



Review Article

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The Use of Medicinal Plants in Digestive System Related Disorders: A Systematic Review

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ABSTRACT

The most prevalent forms of ailments affecting a huge number of individuals throughout the world are digestive system problems. According to the World Health Organization (WHO), over 100 million people died globally as a result of digestive system diseases in 2012. Despite this, most scientific bodies disregard the relevance of a healthy digestive system and associated problems in health debates. Food and lifestyle have a direct influence on digestive health, and a healthy diet or a change in lifestyle can address a variety of issues. Plants provide a variety of phytochemicals and nutraceuticals that may aid in the treatment and prevention of a number of digestive problems. Plant-based remedies, including spices, are widely used by ordinary people across the world and can help digestion without causing adverse effects. Numerous ethnomedicinal studies show that the use of medicinal plants by traditional populations to treat digestive problems is widespread across the world. The biological activities of traditional herbal medicine used to treat digestive problems have been studied and generally indicate minimal side effects. However, as the demand for herbal medicines derived from plants grows across the world, more comprehensive clinical research on the advantages and toxicity of herbal medicines should be conducted. The goal of this study is to provide examples of research that have established and verified the use of plant-based medicines to treat digestive problems. In particular, traditional medicinal plant extracts or phytochemicals that have been shown to reduce symptoms of digestive system disorders along with mode of action and safety will be discussed.

Keywords: *C. scolyumus, T. officinale, S. marianum, Z. officinale, P. ovata, M. piperita.*

INTRODUCTION

The cornerstone to our general well-being and health is gentle digestion. Digestion is a complex process in which large insoluble food molecules are broken down into smaller water-soluble food molecules. Thereafter, the soluble food molecules move to the small intestine which absorbs its nutrients and are transferred to the blood circulation from where they are transferred to different parts of the body. The main purpose of digestion is the continuous supply of energy for growth, development, differentiation and other body activities such as repair, reproduction and lactation etc. Digestion has a strong effect on our entire body system and controls including the nervous, hormonal and immune systems. There are a wide number of digestive system disorders, which have a substantial impact on morbidity and mortality worldwide [1]. Digestive disorders, especially diarrhea, were the fifth leading cause of global mortality [2]. However, the importance of an active digestive system for overall health is rarely emphasized in health discussions in most countries. Common digestive problems symptoms are Stomach pain, Indigestion, Irritable Bowel Syndrome (IBS), Dyspepsia, Nausea, Vomiting, Gas, Bloating, Heartburn, Constipation, Diarrhoea, General malaise, Fatigue, Headache and Epigastric pain. However, the role of digestion in various disorders such as arthritis, depression, asthma, obesity, heart disease and allergic conditions including cancer is now increasingly recognized [3].

Herbal medicine has made a significant contribution in improving human health through its health promoting, curative and rehabilitative properties. Herbal medicine, also called botanical medicine, phytomedicine or phytotherapy, refers to herbs, herbal ingredients, herbal preparations and prepared herbal products that contain active ingredients of plants or other ingredients [4]. Numerous studies suggest that the practice of herbal medicines or plant-based preparations by traditional people against digestive system disorders is a common practice throughout the world. People can treat many problems related to the digestive system by regularly using herbal preparations in the diet that can improve the function of the digestive system. These digestive herbal preparations act in a variety of ways, viz., healing the lining of the intestine, activating the digestive process and promoting easy bowel movements, increasing the frequency of bowel movements, detoxification and elimination of toxins, helps to soothe

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an upset stomach and reduces gas, bloating and digestive discomfort.

Medicinal plants are arguably the oldest form of medicine to cure diverse human diseases and have been used by all cultures throughout history and still remain an integral part of our modern technology-based civilization. Plant based drugs or natural products and their derivatives represent about half of all drugs in clinical use today [5]. About 80% of people in developing countries rely mainly on traditional herbal medicines for their health care that involve the use of plant extracts or their active substances [6]. Medicinal plants contain numerous secondary metabolites or phytochemicals and their derivatives have various biological activities including anti-plasmodial, anti-inflammatory, anticancer antioxidant etc [5, 7, 8]. Various plants or a specific part of a plant, which contains the maximum number of active components responsible for giving the desired action, are used in Ayurveda, Siddha, Unani and traditional Chinese system of medicine. Many plant-based medicines used in traditional African, American, Asian, European and other indigenous medicinal systems have been recorded in pharmacopeias as agent used to improve digestive system. Even fennel, mint and ginger are available in an enteric-coated hard gelatin capsule to treat discomfort, colic and gastrointestinal disease. There are five commercial Ayurvedic products, Satpushpadi Churna, Satpushpa Arka, Satpushpadya Ghrita, Abhayarishta and Panchsakar Churna, which are prescribed by Ayurvedic practitioners to improve digestion, control colic and other gastrointestinal problems.

The purpose of this review is to present some examples of studies that have worked to document and validate plants used as digestive stimulants or digestive tonics. In particular, traditional medicinal plant extracts or phytochemicals that have been shown to reduce symptoms of digestive system disorders along with mode of action and safety will be discussed.

1. *Cynara scolymus* (Artichoke)

C. scolymus is native to the Mediterranean region and is now widely cultivated in various parts of the world for its large immature inflorescences (capitula), edible fleshy leaves and receptacles. Its leaves are the important constituent of the Mediterranean diet and also a ironic source of fibre, minerals and bioactive phenolic compounds inulin [9]. *C. scolymus* used to reduce symptoms of irritable bowel syndrome, improve nausea, bloating, constipation and gas. The *C. scolymus* leaf extract has shown hepatoprotective [10], antioxidative [11], anti-bacterial, anti-HIV, bile-expelling, and urinate activities [9]. The leaf extract of *C. scolymus* also have the ability to inhibit cholesterol biosynthesis and LDL oxidation which can help to maintains a healthy digestive system [12]. Hydroxycinnamic acids (caffeic acid, chlorogenic acid, ferulic acid, dicaffeoylquinic acids), flavonoids (luteolin, scolymoside, cynaroside), cynarin (1,5-di-caffeoylquinic acid), are the main ingredients of *C. scolymus* leaf extract [13]. *C. scolymus* dried leaves have long been utilised in folk medicine for their choleric and hepatoprotective properties, which are typically linked to the presence of cynarin [9]. The cynarin is the active ingredient of plant that improves appetite and also has a stimulating effect on the liver. The wide-ranging therapeutic effects cannot be linked to a single component, but to multiple active chemicals that collectively generate additive or synergistic pharmacologic actions; these include mono- and dicaffeoylquinic acids, and flavonoids like luteolin and its 7-O-glucoside [14].

The confirmed evidence for the useful effects of *C. scolymus* leaf extract on the gastrointestinal system is to promote the bile flow secretion leading to healthy digestion and helping the body to breakdown food more efficiently [15]. *C. scolymus* causes a substantial increase in bile secretion in the duodenum by increasing the size and quantity of secreting bile channels in liver cells [16]. A single dosage of standardised *C. scolymus* extract (1.92 g as six capsules 320 mg) significantly enhanced bile production when compared to placebo (p 0.05) in a randomised placebo-controlled double-blind cross-over controlled trial [17]. Held *et al* studied the effect of leaf extract on patients with epigastric pain, bloating, constipation, lack of appetite and nausea and found that 70% of the patients experienced improvement after one week of treatment [18]. In another open label study, where 553 patients with nonspecific dyspepsia complaints were treated with *C. scolymus* leaf extract and after 6 weeks of treatment, an improvement in vomiting, nausea, abdominal pain, loss of appetite, severe constipation, flatulence and fat intolerance was found [19].

The *C. Scolymus* has been used as a food in many countries since time immemorial. The prescribed amount of leaf extract is effectively tolerated with no negative side effects. However, further clinical research and studies are needed to further support its biological activities and toxicity using experimental models.

2. *Taraxacum officinalis* (Dandelion)

Taraxacum officinale root and leaf are used in traditional, as well as modern herbal medical systems for gastrointestinal diseases in various region of the world [20]. Dandelion is one of the worlds widely used and familiar herbs. It is included in the three most commonly prescribed digestive and liver herbs, the other two being Milk thistle (*Silybum marianum*) and globe *C. scolymus*. Sesquiterpene lactones, phenylpropanoids, triterpenoid saponins, and polysaccharides are the most abundant chemicals in dandelion. Taraxacosides, taraxacolides, dihydro-lactucin, ixerin, taraxinic acids, and ainslioside are major sesquiterpene lactones that are found as glycosides (sugars). Dandelion root has a significant quantity of inulin [21].

The root of the dandelion plant is used as a gastrointestinal remedy that aids in improving digestion and liver function, while the leaf considered primarily as diuretic and bitter digestive stimulant [22]. Preclinical studies on Dandelion have confirmed various biological properties including diuretics, digestive stimulants, a gastrointestinal remedy, demulcent, prebiotic and inflammation modulator [23]. Due the presence of inulin, roots have distinct demulcent action and prebiotic properties [20]. In animal studies, sesquiterpene lactones found in the leaf and root impart a bitter taste to the plant, responsible for increased bile production [24]. The European Scientific Cooperative on Phytotherapy recommends dandelion root for restoration of hepatic and biliary function, dyspepsia and loss of appetite. The German Commission E authorizes the use of combination products containing dandelion root and herbs for biliary abnormalities, loss of appetite, dyspepsia and for stimulation of diuresis [25]. Dandelion leaf is a unique source of potassium; by dry weight, dandelion leaf contains up to 4% potassium. The high potassium (K) content is thought to be responsible for the diuretic activity [23].

The US Food and Drug Administration lists dandelion plant extract as generally regarded as safe in meals and supplements [20]. In rabbits,

dosages of dandelion up to 6 g/kg body weight were shown to be safe [26]. Dandelion has great potential for being used in various traditional and herbal medicines around the world. Overall, dandelion is very safe but there are a very limited number of clinical trials on its use in treating various diseases. In addition, preclinical and clinical research is clearly needed on this widely used herbal medicine.

3. *Silybum marianum* (Milk Thistle)

Silybum marianum (L.) Gaertn plant is native to the Mediterranean region and is probably the oldest and best studied for its hepatoprotective effect. *Silybum marianum* seeds and leaves are very popular and widely prescribed medicinal herbs for the treatment of many diseases affecting the liver since Greco-Roman days [27]. The Basque people used a decoction of milk thistle seeds as a digestive aid, aphrodisiac, anti-inflammatory, antineoplastic, hypotensive, general tonifier, venous tonifier, styptic and diuretic [28].

Research studies on *S. marianum* was started in 1929 based on the use of this plant by German physicians to treat jaundice and liver ailments. Later in the 1950s, silymarin was isolated from the seeds and is a complex of bioflavonoids consisting of seven flavonolignans including silybin, silibinin A and B, silicristin, silidianin, apigenin, dehydrosilybin, deoxycillin cristin, deoxysilybin dianin, among others [27, 28, 29]. The dried seed extract of this plant contains up to 4% silymarin. Silybin is the most active and predominant material of biologically complex extracts (60–70%), followed by silicristin (20%), silidianin (10%) and isosilybin (5%) [30]. Clinical studies on silymarin have been shown to maintain the health of liver cells and neutralize the effects of various toxins, promote the flow of bile in liver diseases, aid in the relief of upset stomach or dyspepsia. Based on clinical studies, the German Commission E approves the use of *S. marianum* standardized extracts for the treatment of toxic liver damage, inflammatory liver diseases and cirrhosis. The use of *S. marianum* seed tea to treat dyspepsia has also been recommended by the German Commission E. [31]. Long term use of this herb is safe with no incidence of abnormality. Silymarin has been shown to be safe in animal tests at maximal oral dosages of 1200 and 1500 mg/kg. [32]. Despite the fact that silymarin is benign, nothing is known regarding its mode of action or drug-food interactions. More clinical and scientific research is needed to confirm and validate *S. marianum* various pharmacological characteristics.

4. *Zingiber officinale* Roscoe (Ginger)

Ginger (*Zingiber officinale*), undoubtedly one of the most consumed household spices in human history [33]. It is a major medicinal herb of Asian medicine, where it has been used as a remedy for many ailments, including those affecting the digestive system, such as dyspepsia, flatulence, colic, vomiting, diarrhea. Includes cramps, nausea, abdominal pain, etc. [34, 35]. The rhizome is the main part of ginger that is consumed. Of the more than 100 chemical constituents identified from ginger by various analytical methods, gingerols are the major constituents. Ginger has been fractionated into 14 bioactive chemicals, including [6]-gingerol, [8]-gingerol, [6]-paradol, [10]-gingerol, [14]-shogaol, [4]-gingerol, 1-dehydro-[10]-gingerdione, [6]-shogaol, [10]-gingerdione, Tetrahydrocurcumin, Gingerenone A, hexahydrocurcumin, 1,7-bis-(4' hydroxyl-3' methoxyphenyl)-5-methoxyheptan-3-one, and Methoxy-[10]-gingerol [36].

The well-studied application of ginger is its use in improving the symptoms of nausea and vomiting. Ginger contains essential oils (1-4%) and a pungent resin that is known to stimulate the flow of saliva, bile and gastric secretions [37]. Ginger enhanced the secretion of digestive enzymes including pancreatic lipase, sucrase, maltase and stimulate trypsin and chymotrypsin. In clinical studies, ginger has been shown to be as effective as dimenhydrinate [38] and even more effective than vitamin B6 [39] in treating nausea and vomiting in pregnancy. It has also been recommended for the treatment of nausea associated with chemotherapy [40], gynecological laparoscopy [41] and postoperative prophylactic antiemetics [42]. Ginger has also been recommended for preventing sea sickness [43] and motion sickness [44]. The mechanism of action of ginger is unknown. However, research suggests that it inhibits serotonin receptors and has antiemetic effects on the gastrointestinal and central neurological systems [45].

The US Food and Drug Administration (FDA) recommends ginger as a generally recognised as safe food ingredient. Various research and statistics suggest that ginger intake is quite safe, with few adverse effects [46]. Male and female rats were given ginger powder (500, 1000, or 2000 mg/kg bw) for 35 days and showed no signs of death or aberrant behaviour, growth, or food and water consumption [47]. Ginger has been proven to have a variety of therapeutic qualities, according to current data, however its particular biological targets are mostly unknown and still to be discovered.

Table 1: Most common plants used in digestive system problems.

Plant Name	Key Ingredients	Action / applications	Ref.
<i>Cynara scolymus</i>	Cyanaroside, sesquiterpene lactones, flavonoids, polyphenols etc.	Antitoxic, Liver restorative, used for liver and renal diseases for its cholagogue and choleric action, Assist digestion of fats	13, 14
<i>Taraxacum officinalis</i>	Sesquiterpene lactones, Triterpenoid saponins, Sterols etc	Diuretic, cholagogue, pancreatic and bile duct stimulant, urinary antiseptic, detoxicant, used in kidney and liver disorders, for rheumatism and general tonic.	21
<i>Silybum marianum</i>	<i>Silymarin</i> (<i>silybin A, silybin B</i>), Taxifolin, quercetin, dihydrokaempferol, kaempferol	Liver and gallbladder protective, antioxidant. Used in jaundice and other biliary affections, fevers, uterine trouble, galactagogue. Sudorific and aperient. Diabetes.	27, 29, 30
<i>Zingiber officinale</i>	Gingerols, Shogaol, Gingerdione etc.	Antiemetic, antispasmodic, Antiflatulent, expectorant, anti-inflammatory, circulatory stimulant, diaphoretic, increases bioavailability of prescription drugs. Used for irritable bowel and diarrhoea, colds and influenza. Loss of appetite, constipation. Throat infections. Migraine and cluster headache.	36, 37
<i>Plantago ovata</i>	<i>Mucilaginous polysaccharide</i>	Laxative, diuretic, demulcent, cholinergic. Used in inflammatory conditions of the mucous membrane of gastrointestinal and genitourinary tract, chronic amoebic and	49
<i>Mentha piperita</i>	Menthol	Digestive, Carminative, Chloretic, Antispasmodic, Diuretic, Antiemetic, Mild sedative, Diaphoretic, Antiseptic, Antiviral, used in many mixtures of indigestion and colic, also used in cough and cold remedies.	57

5. *Plantago ovata* Forsk (*Ispaghula*, *Isabgol*),

Plantago ovata (*psyllium*) plant was native to Persia and is now cultivated in many parts of the world including India [48]. *Psyllium* is the common name for many species of the *Plantago* genus, whose seeds are used commercially to produce mucilage and are an excellent source of soluble and insoluble fibre [49]. Mucilage is defined as a group of clear, colourless, gelling agents derived from the seed coat and often called the husk or *psyllium* husky. It has been used as a home remedy in different culture systems in conditions like constipation, diarrhea, inflammatory bowel disease, colitis, colon cancer, diabetes and hypercholesterolemia [50]. The primary ingredient of the seeds and husk is mucilaginous polysaccharide composed mainly of xylose, arabinose, galacturonic acid, rhamnose and galactose. The seeds also contain fatty acids mainly linoleic (40.6%), oleic (39.1%) and linolenic acids (6.9%). The dietary fibre extracted from *Plantago ovata* has medicinal properties and would be a good source of low-calorie food production [49].

Psyllium husk is popularly used as therapeutic agent for the treatment of chronic constipation, mild diarrhea, improving digestion, cleansing the colon, duodenal ulcer, hemorrhoids, demulcent, inflammatory bowel disease (ulcerative) and gastro esophageal reflux disease (GERD) etc [51]. *Psyllium* husk has been recommended as a natural non-irritant laxative, which aids in facilitating digestion. When soaked in water, it becomes gelatinous and viscous and absorbs water to perform a specific function. Constipation is commonly treated with *psyllium* husk fibre, which is frequently used as a fibre supplement. It has been repeatedly reported in clinical trials that it can increase the moisture level of the stool, resulting in the stool becoming softer and heavier thus making the process of bowel movement easier [52]. On the other hand, because of its water-holding capacity, *psyllium* has also been shown to slow gastric emptying and colon transit, which is beneficial for individuals with stool incompatibility with liquid stools or diarrhea. It increases bowel movements and reduces the pressure on the gastrointestinal walls. *Psyllium* husk is also useful for treating hemorrhoids and diverticulitis [53]. The FDA has permitted the use of *psyllium* husk in food products because of its associated health claims of benefits [54].

Several studies indicate that the therapeutic application of *psyllium* husk is safe with negligible side effects [50]. However, advance research is essentially necessary to approve its pharmacological properties and proposed mechanism of action for human health benefits.

6. *Mentha piperita* L. (Peppermint)

Mentha piperita is the oldest medicinal plant that was used in Eastern and Western traditional systems of medicine. It has been used by herbalists as an astringent, antiseptic, antipruritic, antispasmodic, antiemetic, carminative, diaphoretic, analgesic, anticatarrhal, antimicrobial, rubefacient, stimulant and emmenagogue [55]. Traditionally it was used as a spasmolytic for various digestive problems such as colic in infants, flatulence, diarrhea, dyspepsia, nausea, vomiting, and to reduce gas and cramps [56]. Menthol is the primary ingredient of peppermint oil, while others include limonene, cineole, menthone, menthofuran, isomethone, menthyl acetate, isopulegol, pulegone, and caron [57]. The *piperita* leaf was used to treat indigestion, flatulence, intestinal colic and biliary disorders, as

documented by the British Herbal Compendium [58]. The German Commission E, ESCOP recommended its use as a carminative, cholagogue in disorders of the gastrointestinal tract, gallbladder and bile ducts disorder.

M. Piperita oil is the main ingredient of Ayurvedic medicines like Dabur's "Pudina Hara" which is used in the treatment of various stomach problems e.g., indigestion, gas problem, acidity etc. The oil is currently used to treat irritable bowel syndrome, ulcerative colitis, liver complaints, gallbladder and biliary tract disorders. In a blindly controlled study, gastric emptying rate is improved in both normal and dyspepsia patients after administration of *M. piperita* oil [59]. It shows a statistically significant effect on patients undergoing gynaecological surgery to reduce nausea [60]. Mechanism of Action Studies show that *M. piperita* relaxes gastro-intestinal smooth muscle by reducing calcium flux to the large intestine and jejunum [61]. In *in-vivo* studies, menthol and related terpenes show choleric effects and are helpful in the treatment of a patient with cholesterol stones in the gallbladder and bile ducts [62].

Piperita is listed on the FDA and documented as safe but care should be taken in patients with GI reflex and it can cause bile duct blockage, inflammation of the gallbladder [56]. With regard to its health benefits, *M. Piperita* has significant promise for treating a variety of human diseases, including digestive problems. However, further research is needed to learn more about *M. piperita* cellular and molecular modes of action.

CONCLUSION

Disorders related to the digestive system have a significant impact on morbidity and mortality worldwide. The situation is worse in most rural areas, as there is a lack of awareness about proper sanitation and disease prevention. People in low- and middle-income countries still use medicinal herbs as first aid in the treatment of various diseases or as preventive measures. Various studies have confirmed the traditional use of the medicinal plant in the treatment of digestive system disorders by examining the biological activity of various plant extracts, which have carminative effects, antispasmodic effects, delay intestinal transit, effects on gut motility, stimulate adsorption or reduce electrolyte secretion. With regard to traditional medicines used to treat digestive system problems, such drugs will continue to be used as long as there are communities with limited access to modern treatments. Current scientific evaluation of medicinal herbs is primarily concerned with validating the traditional uses of plants and identifying the active components of extracts and other preparations. Some herbal preparations or active ingredients of medicinal plants can be toxic in certain situations. Therefore, continuous examination of traditional plant medicines is required to establish the scientific basis for activity as well as better assessed the quality, efficacy and safety of such preparations. For validation of herbal remedies, well-designed clinical trials will provide the necessary evidence to support efficacy. Few clinical trials have evaluated the safety and tolerability of traditional and herbal medicines used to treat digestive system disorders and generally indicate that minimal side effects have been observed. The evidence provided by recent studies of traditional plant-based therapies encourages further investigation in anticipation that alternative treatments for digestive diseases will be developed.

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Conflict of interests

None declared.

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