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ROLE OF MEDICINAL PLANT-DERIVED NUTRACEUTICALS IN ULCER THERAPY: A COMPREHENSIVE AND EVIDENCE-BASED REVIEW

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ABSTRACT

A common gastrointestinal condition known as gastric ulcers causes mucosal damage to the stomach lining. Proton pump inhibitors, histamine-2 receptor antagonists, and antibiotics are currently the primary treatments for stomach ulcers. The extended use of these conventional treatments, however, could result in negative side effects and drug resistance. To control stomach ulcers, there has been an increase in interest in researching alternative and complementary therapies, such as nutraceuticals. The term "nutraceuticals" refers to a broad category of bioactive substances derived from natural sources, such as polyphenols, flavonoids, antioxidants, and dietary fibres. These substances have been shown to have a variety of pharmacological properties, such as anti inflammatory, antioxidant, antiulcerogenic, and cytoprotective effects. The review also examines the mechanisms underlying the antiulcerogenic effects of nutraceuticals, such as the modulation of pro-inflammatory cytokines, improvement of antioxidant defences, reduction of gastric acid secretion, stimulation of mucin production, and promotion of mucosal blood flow. Although nutraceutical approaches to treating stomach ulcers appear promising, it is important to consider their drawbacks, such as bioavailability, dose optimisation, and potential herb-drug interactions. Standardised formulations, ideal dosing schedules, and long-term safety profiles of these nutraceutical therapies must all be determined through more research. Finally, nutraceutical methods present a potentially effective route for the treatment of stomach ulcers.

KEYWORDS: Gastric ulcers, Proton pump inhibitors, Histamine-2 receptor antagonists, Nutraceuticals, *Helicobacter pylori* infection

INTRODUCTION

Peptic ulcer disease is a serious medical condition. Each year, roughly 500,000 new cases are reported, with 5 million people affected in the United States alone. Surprisingly, those born around the middle of the twentieth century have the highest risk of developing peptic ulcer Depending on the cause of the patient's stomach ulcer, numerous treatment options may be available[1]. The stomach mucosa is normally protected by the body from the acidic environment of the gastric lumen. The stomach mucosa may change, leading to erosion and ulcers, when these defences are weakened. Prostaglandins, mucus, growth factors, and proper blood inflow all work to cover the gastric mucosaSmoking, hydrochloric acid, ischaemia, NSAIDs, hypoxia, alcohol, and Helicobacter pylori infection are known to be harmful components of this barrier.[1] An individual with H. pylori infection may develop strong acid secretion (predominantly antral gastritis), low acid secretion (predominantly corpus gastritis), or neither depending on the environment, the bacteria, or the host. This concept is appealing because it enables the integration of research on stomach physiology with other factors that affect illness outcomes just as much [2].

Management of Ulcer

Proton pump inhibitors, such as pantoprazole, can be used to raise the stomach pH and promote the healing of the gastric mucosa, which are the initial steps in treating and managing gastric ulcers. The next choice should be whether to continue with an EGD. Recognising alarm symptoms would increase the urgency of the requirement for an EGD. Unintentional weight loss, bleeding, being older than 50, nausea, and vomiting are all alarming signs[3]. To rule out gastritis, *Helicobacter pylori* infection, and cancer, biopsies of the mucosa around the ulcer will be required if a stomach ulcer is detected on an EGD. These patients must get PPI medication twice daily for 8 weeks before having another endoscopy to ensure that their wounds have healed[3]. If the patient is using NSAIDs, these must be stopped as a result. If the biopsies or laboratory tests reveal *Helicobacter pylori* infection, antibiotic medication is necessary to treat the problem, and eradication must be verified. Several methods can be employed to stop the bleeding and stop it from recurring again if the stomach ulcer is bleeding or has a higher Forrest classification.The implantation of metal or absorbable clips together with an injection of epinephrine is typically helpful. In cases where endoscopic treatment is ineffective or not recommended, surgery may be required. Perforation, uncontrolled bleeding, significant gastric outlet blockage, and ulcers that do not heal with medical treatment are indications of surgery [4].

Nutraceutical

Regarding potential growth and extension in terms of health advantages, the phrase "nutraceuticals" has a lot of potential. It has demonstrated subsequent benefits in minimising the need for traditional medications and has decreased the likelihood of harmful effects, depending on the type and alternative uses of the current medicines[5]. As advantageous health goods, nutraceuticals are now sourced from a variety of businesses, including the food, herbal, and pharmaceutical production sectors. The importance of these items has been linked to the treatment of a variety of illnesses, including cancer, metabolic issues, colds and coughs, depression, coronary heart disease, delayed gastric emptying, and several other situations that require particular attention [5]. Traditional nutraceuticals The food in this category does not go through any manual modifications. The ingredients are all-natural and could actively contribute to improved health [6]. Lycopene, a component in tomatoes, is one example of this group[3]. Novel nutraceuticals, This category of nutraceuticals consists of dietary supplements for enhancing the quality of nutrition and increasing nutritional content through the addition of nutrients [3]. An illustration of this category is rice which has been fortified with beta-carotene [6].

Traditional nutraceuticals The food in this category does not go through any hand processing. The ingredients are all-natural and could actively promote good health [3]. E.g.- Lycopene from tomatoes[4].

Nontraditional nutraceuticals This category of nutraceuticals consists of dietary supplements for enhancing the quality of nutrition and increasing nutritional content by nutrient addition [5]. This category includes foods like β-carotene-enriched rice and soybeans.

Fortified nutraceuticals The process of fortifying food components involves adding micronutrients (vitamins, minerals, and critical trace elements) to food to improve its efficacy and nutritional value. Calcium and milk products like Vegetable oils, Whole grain, Breakfast cereals and granolas[5] **Recombinant nutraceuticals** It entails the use of genetic engineering and biotechnology in the manufacture of foods that provide energy, such as cheese and yoghurt, or the extraction of bioactive components using fermentation or enzymatic technologies like bread, alcohol, fermented starch, yoghurt, cheese, vinegar [4].

Existing and prospective nutraceuticals The potential therapeutic effects of nutraceuticals are undeniable. Only once adequate facts supporting their effectiveness and safety were

demonstrated via clinical testing did these nutraceuticals become recognised medications. All supplements have the potential to be supplements, however, not all supplements are supplements like folic acid [14].

Phytochemicals These are the chemical elements in plants that have unique biological effects. According to reports, they have active ingredients that influence living things' metabolisms and biochemical processes for the betterment of their health like grains, fruits, vegetables, nuts and herbs
[4].

Herbals The class includes plants that have therapeutic properties that may be used in the treatment and prevention of illnesses. Botanical goods can include any plant component, including dried leaves, fruits, stems, or roots, as well as fresh plant material like oils, roots, seeds, berries, or flowers [4].

Role of nutraceuticals on the Gastrointestinal

It is widely known that the dietary effects of nutraceuticals on gastrointestinal (GI) health and that diets can prevent or lessen the incidence of certain GI diseases. Additionally, dietary components that mediate these effects have been identified, and characterised and their effectiveness has been tested in experiments. The use of nutraceuticals and dietary components generally for the treatment and prevention of GI disorders or the general enhancement of GI health is supported by this data. Additionally, patients with inflammatory and functional GI illnesses frequently embrace and utilise complementary and alternative medicine, which furthers the interest in creating nutraceuticals that target the GI tract [5].

The gut microbiota has a profound impact on GI health by influencing digestion, metabolism and immune responses For example- Prebiotics and probiotics can boost beneficial bacteria populations, hence supporting gut homeostasis. Anti-inflammatory qualities of certain nutraceuticals, such as omega-3 fatty acids and curcumin, regulate immune responses and cytokine production and potentially reduce inflammatory GI disorders. Nutraceuticals such as glutamine and butyrate also help to maintain gut barrier integrity by promoting tight junctions and mucosal integrity by avoiding hazardous material transfer. Nutraceuticals show potential in the treatment of GI diseases; for example, curcumin may assist those with inflammatory bowel disease and fibre-rich nutraceuticals may relieve constipation symptoms[6].

***Psoralea corylifolia* (Babchi)**

One of the most well-known Traditional Chinese Medicines is Psoralea corylifolia Linn. (Syn: Cullen corylifolium Linn.) [9]

Phytoconstituent

Reducing sugars, alkaloids, anthraquinones, glycosides, flavonoids, tannins, steroids, saponins, triterpenoids and phlobatanins, may be found in Babchi to determine the existence of metabolites [9].

Traditional Uses

Herbal remedies used in traditional Chinese and Indian medicine for conditions like cancer, asthma, viral infections, coughing, stomach issues, ulcers, and renal diseases [8].

Antiulcer Activity- Plant parts have been extensively used in ulcers. It is effective against *Helicobacter pylori* so can treat diseases caused by any infection [8].

***Calophyllum brasiliense* (Guanandi)**

The Brazilian tree known as Guanandi (Calophyllum brasiliense) belongs to the Calophyllaceae family[10].

Phytoconstituent

The results of the phytochemical examination have shown that the genus contains a variety of classes of secondary metabolites, with coumarins, xanthones, chromanones, triterpenes, steroids and glycosides being the most prevalent [10].

Traditional Uses

For the treatment of chronic illnesses like ulcers, eye infections, haemorrhoids, hypertension, infections, inflammation, leprosy, malaria, nephritis, pain, rheumatism, skin infections, tumours, varicose veins, venereal diseases, wounds and peptic ulcers, a number of Calophyllum plants are employed [10].

Antiulcer Activity- Latex exuding from its bark is used in the treatment of gastric ulcers in folk medicine[10].

***Lycoris radiate* (red spider lily)**

Bulbous plants belong to the Amaryllidaceae genus Lycoris Herb as well. The two species are used as decorative plants: Yellow-flowering Lycoris Aurea herb and red-flowering Lycoris radiata herb [11].

Phytoconstituent

Since alkaloids are the most investigated component of this species [11].

Traditional uses

This plant's root is used to treat paediatric neurological problems, ulcers, and swellings. These extracts are also being researched for COVID-19 disease.

Antiulcer Activity -The roots of this plant are used for ulcers [12].

Isabgol

(*Plantaginaceae*)) was used as a matrix agent.

Plantago ovata Forks, a member of the Plantaginaceae family, is often known as "isabgol."[14].

Phytoconstituent

Hemicellulose, which has a xylem backbone connected to arabinose, rhamnose, and galacturonic acid units (arabinoxylans), makes up a significant component of the psyllium husk. Plantago species have a great capacity to create a variety of secondary bioactive metabolites, such as iridoids, phenols, polysaccharides, sterols, alkaloids, and cavities, which are useful for the polysaccharides cellulose, hemicellulose, and lignin make up 65 per cent of the seed's insoluble and 35 per cent of its soluble composition [13].

Traditional uses

Numerous ailments, such as diarrhoea, inflammatory bowel disease, ulcerative colitis, colon cancer, diabetes, hypercholesterolaemia, and irritable bowel syndrome, have been treated with its husk.[14].

P. ovata seeds significantly reduced several pro-inflammatory mediators, improved intestinal cytoarchitecture, and increased synthesis of short-chain fatty acids were all signs that they had reduced the development of colonic inflammation in transgenic rats [13].

Antiulcer Activity -The husk is used to cure the inflammation of mucous membranes of gastro- intestinal, and gastro-urinary tracts and duodenal ulcers [13].

Glycyrrhiza glabra

The Fabaceae family (also known as Leguminosae), which includes Glycyrrhiza glabra, is one of the most well-known groups of medicinal plants [16].

Phytoconstituent

Glycyrrhizin, a saponin found in the roots of Glycyrrhiza glabra Linn., is 60 times sweeter than cane sugar; Liquirtin, isoliquiritin, liquiritigenin, and rhamnoliquirilin are among the flavonoid-rich fractions. Five other flavonoids, including glucoliquiritin apposite, prenyllicoflavone A, shin flavanone, shinpterocarpin, and 1-methoxy phaseolin, were also extracted from dried roots [15].

Traditional uses

According to some reports, liquorice is effective at treating stomach ulcers and glycyrrhizin acid. Glycyrrhizin aglycone's anti-inflammatory and anti-ulcerative properties. It has also been claimed that liquorice increases the lifespan of stomach surface neurones and exerts an anti-pepsin action.

Antiulcer Activity -Medicinally, Its leaves are used for Peptic ulcer [16].

Jamun

Syzygium cumin, a member of the Myrtaceae family, is also known as Eugenia cumin and Syzygium jambolanum [17].

Phytoconstituent

Gallic acid, cyanidin glycoside, glycoside jamboline, triterpenoids, tannins, glutamines, essential oils, myricetin, -sitosterol, myricyl alcohol, etc. have all been discovered by photochemical research. Epi- friedeanol, and botulinic acid are all found in S. cumini stem bark.[18].

Traditional uses

Bark: Stem bark, which has an 8–19% tannin content, is highly beneficial to the leather and fishing net preservation industries. Asthma, diarrhoea, a sore throat, diabetes, ulcers, and blood impurities can all be treated with the bark.

Seed The jamun seed powder has astringent, antipyretic, analgesic, and anti-inflammatory properties which are administered topically to cure opium intoxication, centipede bites, blisters, and ulcers [19]. **Antiulcer Activity -**The ethanol extract from the jamun seed reduced in anti-ulcer activity of jamun against both physical (4 h pylorus ligation and 2 h cold restraint stress) and chemical (aspirin and alcohol) induced gastric ulcers in rats [19].

Honey

Honey is a nourishing viscous fluid that honeybees produce from blossom nectar. [20].

Phytoconstituent

According to the study, honey contains phytochemicals such as phlobatanins, saponins, flavonoids, terpenoids, cardiac glycosides and steroids. Phlobatanins were found in 8 of the 33 samples that were examined for the presence of phytochemicals; saponins were found in 27, flavonoids in 20, terpenoids in 22, terpenoids in 22, cardiac glycosides in 26, and steroids in 21, but tannins were not found in any of the samples [21].

Traditional uses

Antiulcer Activity -Stomach ulcers such as nonsteroidal anti-inflammatory drugs (NSAIDs could be cured by Honey. It reported that Asl (Honey) cure peptic ulcers by eliminating *Helicobacter pylori* [22]. Additionally, it has anti-inflammatory, antioxidant, wound-healing, anti-diabetic and antimicrobial effects [23].

Benincasa hispida

The annual climber plant Benincasa hispida (Thunb.) Cong. (Cucurbitaceae), is native to Asia and has a wide range of medicinal uses in conventional medicine [24].

Phytoconstituent

Pentacyclic triterpene and bryonolic acid from the root.

The fatty acids , ß-sitosterol, cucurbitin, the rhamnose, mannitol, triacontanol, alkali, fat, vitamins, glucose, the amino acid a trigonelline, histidine, pentacyclic triterpenes, hexanal, and pyrazine are among the several compounds found in fruit.

24-ethyl cholesterol, it 7-enol cholesterol, and 24-z-ethylidene are found in the seeds.

[25].

Traditional Uses

Antiulcer Activity -The fruit of Benincasa is also used in peptic ulcers [24].

It has anxiolytic, depressive, anticonvulsant, gastrointestinal, and antioxidant properties. Antidiabetic has an impact on the induction of stomach ulcers by indomethacin active against helminths impact of antioxidants, action, analgesic, anti-inflammatory and anti-asthmatic effects [25].

Rumex nepalensis

Nepalese remex the plant Spreng. (Polygonaceous), often known as Nepal Dock, has a wide range of medicinal properties and has been widely utilised in traditional medical systems for many years [26]. **Phytoconstituent**

A considerable number of complex and physiologically active organic compounds are present in R. nepalensis. Numerous secondary metabolites, including flavonoids, phenols, anthraquinones, naphthalenes, saponins, cardiac glycosides, stilbenes, terpenes, sterols, tannins, steroids, and reducing sugars, were found in the majority of prior phytochemical research investigations [27].

Traditional uses

Its leaf extract, which has antimicrobial properties, is used to stop bleeding. Syphilis, colic

ulcers, and allergies brought on by Acacia Nilotic (L.) Willd ex Delile's leaves are also treated with it [26]. R. nepalensis roots have long been used in traditional medicine to treat tumours, constipation, discomfort, inflammation, bleeding, and tinea.They are also believed to have diuretic, analgesic, anticancer, antibacterial, and antioxidant qualities.

The plant's leaves are another component that is frequently used to cure headaches and colic [27]. **Antiulcer Activity -**It is concluded that hydromethanolic crude extract and solvent fractions of R. nepalensis root showed promising anti-ulcer activity[27].

Custard apple (Annona squamosa) Linn

Originally from South America and the West Indies, Annona squamosa Linn is a common species in India and constitutes part of the Annonacin family. [28].

Phytoconstituent

Glycosides, alkaloids, saponins, flavonoids, tannins, carbohydrates, proteins, phenolic compounds, phytosterols, and amino acids are said to be present in the plant. Anonaine, acoryeline, porphine, norcorydine,isocorydine, and glaucine are among the chemical constituents present in the plant's overall leaves, stems, and roots [28].

Traditional uses

Antiulcer activity is the production of a particular chemical, 1-(4-Dglucopyranosyloxyphenyl)-2-(D- glucopyranosyl)-ethane which was spontaneously isolated for the first time from Annona squamosa twigs. The chemicals that were extracted from plant twigs were tested for their ability to treat ulcers.[29]. It also possesses antimicrobial, antioxidant, hepatoprotective, anti-head-lice effect, anti- diabetic, anti-genotoxic, anti-hyperlipidaemic and anti-tumour activity [28].

Carissa carandas Linn. (Karonda)

Karonda is cultivated sparingly mainly in the tropical and subtropical coastal areas of India.[30].

Phytoconstituent

The crude extract of the root was found to contain significant levels of cardiac glycosides, triterpenoids, phenolic compounds and tannins along with modest amounts of alkaloids, flavonoids, and saponins. Additionally, roots were said to contain volatile compounds such as 2-acetyl phenol, lignan, carinol, sesquiterpenes (carissone, carindone), lupeol, -sitosterol, 16-hydroxy betulin ic acid, - amyrin and -sitosterol glycoside, as well as des-N Nmethylnoracronycine, an acridone alkaloid. Sesquiterpene glucoside was discovered during

a chemical examination of the stem [31].

Traditional uses

Several pharmacological properties, including anti-inflammatory, antipyretic, antioxidant, anticancer, anti-diabetic, hepatoprotective, cardiovascular, antimalarial, anthelmintic, antiviral, antimicrobial and adaptogenic activity, have been linked to the chemical composition of fresh and dried Karonda fruit. The phytonutrients in the fruit, including its organic acid, minerals, flavonoids, steroids, terpenoids, and vitamins, can cure ulcers, tumours, allergies, hypertension, and platelet aggregation [30].

Antiulcer Activity -Similar to how ethanol causes acute gastric ulcers, pylorus ligation causes habitual gastric ulcers, and acetic acid causes habitual gastric ulcers, C. carandas extracts, when taken orally at a dose of 500 mg/kg, cause several types of gastric ulcers. It's estimated that the alcoholic excerpt of

C. carandas displayed largely significant anti-ulcer exertion.[30].

Zanthoxylum Species

Zanthoxylum species (also known as Fagara species) of the Rosaceae family are widely used in many countries as food and herbal remedies.[32].

Phytoconstituent

Proteins and amino acids, Phytosterols, Phenolic Compounds, Tannins, Flavonoids, Anthocyanins and Lignin [33].

Traditional uses

The pharmacological potentials of Z. species were investigated in metabolic health. These potentials included antioxidant, analgesic, anti-inflammatory, obesity, dementia and diabetes as well as indications of organ damage [32].

Antiulcer Activity -Z. species are historically used to cure ulcers in several parts of the world. The ethanolic extract of Z. zanthxyloides root bark reduced indomethacin-induced stomach ulceration in rats by 71% and 85% at 250 and 500 mg/kg, respectively, compared to 67% with 20 mg/kg esomeprazole, an antiulcer medication. It demonstrates substantial anti-ulcer action.[32].

Moringa oleifera

A common tree found in many tropical and subtropical nations is the Moringa oleifera Lam[34].

Phytoconstituent

Moringa oleifera is rich in compounds including rhamnose, a simple sugar, as well as the rare

group of chemicals known as glycosylates and isothiocyanates. From the stem of M. oleifera 10, compounds such as vanillin, -sitosterol 14, -sitostenone, 4-hydroxymellin and tetracosanoic acid have been identified [35].

Medicinal Uses and Pharmacological Properties: The Ayurvedic and Unani systems of medicine have long recognised the numerous therapeutic benefits of Moringa oleifera, including its antihypertensive, diuretic, cholesterol-lowering properties, antispasmodic, antiulcer, hepatoprotective, as well as antibacterial, antifungal, antitumor, anticancer, and anti-inflammatory properties.

Antiulcer Activity -Root and the fresh leaf juice of Moringa oleifera have potent anti-ulcer activity

[35].

Opuntia Ficus Indica

There are more than 1500 species in the family Cactaceae, which are spread throughout 130 genera, as per sources. [36]

Phytoconstituent

Sterols/Terpenes, Flavonoids, Tannins, Anthraquinones, Alkaloids, and Saponins were among the many different kinds of phytochemicals that were present[38].

Antiulcer Activity and Action on Digestive Disturbances

According to the literature, Opuntia fruits and stems have been used for centuries to treat problems such as indigestion, diabetes, hypertension, burns, and oedema. Additionally, antioxidant, analgesic, anti-ulcer, anti-allergic and hypoglycaemic activities have allegedly been associated with fruit or stem extracts [37].

Fennel (*foeniculum vulgare*)

The Apiaceous (Umbelliferaceae) family includes the biennial medicinal and fragrant plant Foeniculum vulgare Mill. It is a hardy perennial plant with feathery leaves and yellow blooms [39].

Phytoconstituent

A lot of investigations have been undertaken to discover various chemical components. Foeniculum vulgare seeds contain roughly 8% volatile oil (around 50%-60% anethole, 10-15% fenchone, and 10- 15% methyl chavicol, among others), flavonoids, coumarins (including bergapten), sterols, and (E)-9- octadecenoic acid.

were examined by Pisidia A. Uranic acid makes up the majority of pectin, although it also

contains small amounts of galactose rhamnose and arabinose [40].

Traditional uses

Fennel is useful in treating gastrointestinal conditions due to its anti-inflammatory, antispasmodic, antibacterial, carminative, diuretic and analgesic properties. Antioxidant and anti-ulcer qualities are also employed to treat neurological conditions.

Antiulcer Activity -Herb is protected against stomach ulcers. Furthermore, the herb lowered the mucosal lining of the stomach. [39].

Bambara Beans and Pigeon Pea

A major portion of the human diet, particularly in economically developing countries, consists of pulses or grain legumes. Pulses with significant nutritional value, fuel, a source of revenue, a way to improve soil fertility, and even medicine [41].

Phytoconstituent

The plant species contain alkaloids, flavonoids, and polyphenols [42].

Traditional uses

It is used to treat menorrhagia during pregnancy as well as anaemia and ulcers. The most common part of C. cajans utilised in conventional folk medicine is its leaves. It has some active ingredients that are useful in treating several human disorders. In the past, the leaves were utilised in Nigeria to treat malaria. Said that boiling leaves may be used as laxatives and that leaf paste may be utilised to treat oral inflammations and ulcers [41].

Antiulcer Activity -The leaves have been used the most in traditional folk medicine. Boiled leaves are used as laxatives and leaves paste can be used to treat oral inflammations and ulcers [41].

Fenugreek (*Trigonella foenum-graecum*):

Trigonella foenum-graecum L. is a worldwide plant belonging to the Fabaceae family. This herb is beneficial against obesity and reduces body fat [43].

Phytoconstituents

The Indian medical system has long used fenugreek, also known as Trigonella foenum-graecum Linne, a plant with beneficial medicinal and nutritional properties. According to a literature review, the plant contains a variety of bioactive compounds, such as alkaloids, flavonoids, saponins, fibres, and fatty acids, among others, which raises its therapeutic potential [44].

Traditional uses

Fenugreek has been utilised as a part of many traditional remedies and foods for many years. Its traditional usage for treating conditions including inflammation, migraine, joint pain, digestion, mucosal, and other stomach difficulties is widely documented in Ayurveda[45].

Antiulcer Activity - Considerable ulcer protective properties were demonstrated by the arid extract and a gel bit that was shielded from the seeds. The cytoprotective effect of the seeds sounded to be not only due to theanti-secretory action but also to the goods on mucosal glycoproteins.[45].

Tamarindus indica

Tamarindus, occasionally referred to as the tamarind tree, belongs to the Leguminosae (Fabaceae) family. [46].

Phytoconstituents

Tamarind pulp typically contains 20.6% water, 3.1% protein, 0.4% fat, 70.8% carbohydrates, 3.0% fibre, and 2.1% ash. As a result, the pulp is low in water content while being high in protein, carbohydrates and minerals. However, the proximate makeup of the tamarind fruit varies according to the region [48].

Traditional uses

Tamarindus indica has a wide range of uses in traditional herbal medicine. The leaves, fruits, and seeds of the tamarind have long been used in traditional Indian and African medicine.

Antiulcer Activity - Peptic ulcers have all been successfully treated with the plant's bark, either topically or as a tonic [47].

Basella rubra Linn

Various other names for the plant species Basella rubra Linn., which is a member of the Basellaceae family, include vine spinach, Malabar spinach, Indian spinach, as well as Ceylon spinach. [49].

Phytoconstituents

The plant Basella alba is rich in calcium, magnesium, iron, vitamins A, C, and B9 (folic acid), as well as a number of essential antioxidants. Contains vitamins, thiamine, riboflavin and niacin along with proteins, lipids, carbs, fibre, ash and calcium. Arginine, isoleucine, leucine, lysine, threonine, and tryptophan are among the necessary amino acids found in plants. They also include many vitamins and minerals, as well as a small number of soluble oxalates [50].

Traditional uses

Basella rubra exhibits androgenic, antiulcer, antioxidant, cytotoxic, antibacterial activity, anti- inflammatory, and depressive effects on the central nervous system (CNS) in addition to nephroprotective, antidiabetic, antimicrobial, antiviral, hepatoprotective, sleep-inducing, wound- healing [49].

Anti-ulcer activity Research revealed that Basella alba leaf extract has anti-ulcer properties and corrected aspirin-altered parameters such as ulcer index, percentage of ulcer inhibition, gastric pH, and pepsin content. [49].

Nigella Seed

Nigella sativa is known as black cumin, black caraway and black seed [50].

Phytoconstituents

The plants are mostly used for their seeds and seed oil. Fixed oil (27-40%), proteins (16-19%), primarily made up of the amino acids arginine, glutamic acid, leucine, and lysine; minerals (1.79- 3.74%), such as Cu, Zn, P, and Fe; carbohydrates (28.5-33.7%), and the primary constituents of N. sativa seeds are solubility dietary fibres (5.5-8.9%). Alkaloids, terpenes, and phenolic chemicals make up the most fascinating plant portion of Nigella, the seeds, in terms of its phytochemical makeup [51]. **Traditional uses**

Traditional uses include treating infertility, fever, bronchitis, asthma, chronic headache, back pain, dysmenorrhea, obesity, diabetes, inflammation, and gastrointestinal illnesses. Applying the seed oil directly to swollen joints, abscesses, and nasal ulcers.

Antiulcer Activity - The seed has been used in peptic ulcers for relief [50].

Asparagus racemosus

According to clinical investigations, the Himalayan native asparagus has been utilised as a galactagogue and may be used to treat infertility [45].

Phytoconstituents

The findings showed that saponins, sugars, glycosides, and mucilage were present [46].

Traditional uses

A.racemosus root extract also acts as an anti-proliferative agent in preclinical trials, reducing tumour volume and raising mean survival in both in vivo and in vitro. Additionally, the dried root powder is used medicinally to treat indigestion, diarrhoea, dysentery, and dyspepsia, and to postpone stomach emptying [45].

Antiulcer Activity has also been proven that the A. racemosus root extract has anti-gastroduodenal ulcer properties in rats [45].

TABLE 1. Medicinal Plants used for the treatment of Ulcer								
S. No	**Plant**	**Part / extractor compound**	***In Vivo* Studies**	***In vitro* Studies**	**Positive control**	**Dose**	**Duration**	**Refer ence**
1.	*Psoralea corylifolia* Family - Fabaceae	Leaves/ 70% ethanol	Dextran sulphate sodium (DSS) induced ulcer	Measurement of nitric oxide (NO) and inflammatory cytokines NF-κB luciferase reporter-based assay Cell viability assay	Mesalamine (50mg/kg)	100mg/kg	11 Days	[51]
2.	*Calophyllum brasiliense* Family - Clusiaceae	Stem and Bark/Hexane	Indomethacin- induced gastric ulcer (IND-ulcer) Ethanol-induced ulcer in rats pretreated with l-NAME	Measurement of catalase (CAT) activity Measurement of malondialdehyde (MDA)	A mixture of chromanone acids (BI, 20 and 100 mg/kg) and carbenoxolone (CBX, 100 mg/kg)	5, 20 and 100 mg/kg 5, 20 and 100 mg/kg	24hrs 18hrs	[52]
3.	Psylliu m	Seed/ chlorof orm	Gastric Ulcer	Antiba cterial	Mesalamine (50mg/kg)	75,100 and 125mg		[53]

	Family - Plantaginacea e	And methanol		and Anti-Inflammatory activity		/kg		
4.	Glycyrrhiza glabra Family - Fabaceae	Roots and Rhizomes/ 70% v/v ethanol and hydroalcoholic	HCl/Ethanol-induced ulcer Indomethacin- induced ulcer Ethanol-induced gastric ulcer Hypothermic restraint stress ulcer	**Antibacterial activity**	Omeprazole (30mg/kg)	(50, 100, 150 and 200 mg/kg)	18hrs 4hrs 18hrs 4hrs	[54,55]
5.	Syzygium Cumini Family - Myrtaceae	Leaves/ Distilled water	Aspirin-induced ulcer Ethanol-induced gastric ulcer	Antimicrobial Assay:	Lansoprazole (8mg/kg, p.o.)	200mg/kg, p.o. and 400mg/kg p.o.)	1 Day	[56]
6.	Honey	Liquid honey	Ethanol-induced gastric ulcer	Antioxidant, Anti-inflammatory	Omeprazole (40mg/kg)	0.1, 1.0, and 2.5 gm/kg,	7 Days	[57]
7.	Beninca sa hispida Family - Cucurbitaceae	Fruit/ petroleum ether and methanol	Ethanol-induced gastric mucosal damage Pylorus ligation model Cold	Antioxidant and Antimicrobial activity	Omeprazole (20mg/kg)	300 mg/kg, p.o.	1 Day	[58,59]

			restraint stress-induced gastric ulcer model					
8.	Rumex nepalensis Family - Polygonaceae.	Roots/ hydroethanol ic	Pylorus Ligation-Induced Ulcer Cold Restraint Stress-Induced Ulcer Acetic Acid-Induced Chronic Ulcer	Thiobarbituric acid reactive substance (TBARS) assay Chelation assay	Cimetidine (100 mg/kg/day) and/or Omeprazole (20 mg/kg/day)	100, 200, and 400 mg/kg,	1 Day	[50,41]
9.	Annona squamosa Linn Family - Annonaceae	Leaves/ Distilled Water	Cold restraint, pyloric ligation, aspirin, alcohol-induced gastric ulcer and histamine-induced duodenal ulcer models	Antifungal and antioxidant activities	Ranitidine (20mg/kg bw p.o)	200 and 500mg/kg	1 Day	[42,43]
10.	*Moringa oleifera* Family - Moringaceae	Leaves/ Distilled Water	Aspirin-induced ulcer	Antioxidant and anti-anti-inflammatory activity	Omeprazole (20mg/kg)	200, 400 and 800 mg/kg	1 Day	[44,45]
11.	*Opuntia Ficus indica*	Seed/ Oil extraction	Ethanol-induced ulcer model	Antimicrobial and Antibi	Ranitidine (75mg/kg)	3.5 mL of OFI oil/kg/ bw 7	48hrs	[46,47]

	Family - Cactaceae			ofilm Activity		mL of OFI oil/kg/ bw		
12.	Foeniculum *vulgare* Family Umbelliferae	Aerial Part/ Distilled Water	Ethanol-induced ulcer model	Antifungal, Antioxidant, and anti-inflammatory	Famotidine (20mg/kg)	75, 150 and 300 mg/kg	1 day	[48,49]
13.	Vigna Subterrana and Cajanus cajan Family - Fabaceae	Seed/ ethanolic extraction	Aspirin-induced ulcer pyloric ligation	Antioxidant activity	Omeprazole (20 mg/kg)	200 and 400 mg/kg	1 Day	[30,31]
14.	*Trigonella foenum-graecum* Family - Leguminosae	Seed/ Aqueous extraction and 95% Ethanol	Ethanol-induced ulcer model	Antiradical and Antioxidants activity	Cimetidine (5 ml/kg)	5ml/kg	1 Day	[32,33]
15.	*Tamarindus indica* Family - Fabaceae	Seed/ methanolic extract	Ibuprofen-induced ulcer model Pylorus ligation-induced ulcer model Alcohol-induced	Antioxidant and Anti-Inflammatory Activity	Ranitidine (50 mg/kg)	100 mg/kg & 200 mg/kg	1 Day	[34,35]

			ulcer model Ethanol-induced ulcer model Indomethacin (IND)induced ulcers. Cold Restraint Induced Ulcer Pyloric Ligation (PL)-induced Ulcers			100 mg/kg & 200 mg/kg		[34]
16.	Nigella Seed Family - Ranunculacea e	Seed/ Distilled water and ethanol	Indomethacin-treated Rats	Antibacterial and Cytotoxicity Activity	Famotidine (100 mg /kg)	1.0, 1.5 and 2.0 g kg	8 Days	[36,37]
17.	*Asparagus racemosus* Family - Asparagaceae	Roots/ methanolic extract	Cold restraint stress (CRS), pyloric ligation, aspirin plus pyloric ligation, and duodenal ulcers induced by cysteamine	Antioxidant and Anti-Inflammatory Activity	Omeprazole (20 mg/kg)	25–100 mg/kg	10 Days	[38,39]

Challenges and Future Directions

An ulcer is an open sore or lesion that develops on the lining of the stomach or the upper part of the small intestine. Two usual kinds of ulcers are duodenal and stomach ulcers. Utilising

bioactive substances originating from plants and foods, as well as other natural sources, in nutraceutical ulcer treatment methods helps to speed up recovery and control symptoms. Despite some encouraging results, there are still many obstacles to overcome and directions that need to be taken to effectively use nutraceuticals in ulcer treatment[6].

CONCLUSION

The rising prevalence of peptic ulcers and the associated limitations of conventional therapies have led to increased interest in medicinal plant-derived nutraceuticals as alternative or complementary treatment strategies. These natural products, sourced from various plant parts such as roots, seeds, leaves, and fruits, have demonstrated potent anti-ulcer effects in both in vivo and in vitro models. The mechanisms underlying their efficacy include antioxidant activity, anti-inflammatory properties, antimicrobial effects, cytoprotective actions, and the ability to modulate biochemical markers such as nitric oxide, malondialdehyde (MDA), and inflammatory cytokines. These bioactivities contribute to enhanced mucosal defense, inhibition of gastric acid secretion, and accelerated ulcer healing.

Phytochemicals such as flavonoids, alkaloids, saponins, terpenoids, and polyphenols are abundant in the variety of medicinal plants, including Psoralea corylifolia, Glycyrrhiza glabra, Syzygium cumini, Moringa oleifera, and Nigella sativa. These substances have systemic effects that support gastrointestinal health in addition to directly targeting the ulcer site. Furthermore, in experimental models, several of these botanicals shown efficacy that was on par with or greater than that of common medications like omeprazole, ranitidine, mesalamine, and cimetidine, with the added advantage of having a better safety record and a lower chance of adverse effects.

Although these encouraging results, there has been little progress in converting plant-derived nutraceuticals from experimental models to clinical use. Their acceptability in conventional medicine is hampered by issues like inconsistent plant composition, a lack of standardised dosage, and a dearth of scientific trials. To guarantee consistency, efficacy, and safety in human use, it is essential to carry out carefully planned clinical trials, create standardised extracts, and set up regulatory frameworks.

To sum up, nutraceuticals made from medicinal plants provide an all-encompassing and scientifically supported method of treating ulcers. They are good candidates for inclusion in traditional treatment plans or as stand-alone treatments because to their multitargeted action and positive safety profile. These natural products have the capacity to contribute

significantly.

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