study using Wistar rats and an ethanol-induced ulcer model, the ethanolic leaf extract of *Trema orientalis* displayed significant gastroprotective activity, comparable to pantoprazole (Kanase *et al.*, 2019). According to Kumadoh *et al.* (2021), Uddin *et al.* (2022) found that when *Trema orientalis* ethanolic leaf extract was compared to pantoprazole and controls at dosages of 100 mg/kg, 150 mg/kg, and 200 mg/kg, there was a dose-dependent decrease in ulcer index.

Figure 3: *Trema orientalis*

Maytenus robusta Reissek

Maytenus robusta Reissek plant belonging to the *Celastraceae* family contains a pentacyclic triterpenoid called Friedelin (Camargo *et al.*, 2022); the anti-inflammatory, anti-allergic, gastroprotective, and anti-cancer properties of this bioactive compound, Friedelin have all been reported (Huda *et al.*, 2023).

In a model involving acetic acid-induced ulcers, histopathological analysis indicated that *Maytenus robusta* treatment reduced ulcer size and enhanced the regeneration of gastric mucosa compared to the control group (Meurer *et al.*, 2022; Paricharak *et al.*, 2021). Another investigation by Shipa *et al.* (2022) revealed that the aqueous leaf extract of *Maytenus robusta* demonstrated antiulcer effects comparable to omeprazole. Similarly, preclinical studies showed that *Maytenus robusta* has gastroprotective properties against ulcers caused by ethanol and nonsteroidal anti-inflammatory medication (Ahmed *et al.*, 2021).

Phytochemical analyses have indicated the abundance of pentacyclic triterpenes in *Maytenusrobusta* (Sharifi-Rad *et al.*, 2018). Consequently, pentacyclic triterpenes in *Maytenus robusta* have been shown to stimulate mucus synthesis and prostaglandin secretion, strengthening the gastric mucosa's defense mechanisms and contributing to the favorable effects of the plant on gastric health (Sharifi-Rad *et al.*, 2018). Nonetheless, other phytochemicals, including flavonoids and steroids, may have also contributed to the plant's antiulcer properties (Sharifi-Rad *et al.*, 2018).

Figure 4: *Maytenus robusta Reissek*

Mangifera indica

The tropical fruit tree known as *Mangifera indica*, commonly referred to as the "mango tree," is extensively cultivated globally (Bura *et al.*, 2023). This plant stands out due to its distinctive flavor, hue, fragrance, and nutritional attributes (dos Santos Pinto *et al.*, 2021). The mango tree, belonging to the *Anacardiaceae* family, contains various bioactive compounds, including vitamins (A, B6, C, and E), polyphenols (mangiferin, gallotannins, quercetin, isoquercetin, ellagic acid, glucogallin, kaempferol, catechins, tannins, and the unique xanthonoid), flavonoids (β-carotene, α-carotene, β-cryptoxanthin, lutein), organic acids, fats (omega-3 and 6 polyunsaturated fatty acids), carbohydrates, phenolic acids such as hydroxybenzoic acids (gallic, vanillic, syringic, protocatechuic, and p-hydroxybenzoic acids) and hydroxycinnamic acid derivatives (p-coumaric, chlorogenic, ferulic, and caffeic acids), micronutrients (potassium, copper), amino acids, and certain volatile compounds (Rajasekaran and Soundarapandian, 2023).

The mango is a rich reservoir of vital nutrients and phytochemicals, serving as a potential nutritional supplement for preventing and treating a range of medical conditions (Choudhary *et al.*, 2023). The leaf extract is employed in various biological applications, such as its immunomodulatory, anti-inflammatory, hepatoprotective, anti-microbial, anti-diabetic, and anti-allergic properties (Ain *et al.*, 2023). *Mangifera indica* has been recognized for providing gastro-protection against gastric ulcers as a result of its antisecretory, antioxidative, and cytoprotective properties (El-Hawary *et al.*, 2020). When the leaf extract was tested on rats using the pylorus ligation ulcer model, the ulcer index significantly decreased when compared to the standard medication ranitidine. This finding raises the possibility that the combination of different secondary metabolites found in the plant leaves is what gives *Mangifera indica* extracts their gastro-protective properties (Boakye-Yiadom *et al.*, 2021). Traditionally, it has been employed for the treatment of ulcers (Paradee *et al.*, 2023). Recent research involved treating rats with stomach lesions with several doses (250, 500, and 1000 mg/kg) of the flower decoction orally in a dose-dependent manner; the results showed a considerable decrease in the amount and acidity of gastric juice as a result of the extract (Fraga *et al.*, 2019).

Boakye-Yiadom*et al.* (2021) reported that pretreatment with 250, 500, and 1000mg/kg In models of stress-induced and hydrochloric/ethanol stomach ulcers, the decoction of *Mangiferaindica* also showed a significant decrease in the ulcer index. This decrease could be ascribed to decreased acid production, inhibition of reactive oxygen species production, prevention of ethanol from passing through the stomach membrane, and increased production of bicarbonates and mucus, contributing to the antiulcer effects of *Mangifera indica*.

Figure 5: *Mangifera indica*

Moringa oleifera

The plant known as *Moringa oleifera*, belonging to the *Moringaceae* family, is often known as the "horse radish tree" or "drumstick" (Joshi and Pandit, 2023). It is also known by certain regional names such as marango, “miracle tree”, saijhan, mulangay, kelor, mlonge, benzolive, nébéday, and sajna (Sarode *et al.*, 2023). This plant naturally thrives in regions such as Arabia, Africa, Pakistan, the Western Hemisphere, the sub-Himalayas, Asia Minor, and India (Awuchi *et al.*, 2023). This plant contains various compounds like kaempferom, zeatin, flavonoids, saponin, terpenoids, tannins, quercetin, and alkaloids (Ibelegbu *et al.*, 2023). Various components within *Moringa* preparations have been identified for their reported hypotensive, anticancer, and antibacterial properties. Examples of these components include niazimicin, pterygospermin, 4-(α-L-rhamnopyranosyloxy)benzyl isothiocyanate, 4-(4'-O-acetyl-α-L-rhamnopyranosyloxy)benzyl isothiocyanate, and 4-(α-L-rhamnopyranosyloxy)benzyl glucosinolate (Hamza and Azmach, 2017).

Moringa oleifera is traditionally used for the treatment of ulcers; to treat stomach ulcers, for instance, Kani tribal people in Tamil Nadu's Pechiparai Hills utilize leaf tea (Khanpara and Mavani, 2022). In Pakistan, the flower buds of *Moringa oleifera* are consumed for their reputed antiulcer effects (Abdu and Ashiru Garba, 2021). Recent researches have demonstrated the protective effects of an ethanol extract of *Moringa oleifera* leaves when orally administered to rats with various induced stomach conditions, such as stomachs caused by the pylorus, stomachs caused by ethanol, stomachs caused by cold stress, and stomachs caused by aspirin. Following the administration of the extract, the results showed a decrease in the development of stomach ulcers as well as a decrease in the secretion of acid pepsin (Paricharak *et al.*, 2021; Yadav *et al.*, 2021; Awuchi *et al.*, 2023).

Figure 6: *Moringa oleifera*

Allium sativum

Garlic, scientifically known as *Allium sativum*, belonging to the *Liliaceae* family, has been utilized both as a culinary spice since ancient times and for its therapeutic properties in addressing various pharmacological conditions like ulcers, cancer, pain, hypertension, asthma, and infections (Ahmed *et al.*, 2022; Hamedi *et al.*, 2022; Vuković *et al.*, 2023). This plant contains starch, mucilage, albumen, sugar, and an acrid volatile oil that acts as an active ingredient. The seeds of the plant can be used to extract fragrant oil (Awuchi *et al.*, 2023). The juice of garlic contains important nutrients, vitamins, and naturally bound combinations of sulphur, iodine, and salicylic acid (Awuchi *et al.*, 2023).

The ability of garlic powder extract to control pro-inflammatory cytokine levels, such as interleukins (IL-10 and IL-1b) and tumor necrosis factor-alpha (TNF-a), is thought to be responsible for its anti-ulcer properties (Johny and Mishra, 2023). Pre-treatment with a methanolic extract of *Allium sativum* demonstrated a reduction in ulcer scores when comparing the treatment group to the control group, indicating its anti-ulcer properties (Kuna *et al.*, 2022). Studies show that at doses of 250 and 500 mg/kg, an oral extract of *Allium sativum* bulb juice shields rats against cysteamine-induced stomach ulcers; the extract also prevents experimentally induced duodenal and stomach ulcers in rats and greatly speeds up the healing process for gastric ulcers (Awuchi *et al.*, 2023). Garlic's therapeutic benefits are attributed to the existence of several allyl polysulphides, including diallyl trisulfide (allitridin), allyl methyl sulphide, and diallyl disulfide (Ozma *et al.*, 2023).

In a study conducted by Sharifi-Rad *et al.* (2019), it was observed that the use of allicin (800 mg/day) for 14 days did not result in the complete eradication of *H. pylori* infection among patients. However, an alternative approach involving the daily administration of 4.2 mg of allicin showed potential effectiveness in eliminating *H. pylori*. For the treatment of gastric *H. pylori* infection, raw garlic may be suggested in addition to conventional drugs due to its purported antibacterial qualities against *H. pylori* in the stomach (Gudalwar *et al.*, 2021). The extract of black garlic has been shown to enhance gastrointestinal motility by effectively increasing 5-HT4 content, thereby stimulating gastrointestinal peristalsis, promoting gastrointestinal tract emptying, and facilitating defecation (Chen *et al.*, 2018).

Figure 7: *Allium sativum*

***Spondia mombin Linn*.**

Spondia mombin, also referred to as yellow mombin, is a perennial tree that grows in Africa and America. It is a member of the *Anacardiaceae* family and is farmed for its oil, leaves, and fruits (Plabon *et al.*, 2021). *Spondia mombin*, a tropical plant that is mainly found in rainforest lowlands but has successfully evolved to flourish in drier locations, is widely known as "hog plum" in English-speaking tropical countries (Ogunro *et al.*, 2023). This deciduous fruit tree is widespread in various regions, including Nigeria (especially in the Southwestern areas), Bolivia, Mexico, Guianas, Peru, Ivory Coast, Colombia, Brazil, and Venezuela (Ogunro *et al.*, 2023). In traditional medicine, *Spondias mombin* is utilized to treat various ailments such as dysentery, stomach aches, discomfort, diarrhea, inflammation, hemorrhoids, and other health conditions (Idaguko and Adeniyi, 2023).

Kumadoh *et al.* (2021) reported that an investigation of the ethanolic extract of *Spondias mombin* identified specific compounds, such as gallic acid and ellagic acid; these compounds demonstrated antiulcer activity. In ulcer models generated by Indomethacin, ethanol, and acetic acid, gallic acid, in particular, showed anti-*H. pylori* action and maybe a synergistic impact with other elements of the ethanolic extract.

Oluwatoyin and Deborah (2019) used ibuprofen, alcohol, and pylorus ligation-induced ulcer animal models to report on the anti-peptic ulcer activities of the aqueous leaf extract of *Spondiamombin*. Oral administration of 50, 100, and 200 mg/kg of *Spondia mombin* leaf extract showed a non-dose-dependent antiulcer efficacy. 200 mg/kg provided the most percentage protection (90.60%), whereas 50 mg/kg demonstrated a percentage protection that was comparable to that of misoprostol (81.30% each).

The antiulcer activity in the ulcer model produced by pylorus ligation showed a dose-dependent pattern. A dosage of 200 mg/kg produced the greatest effect, offering 64.30% protection. The protection was marginally less but still considerable at 52.40% at a dosage of 100 mg/kg. Interestingly, omeprazole, the conventional medication, showed a lower level of protection (47.60%) than the extract given at 50 mg/kg (Kumadoh *et al*., 2021).

Figure 8: *Spondia mombin Linn*

Acacia arabica

Acacia arabica, also referred to as the "Babul tree," is a member of the *Mimoaceae* family (Balkrishna *et al*., 2022). Chemical investigation of this plant has revealed the following components: a gum with 14% moisture, 3-4% ash, potassium, magnesium, calcium, and arabic acid, along with a negligible quantity of malic acid (Mohiuddin, 2019). The bark is rich in tannin, while the pods contain approximately 22.44% each (Roy *et al*., 2023).

Acacia arabica can be employed as a gargle for hemorrhagic ulcers and wounds (Khatun *et al*., 2022). Additionally, when its delicate leaves are crushed into a poultice, they can serve as a stimulant and astringent for ulcers (Roy *et al*., 2023). Research has indicated that in rats subjected to cold restraint stress, the application of *acacia senegal* gum inhibited the development of stomach ulcers (Singh *et al*., 2022). Additionally, studies using an aqueous extract of *Acacia arabica* gum demonstrated protective benefits against meloxicam-induced intestinal damage and a decrease in the activity of intestinal enzymes (Al-Jubori *et al*., 2023).

Figure 9: *Acacia arabica*

Muntingia calabura

Muntingia calabura, belonging to the *Muntingiaceae* family, is a perennial shrub that can be found in tropical and subtropical regions of both America and Asia (Upadhye *et al*., 2021). Using an ethanol-induced stomach ulcer model in rats, a team of researchers led by Balan *et al*. (2015) investigated the preventative anti-ulcer capabilities of the methanolic extract derived from *Muntingia calabura* leaves. The study findings indicate that a dose-dependent decrease in gastric lesions and ulcer scores was observed upon pre-treatment with a methanolic extract derived from *Muntingia calabura* leaves. Gallic acid and volatile oils were found to be responsible for the observed reduction in nitric oxide, lipoxygenase, and xanthine oxidase as well as the maintenance of cell viability.

In a study carried out on rats with pyloric ligated ulcers, Zakaria *et al*. (2014) assessed the gastroprotective benefits of a methanolic extract derived from *Muntingia calabura*. The findings indicated a decrease in acidity and gastric content, coupled with an increase in mucus content, indicating that it may have anti-inflammatory, anti-secretory, and antioxidant properties. Moreover, tannins, squalene, saponins, and flavonoids (such as quercetin, rutin, and fisetin) were linked to the pharmacological actions of the *Muntingia calabura* extract.

Figure 10:*Muntingia calabura*

Maytenus senegalensis

Maytenus senegalensis, belonging to the *Celastraceae* family, is a perennial plant that can take the form of a shrub, typically reaching a height of up to 7-9 meters (Kumadoh *et al.*, 2021). It lacks thorns or may have spines measuring up to 7 cm, found either in the axils or at the tips of short axillary branches. The plant is smooth, devoid of latex, and its young branches are mostly unlined, often displaying a glaucous appearance (Da Silva *et al.*, 2011). In tropical Africa, *Maytenus senegalensis* is found in the Savannah regions, thriving in diverse habitats such as deciduous woodlands, thickets, scrub, wooded grasslands, as well as along riverbanks and swamp margins (Da Silva *et al.*, 2011).

The chemical makeup of *Maytenus senegalensis* consists of a range of substances, including tannins, flavonoids, glycosides, triterpenes, alkaloids, phenols, and saponins (Umar *et al.*, 2019). Research revealed various traditional medicinal applications of *Maytenus* senegalensis, treating ailments including helminth infections, rheumatism, cough, asthma, diarrhea, malaria, inflammatory illnesses, chronic wound healing, and dyspepsia (Owoyemi and Oladunmoye, 2017).

Several bioactive substances derived from *Maytenus senegalensis*, including phytosterols and epicatechin, play a significant role in promoting advantageous anti-ulcer effects. Haule *et al.* (2012) conducted an assessment of the antiulcer properties using an ethanol-induced model, employing a polyherbal extract that included *Maytenus senegalensis* in an animal model. Similar to pantoprazole, the extract showed a decrease in stomach mucosal lesions. One possible explanation for the decreased ulceration is the release of more gastric mucus, the stabilisation of the mucosal lining, and a decrease in acid distribution and gastric mucosal absorption. These findings align with the findings of Vecchia *et al.* (2022), who noted that the hydro-alcoholic extract of *Maytenus robusta* had antiulcer properties. At 500 mg/kg body weight, the extract lowered ulceration in a manner akin to that of omeprazole (30 mg/kg body weight), offering virtually equal levels of gastro-protection. Studies on the effects of *Maytenus senegalensis* on animal models revealed that its aqueous oral extract was generally harmless (Da Silva *et al.*, 2011; Ahmed *et al.*, 2013).

Jigam *et al.* (2020) analyzed the leaf extract of *Maytenus senegalensis*, demonstrating the existence of bioactive substances like phytol, 3,5,7-tetraen-carboxylic acid-methylester, 20α)-3-hydroxy-2-oxo-24-nor-friedela-1, 2(4H)-Benzofuranone, and 3-hydroxy-20-lupen-28-ol. These bioactive compounds, obtained from the leaf extract, exhibit potential for antiulcer activity and other pharmacological benefits.

Figure 11: *Maytenus senegalensis*

Stryphnodendron rotundifolium Mart

Stryphnodendron rotundifolium Mart., a member of the *Leguminosae* family, has been traditionally utilised in folk medicine to treat conditions like gynaecological difficulties, inflammation, injuries, and gastritis (Souza-Moreira *et al.*, 2018; Shipa *et al.*, 2022). The flavonoids found in *Stryphnodendron rotundifolium*, such as gallocatechin, rutin, catechin, and caffeic and gallic acids, are thought to have medicinal qualities (de Souza Ribeiro *et al.*, 2022). Preclinical investigations have demonstrated that prior administration of *Stryphnodendron rotundifolium* led to a reduction in glucose absorption and ulcer scores in Wistar rats, indicating its potential anti-ulcer effects (Demarque *et al.*, 2018).

Moreover, the hydroalcoholic extract of *Stryphnodendron rotundifolium* has been shown to mitigate gastric lesions in rat models induced by ethanol and indomethacin (Shipa *et al.*, 2022); this protective effect involves the activation of potassium channels and transient receptor potential cation channels, as well as a decrease in gastric lesions and motility, which is associated with the release of prostaglandins and nitric oxide (de Oliveira *et al.*, 2018). Additionally, the observed reduction in lipid peroxidation implies the beneficial impact of *Stryphnodendron rotundifolium* in conditions associated with oxidative stress (Salazar *et al.*, 2022).

Figure 12: *Stryphnodendron rotundifolium*

Oryza sativa

The popular name for the cereal grass *Oryza sativa*, a member of the *Gramineae* family, is rice, commonly referred to as paddy. Rice have starch content more than any other starchy grain, with minimal amounts of fat, protein, or minerals, as noted by Awuchi *et al.* (2023). Rice is a primary essential crop following wheat, providing sustenance for billions of individuals worldwide and earning the title of the global grain (Gómez de Barreda *et al.*, 2021). Cultivated on every habitable continent, rice demonstrates remarkable adaptability to diverse pedo-climatic conditions (Abbas *et al.*, 2021).

Oryza sativa contains numerous bioactive substances, such as carotenoids, anthocyanins, phenolic acids, flavonoids, proanthocyanidins, phytosterols, and γ-oryzanol. Extensive research has demonstrated their pharmacological activities, such as gastroprotective, antibacterial, antivirus, antiultraviolet, antiobesity, antiproliferative, antioxidant, neuroprotective, and hepatoprotective effects (Kusumawati *et al.*, 2023).

When mice were given 2000 mg/kg of black rice bran orally, there was no acute toxicity, indicating that the product is safe to use. Due to their strong antioxidant properties, important chemical components found in black rice bran, such as gallic acid, γ-oryzanol, α-tocopherol, phenolic acids, and anthocyanins, are essential for the renewal of gastric ulcers (Tonchaiyaphum *et al.*, 2021).

Rice gruel, commonly referred to as conjee water, is a thicker drinkprepared by boiling rice powder in water, generally with a squeeze of lemon and a teaspoon of salt; this mixture serves as a beneficial beverage in cases of irritable or inflammatory stomach conditions. When excluding lime juice and salt, rice gruel is recommended for individuals with gastric ulcers (Awuchi *et al.*, 2023).

Additionally, rats' stomach ulcers caused by pylorus ligation and swimming stress were prevented by an oral dose of 1 millilitre of rice bran oil (*Oryza sativa* bran) given for four (4) days. The amount of stomach acid secreted when at rest was greatly decreased by the extract, as reported by Żurek *et al.* (2022).

Figure 13: *Oryza sativa*

Momordica charantia Linn.

Momordica charantia, also known as bitter gourd and belonging to the *Cucurbitaceae* family, is a flowering vine that stands out as a significant global vegetable crop (Bhati *et al.*, 2023). The plant, also known as bitter melon, balsam pear, or bitter apple, boasts notable nutritional value with elevated levels of iron and ascorbic acid (Asna *et al.*, 2020). It is recognized for its reported properties, such as antioxidant, anti-inflammatory, anti-cancer, anti-dementia, anti-cholesterol, antimicrobial, antiviral, and anti-diabetic effects (Gayathry and John, 2022).

There is a clear historically evidence for the use of bitter gourd leaves and fruits as remedies for conditions such as diabetes, colic, and the healing of skin sores and wounds (Tanwar *et al.*, 2022). While the entire plant is edible, bitter gourd cultivation primarily focuses on its fruit (Gayathry and John, 2022). In addition to the fruits, the roots, leaves, and vines are utilized to alleviate toothaches, diarrhea, and furuncles (Gayathry and John, 2022).

Traditionally, it has been employed for wound healing and addressing malignant ulcers. Studies have reported that *Momordicacharantia* fruits have anti-*H. pylori* effect (Kumadoh *et al.*, 2021). Methanolic extract derived from the fruits of bitter gourddemonstrated efficacy in managing duodenal, gastric and stress-induced ulcers in animal models. The suggested mechanism involves a reduction in acid production and an increase in mucus secretion (Kumadoh *et al.*, 2021). Additionally, similar therapeutic effects were seen while treating peptic ulcers with an extract of the fruit dissolved in olive oil (Airaodion *et al.*, 2019). Furthermore, when *Momordicacharantia* fruit extracts were used to treat rats with ulcers brought on by stress, pylorus ligation, and aspirin, the outcomes were encouraging (Mbatchou *et al.*, 2017).

Figure 14:*Momordica charantia Linn.*

Calophyllum brasiliense Cambess

Calophyllum brasiliense Cambess belonging to the *Clusiaceae* family, contains derivatives of chromanone: isobrasiliensic acid and Brasiliensic acid (Lemos*et al.*, 2023); these compounds have been shown to be effective in treating a number of pharmacological disorders, such as ulcers, rheumatism, pain, haemorrhoids, inflammation, and *H. pylori* infection (Gupta *et al.*, 2021).

The anti-ulcer properties of *Calophyllum brasiliense* bark were assessed using indomethacin and ethanol-induced ulcer models, with measurements of malondialdehyde, catalase, and glutathione levels in stomach tissue. The findings showed an increase in catalase level, a decrease in malondialdehyde level, and no observable effect on glutathione level (Gupta *et al.*, 2021). The results of the gastro-protective potential of the bark's dichloromethane extract examination for stress, indomethacin, and ethanol-induced ulcers using rat models demonstrated a total/free acidity and reduction in gastric secretion, underscoring the antiulcer effects of *Calophyllum brasiliense* (Gupta *et al.*, 2021).

Figure 15:*Calophyllum brasiliense Cambess*

***Psidium guajava* Linn.**

Psidium guajava, a member of the *Myrtaceae* family, reaches a height of up to 10 meters and is extensively found in various countries (Ugbogu *et al.*, 2022). According to Naseer *et al.* (2018), the plant has a short trunk, peeling, smooth, irregular bark, and fleshy, dark green leaves with distinct veins. The shrub bears white flowers and pulpy, hard, tiny seeds in its fruit. Packed with minerals (iron, phosphorus, and calcium), vitamins (A and C), dietary fiber (pectin), and protein, the fruit serves as a valuable nutritional source.

Psidium guajava composition includes essential chemical constituents like tannins, carotenoids, lectins, glycosides, phenols, alkaloids, saponins, flavonoids, triterpenes, vitamins, carbohydrates, and fatty acids (Weli *et al.*, 2019). The leaves are rich in beneficial phenolic compounds such as caffeic acid, kaempferol, myricetin, chlorogenic acid, gallate, hyperin, guaijaverin, apigenin, epigallocatechin, catechin, gallic acid, epicatechin, and quercetin (Kumar *et al.*, 2021).

Pharmacological investigations have revealed that extracts from *Psidium guajava* possess various therapeutic properties, including analgesic, lipid-lowering, anti-hyperglycemic, antiparasitic, anti-inflammatory, adaptogenic, antidiabetic, cardioprotective, antimutagenic, antidiarrheal, anti-angiogenic, hepato-protective, anticestodal, antioxidant, spermatoprotective, anticough, and anti-hypertensive activities. These pharmacological effects are attributed to the presence of numerous bioactive compounds in the plant. (Ugbogu *et al.*, 2022).

Psidium guajava is utilized in ethnobotanical practices for addressing various stomach ailments, including peptic ulcers (Poudel *et al.*, 2021). *Psidiumguajava* may be useful in treating peptic ulcers, according to a study by Livingston and Sundar (2012) that used pylorus ligation, ethanol-induced, and aspirin-induced models in Wistar rats. Treatment with extract doses of 100 mg/kg and 200 mg/kg significantly reduced gastric ulcers induced by aspirin (70.5%), ethanol (70.4%), and pylorus ligation (65.07%), showing efficacy comparable to omeprazole (74.1%).

In a report of an analysis of the anti-ulcerogenic efficacy of guava leaf aqueous extract using an ethanol-induced ulcer model, rats treated with 500 mg/kg and 1000 mg/kg of the extract showed a dose-dependent decrease in stomach lesions in comparison to animals who were not treated. The anti-peptic ulcer activity exhibited by *Psidium guajava* leaves is attributed to phytochemical constituents such as volatile oils, flavonoids, and saponins (Kumadoh *et al.*, 2021; Tende *et al.*, 2020).

Figure 16: *Psidium guajava*

Zingiber officinale Roscoe

Zingiber officinale Roscoe, the scientific name for ginger, is a member of the *Zingiberaceae* family and is a natural rhizome with diverse biological properties (Pai *et al.*, 2022). Its health benefits are ascribed to various biological components, including zingerones, gingerdiols, gingerols, paradols, and shogaols (Darekar *et al.*, 2023; Ma *et al.*, 2021). Notably, shogaol, present in forms like 4-, 6-, 8-, 10-, and 12-shogaol, is identified as a major active compound in ginger (Zhang *et al.*, 2022).

In rat models exposed to ethanol and stress-induced ulcers, research has investigated the ulcer-preventive effects of ginger extracts (Beiranvand, 2022); pre-treatment with ginger extract showed protective effects against *Helicobacter pylori* infection and displayed free radical scavenging activity, which suggests its potential use in ulcer treatment (Gupta *et al.*, 2021). Ahmed *et al.* (2021) conducted a preclinical study on albino rats to evaluate the cytoprotective and anti-ulcer properties of ginger. The study also revealed that different agents induced gastric lesions in different dose-dependent ways, emphasising the potential of ginger as an anti-secretory and gastro-protective agent (Djanaev *et al.*, 2022).

Elbestawy *et al.* (2023) assessed the antibacterial activity of *Zingiber officinale* extract against *Helicobacter pylori* isolates and the reference strain NCTC 11637 using a disc diffusion experiment. The results showed that the *Zingiber officinale* extract had significant antibacterial activity against both *H. pylori* isolates and the reference strain NCTC 11637, with a mean ± standard deviation imbibition zone ranging from 10±0.3 to 24±0.4 mm. These outcomes were similar to those obtained with gentamicin, which, against the reference strain NCTC 11637, demonstrated an imbibition zone of 22±0.04 mm. *Zingiber officinale*'s lowest inhibitory concentration against both the standard strain and resistant *H. pylori* isolates varied from 20 to 48 µg/ml. Elbestawy *et al.* (2023) also found that the ATCC-43504 strain, four CagA+ strains, and fourteen clinical isolates of *H. pylori* were inhibited from growing at a concentration of 50.0 µg/ml crude methanol extract of *Zingiber officinale*.

Additionally, *Zingiber officinale*'s ethanolic extract was found to have a minimum inhibitory concentration (MIC) of 58 µg/ml against the *H. pylori* CagA+ strain by Azadi *et al.* (2019). Furthermore, it was discovered that combining *Zingiber officinale* with cinnamon extract reduced the CagA gene level by 1.94 times. According to Chakotiya *et al.* (2017), bacterial cells' permeability and efflux activity were altered by *Zingiber officinale* extract.

Figure 17: *Zingiber officinale*

Morinda lucida Benth

Morinda lucida, commonly known as the Brimstone tree (due to the yellow colour of the wood), belonging to the *Rubiaceae* family, is a medium-sized, evergreen tree with dark, glossy leaves on the upper side (Adewole *et al.*, 2021). The plants is one of the most frequently collected and utilized medicinal plant in the traditional healing practices of Africa, thriving in the tropical rainforests of Central and West Africa (Evbuomwan *et al.*, 2023).

Traditional medicine utilizes various parts of the plant, including roots, stem bark, and leaves, to address ailments such as ulcers, hypertension, diabetes, and leprosy (Olaniyan and Olaniyan, 2023). The leaves of *Morinda lucida* have been found to contain phytochemical constituents like anthraquinones (rubiadin, soranjidol, lucidin, nordamnacanthal, purpuroxanthin and molucidin, a tetracyclic iridoid), saponins, tannins, triterpenes, alkaloids and flavonoids (Kumadoh *et al.*, 2021).

Research has examined the antiulcer properties of the methanol extract from *Morinda lucida* leaves using a rat model with acetylsalicylic acid-induced gastric ulcers and a mouse model assessing intestinal motility. The findings indicated that *the Morinda lucida* leaf extract promoted intestinal motility and reduced gastric emptying time in the tested animals (Kumadoh *et al*., 2023).

Christophe *et al.* (2017) conducted an assessment using aqueous extract from *Morinda lucida* leaves at doses of 100, 200, and 400 mg/kg body weight on indomethacin and acetic acid induced gastric ulcers. According to the results, the ulcer index showed a noteworthy decline. The authors suggest that a rise in prostaglandins, which function as a cytoprotective agent in the stomach, could be the cause of the observed activity. Furthermore, the preservation of the stomach membrane through the promotion of mucus and bicarbonate ion secretion is suggested as another possible mechanism for the recorded effects Christophe *et al*., (2017).

Figure 18: *Morinda lucida Benth*

Adansonia digitata

The *Adansoniadigitata* tree, a member of the family *Malvaceae*, is referred to as the "African baobab or monkey-bread tree" (Bharskar, 2022; Malabadi *et al*., 2021). It stands as one of the largest and oldest trees globally (Kelly *et al*., 2022). The plant contains various chemical components in its pulp, such as tartrate, acetate of potash, mucilage, gum, glucose, and other salts (Vaishnavi Burley *et al*., 2021). Wax, glucose, salts, gum, and albuminoids are found in the leaf; albuminous carbonate, potassium and sodium chloride, and the glucoside adansonin are found in the bark (Vaishnavi Burley *et al*., 2021).

To address indolent syphilitic ulcers, effectively apply fresh leaf juice mixed with powdered ginger and *Salvadoraindica* root juice (Awuchi *et al*., 2023). Additionally, the leaves can be used to treat irritable, inflammatory ulcers by making poultices and fermentations (Wakodkar *et al*., 2021).

Rats were used in a study by Malgave *et al.* (2019) to evaluate the antiulcer potential of three different extracts: ADFP (ethanolic extract from *Adansonia digitata* fruit pulp), ADSO (n-hexane extract from Adansonia digitata seed oil), and ADFP+ADSO. The study included ethanol administration models and pylorus ligation-induced stomach ulcers. For ten days, doses of ADFO (500 mg/kg), ADSO (300 mg/kg), and the combination of ADFP & ADSO were given. The reference medication used was omeprazole (10 mg/kg). Results from both models demonstrated a significant ($p<0.001$) reduction in the ulcer index for ADFP, ADSO, and the combination of ADFP+ADSO. The control group exhibited a severe ulcer index, whereas the test groups showed a decrease, with the combination group demonstrating the highest inhibition of ulcer index.

When the fruit extract was administered, the levels of gastric mucus and pH increased, whereas offensive indicators like stomach volume, free acidity, total acidity, ulcer index, protein, and pepsin significantly decreased ($p<0.001$). In comparison to the test group, the control group's total protein content in the stomach was greater. The stomach juice's protein level decreased as a result of taking omeprazole. Furthermore, lipid peroxidation rose, whereas antioxidant enzyme activity, such as those of catalase and Superoxide Dismutase (SOD), declined in the control group. Lipid peroxidation was reduced, although superoxide dismutase and catalase levels were increased upon treatment with both the fruit extract and omeprazole.

Figure 19: *Adansonia digitata*

Carica papaya

The *Carica papaya*, a herbaceous succulent plant native to tropical and subtropical regions worldwide, belongs to the *Caricaceae* family (Babalola *et al*., 2024). *Carica papaya* is used pharmacologically for a number of medicinal applications because of its antibacterial, immunomodulatory, antioxidant, and anti-inflammatory properties (Kumar *et al*., 2022). While the ripe fruits of the *Carica papaya* are often eaten fresh after removing the peel and seeds, the unripe fruit can be useful for healing indolent ulcers when cooked (Rani *et al*., 2020). Eating unripe fruit has been linked to a reduction in the risk of stomach ulcers (Awuchi *et al*., 2023). Caffeic acid, kaempferol, raffinose, β-carotene, myricetin, xylitol, dehydrocarpain I and II, lycopene, ferulic acid, carpaine, β-sitosterol, and galactose are among the bioactive substances present in papaya (Gupta *et al*., 2021).

Using a variety of ulcer models, such as those generated by pyloric ligation, ethanol, acetic acid, and indomethacin, the anti-ulcerogenic efficacy of *Carica papaya* methanolic extract was evaluated (Bhatti *et al*., 2022). An increase in mucus production, elevated levels of glutathione, and gastric acidity showed a significant reduction of gastric acid observed after treatment with both aqueous and methanolic extracts of *Carica papaya*, demonstrating gastroprotective effects (El Mehiry and Abd El-Hay, 2022).

Studies have demonstrated that ethanol-induced stomach ulcers in rats were protected by administering 50 and 100 mg/kg of a *Carica papaya* seed extract diluted in water; the extract effectively prevented damage to the stomach lining caused by ethanol, significantly reducing both the production of gastric juice and its acidity (Daharia *et al*., 2022).

Pinto *et al*. (2015) investigated whether methanolic extracts from *Carica papaya* seeds could prevent stomach ulcers brought on by indomethacin and ethanol. Methanolic extracts at dosages of 125, 250, and 500 mg/kg were pre-treated in experimental groups of rats. The study found that ethanol-induced stomach lesions decreased in a dose-dependent manner. When the maximum dosage (500 mg/kg) was administered to rats with indomethacin-induced ulcers, the lesions were shown to lessen clinically. These results imply the possibility of the presence of bioactive substances with anti-ulcerogenic qualities in the *Carica papaya* extracts.

Figure 20: *Carica papaya*

Table 1: Cultivation and Global Distribution of Selected Medicinal Plants

Plants	Family	Cultivation and Distribution	Reference
Curcuma longa	*Zingiberaceae*	Nigeria, Australia, Taiwan, Myanmar, China, Sri Lanka, Jamaica, Peru, Bangladesh, West Indies, Caribbean, Latin America	Jyotirmayee and Mahalik, (2022)
Trema orientalis	*Ulmaceae*	South Africa, tropical Asia, Australia	Al-Robai *et al*. (2022). Niranjan *et al*. (2023)
Maytenus robusta	*Celastraceae*	Africa, Southeast AsiaBrazil, Argentina, and Paraguay	Camargo *et al*. (2022)
Mangifera indica	*Anacardiaceae*	Globally cultivated	Bura *et al*. (2023)

To be continued next page

Table 1 continued

Plants	Family	Cultivation and Distribution	Reference
Moringa oleifera	*Moringaceae*	Arabia, Africa, Pakistan, Western Hemisphere, sub-Himalayas, Asia Minor, India	Awuchi *et al.* (2023)
Allium sativum	*Liliaceae*	Widely cultivated globally, particularly common in regions with temperate climates, including parts of Africa, Europe, and Asia	Ahmed *et al.* (2022), Hamedi *et al.* (2022)
Spondia mombin	*Anacardiaceae*	Nigeria, Bolivia, Mexico, Guianas, Peru, Ivory Coast, Colombia, Brazil, Venezuela	Idaguko and Adeniyi, (2023), Ogunro *et al.* (2023)
Acacia Arabica	*Mimoaceae*	Widely distributed in tropical and subtropical regions, particularly found in parts of Africa and India	Mohiuddin, (2019)
Muntingia calabura	*Muntingiaceae*	Tropical and subtropical regions of America and Asia	Upadhye *et al.* (2021)
Maytenus senegalensis	*Celastraceae*	Savannah regions of tropical Africa; found in diverse habitats including deciduous woodlands, thickets, and riverbanks	Owoyemi and Oladunmoye, (2017)
Stryphnodendron rotundifolium	*Leguminosae*	Found in Brazil and other parts of South America.	Souza-Moreira *et al.* (2018)
Oryza sativa	*Gramineae*	Cultivated globally on every habitable continent; highly adaptable to diverse climatic and soil conditions.	Abbas *et al.* (2021), Gómez de Barreda *et al.*(2021)
Momordica charantia	*Cucurbitaceae*	Widely cultivated in tropical and subtropical regions worldwide; significant in Asia, Africa, and the Americas.	Gayathry and John, (2022), Bhati *et al.* (2023)
Calophyllum brasiliense	*Clusiaceae*	Native to tropical regions of South America, particularly Brazil.	Gupta *et al.* (2021)
Psidium guajava	*Myrtaceae*	Cultivated in tropical and subtropical regions around the world; common in countries like Brazil, Mexico, India, and parts of Africa.	Naseer *et al.* (2018), Ugbogu *et al.* (2022)

To be continued next page

Table 1 continued

Plants	Family	Cultivation and Distribution	Reference
Zingiber officinale	*Zingiberaceae*	Grown in tropical and subtropical regions worldwide; particularly common in India, China, Indonesia, and parts of Africa.	Pai *et al.* (2022), Darekar *et al.* (2023)
Morinda lucida	*Rubiaceae*	Native to tropical rainforests of Central and West Africa.	Adewole *et al.* (2021), Evbuomwan *et al.* (2023)
Adansonia digitata	*Malvaceae*	Native to Africa; widely distributed across tropical Africa, Madagascar, and parts of Australia.	Vaishnavi Burley *et al.* (2021)
Carica papaya	*Caricaceae*	Indigenous to tropical and subtropical regions worldwide, including parts of Central and South America, Africa, and Asia.	Babalola *et al.* (2024)

Table 2: Phytochemical Constituents and PharmacologicalActivities of Selected Medicinal Plants

Plants	Phytochemical constituent	Pharmacological activities	Reference
Curcuma longa	Curcumin (diferuloylmethane)	Anti-ulcer, anti-inflammatory, wound healing, digestive disorders, liver ailments	Gandhi *et al.* (2022), and Fayez *et al.* (2023).
Trema orientalis	Saponins, alkaloids, cardiac glycosides, steroids, terpenoids, tannins, coumarins, flavonoids, phenolics, 2α, 3ß-dihydroxyurs-12-en-28-oic acid, scopoletin, methylswertianin	Cytoprotective, antiulcerogenic, antioxidant, *H. pylori* inhibition	Kumadoh *et al.* (2021), Al-Robai *et al.* (2022), Appau *et al.* (2023), Niranjan *et al.* (2023).
Maytenus robusta	Friedelin, pentacyclic triterpenes, steroids, flavonoids	Gastroprotective, anti-inflammatory, anti-allergic, anti-cancer, stimulates mucus synthesis and prostaglandin secretion	Meurer *et al.* (2022), Shipa *et al.* (2022), Huda *et al.* (2023).

To be continued next page

Table 2 continued

Plants	Phytochemical constituent	Pharmacological activities	Reference
Mangifera indica	Flavonoids (β-carotene, α-carotene, β-cryptoxanthin, lutein), phenolic acids, polyphenols (mangiferin, quercetin, ellagic acid), vitamins, micronutrients, omega fatty acids	Cytoprotective, antioxidative, antisecretory, anti-allergic, immunomodulatory, anti-diabetic, anti-microbial, hepatoprotective, cardioprotective	Ain *et al.* (2023), Bura *et al.* (2023), Rajasekaran and Soundarapandian (2023), Paradee *et al.* (2023).
Moringa oleifera	Kaempferol, zeatin, flavonoids, saponin, terpenoids, tannins, quercetin, alkaloids, 4-(4'-O-acetyl-α-L-rhamnopyranosyloxy) benzyl isothiocyanate, niazimicin, benzyl isothiocyanate	Hypotensive, anticancer, antibacterial, antiulcer	Ibelegbu *et al.* (2023), Joshi and Pandit (2023), Sarode *et al.* (2023).
Allium sativum	Acrid volatile oil, starch, mucilage, albumen, sugar, sulphur compounds (e.g., diallyl trisulfide, diallyl disulfide, allyl methyl sulfide)	Anti-ulcer, antibacterial, anti-inflammatory, anticancer, cardiovascular health benefits	Awuchi *et al.* (2023), Vuković *et al.* (2023), Johny and Mishra (2023).
Spondias mombin	Gallic acid, ellagic acid	Antiulcer, anti-inflammatory, antibacterial	Idaguko and Adeniyi (2023), Orumwensodia and Uadia (2023).
Acacia Arabica	Tannins, gum containing arabic acid, calcium, magnesium, potassium, malic acid, sugar	Anti-ulcer, anti-inflammatory, antibacterial, antioxidant	Roy *et al.* (2023), Al-Jubori *et al.* (2023).
Muntingia calabura	Volatile oils, gallic acid, tannins, squalene, saponins, flavonoids (quercetin, rutin, fisetin)	Anti-ulcer, antioxidant, anti-inflammatory, antibacterial	Zakaria *et al.* (2014), Upadhye *et al.* (2021).
Maytenus senegalensis	Tannins, flavonoids, glycosides, triterpenes, alkaloids, phenols, saponins, epicatechin, phytosterols	Anti-ulcer, anti-inflammatory, antioxidant, antibacterial, antimalarial, rheumatism, chronic wound healing	Umar *et al.* (2019), Kumadoh *et al.* (2021), Vecchia *et al.* (2022).

To be continued next page

Table 2 continued

Plants	Phytochemical constituent	Pharmacological activities	Reference
Stryphnodendron rotundifolium	Flavonoids (catechin, rutin, gallocatechin), caffeic acid, gallic acid	Anti-ulcer, anti-inflammatory, reduction in glucose absorption, oxidative stress reduction	Demarque *et al.* (2018), Salazar *et al.* (2022).
Oryza sativa	Phenolic acids, flavonoids, anthocyanins, carotenoids, proanthocyanidins, phytosterols, γ-oryzanol	Gastroprotective, antioxidant, antiulcer, antibacterial, antivirus, antiobesity, neuroprotective, hepatoprotective	Tonchaiyaphum *et al.* (2021), Żurek *et al.* (2022), Kusumawati *et al.* (2023).
Momordica charantia	Iron, ascorbic acid, flavonoids	Anti-cancer, anti-inflammatory, antioxidant, anti-dementia, anti-cholesterol, antimicrobial, antiviral, anti-diabetic, wound healing	Mbatchou *et al.* (2017), Gayathry and John (2022), Bhati *et al.* (2023).
Calophyllum brasiliense	Brasiliensic acid, isobrasiliensic acid	Anti-ulcer, anti-inflammatory, pain relief, treatment for hemorrhoids, rheumatism, *H. pylori* infection	Gupta *et al.* (2021) Lemos *et al.* (2023)
Psidium guajava	Tannins, carotenoids, lectins, glycosides, phenols, alkaloids, saponins, flavonoids, triterpenes	Anti-parasitic, anti-hyperglycemic, anti-inflammatory, antioxidant, anti-diabetic, hepato-protective, anti-hypertensive, anti-mutagenic, anti-diarrheal	Tende *et al.* (2020), Kumar *et al.* (2021), Ugbogu *et al.* (2022).
Zingiber officinale	Gingerols, gingerdiols, shogaols, paradols, zingerones	Anti-ulcer, antioxidant, antibacterial, free radical scavenging, protection against *H. pylori*, gastroprotective	Chakotiya *et al.* (2017), Azadi *et al.* (2019), Darekar *et al.* (2023)
Morinda lucida	Anthraquinones (rubiadin, soranjidol), saponins, tannins, triterpenes, alkaloids, flavonoids	Anti-ulcer, improvement in intestinal motility, cytoprotective, mucus and bicarbonate ion secretion	Adewole *et al.* (2021), Kumadoh *et al.* (2023), Evbuomwan *et al.* (2023).

To be continued next page

Table 2 continued

Plants	Phytochemical constituent	Pharmacological activities	Reference
Adansonia digitata	Phobaphenes, mucilage, gum, glucose, tartrate, acetate of potash, glucoside adansonin	Anti-ulcer, reduction in gastric volume, acidity, ulcer index, protein and pepsin levels, increase in pH and gastric mucus levels	Malgave *et al.* (2019), Malabadi *et al.* (2021), Bharskar, (2022).
Carica papaya	β-carotene, lycopene, kaempferol, myricetin, dehydrocarpain I & II, ferulic acid, caffeic acid, carpaine	Anti-ulcer, antioxidant, anti-inflammatory, immunomodulatory, antimicrobial, protection against ethanol-induced ulcers	Daharia *et al.* (2022), El Mehiry and Abd El-Hay (2022), Babalola *et al.* (2024).

Table 3: Studies on Gastroprotective Effects of Selected Medicinal Plants

Plants	Model Used	Findings	Reference
Curcuma longa	Ethanol-induced ulcer model	Curcumin extract provided significant protection against ethanol-induced ulcers.	Gupta *et al.* (2021)
	Pyloric ligation ulcer model	Curcumin increased gastric wall mucus and restored non-protein sulfhydryl content and glutathione levels.	Fayez *et al.* (2023)
	Stress-induced ulcer model	Demonstrated anti-ulcer properties through the inhibition of the cyclooxygenase enzyme and reduction of inflammatory mediators (ILs and TNF).	Gandhi *et al.* (2022)
	Indomethacin-induced ulcer model	Curcumin showed effective gastroprotection by inhibiting ulcer formation in indomethacin-induced ulcers.	Gupta *et al.* (2021)
Trema orientalis	Ethanol-induced ulcer model	Ethanolic leaf extract showed significant gastroprotective activity comparable to pantoprazole at doses of 100 mg/kg, 150 mg/kg, and 200 mg/kg.	Kanase *et al.* (2019),Kumadoh *et al.* (2021)
	Wistar rats model	Dose-dependent reduction in ulcer index with ethanolic leaf extract at doses of 100 mg/kg, 150 mg/kg, and 200 mg/kg.	Kumadoh *et al.* (2021)

To be continued next page

Table 3 continued

Plants	Model Used	Findings	Reference
Trema orientalis	*H. pylori* infection model	Flavonoids and phytosterols identified as key contributors to anti-ulcerogenic and gastroprotective effects	Uddin *et al.* (2022)
Maytenus robusta	Acetic acid-induced ulcer model	Treatment with *Maytenusrobusta* reduced ulcer size and enhanced regeneration of gastric mucosa.	Paricharak *et al.*(2021), Meurer *et al.* (2022)
	Ethanol-induced ulcer model	Preclinical studies showed gastroprotective effects against ethanol-induced ulcers.	Ahmed *et al.*(2021)
	NSAID-induced ulcer model	Demonstrated gastroprotective effects against nonsteroidal anti-inflammatory drug-induced ulcers.	Ahmed *et al.*(2021)
Mangifera indica	Pylorus ligation ulcer model	Leaf extract significantly decreased ulcer index, comparable to ranitidine.	Boakye-Yiadom *et al.*(2021)
	Stress-induced gastric ulcer model	Decoction exhibited a significant reduction in ulcer index in stress-induced gastric ulcers with doses of 250, 500, and 1000 mg/kg.	Boakye-Yiadom *et al.*(2021)
	Hydrochloric/ethanol ulcer model	Flower decoction reduced gastric juice quantity and acidity in a dose-dependent manner with doses of 250, 500, and 1000 mg/kg.	Fraga *et al.*(2019)
Moringa oleifera	Ethanol-induced stomach ulcers	Ethanol extract reduced ulcer development and acid pepsin secretion.	Paricharak *et al.*(2021), Yadav *et al.*(2021)
Allium sativum	Ethanol-induced stomach ulcers	Methanolic extract reduced ulcer scores	Kuna *et al.* (2022)
	Cysteamine-induced ulcer model	Oral extract prevented ulcers and accelerated healing. Active compounds: allicin at doses of 250 and 500 mg/kg.	Awuchi *et al.* (2023)
Spondia mombin	Indomethacin, ethanol, and acetic acid-induced ulcer models	Ethanolic extract showed antiulcer activity. Active compounds: gallic acid, ellagic acid.	Oluwatoyin and Deborah (2019), Kumadoh *et al.* (2021)

To be continued next page

Table 3 continued

Plants	Model Used	Findings	Reference
Acacia Arabica	Cold restraint stress-induced ulcer model	Gum extract prevented ulcers. Active compounds: arabic acid, calcium, magnesium, potassium.	Singh *et al.* (2022)
	Meloxicam-induced intestinal damage model	Aqueous extract reduced intestinal enzyme activity.	Al-Jubori *et al.* (2023)
Muntingia calabura	Ethanol-induced gastric ulcer model	Methanolic extract showed dose-dependent reduction in gastric lesions.	Balan *et al.* (2015)
	Pyloric ligation ulcer model	Extract reduced acidity and increased mucus content.	Zakaria *et al.* (2014)
Maytenus senegalensis	Ethanol-induced gastric ulcer model	Polyherbal extract including *Maytenus senegalensis* reduced gastric lesions.	Haule *et al.* (2022)
Oryza sativa	Mice	Oral administration of 2000 mg/kg black rice bran showed no acute toxicity. Noteworthy components like γ-oryzanol and anthocyanins aid in gastric ulcer rejuvenation.	Tonchaiyaphum *et al.* (2021)
	Rice bran oil in rats	1 ml/day for 4 days showed preventive effects on ulcers induced by swimming stress and pylorus ligation. Significantly reduced stomach acid secretion.	Żurek *et al.* (2022)
Momordica charantia	*H. pylori* growth inhibition model	Fruits inhibited *H.pylori* growth. Methanolic extract managed duodenal, gastric, and stress-induced ulcers.	Kumadoh *et al.* (2021)
	Rats	Ethanolic and aqueous extracts showed promising results against aspirin, pylorus ligation, and stress-induced ulcers.	Mbatchou *et al.* (2017)
Calophyllum brasiliense	Ethanol and indomethacin-induced ulcer models	Bark extract showed increased catalase, decreased malondialdehyde levels, and reduced gastric secretion and acidity.	Gupta *et al.* (2021)
	Rat model	Dichloromethane extract demonstrated anti-ulcer capabilities in stress-induced ulcers.	Gupta *et al.* (2021)

To be continued next page

Table 3 continued

Plants	Model Used	Findings	Reference
Psidium guajava	Wistar rats	Extract doses of 100 mg/kg and 200 mg/kg reduced gastric ulcers induced by aspirin, ethanol, and pylorus ligation. Comparable to omeprazole.	Livingston and Sundar, (2022)
	Ethanol-induced ulcer model	Aqueous extract showed a dose-dependent decrease in stomach lesions with 500 mg/kg and 1000 mg/kg doses.	Tende *et al.*(2020)
Zingiber officinale	Ethanol and stress-induced ulcer models in rats	Ginger extract demonstrated protective effects against *H. pylori* infection and free radical scavenging activity.	Gupta *et al.*(2021), Beiranvand, (2022)
	H. pylori inhibition model	Extract showed antibacterial activity with zones of inhibition (10±0.3 to 24±0.4 mm). MIC against *H. pylori* ranged from 20 to 48 µg/ml.	Elbestawy *et al.*(2023)
Morinda lucida	Acetylsalicylic acid-induced ulcer model in rats	Leaf extract promoted intestinal motility and reduced gastric emptying time.	Kumadoh *et al.*(2023)
	Indomethacin and acetic acid-induced ulcer models in rats	Aqueous extract showed a significant decrease in the ulcer index. Increased prostaglandin and mucus secretion suggested as mechanisms.	Christophe *et al.*(2017)
Adansonia digitata	Pylorus ligation and ethanol administration models in rats	Ethanolic extract (500 mg/kg) and seed oil (300 mg/kg) reduced ulcer index. Increased gastric mucus, decreased acidity, and enhanced antioxidant enzyme activities.	Malgave *et al.*(2019)
Carica papaya	Various ulcer models (pyloric ligation, ethanol, etc.)	Methanolic extract reduced gastric acidity and increased mucus production.	El Mehiry and Abd El-Hay, (2022)
	Ethanol-induced ulcer model in rats	Seed extract (50 and 100 mg/kg) prevented damage to the stomach lining and reduced gastric juice acidity.	Daharia *et al.*(2022)
	Gastric ulcers induced by ethanol and indomethacin	Methanolic extracts reduced gastric lesions in a dose-dependent manner.	Pinto *et al.*(2015)

DISCUSSION

The study of different plant species reveals that they have a great deal of potential to offer medical advantages due to the variety of phytochemical components they contain. These plants are useful in the management and treatment of a wide range of medical diseases because of their diverse range of biological activity. Strong anti-inflammatory, antibacterial, and anti-ulcer characteristics are found in plants, including *Curcuma longa*, *Moringa oleifera*, and *Allium sativum*, which makes them useful for treating digestive disorders and other medical conditions. The anti-diabetic and hepatoprotective properties of *Mangifera indica* and *Psidium guajava* are attributed to their antioxidative and immunomodulatory properties.

A review of several plants indicates that they have significant pharmacological potential for the treatment of ulcers and associated gastrointestinal disorders. *Curcuma longa* and *Trema orientalis* are notable for their gastroprotective and anti-ulcerogenic properties, which are mainly attributed to their stimulation of prostaglandin and mucus secretion, as well as their inhibition of *H. pylori*. By using substances like flavonoids and triterpenes, *Maytenus robusta* and *Mangifera indica* demonstrate encouraging effects in decreasing the size of ulcers and strengthening the defences of the gastrointestinal mucosa. The antiulcerogenic, antimicrobial, and anti-inflammatory properties of *Allium sativum* and *Moringa oleifera* underscore their potential as natural treatments. Other plants that show antioxidant and anti-ulcer qualities, like *Spondias mombin*, *Acacia arabica*, and *Muntingia calabura*, further support the therapeutic prospects. Additional studies on *Psidium guajava* and *Zingiber officinale* reveal their capacity to reduce gastric ulcers and protect against *H. pylori* infection, confirming their therapeutic potential. All of these results highlight the effectiveness of these plants as natural therapeutic options for improving stomach health and stress the need for more study to fully realize their therapeutic potential.

CONCLUSION

The research on a variety of plant species highlights their significant pharmacological potential in the treatment of a number of medical disorders, most notably peptic ulcers and associated gastrointestinal problems. Strong anti-inflammatory, antibacterial, and anti-ulcer qualities have been demonstrated by plants, including *Curcuma longa*, *Moringa oleifera*, and *Allium sativum*, making them useful natural treatments for digestive issues. These plants have a variety of processes that include increasing mucus production, modifying stomach secretions, and suppressing inflammatory mediators. These mechanisms demonstrate the effectiveness of these plants as therapeutics and the necessity of more research to fully realize their medical potential.

REFERENCES

Abbas, R. N., Iqbal, A., Iqbal, M. A., Ali, O. M., Ahmed, R., Ijaz, R., and Bethune, B. J. (2021). Weed-free durations and fertilization regimes boost nutrient uptake and paddy yield of direct-seeded fine rice (*Oryza sativaL.*). *Agronomy*, **11**(12): 2448. **[**Crossref**]**

Abbass, A., Khalid, S., Boppana, V., Hanson, J., Lin, H., and McCarthy, D. (2020). Giant gastric ulcers: an unusual culprit. Digestive Diseases and Sciences, **65**: 2811-2817. **[**Crossref**]**

Abd_Elhamid, A., Salem, M. A. E. N., and Mahmoud, S. M. (2021). Histological Study of the Caffeine Effect on Intact Gastric Mucosa and Induced Gastric Ulcer in Adult Male Albino Rats. *Egyptian Journal of Histology*, **44**(1): 163-187.

Abdu, H., and Ashiru Garba, A. (2021). Proximate analysis and anti-ulcer activity of methanolic extract of *Moringa oleifera*. *African Scholar Journal of Agriculture and Agricultural Technology*, **20**(1): 188-201.

Adewole, K. E., Attah, A. F., and Adebayo, J. O. (2021). *Morinda lucida Benth* (*Rubiaceae*): A review of its ethnomedicine, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, **276**: 114055. **[**Crossref**]**

Ahmed, A. S., McGaw, L. J., and Eloff, J. N. (2013). Evaluation of pharmacological activities, cytotoxicity and phenolic composition of four *Maytenus species* used in southern African traditional medicine to treat intestinal infections and diarrhoeal diseases. *BMC complementary and alternative medicine*, **13**(1): 1-15. **[**Crossref**]**

Ahmed, S. R., Rabbee, M. F., Roy, A., Chowdhury, R., Banik, A., Kubra, K., and Baek, K. H. (2021). Therapeutic promises of medicinal plants in Bangladesh and their bioactive compounds against ulcers and inflammatory diseases. *Plants,* **10**(7): 1348. **[Crossref]**

Ahmed, S. S. T., Fahim, J. R., and Abdelmohsen, U. R. (2022). Chemical and biological studies on *Allium sativum L.* (1952-2020): A comprehensive review. *Journal of advanced Biomedical and Pharmaceutical Sciences*, **5**(1): 1-22. **[Crossref]**

Ain, Q. U., Iqbal, M. O., Khan, I. A., Bano, N., Naeem, M., Jamaludin, M. I., and Devaraj, S. (2023). Phytochemical, antioxidant, antipyretic and anti-inflammatory activities of aqueous-methanolic leaf extract of *Mangifera indica*. *American Journal of Translational Research*, **15**(7): 4533.

Airaodion, A. I., Ogbuagu, E. O., Ekenjoku, J. A., Ogbuagu, U., and Airaodion, E. O. (2019). Therapeutic effect of methanolic extract of *Telfairia occidentalis* leaves against acute ethanol-induced oxidative stress in Wistar rats. *International Journal of Bio-Science and Bio-Technology*, **11**(7): 179-189.

Aljezani, H. A. M., Rashid, R. Y., and Ali, E. H. (2023). Article Review: Description Histology to Gastric Ulcer in Human. Journal for Research in Applied Sciences and Biotechnology, **2**(5): 192-204.

Al-Jubori, Y., Ahmed, N. T. B., Albusaidi, R., Madden, J., Das, S., and Sirasanagandla, S. R. (2023). The Efficacy of Gum Arabic in Managing Diseases: A Systematic Review of Evidence-Based Clinical Trials. *Biomolecules*, **13**(1): 138. **[Crossref]**

Al-Robai, S. A., Zabin, S. A., Ahmed, A. A., Mohamed, H. A., Alghamdi, A. A., and Ahmed, A. A. (2022). Phenolic contents, anticancer, antioxidant, and antimicrobial capacities of MeOH extract from the aerial parts of *Tremaorientalis* plant. *Open Chemistry*, **20**(1): 666-678. **[Crossref]**

Anaemene, D. I., and Ochogu, E. U. (2022). Prevalence, Symptoms and Lifestyle Aspect of Peptic Ulcer Disease among Undergraduate Students of a Nigerian University. *African Journal of Biomedical Research*, **25**(2). **[Crossref]**

Appau, Y., Gordon, P. K., Kumordzie, S., Kyene, M. O., and Jnr, P. A. A. (2023). *Trema orientale (L.)* Blume: A review of its taxonomy, traditional uses, phytochemistry, pharmacological activities and domestication potential. Heliyon. **[Crossref]**

Asali, A. C., Joseph, J., and Joseph John, K. (2020). Botanical description of bitter gourd. *The Bitter Gourd Genome*, 7-31. **[Crossref]**

Asna, A. C., Joseph, J., and Joseph John, K. (2020). Botanical description of bitter gourd. *The Bitter Gourd Genome*, 7-31. **[Crossref]**

Awuchi, C. G., Saha, P., Amle, V. S., Nyarko, R. O., Kumar, R., Boateng, E. A., and Asum, C. (2023). A Study of Various Medicinal Plants used in Ulcer Treatment: A Review. *Journal for Research in Applied Sciences and Biotechnology*, **2**(1): 234-246. **[Crossref]**

Azadi, M., Ebrahimi, A., Khaledi, A., and Esmaeili, D. (2019). Study of inhibitory effects of the mixture of cinnamon and ginger extracts on cagA gene expression of *Helicobacter pylori* by Real-Time RT-PCR technique. *Gene Reports*, **17**: 100493. **[Crossref]**

Babalola, B. A., Akinwande, A. I., Otunba, A. A., Adebami, G. E., Babalola, O., and Nwufo, C. (2024). Therapeutic benefits of *Carica papaya*: A review on its pharmacological activities and characterization of papain. *Arabian Journal of Chemistry*, **17**(1): 105369. **[Crossref]**

Balan, T., Sani, M. H. M., Ahmad, S. H. M., Suppaiah, V., Mohtarrudin, N., and Zakaria, Z. A. (2015). Antioxidant and anti-inflammatory activities contribute to the prophylactic effect of semi-purified fractions obtained from the crude methanol extract of *Muntingiacalabura* leaves against gastric ulceration in rats. *Journal of ethnopharmacology*, **164**: 1-15. **[Crossref]**

Balkrishna, A., Joshi, B., Srivastava, A., Mishra, R. K., Aqib, A. K., Kumar, A., and Singh, V. (2022). Vascular Plants Diversity of Rashtrapati Bhavan Estate, New Delhi, India. *The Indian Ecological Society*, **49**(3): 1068-1088.

Behera, T. K., Matsumura, H., and Kole, C. (2020). Glimpse on Genomics and Breeding in Bitter Gourd: A Crop of the Future for Food, Nutrition and Health Security. *The Bitter Gourd Genome*, 1-6. **[Crossref]**

Beiranvand, M. (2022). A review of the most common in vivo models of stomach ulcers and natural and synthetic anti-ulcer compounds: a comparative systematic study. *Phytomedicine Plus*, **2**(2): 100264. **[Crossref]**

Bereda, G. (2020). Gastroesophageal Reflux Disease: Definition, Risk Factors, Pathophysiology, and Management. *Journal of Biomedical and Biological Sciences*, **1**(2): 1-11.

Bereda, G. (2022). Peptic Ulcer disease: definition, pathophysiology, and treatment. *Journal of Biomedical and Biological Sciences*, **1**(2): 1-10.

Bharskar, G. R. (2022). A review on *Adansoniadigitata*: An African tree. *Research Journal of Science and Technology*, **14**(2): 127-132. **[Crossref]**

Bhati, S., Prakash, S., Kumar, V., Singh, B., Singh, M. K., Gangwar, L. K., and Kumar, A. (2023). Genetic Variability, Heritability and Genetic Advance for Yield and Yield Contributing Characters in Bitter Gourd (*MomordicacharantiaL.*) Genotypes. *Int. J. Environ. Clim. Change*, **13**(9): 1867-1875. **[Crossref]**

Bhatti, M., Bhandari, D. D., and Singh, J. (2022). Review on Peptic ulcer and its effective Management and Treatment with Herbals. *Research Journal of Pharmacy and Technology*, **15**(8): 3580-3588. **[Crossref]**

Boakye-Yiadom, M., Kumadoh, D., Adase, E., and Woode, E. (2021). Medicinal plants with prospective benefits in the management of peptic ulcer diseases in Ghana. *BioMed Research International*, 2021. **[Crossref]**

Bura, S., Jasrotia, A., Sharma, S., Sharma, A., and Tutlani, A. (2023). Recent Advances in Breeding of Mango (*Mangiferaindica*): A Review. *International Journal of Environment and Climate Change*, **13**(11): 521-538. **[Crossref]**

Camargo, K. C., de Aguilar, M. G., Moraes, A. R. A., de Castro, R. G., Szczerbowski, D., Miguel, E. L. M., and Duarte, L. P. (2022). Pentacyclic Triterpenoids Isolated from *Celastraceae*: A Focus on the 13C-NMR Data. *Molecules*, **27**(3): 959. **[Crossref]**

Chakotiya, A. S., Tanwar, A., Narula, A., and Sharma, R. K. (2017). *Zingiber officinale*: Its antibacterial activity on *Pseudomonasaeruginosa* and mode of action evaluated by flow cytometry. *Microbialpathogenesis*, **107**: 254-260. **[Crossref]**

Chen, Y. A., Tsai, J. C., Cheng, K. C., Liu, K. F., Chang, C. K., and Hsieh, C. W. (2018). Extracts of black garlic exhibit gastrointestinal motility effect. *Food Research International*, **107**: 102-109. **[Crossref]**

Choudhary, M. K., Bodakhe, S. H., and Gupta, S. K. (2013). Assessment of the antiulcer potential of *Moringa oleifera* root-bark extract in rats. *Journal of acupuncture and meridian studies,* **6**(4): 214-220. **[Crossref]**

Choudhary, P., Devi, T. B., Tushir, S., Kasana, R. C., Popatrao, D. S., and K, N. (2023). Mango seed kernel: A bountiful source of nutritional and bioactive compounds. *Food and Bioprocess Technology*, **16**(2): 289-312. **[Crossref]**

Chowdhury, A. A., Amran, M. S., and Rana, M. R. H. (2018). Antitumor and cytotoxic effect of different partitionates of methanol extract of *Tremaorientalis*: A preliminary in-vitro study. *Journal of Ayurveda and Integrated Medical Sciences*, **3**(04): 44-50. **[Crossref]**

Christophe, M., Perfusion, A., Pascal, B., Ginette, M., Serges, T., Liliane, T., and Vernyuy, T. (2017). Analgesic, non-ulcerogenic and antioxidant activities of the aqueous stem bark extract of *Morindalucida* (*rubiaceae*) in mice. *Journal of Applied Life Sciences International*, **11**(3): 1-10. **[Crossref]**

Courric, E., Brinvilier, D., Couderc, P., Ponce-Mora, A., Méril-Mamert, V., Sylvestre, M., and Cebrian-Torrejon, G. (2023). Medicinal Plants and Plant-Based Remedies in Grande-Terre: An Ethnopharmacological Approach. *Plants*, **12**(3): 654. **[Crossref]**

Da Silva, G., Serrano, R., and Silva, O. (2011). *Maytenus heterophylla* and *Maytenus senegalensis*, two traditional herbal medicines. *Journal of Natural Science, Biology, and Medicine*, **2**(1): 59. **[Crossref]**

Daharia, A., Jaiswal, V. K., Royal, K. P., Sharma, H., Joginath, A. K., Kumar, R., and Saha, P. (2022). A Comparative review on ginger and garlic with their pharmacological Action. Asian Journal of Pharmaceutical Research and Development, **10**(3): 65-69. **[Crossref]**

Danilo, C. O. C. O., and Leanza, S. (2022). A Review on Treatment of Perforated Peptic Ulcer by Minimally Invasive Techniques. *Maedica*, **17**(3): 692. **[Crossref]**

Darekar, S. U., Nagrale, S. N., Babar, V. B., and Pondkule, A. (2023). Review on ginger: Chemical constituents and biological effects. *Journal of Pharmacognosy and Phytochemistry*,**12**(6): 267-271. [Crossref]

de Oliveira, D. R., Quintans-Junior, L. J., de Albuquerque, T. R., de Brito Junior, F. E., Fernandes, C. N., Fernandes de Souza, H. H.,, and de Menezes, I. R. (2018). Gastroprotective activity of hydroalcoholic extract of the *Stryphnodendronrotundifolium* Mart. In mice: mechanism actions assay. *Letters in Drug Design and Discovery*, **15**(3): 316-324. [Crossref]

de Souza Ribeiro, M. M., dos Santos, L. C., de Novais, N. S., Viganó, J., and Veggi, P. C. (2022). An evaluative review on *Stryphnodendronadstringens* extract composition: Current and future perspectives on extraction and application. *Industrial Crops and Products*, **187**: 115325. [Crossref]

Demarque, D. P., Callejon, D. R., Oliveira, G. G. D., Silva, D. B., Carollo, C. A., and Lopes, N. P. (2018). The role of tannins as antiulcer agents: a fluorescence-imaging based study. *Revista Brasileira de Farmacognosia*, **28**: 425-432. [Crossref]

Djanaev, G. Y., Askarov, O. O., and Sultanov, S. A. (2022). Phytotherapy of Gastric Ulcer (Literature Review). *Texas Journal of Medical Science*, **15**: 51-59. [Crossref]

dos Santos Pinto, D., de Souza, A. G. R., da Costa, J. N., Carneiro, L. T., Farias, M. D. P., and Sá, D. M. A. T. (2021). Effect of Tommy Atkins mango (*MangiferaIndica*) almond starch as a thickener in fish pâtés: Physicochemical and sensorial. *Research, Society and Development*, **10**(3): e54710313694-e54710313694. [Crossref]

El Hawary, S. S., Ashour, R. M., El Gayed, S. H., Gad, H. A., Jaleel, G. A. A., and El Gedaily, R. A. (2020). Genetic, chemical, and biological diversity in *MangiferaindicaL.* cultivars. *Pharmacognosy Research*, **12**(2). [Crossref]

El Mehiry, H. F, Abd El-Hay, M. M. (2022). Effect of probiotic camel milk-enriched with *Carica papaya* oil or extract against indomethacin-induced gastric mucosal toxicity in Rats. **8**(2): 1036-1056. [Crossref]

Elbeltagi, R., Al-Beltagi, M., Saeed, N. K., and Bediwy, A. S. (2023). COVID-19-induced gastrointestinal autonomic dysfunction: A systematic review. *World Journal of Clinical Cases*, **11**(22): 5252. [Crossref]

Elbestawy, M. K., El-sherbiny, G. M. and Moghannem, S. M. (2023). Antibacterial, Antibiofilm, and Anti-inflammatory Activities of *Zingiber Officinale* Extract Against *Helicobacter Pylori*. [Crossref]

Evbuomwan, I. O., Stephen Adeyemi, O., and Oluba, O. M. (2023). Indigenous medicinal plants used in folk medicine for malaria treatment in Kwara State, Nigeria: an ethnobotanical study. *BMC Complementary Medicine and Therapies*, **23**(1): 324. [Crossref]

Fayez, S. M., Elnahas, O. S., Fayez, A. M., and El-Mancy, S. S. (2023). Coconut oil based self-nano emulsifying delivery systems mitigate ulcerogenic NSAIDs side effect and enhance drug dissolution: Formula optimization, in-vitro, and in-vivo assessments. *International Journal of Pharmaceutics*, **634**: 122666. [Crossref]

Fraga, C. G., Croft, K. D., Kennedy, D. O., and Tomás-Barberán, F. A. (2019). The effects of polyphenols and other bioactives on human health. *Food and function*, **10**(2): 514-528. [Crossref]

Gad, S., Hanna, P., Ibrahem, H., and Mortagi, Y. (2023). Surfactants' Role in Nanovesicles Drug Delivery System. *Records of Pharmaceutical and Biomedical Sciences*, **7**(3): 140-149. [Crossref]

Gandhi, G. R., Antony, P. J., de Paula Lana, M. J. M., da Silva, B. F. X., Oliveira, R. V., Jothi, G. and Júnior, L. J. Q. (2022). Natural products modulating interleukins and other inflammatory mediators in tumor-bearing animals: A systematic review. *Phytomedicine*, **100**: 154038. [Crossref]

Gayathry, K. S., and John, J. A. (2022). A comprehensive review on bitter gourd (*Momordica charantia L.)* as a gold mine of functional bioactive components for therapeutic foods. *Food Production, Processing and Nutrition*, **4**(1): 1-14. [Crossref]

Gómez de Barreda, D., Pardo, G., Osca, J. M., Catala-Forner, M., Consola, S., Garnica, I. and Osuna, M. D. (2021). An overview of rice cultivation in Spain and the management of herbicide-resistant weeds. *Agronomy*, **11**(6): 1095. [Crossref]

Gudalwar, B. R., Nimbalwar, M. G., Panchale, W. A., Wadekar, A. B., Manwar, J. V., and Bakal, R. L. (2021). *Allium sativum*, a potential phytopharmacological source of natural medicine for better health. *GSC Advanced Research and Reviews*, **6**(3): 220-232. [Crossref]

Günbatan, T. (2022). *Curcuma longa L.* Novel Drug Targets with Traditional Herbal Medicines: Scientific and Clinical Evidence, 191-208. [Crossref]

Gupta, M., Kapoor, B., Gupta, R., and Singh, N. (2021). Plants and phytochemicals for treatment of peptic ulcer: An overview. *South African Journal of Botany*, **138**: 105-114. [Crossref]

Hamedi, A., Bayat, M., Asemani, Y., and Amirghofran, Z. (2022). A review of potential anti-cancer properties of some selected medicinal plants grown in Iran. *Journal of Herbal Medicine*, **33**: 100557. [Crossref]

Hamza, T. A., and Azmach, N. N. (2017). The miraculous *moringa* trees: From nutritional and medicinal point of views in tropical regions. *Journal of Medicinal Plants Studies*, **5**(4): 151-162.

Haule, E. E., Moshi, M. J., Nondo, R. S., Mwangomo, D. T., and Mahunnah, R. L. (2012). A study of antimicrobial activity, acute toxicity and cytoprotective effect of a polyherbal extract in a rat ethanol-HCl gastric ulcer model. *BMC Research notes*, **5**: 1-9. [Crossref]

Herszényi, L., Bakucz, T., Barabás, L., and Tulassay, Z. (2020). Pharmacological approach to gastric acid suppression: past, present, and future. *Digestive Diseases*, **38**(2): 104-111. [Crossref]

Huda, M. N., Li, X., Jahan, T., He, Y., Guan, C., Zhang, K., and Zhou, M. (2023). Acceleration of the genetic gain for nutraceutical improvement of adlay (Coix L.) through genomic approaches: Current status and future prospects. *Food Reviews International*, **39**(8): 5377-5401. [Crossref]

Ibelegbu, G. E., Ezeagwula, C. G., and Oji, N. C. (2023). Phytochemical Analysis and Antibacterial Effect of *Medicago sativa* and *Moringa oleifera* on Selected Bacteria Isolates. *Asian Journal of Biotechnology and Genetic Engineering*, **6**(2): 115-122.

Idaguko, C. A., and Adeniyi, M. J. (2023). Indigenous Antidiabetic Medicinal Plants Used in Nigeria: A Review. *Asian Plant Research Journal*, **11**(6): 81-97. [Crossref]

Jaiswal, F., Rai, A. K., Wal, P., Wal, A., and Singh, S. P. (2021). Peptic ulcer: a review on etiology, pathogenesis and treatment. *Asian Journal of Pharmaceutical Education and Research*, **10**(4): 1. [Crossref]

Jigam, A. A., Musa, R., Abdullahi, A., and Lawal, B. (2020). Characterization of anti-plasmodial, analgesic and anti-inflammatory fraction of *Maytenus senegalensis* (*lam.*) Exell leaf extract in mice. *Clinical Phytoscience*, **6**(1): 1-8. [Crossref]

Johny, A., and Mishra, S. K. (2023). Pharmacological Effects of Bioactive Compounds from *Allium sativum*. *In Pharmacological Benefits of Natural Agents* (pp. 13-30). IGI Global. [Crossref]

Joshi, M. R., and Pandit, S. (2023). *Moringa oleifera*: A Boon to Agriculture. *Journal of the Institute of Agriculture and Animal Science*, 113-120. [Crossref]

Jyotirmayee, B., and Mahalik, G. (2022). A review on selected pharmacological activities of *Curcuma longa L. International Journal of Food Properties*, **25**(1): 1377-1398. [Crossref]

Kanase, V. G., and Singh, J. Y. O. T. I. (2019). Evaluation of antipyretic and antiulcer activity of ethanolic extract of leaves of *Trema orientalis L.* In albino wistar rats. *Asia J. Pharmaceut. Clin. Res*, **12**(12): 149-154. [Crossref]

Kelly, B. A., Sanogo, S., Sidibé, S. I., Ceci, P., Castillo-Lorenzo, E., and Ulian, T. (2022). Survival and growth of *Adansoniadigitata L.* tall bare-roots in farm fields: a case study from Bankass, Mali (West Africa). *Environment, Development and Sustainability*, **24**(6): 8883-8899. [Crossref]

Khanpara, P., and Mavani, P. (2022). A review on herbal plants used in peptic ulcer. *Journal of Medicinal Plants*, **10**(5): 122-130. [Crossref]

Khatun, L., Khatun, S., Ame, M. A., Sumona, S. A., Easmin, F., and Rahman, A. M. (2022). Medicinal plants used by the local peoples at sadar upazila of Sirajganj District, Bangladesh. *GSC Biological and Pharmaceutical Sciences*, **19**(3): 309-328. [Crossref]

Kim, N. (2022). Peptic ulcer disease. In Sex/Gender-Specific Medicine in the

Gastrointestinal Diseases (pp. 131-151). Singapore: Springer Nature Singapore. [Crossref]

Kővári, B., Báthori, Á., Friedman, M. S., and Lauwers, G. Y. (2022). Histologic diagnosis of inflammatory bowel diseases. *Advances in Anatomic Pathology*, **29**(1): 48-61. [Crossref]

Kumadoh, D., Archer, M. A., Yeboah, G. N., Kyene, M. O., Boakye-Yiadom, M., Adi-Dako, O., and Mintah, S. O. (2021). A review on anti-peptic ulcer activities of medicinal plants used in the formulation of Enterica, Dyspepsia and NPK 500 capsules. *Heliyon*, **7**(12). [Crossref]

Kumar, M., Tomar, M., Amarowicz, R., Saurabh, V., Nair, M. S., Maheshwari, C., and Satankar, V. (2021). Guava (*Psidium guajava L.*) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. *Foods*, 2021; **10**: 752. [Crossref]

Kumar, N., and Sharma, S. (2023). Pharmacology, Ethnopharmacology, and Phytochemistry of Medicinally Active *Moringa oleifera*: A Review. *The Natural Products Journal*, **13**(8): 13-41. [Crossref]

Kumar, S., Kumar, A., Kumar, R., Kumar, V., Kumar, N., and Tyagi, A. (2022). Phytochemical, Pharmacognostical and Pharmacological Activities of *Carica papaya*. *International Journal for Research in Applied Sciences and Biotechnology*, **9**(2): 310-315. [Crossref]

Kumar, S., Sharma, V., and Devi, M. (2023). Gastric Ulcer Mechanism, Protection and Treatment from Natural Sources. *Journal of Pharmaceutical Research International*, **35**(28): 49-58. [Crossref]

Kumaria, A., Kirkman, M. A., Scott, R. A., Dow, G. R., Leggate, A. J., Macarthur, D. C.,and Basu, S. (2023). A Reappraisal of the Pathophysiology of Cushing Ulcer: A Narrative Review. *Journal of Neurosurgical Anesthesiology*, 10-1097. [Crossref]

Kuna, L., Zjalic, M., Kizivat, T., Roguljic, H., Nincevic, V., Omanovic Kolaric, T., and Smolic, R. (2022). Pretreatment of garlic oil extracts hampers epithelial damage in cell culture model of peptic ulcer disease. *Medicina*, **58**(1): 91. [Crossref]

Kusumawati, A. H., Garmana, A. N., Elfahmi, E., and Mauludin, R. (2023). Pharmacological studies of the genus rice (*Oryza L.*): a literature review. *Brazilian Journal of Biology*, **83**: e272205. [Crossref]

Laine, L., Barkun, A. N., Saltzman, J. R., Martel, M., and Leontiadis, G. I. (2021). ACG clinical guideline: upper gastrointestinal and ulcer bleeding. *Official journal of the American College of Gastroenterology| ACG*, **116**(5): 899-917. [Crossref]

Lemos, L. M. S., Ọlọ́ba-Whẹ̀nù, O. A., Olasupo, I. A., Balogun, S. O., Macho, A., Pavan, E., and de Oliveira Martins, D. T. (2023). *Brasiliensic* acid: in vitro cytotoxic and genotoxic, in vivo acute toxicity and in silico pharmacological prediction of a new promising molecule. *Journal of Biomolecular Structure and Dynamics*, 1-14. [Crossref]

Li, R., Wang, W., Ma, Y., and Chen, H. (2023). Analysis of risk factors for ulcer recurrence and upper gastrointestinal bleeding in children with peptic ulcer treated with *Helicobacter pylori* eradication therapy. *Translational Pediatrics*, **12**(4): 618. [Crossref]

Lin, N., Smiley, A., Goud, M., Lin, C., and Latifi, R. (2022). Risk Factors of Mortality in Patients Hospitalized with Chronic Duodenal Ulcers. *The American Surgeon*, **88**(4): 764-769. [Crossref]

Livingston Raja, N. R., and Sundar, K. (2012). *Psidium guajava Linn* confers gastroprotective effects on rats. *European Review for Medical and Pharmacological Sciences*, **16**(2).

Ma, R. H., Ni, Z. J., Zhu, Y. Y., Thakur, K., Zhang, F., Zhang, Y. Y., and Wei, Z. J. (2021). A recent update on the multifaceted health benefits associated with ginger and its bioactive components. *Food and Function*, **12**(2): 519-542. [Crossref]

Malabadi, R. B., Kolkar, P., Meti, T., and Chalannavar, K. (2021). The iconic Baobab (*Adansonia digitata L.*): Herbal medicine for controlling coronavirus (SARS-CoV-2) disease (Covid-19). *International Journal of Innovation Scientific Research and Review*, **3**(8): 1635-1647. [Crossref]

Malgave, K. K., Naikwade, N. S., Ladda, P. L., Shikalgar, T. S. and Patil, S. S. (2019). Peptic Ulcer Healing Activity of Fruit Pulp Extract and Seed Oil of *Adansoniadigitata Linn. International Journal of Pharmaceutical Sciences and Drug Research*, **11**(5): 263-271. [Crossref]

Mazumder, A., Yadav, B., and Sharma, H. (2021). Phytotherapy for Peptic-ulcer: An overview on important Indian herbal plants having flavonoid as antiulcer activity. *Plant Science Today*, **8**(4): 1006-1014. **[Crossref]**

Mbatchou, V. C., Nabayire, K. O., and Akuoko, Y. J. C. S. (2017). *Vernoniaamygdalina* Leaf: Unveiling its antacid and carminative properties In Vitro. *CurrentScience*, **3**(3): 148-155.

Meurer, M., de Oliveira, B. M., Cury, B. J., Jerônimo, D. T., Venzon, L., França, T. C., and da Silva, L. (2022). Extract of *Tagetes erecta L.*, a medicinal plant rich in lutein, promotes gastric healing and reduces ulcer recurrence in rodents. *Journal of Ethnopharmacology*, **293**, 115258. **[Crossref]**

Mohiuddin, A. K. (2019). Alternative Treatments for Minor GI Ailments. *Innovations in pharmacy*, **10**(3). **[Crossref]**

Naseer, S., Hussain, S., Naeem, N., Pervaiz, M., and Rahman, M. (2018). The phytochemistry and medicinal value of *Psidium guajava* (guava). *Clinical phytoscience*, **4**(1): 1-8. **[Crossref]**

Niranjan, D., Shridhar, N. B., Vinuta, M. H., Manjunatha, S. S., Sunilchandra, U., Pradeep, B. S., and Manju, G. U. (2023). Botanical, pharmacological and toxicological properties of *Trema orientalis*: A Review. **[Crossref]**

Ogunro, O. B., Oyeyinka, B. O., Gyebi, G. A., and Batiha, G. E. S. (2023). Nutritional benefits, ethnomedicinal uses, phytochemistry, pharmacological properties and toxicity of *Spondias mombin Linn*: a comprehensive review. *Journal of Pharmacy and Pharmacology*, **75**(2): 162-226. **[Crossref]**

Olaniyan, M. F., and Olaniyan, T. B. (2023). Inflammatory response in Plasmodium falciparum-infected patients treated using raw liquid extract of *Morinda lucida* (Oowo) leaf in some traditional homes in Nigeria. *Environmental Disease*, **8**(3): 71-77. **[Crossref]**

Oluwatoyin, A. E., and Deborah, O. W. (2019). Study of aqueous leaf extracts of *Spondias mombin Linn.*(*Anacardiaceae*) in gastric ulcer models and the possible mechanisms of action. *J. Phytopharmacol*, **8**(5): 238-247. **[Crossref]**

Orumwensodia, K. O., and Uadia, P. O. (2023). Bioactivity-guided fractionation of antimalarial active extract of *Spondias mombin Linn* stem bark. *Nigerian Journal of Biochemistry and Molecular Biology*, **38**(3): 112-122. **[Crossref]**

Owoyemi, O. O., and Oladunmoye, M. K. (2017). Phytochemical screening and antibacterial activities of *Bidens pilosa L.* and *Tridax procumbens L.* on skin pathogens. *International Journal of Modern Biology and Medicine*, **8**(1): 24-46.

Ozma, M. A., Abbasi, A., Ahangarzadeh Rezaee, M., Hosseini, H., Hosseinzadeh, N., Sabahi, S. and Kafil, H. S. (2023). A critical review on the nutritional and medicinal profiles of garlic's (*Allium sativum L.*) bioactive compounds. *Food Reviews International*, **39**(9): 6324-6361. **[Crossref]**

Pai, V., Subraya, C. K., Sri, B. S., and Nanjundaiah, A. R. H. (2022). Phytopharmacological Review of a Food Supplement *Zingiber officinale Roscoe* (*Zingiberaceae*). *Current Nutrition and Food Science*, **18**(8): 746-751. **[Crossref]**

Paradee, N., Janthip, R., Taesothikul, T., Kanjanapothi, D., Settakorn, K., Srichairatanakool, S., and Koonyosying, P. (2023). Antioxidant and Biological Activities of *Mahajanaka Mango* Pulp Extract in Murine Models. *Applied Sciences*, **13**(22): 12216. **[Crossref]**

Paricharak, S. P., Chougule, S. S., Masal, A. V., Baravkar, A. A., Shinde, S. G., Deshmane, P., and Kulkarni, S. B. (2021). A methodical review on antiulcer potential of herbal medicines from natural origin. *World Journal of Pharmaceutical Research*, **10**(4): 679-706.

Paul, S., Chakraborty, S., Anand, U., Dey, S., Nandy, S., Ghorai, M., and Dey, A. (2021). *Withania somnifera* (*L.*) *Dunal* (*Ashwagandha*): A comprehensive review on ethnopharmacology, pharmacotherapeutics, biomedicinal and toxicological aspects. *Biomedicine and Pharmacotherapy*, **143**, 112175. **[Crossref]**

Pinto, L. A., Cordeiro, K. W., Carrasco, V., Carollo, C. A., Cardoso, C. A. L., Argadoña, E. J. S. and Freitas, K. D. C. (2015). Antiulcerogenic activity of *Carica papaya* seed in rats. *Naunyn-Schmiedeberg's archives of pharmacology*, **388**, 305-317. **[Crossref]**

Plabon, M. E. A., Mondal, S. C., Or Rashid, M. M., Chowdhury, M. K., Saeid, A., Althobaiti,

F. and Islam, M. S. (2021). Chemical composition and anti-microbial activity of hog plum (*Spondias mombin L.*) peel oil extracted from different regions of tropical climates. *Horticulturae*, **7**(11): 428. **[Crossref]**

Poudel, B., Bhandari, J., Poudel, A., and Gautam, D. (2021). Ethnomedicinal use of common garden species in Arghakhanchi district, Western Nepal. *Asian Journal of Pharmacognocy*, **4**, 31-65.

Putra, N. R., Yustisia, Y., Heryanto, B., Asmaliyah, A., Miswarti, M., Rizkiyah, D. N., and Rohman, G. A. N. (2023). Advancements and challenges in green extraction techniques for Indonesian natural products: A review. *South African Journal of Chemical Engineering*. **46**, 88-98. **[Crossref]**

Rahaman, M. M., Rakib, A., Mitra, S., Tareq, A. M., Emran, T. B., Shahid-Ud-Daula, A. F. M. and Simal-Gandara, J. (2020). The genus *Curcuma* and inflammation: Overview of the pharmacological perspectives. *Plants*, **10**(1): 63. **[Crossref]**

Rajasekaran, A. and Soundarapandian, S. (2023). Nutritional and medicinal values of *Mangifera indica L.* fruit. *Trends in Horticulture*, **6**(2): 2949. **[Crossref]**

Rani, M., Chongtham, R. and Singh, A. (2020). Anti-ulcer activities of medicinal plants and natural products. In Advanced Pharmacological Uses of Medicinal Plants and Natural Products (pp. 114-127). IGI Global. **[Crossref]**

Rathore, S., Mukim, M., Sharma, P., Devi, S., Nagar, J. C. and Khalid, M. (2020). *Curcumin*: A review for health benefits. *International Journal of Research and Reviews*, **7**(1): 273-290.

Roy, A. J., Maut, C., Gogoi, H. K., Ahmed, S. I. and Kashyap, A. (2023). A review on herbal drugs used in the treatment of peptic ulcer. *Current Drug Discovery Technologies*, **20**(3): 4-15. **[Crossref]**

Saidovich, K. B. (2023). Autonomic dystonia syndrome as one of the etiofactors in the development of peptic ulcer. *Journal of Universal Science Research*, **1**(12): 810-818.

Salazar, G. J. T., Ecker, A., Adefegha, S. A. and da Costa, J. G. M. (2022). Advances in Evaluation of Antioxidant and Toxicological Properties of *Stryphnodendron rotundifolium Mart*. in Drosophila melanogaster Model. *Foods*, **11**(15): 2236. **[Crossref]**

Salisu, B. U., Anua, S. M., Ishak, W. R. W., and Mazlan, N. (2021). A Review on *Hepatocellular Carcinoma* Attributable to Chronic Aflatoxins' Exposure in Malaysia for the Last Two Decades. *Malaysian Journal of Medicine and Health Sciences, 17.*

Sari, L. G. M. P. and Suryawati, N. (2023). Characteristics of lower extremity ulcers among patients treated at Prof. Dr. IGNG Ngoerah General Hospital, Denpasar, Bali. *Journal of the Medical Sciences* (Berkala Ilmu Kedokteran), **55**(4).

Sarode, S. A., Sonawane, Y. N., Suralkar, R. K., Kumbhar, D. D., Warade, P. P. and Patil, P. R. (2023). *Moringa Oleifera*: Phytochemistry, pharmacology. *GSC Biological and Pharmaceutical Sciences*, **24**(3): 041-055. **[Crossref]**

Sharifi-Rad, J., Cristina Cirone Silva, N., Jantwal, A., D Bhatt, I., Sharopov, F., C Cho, W. and Martins, N. (2019). Therapeutic potential of allicin-rich garlic preparations: emphasis on clinical evidence toward upcoming drugs formulation. *Applied Sciences*, **9**(24): 5555. **[Crossref]**

Sharifi-Rad, J., Salehi, B., Stojanović-Radić, Z. Z., Fokou, P. V. T., Sharifi-Rad, M., Mahady, G. B. and Iriti, M. (2020). Medicinal plants used in the treatment of tuberculosis-Ethnobotanical and ethnopharmacological approaches. *Biotechnology advances*, **44**, 107629. **[Crossref]**

Sharifi-Rad, M., Fokou, P. V. T., Sharopov, F., Martorell, M., Ademiluyi, A. O., Rajkovic, J. and Sharifi-Rad, J. (2018). Antiulcer agents: From plant extracts to phytochemicals in healing promotion. *Molecules*, **23**(7): 1751. **[Crossref]**

Shatila, M. and Thomas, A. S. (2022). Current and future perspectives in the diagnosis and management of Helicobacter pylori infection. *Journal of Clinical Medicine*, **11**(17): 5086. **[Crossref]**

Shipa, S. J., Khandokar, L., Bari, M. S., Qais, N., Rashid, M. A., Haque, M. A. and Mohamed, I. N. (2022). An insight into the anti-ulcerogenic potentials of medicinal herbs and their bioactive metabolites. *Journal of Ethnopharmacology*, **293**, 115245. **[Crossref]**

Shivachi, H. A. (2022). Profiles and Predictive Factors for Poor Outcomes in Patients Managed Surgically for Perforated Peptic Ulcer Disease at Kenyatta National Hospital (Doctoral dissertation, University of Nairobi).

Singh, D. B., Pathak, R. K. and Rai, D. (2022). From traditional herbal medicine to rational drug discovery: strategies, challenges, and future perspectives. *Revista Brasileira de Farmacognosia*, **32**(2): 147-159. **[Crossref]**

Singh, M. P., Chawla, V., Kaushik, D., Chawla, P. A. and Sisodia, S. S. (2022). Pharmacodynamic stance of phytoconstituents as a gastric ulcer protective mechanism: an overview. *Current Molecular Medicine*, **22**(5): 431-441. **[Crossref]**

Singh, P. K. and Easwari, T. S. (2022). Emerging Trends and their Impacts on Peptic Ulcer Diseases: Treatments and Techniques. *Current Drug Therapy*, **17**(1): 2-11. **[Crossref]**

Sisay, W., Andargie, Y., Molla, M. and Norahun, A. (2021). Hydromethanolic crude extract of the leaf of *Urtica simensis Hochst*. ex. A. Rich.(*Urticaceae*) acquires appreciable antiulcer effect: validation for in vivo antiulcer activity. Evidence-based Complementary and Alternative Medicine, 2021. **[Crossref]**

Souza-Moreira, T. M., Queiroz-Fernandes, G. M., and Pietro, R. C. (2018). Stryphnodendron species known as “barbatimão”: a comprehensive report. *Molecules*, ***23***(4): 910. **[Crossref]**

Srivastav, Y., Kumar, V., Srivastava, Y. and Kumar, M. (2023). Peptic Ulcer Disease (PUD), Diagnosis, and Current Medication-Based Management Options: Schematic Overview. *Journal of Advances in Medical and Pharmaceutical Sciences*, **25**(11): 14-27. **[Crossref]**

Tanwar, S., Dhakad, P., Dhingra, G., and Tanwar, K. (2022). A review on salient pharmacological features and chemical constituents of bitter melon. *Biological Sciences*, ***2***(2): 229-239. **[Crossref]**

Tende, J. A., Eze, E. D., Tende, Y. A., Onaadepo, O. and Shaibu, A. (2020). Research Article Annals of Experimental Biology.

Tonchaiyaphum, P., Arpornchayanon, W., Khonsung, P., Chiranthanut, N., Pitchakarn, P. and Kunanusorn, P. (2021). Gastropr/otective activities of ethanol extract of black rice bran (*Oryza sativa L*.) in rats. *Molecules*, **26**(13), 3812. **[Crossref]**

Uddin, M. M., Hossain, M. M., Aziz, A. A. and Lovelock, C. E. (2022). Ecological development of mangrove plantations in the Bangladesh Delta. Forest Ecology and Management, 517, 120269. **[Crossref]**

Ugbogu, E. A., Emmanuel, O., Uche, M. E., Dike, E. D., Okoro, B. C., Ibe, C. and Ugbogu, O. C. (2022). The ethnobotanical, phytochemistry and pharmacological activities of *Psidium guajava L. Arabian Journal of Chemistry*, **15**(5): 103759. **[Crossref]**

Umar, N. M., Parumasivam, T., Aminu, N. and Toh, S. M. (2020). Phytochemical and pharmacological properties of *Curcuma aromatica Salisb* (wild turmeric). *Journal of applied pharmaceutical science*,**10**(10): 180-194.

Umar, S. I., Ndako, M., Jigam, A. A., Adefolalu, S. F., Ibikunle, G. F. and Lawal, B. (2019). Anti-plasmodial, Anti-inflammatory, anti-nociceptive and safety profile of *Maytenus senegalensis* root bark extract on hepato-renal integrity in experimental animals. *Comparative Clinical Pathology*, **28**, 1571-1579. **[Crossref]**

Upadhye, M., Kuchekar, M., Pujari, R., Kadam, S. and Gunjal, P. (2021). *Muntingia calabura*: A comprehensive review. *Journal of Pharmaceutical and Biological Sciences*, **9**(2): 81. **[Crossref]**

Vaishnavi Burley, D., Biyani, D., Umekar, M. and Naidu, N. (2021). Medicinal plants for treatment of ulcer: A review. *Journal of Medicinal Plants*, **9**(4): 51-59. **[Crossref]**

Vecchia, C. A., Locateli, G., Serpa, P. Z., Bianchin Gomes, D., Ernetti, J., Miorando, D., and Roman Junior, W. A. (2022). *Sonchus oleraceus L*. Promotes gastroprotection in rodents via antioxidant, anti-inflammatory, and antisecretory activities. *Evidence-Based Complementary and Alternative Medicine*, *2022*. **[Crossref]**

Vuković, S., Popović-Djordjević, J. B., Kostić, A. Ž., Pantelić, N. D., Srećković, N., Akram, M., ... and Katanić Stanković, J. S. (2023). *Allium Species* in the Balkan Region—Major Metabolites, Antioxidant and Antimicrobial Properties. *Horticulturae*, **9**(3): 408. **[Crossref]**

Wakodkar, S., Shuddalwar, A. and Baheti, D. (2021). Herbal Potentials for Treatment of Peptic Ulcers: A Review. *International Journal of Pharmaceutical Sciences Review and Research*, **68**. [Crossref]

Walia, Z., Rai, S. N., Birla, H., Singh, S. S., Rathore, A. S., Dilnashin, H. and Singh, S. P. (2020). Economic importance of medicinal plants in Asian countries. *Bioeconomy for sustainable development*, 359-377. [Crossref]

Weli, A., Al-Kaabi, A., Al-Sabahi, J., Said, S., Hossain, M. A. and Al-Riyami, S. (2019). Chemical composition and biological activities of the essential oils of *Psidium guajava* leaf. *Journal of King Saud University-Science*, **31**(4): 993-998. [Crossref]

Yadav, B., Majumder, A., Sharma, H., Sharma, P. and Bind, A. (2021). Treatment and cure of ulcer by herbal plants having flavonoids as active constituents. *Journal of Pharmaceutical Sciences and Research*, **13**(5): 271-278.

Yang, P., Zheng, Y., Zhang, L. and Hou, X. (2021). Incidence and characteristics of death from peptic ulcer among cancer patients in the United States. *Scientific Reports*, **11**(1): 23579. [Crossref]

Zahra, W., Rai, S. N., Birla, H., Singh, S. S., Rathore, A. S., Dilnashin, H. and Singh, S. P. (2020). Economic importance of medicinal plants in Asian countries. *Bioeconomy for sustainable development*, 359-377. [Crossref]

Zakaria, Z. A., Balan, T., Suppaiah, V., Ahmad, S. and Jamaludin, F. (2014). Mechanism (s) of action involved in the gastroprotective activity of *Muntingia calabura*. *Journal of Ethnopharmacology*, **151**(3): 1184-1193. [Crossref]

Zhang, S., DiMango, E., Zhu, Y., Saroya, T. K., Emala, C. W. and Sang, S. (2022). Pharmacokinetics of Gingerols, Shogaols, and Their Metabolites in Asthma Patients. *Journal of Agricultural and Food Chemistry*, **70**(31): 9674-9683. [Crossref]

Ziogas, I. A., Evangeliou, A. P., Giannis, D., Hayat, M. H., Mylonas, K. S., Tohme, S. and Tsoulfas, G. (2021). The role of immunotherapy in hepatocellular carcinoma: a systematic review and pooled analysis of 2,402 patients. *The oncologist*, ***26***(6): 1036-1049. [Crossref]

Żurek, N., Pawłowska, A., Pycia, K., Grabek-Lejko, D. and Kapusta, I. T. (2022). Phenolic profile and antioxidant, antibacterial, and antiproliferative activity of *Juglans regia L.* male flowers. *Molecules*, **27**(9): 2762. [Crossref]